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What skills do star fund managers possess?

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Li-Wen in Edinburgh
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ABSTRACT

Kosowski, Timmermann, Wermers, and White (2006) find that certain growth-oriented fund managers have substantial skill but do not stipulate the particular skills that they possess. I use novel style timing models to examine in detail the timing skills of 3,181 US equity mutual funds classified as having a growth investment objective by Standard & Poor's, over the period from 1993 to 2006. To control for idiosyncratic variation in mutual fund returns, the bootstrap method of Kosowski et al. is used to analyze the significance of alpha and timing coefficient estimates. To exclude the possibility that the observed timing ability is due to good luck, synthetic funds are examined as in Busse (1999). The results indicate that growth-oriented fund managers who earn abnormal returns demonstrate substantial growth timing skill, i.e. successful timing activity across the value/growth continuum. This observed growth timing ability accounts for at least 45% of abnormal returns and is persistent; the top 10% of funds which demonstrate growth timing ability in the past three years also demonstrate the best growth timing ability in the following year. Successful growth timing is confined to those managers who invest primarily in growth stocks. However, there is little evidence of successful market timing (i.e. forecasting future market states and weighting equity exposure accordingly), size timing (i.e. adjusting exposure between small and large capitalization stocks) or momentum timing (i.e. switching between momentum investing and contrarian investing strategies). The models employed clearly distinguish between growth timing and market timing skills, thereby avoiding a common misidentification problem.

CHAPTER 1

INTRODUCTION

Kosowski, Timmermann, Wermers, and White (2006) demonstrate that, in contrast to earlier work (e.g. Carhart, 1997), some growth-oriented mutual fund managers do earn positive abnormal returns due to genuine skill rather than good luck. However, they do not ask what skills these star managers exhibit. This thesis uses novel style timing models that can help to explain their superior performance. I demonstrate that the main explanation for these persistent abnormal returns is growth timing, i.e. switching stocks along the value/growth continuum, and that this explains about half of the abnormal returns reported in Kosowski *et al.* (2006). I also find that only "growth" fund managers who invest primarily in growth stocks demonstrate such growth timing skill.

Fama (1972) suggests that mutual fund returns can be subdivided into two parts: return from stock selection and the return from market timing activity. The return from stock selection is defined as the difference between the return on the managed portfolio and the return on a naively selected portfolio with the same level of market risk. Market timing concerns the ability to forecast future market states and weight equity exposure accordingly. However, fund managers have other style timing opportunities apart from market timing, such as size timing, growth timing and momentum timing. Size timers adjust exposure between small and big capitalization companies; growth timers modify exposure along the value/growth continuum; momentum timers choose between momentum investing and contrarian investing strategies.[1] These four timing skills correspond to the four investment styles summarized by Carhart (1997).

Broadly speaking, value stocks are stocks considered to be undervalued and growth stocks are those believed to offer above-average capital growth. The rationale for value investing is to evaluate the fundamental value of stocks and then to buy-and-hold the under-priced stocks until their full value is realized. In contrast, the expectation of strong capital growth can push growth stock prices to relatively high levels in terms of price-to-earnings or price-to-book. In some states of the market, value stocks tend to do well; in other states, it is growth stocks. If growth stocks are forecast as likely to go out-of-favour, shrewd growth-oriented fund managers will leave the market or reduce exposure to high growth stocks. If they leave the market, this is market timing activity; otherwise, it is growth timing. The data in this study show that, on average, growth-oriented funds invest over 90% of their assets in the stock market and adjust their market exposure only slightly. Indeed, equity fund managers do not normally claim to implement a market timing strategy. Furthermore, Wermers (1999) finds evidence of herding and positive-feedback trading by growth-oriented mutual fund managers. In other words, these managers tend to implement a momentum-based investment strategy, suggesting that they do not attempt momentum timing. I also find, using the S&P Returns-Based Style Analysis, that more than 9 out of 10 of the growth-oriented funds in my sample invest primarily in large capitalization companies.[2] Thus there is unlikely to be much

[1] Fama and French (1992) define growth (value) stocks as stocks with low (high) book-to-market ratio. Momentum investing is to buy high past-return stocks and sell low past-return stocks, while contrarian investing is the opposite strategy (Jegadeesh and Titman, 1993; Carhart, 1997).

[2] Standard & Poor's uses Returns-Based Style Analysis is derived from Sharpe (1992), and compare the historical performance of each fund with a series of index benchmarks to determine which

evidence of size timing. To sum up, successful growth-oriented fund managers can be expected to exhibit growth timing ability.[3]

Several methods have been proposed to measure the timing skills of mutual fund managers, such as those of Treynor and Mazuy (1966), Henriksson and Merton (1981), Daniel, Grinblatt, Titman and Wermers (1997), Lu (2005) and Swinkels and Tjong-A-Tjoe (2007). Most studies, however, focus on market timing and do not reach a consistent conclusion. Kon and Jen (1979), Kon (1983), Chang and Lewellen (1984), Lee and Rahman (1990), Busse (1999), Bollen and Busse (2001), Jiang, Yao, and Yu (2007), and Swinkels and Tjong-A-Tjoe (2007) find evidence of successful market timing activity, whereas contrary evidence is provided by Treynor and Mazuy (1966), Henriksson (1984), Chen, Lee, Rahman and Chan (1992), Jiang (2003), and Cuthbertson, Nitzsche and O'Sullivan (2008). In addition to market timing, Daniel *et al.* (1997) evaluate fund manager style timing skill in aggregate, but find no evidence of such ability in practice. Both Lu (2005) and Swinkels and Tjong-A-Tjoe (2007) consider market timing, size timing, growth timing and momentum timing separately. Lu (2005) finds evidence of size timing and growth timing skill, while Swinkels and Tjong-A-Tjoe (2007) find evidence of market timing, growth timing and momentum timing skill.

In this thesis, the style timing models of Lu (2005) are used to examine four timing skills: growth timing, market timing, momentum timing, and size timing abilities.

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benchmark (or combination of benchmarks) most closely describes the fund's actual returns.

[3] I recognize that fund managers change from time to time, and thus it is not necessarily correct to identify abnormal fund returns over time with the same fund manager. Nonetheless, I adopt the same approach as in extant work in considering funds and fund managers as synonymous. To the extent that this does not hold, my results must be considered as lower-bounded on this basis.

These models apply the approaches of Treynor and Mazuy (1966) and Henriksson and Merton (1981) to Carhart's (1997) four-factor model. In contrast to Swinkels and Tjong-A-Tjoe (2007), who use different timing models to measure the four timing abilities, integrated style timing models are used to measure all four timing abilities at the same time. That is, the correlations between the timing parameters are considered. This makes it possible to separate out the impact of each timing skill more precisely. Unlike Lu (2005) and Swinkels and Tjong-A-Tjoe (2007), I focus on superior performing growth oriented fund managers which are shown to possess real skill in Kosowski *et al.* (2006).

The monthly net returns of 3,181 U.S. open-ended domestic growth-oriented equity mutual funds are examined from January 1993 to December 2006. The test method is based on the idea that superior performing fund managers, who earn abnormal returns, have timing skill if they have an abnormally high proportion of demonstrating timing ability. To control for idiosyncratic variation in mutual fund returns, the bootstrap method of Kosowski *et al.* (2006) is used to analyze the significance of alpha and timing coefficients.[4] In addition, synthetic funds (Busse, 1999) are used to exclude the possibility that the observed timing ability is due to good luck.

The test results show that superior performing growth-oriented fund managers possess significant growth timing skill. In fact, growth timing accounts for at least

[4] Residuals for over a third (36%) of funds in my sample generated by Carhart's (1997) four-factor model are not normally distributed. Therefore, I apply the bootstrap method of Kosowski *et al.* (2006) to reconstruct the distribution of my model coefficients, and then use this distribution to test for statistical significance, instead of employing the standard t-test.

45% of the abnormal returns earned by these fund managers. There is no significant evidence, however, of successful market timing, size timing or momentum timing. Various sensitivity tests suggest that the observed success in growth timing is not due to sampling variability, spurious statistics (Jagannathan and Korajczyk, 1986; Kosowski *et al.*, 2006) or chance.

The evidence also suggests that the use of growth timing skill is confined to those "growth" fund managers who actually invest primarily in growth stocks. According to the S&P Returns-Based Style Analysis, 1,283 (40%) of the 3,181 "growth-oriented" funds in my sample invest primarily in value stocks rather than growth stocks.[5] Little evidence of growth timing skill is found for such funds. In contrast, there is strong evidence of growth timing skill for superior performing funds invested mainly in growth stocks. Moreover, on studying the sample funds' investment objectives (which include aggressive growth, growth, growth-and-income and income-and-growth), it is found that the more growth-oriented the investment objective, the stronger the evidence of growth timing ability.

Importantly, the growth timing skill persists. Applying the method of Hendricks, Patel and Zeckhauser (1993), which is also used in Carhart (1997) and Kosowski *et al.* (2006), to test the persistence of growth timing ability, the results indicate that the top 10% of funds which demonstrate growth timing ability in the past three years

[5] Sample funds are selected on the basis of their investment objectives which are classified according to fund names, mandates, prospectuses, and/or the objectives claimed by mutual funds. Like Cooper, Gulen, and Rau (2005), who observe inconsistency between fund name and investment style, I find inconsistency between investment objective and style among my sample funds.

also demonstrate the best growth timing ability in the following year. This confirms, as before, that superior performing fund managers possess growth timing skill.

Finally, it is found that growth timing ability can be misidentified as market timing if the timing model focuses only on market timing skill (as in Treynor and Mazuy, 1966; Henriksson and Merton, 1981; Swinkels and Tjong-A-Tjoe, 2007). The style timing models used in this study enable this problem to be resolved by considering correlations between the timing parameters. The results demonstrate growth timing skill, but not momentum or size-based timing skill, which helps to explain growth-oriented mutual fund superior returns.

To sum up, fund managers classified as having a growth investment objective by Standard & Poor's strive to buy or sell growth stocks in the knowledge that growth stocks go in and out of fashion. This study demonstrates that this activity is growth timing rather than market timing. Growth timing skill is rewarded, with around half of the abnormal returns of superior performing growth-oriented funds attributable to successful growth timing activity.[6] In addition, successful growth timing activity persists. It is likely that growth timing ability has been ignored in previous studies because growth timing ability is easily misidentified as market timing ability.

The main contribution of this thesis is to provide an explanation of the persistent abnormal returns identified by Kosowski *et al.* (2006) – namely growth timing skill. This finding contributes to the mutual fund performance evaluation literature by

[6] The remaining part of the abnormal return is likely due to stock picking skill, other unidentified timing skills, or luck.

discovering a factor that is important for growth-oriented fund managers but usually ignored in previous studies. The discovery of growth timing skill extends current studies on mutual fund timing activities beyond market timing. This is likely to stimulate a new approach to mutual fund management and investment. In particular, fund managers' growth timing ability should be carefully considered before investing in growth-oriented funds.

The rest of this thesis is organized as follows. Chapter 2 provides an overview of the mutual fund industry and the relevant research literature. Chapter 3 develops testable hypotheses from the research questions. Chapter 4 explains the data and the methods employed in the analysis. Chapters 5, 6, and 7 describe the main tests and sensitivity tests. Section 8 sets out the conclusions and future research topics.

CHAPTER 2

RESEARCH BACKGROUND

2.1. Introduction

The US mutual fund industry managed assets worth over $12 trillion at the end of 2007 and it has attracted much research interest. One important question is whether mutual fund managers can beat the market. To answer this question, various methods have been developed to measure mutual fund performance and the skills fund managers use to achieve superior performance. Although there is now a huge body of literature devoted to this topic, there is still no final answer. This chapter introduces the relevant institutional background and studies of the US mutual fund industry which provide the motivation for this research.

Section 2.2 outlines the organization and structure of the US mutual fund industry. Section 2.3 discusses how to evaluate mutual fund performance and Section 2.4 reviews the debate as to whether mutual fund managers can beat the market. Section 2.5 introduces the studies concerning the skills that mutual fund managers use to earn abnormal returns. Section 2.6 discusses the definition of growth and value stocks and growth-oriented mutual funds. Section 2.7 gives a brief summary.

2.2. Overview of the US Mutual Fund Industry

According to the *2008 Investment Company Fact Book*, published by the Investment Company Institute (http://www.ici.org/), the US mutual fund market is the largest in the world, accounting for 46% of the $26.2 trillion in mutual fund assets worldwide. Investors can choose from 8,029 funds offering a wide range of investment profiles, from relatively safe short-term debt instruments to relatively risky stocks and derivatives. About 88 million individuals and more than four in ten US households (50.6 million US households) own mutual fund shares. In 2007 the US mutual fund industry generated $23.6 trillion in total sales and $883 billion in net inflows.

A mutual fund is an investment company that pools money from shareholders and invests in a diversified portfolio of securities (Investment Company Institute, 2008). Mutual funds are "open-end" companies, since they are obliged to sell or redeem their shares at net asset value (NAV), which is equal to the fund's total net assets (total assets minus total liabilities) divided by the outstanding number of shares. The NAV must reflect the current market value of securities in the fund portfolio and is usually calculated daily on the basis of closing prices.

Mutual funds must register with the US Securities and Exchange Commission (SEC). Virtually every aspect of a mutual fund's structure and operation is subject to strict regulation under four federal laws: the Securities Act of 1933, the Securities Exchange Act of 1934, the Investment Company Act of 1940 and the Investment Advisors Act of 1940. The core objectives of these laws include ensuring that investors receive adequate and accurate information about the fund and protecting the integrity of the fund's assets. The SEC is charged with overseeing the mutual fund industry's compliance with these regulations. The Internal Revenue Code sets additional requirements regarding a fund's portfolio diversification and its distribution of earnings, and the National Association of Securities Dealers (NASD) oversees most mutual fund advertising and sales materials. In addition, mutual funds must have directors who are responsible for extensive oversight of the fund's policies and procedures, and at least 40% of those directors must be independent of the fund's management.

An investor in a mutual fund buys shares of the fund. Each share represents proportionate ownership of the fund's underlying securities. The securities are selected by professional investment advisers to meet a specified financial goal, such as growth or income. These professionals choose investments that best match the fund's objectives as described in the prospectus. Their investment decisions are based on research of market conditions and the financial performance of individual companies and specific securities. As economic conditions change, the fund may adjust the mix of its investments to adopt a more aggressive or a more defensive posture to meet its investment objective.

There are four basic types of mutual fund: equity, bond, hybrid and money market. Equity and bond funds concentrate their investment in stocks and bonds respectively. Equity funds include domestic stock and international stock funds. Hybrid funds typically invest in a combination of stocks, bonds and other securities. These three types of fund are known as long-term funds, whereas money market funds are referred to as short-term funds, since they invest in securities maturing in less than one year. Equity, bond, hybrid and money market funds manage 54%, 14%, 6% and 26% respectively of total assets in the US mutual fund industry.

Mutual funds differ with respect to the share distribution method used. Load funds distribute their shares through broker-dealers who charge investors a commission proportional to the amount of their investment. Load fees may be front-end (charged at the time of purchase) or back-end (charged at the time of redemption). For US funds, the front-end load is on average between 4% and 5%, while the back-end load usually declines the longer a shareholder holds the fund shares, e.g. from 5% after one year to 4% after two years, etc. (Pozen, 1998). In addition, brokers often receive annual distribution fees, called 12b-1 fees, typically ranging from 25 to 75 basis points of assets under management each year. No-load funds use direct distribution channels such as mail and phone, charge no front- or back-end loads and have limited (up to 25 basis points per year) 12b-1 fees. Many funds have multiple share classes corresponding to different combinations of load and 12b-1 fees. For example, class A shares are usually sold with a front-end load, while class B shares with a back-end load. In addition, 12b-1 fees and the annual fund operating expenses paid by its shareholders also include the management fee and the record-keeping fee, etc.

Mutual funds provide a number of benefits to their shareholders compared to investing directly in the financial markets:

1. *Diversification*. The average investor would find it expensive and difficult to construct a portfolio as diversified as that of a mutual fund.
2. *Professional Management*. The investment strategy of a mutual fund is developed by financial professionals who aim to select the right stocks at the right time.
3. *Economies of Scale*. Mutual funds are able to take advantage of their buying and selling size and thereby reduce the transaction costs for investors.

4. *Divisibility*. Many investors don't have the exact sums of money to buy round lots of securities. Smaller denominations of mutual funds enable investors to make periodic investments through monthly purchase plans.
5. *Liquidity*. In general, investors are able to sell mutual funds quickly at a sale price close to current market value.

Thus, mutual funds provide a low cost way for small investors to obtain the same kind of professional money management and diversification that are available to large institutions and wealthy individuals.

2.3. Mutual Fund Performance Evaluation

Over the years, the Investment Company Institute (ICI) has surveyed investors about the mutual fund information they want before purchasing fund shares. A fund's historical performance is always one of the top three pieces of information they require.[7] Various methods used to evaluate mutual fund performance are now introduced.

The most basic measure of mutual fund performance is a fund's raw return over a certain period of time. Although a fund's raw return is the simplest and most easily understood by investors, this measure is not able to distinguish between performance attributable to fund managers' superior skill, good luck or high-risk exposure. There

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[7] In 2006, ICI conducted in-home interviews with more than 700 shareholders who owned funds outside workplace retirement plans about their mutual fund information needs. The study found that investors usually review a wide range of information before purchasing fund shares outside these plans. Most often, investors want to know about a fund's fees and expenses, its historical performance and its associated risks prior to purchasing shares.

are two factors driving the expected raw returns of mutual funds: (i) the fund's exposure to the market systematic risk factors, and (ii) the skills of the portfolio managers. Various risk-adjusted performance measures have been developed to measure fund managers' skill, which plays an important role for investors in choosing among funds and for fund management companies devising managerial compensation procedures.

The first method used to measure risk-adjusted performance is absolute performance, which is defined as a difference between the fund's return and the return on a passive portfolio with similar risk characteristics. Since a passive portfolio represents the fund's exposure to the market systematic risk factors, the absolute performance should be attributable to the portfolio manager. In practice, funds are often assigned a stylized stock index as a benchmark, e.g. a small-cap index for funds primarily investing in the stocks of small companies. Hence, the stylized stock index is treated as an ideal passive portfolio. The simplicity of measuring fund performance as an index-adjusted return makes it appealing to investors. However, one should keep in mind that indices based on relatively large market segments provide only a rough approximation of the risk profile of a non-index fund. More precise passive portfolios can be formed using a return-based approach or a holdings-based approach. These two approaches are explained below.

According to the return-based approach, fund performance is defined as the intercept in the time series regression of the excess fund return[8] on the excess returns of passive benchmark portfolios (factor-mimicking portfolios in the context of

[8] Henceforth, the excess return denotes the rate of return in excess of the risk-free interest rate.

arbitrage pricing theory):

$$R_{i,t} - R_t^f = \alpha_i + \sum_{k=1}^{K} \beta_i^k F_t^k + \varepsilon_{i,t} \tag{2.1}$$

where $R_{i,t}$ is fund *i*'s return, R_t^f is a risk-free rate and F_t^k is the excess return on the *k*-th benchmark portfolio in period *t*.

This measure is often referred to as Jensen's alpha, since it was introduced by Jensen (1968), who used the excess market return as a single benchmark. Intuitively, Jensen's alpha can be interpreted as the difference between the fund's return and the return of the passive portfolio consisting of β_i^k units of the k-th benchmark (k=1,…K) and one unit of the risk-free asset. A positive Jensen's alpha implies that mean-variance investors who restrict their attention to the K benchmark assets and a riskless asset only are able to extend their efficient set by taking a long position in the given fund, neglecting other effects such as transaction costs and taxes.

Currently, most studies use multi-factor models to estimate Jensen's alpha. One of the most frequently used specifications is the three-factor model of Fama and French (1993). Besides an overall market factor, they use two additional stock market factors related to firm size (stock price multiplied by the number of shares outstanding) and book-to-market equity (the ratio of the book value of the firm's common stock to its market value). The corresponding factor returns are calculated as the difference between the returns on small- and big-stock portfolios and the returns on portfolios with high and low book-to-market equity respectively. The four-factor model of Carhart (1997) adds one more factor related to one-year momentum in stock returns. The excess return on the corresponding factor-mimicking portfolio is computed as the difference between returns on stocks with high and low returns over the previous year. Thus, the Fama-French three-factor alpha measures fund performance taking into account exposure to size and growth factors, while the Carhart four-factor alpha also adjusts for the momentum effect.

Ferson and Schadt (1996) argue that if expected returns and risks vary over time, traditional performance measures may be upward- or downward-biased due to the common time variation in risks and risk premiums. They propose using as a benchmark a managed portfolio strategy that can be replicated using publicly available information. Such a conditional performance evaluation approach is consistent with the semi-strong form of market efficiency. In their model, Jensen's alpha is based on a factor model with time-varying conditional betas that are linear functions of the lagged public information variables including the short-term interest rate, dividend yield, term spread and default spread. Using a sample of 67 US open funds from 1968 to 1990, they find that the distribution of the conditional Jensen's alphas is consistent with the neutral performance of mutual funds, whereas the unconditional Jensen's alphas indicate average underperformance.

In the holdings-based approach, fund performance is measured as the difference between fund return and return on a passive portfolio with characteristics matching the portfolio of the fund under consideration. For example, Daniel, Grinblatt, Titman and Wermers (1997) construct a synthetic portfolio of stocks matching fund holdings along the dimensions of size, book-to-market ratio and one-year momentum. Zero performance indicates that the fund's performance could have been replicated by buying stocks with the same three characteristics as those held by the fund, while positive performance suggests that a manager has additional stock selection ability.

In addition to this absolute performance measure, another type of absolute performance measure is the fund average excess return earned per unit of risk exposure. The most popular measure of this type is the Sharpe ratio, which is calculated as the average excess return of a fund divided by the standard deviation of the fund's returns:

$$Sharpe_i = \frac{\overline{R}_i - R^f}{\sigma_i} \tag{2.2}$$

If the slope of the capital market line is greater than the fund's Sharpe ratio (the slope of the line connecting the position of the fund with the point of the risk-free rate), this is taken as evidence that the fund underperformed the market. Note that in contrast to Jensen's alpha, which takes the covariance of the fund return with benchmark returns into account, the Sharpe ratio is only based on the characteristics of a given fund. Therefore, the Sharpe ratio does not show whether investors should add a given fund to their current portfolios, but helps to compare different mutual funds with each other. Specifically, a mean-variance investor restricted to invest either in fund A and a riskless asset or in fund B and a riskless asset will choose the one with the highest Sharpe ratio.

We can also obtain a risk-adjusted performance measure by comparing fund performance relative to its peers; funds with a similar investment approach (i.e. funds with similar exposures to common risk factors). A typical relative cardinal measure of fund performance is the fund return in excess of the median or mean return in the fund's category. Note that this measure may not be appropriate if a fund's investment style differs significantly from those of other funds in the category. One should also keep in mind a potential effect of the survivorship bias if the peer group contains only survived funds (as reported, for example, by Brown and Goetzmann, 1995, disappearing funds tend to have poor performance). The use of category-specific returns as a benchmark, similarly to benchmarking by stock indices, may lead to undesirable changes in fund strategies.

The financial media and fund advertisements pay at least as much attention to ordinal performance measures based on the underlying cardinal measures. A typical ordinal measure is defined as a performance rank of a given fund within its category, which groups funds with a similar investment approach. The main difference between cardinal and ordinal performance measures is that the latter do not take into account by how much one fund outperforms another. This can induce adverse risk-taking incentives to fund managers competing for the top performance ranks rather than maximizing risk-adjusted returns. In addition, ordinal performance measures are susceptible to the same criticisms as their underlying cardinal measures. At present, the Morningstar Star Rating and the Lipper Leader are two prevailing ordinal systems in the US mutual fund industry.

2.4. Can Mutual Fund Managers Beat the Market?

Whether mutual fund managers can beat the market is important for both academic research and practical application. For academic purposes, studying this question would provide evidence for or against the efficient market hypothesis (EMH). In practice, the answer would indicate how to achieve abnormal performance for fund managers and provide a new clue in the search for good funds from the point of view of investors. In fact, all the mutual fund performance evaluation methods are developed to study whether and to what extent mutual fund managers can beat the market. The studies concerning this topic are now introduced.

After the EMH was developed by Eugene Fama in the early 1960s, various stock anomalies with respect to the Sharpe-Lintner-Mossin capital asset pricing model (CAPM) (Sharpe, 1964; Lintner, 1965; Mossin, 1966) were discovered. Dimson (1988) reviews these anomalies, including the weekend effect, monthly effect, January effect, P/B, P/E or Price effect, size effect and value line enigma. Fama and French (1992) find that market capitalization and book-to-market combine to capture most of the cross-sectional variation in average stock returns. Hence, Fama and French (1993) propose a three-factor model, which includes the two factors SMB and HML, to consider the influence of market capitalization and book-to-market ratio in addition to the market excess return of the CAPM.

Based on this three-factor model, most of the anomalies become insignificant, but Hendricks, Patel and Zeckhauser's (1993) "hot hands" effect, i.e. the value line enigma, is not well explained. Hendricks, Patel and Zeckhauser (1993), Goetzmann and Ibbotson (1994), Brown and Goetzmann (1995) and Wermers (1996) find evidence of persistence in mutual fund performance over short-term horizons of one to three years, and attribute the persistence to "hot hands" or common investment strategies. Grinblatt and Titman (1992), Elton, Gruber, Das and Hlavka (1993) and Elton, Gruber, Das and Blake (1996) document mutual fund return predictability over longer horizons of five to ten years, and attribute this to manager differential information or stock-picking talent.

Gruber (1996) also finds that, based on his four-factor model, an average mutual fund earns positive risk-adjusted returns. His main measure of performance is Jensen's alpha from a four-factor model with the market, size, style and bond factors. His sample consists of 270 US common stock funds over the period from 1985 to 1994 (almost all funds of this type that existed in 1984) and is free from survivorship bias. He finds that US stock funds, on average, offer a negative 65 basis points per year risk-adjusted returns to fund investors. Since the average expense ratio in the sample is about 113 basis points per year, this implies that an average mutual fund earns positive risk-adjusted returns but charges the investors more than the value added.

Carhart (1997) demonstrates that Jegadeesh and Titman's (1993) momentum effect in stock returns accounts for the "hot hands" in mutual fund performance. His database covers 1,892 diversified US equity mutual funds from January 1962 to December 1993 and is free of survivorship bias. When he sorts funds on the basis of lagged one-year raw return, his four-factor model with the market, size, book-to-market and one-year momentum factors explains almost all of the cross-sectional variation in expected returns. In accordance with the previous evidence, funds with better last-year performance have a higher return and one-factor Jensen's alpha than funds that underperformed last year. However, this difference is mostly due to the size and especially momentum factors, as last-year winners tend to hold more small stocks and momentum stocks than last-year losers. The only significant persistence unexplained by the Carhart model is consistent underperformance by the worst performing funds, which have significantly negative four-factor alphas. Investigating the factors explaining the differences in fund risk-adjusted performance, Carhart finds a significantly negative relationship between fund four-factor alphas and expense ratios, turnover and load fees. A 1% increase in expense ratio, turnover and maximum load fee is associated with a 1.54%, 0.95%, and 0.11% decline in annual risk-adjusted return respectively. Testing the consistency in funds' annual return rankings, Carhart finds that the year-to-year rankings of most funds are largely random. Only funds in the top and bottom performance deciles in the last year are likely to remain in these deciles next year. As a result, one-year performance persistence is short lived, being mostly eliminated after one year. Carhart finds slight evidence of persistence in risk-adjusted performance, as funds with high four-factor alphas tend to have above-average alphas in subsequent periods. However, this result should be treated with caution, since using the same model to sort and estimate performance may pick up the model bias that appears between ranking and formation periods.

Similar conclusions are reached by Daniel *et al.* (1997), who measure the performance of equity holdings of over 2,500 US equity funds in the period 1975–1994 using a holdings-based approach. They use as a benchmark the return on a portfolio of stocks that is matched to the fund's equity holdings each quarter on the basis of size, book-to-market and one-year momentum characteristics. The authors find that US equity funds have some stock selection ability (e.g., buying those growth stocks that have higher expected returns than other growth stocks), but hardly any ability to time the different stock characteristics (e.g., buying growth stocks when they have unusually high returns). Overall, the performance earned by the managers of active funds is not significantly greater than the difference between their expenses and the expenses of passive index funds. Using the same sample of funds, Wermers (2000) extends this analysis by considering not only gross returns on funds' equity holdings, but also their net returns to investors. He finds that funds' stock portfolios outperformed the CRSP value-weighted market index by 1.3% per year, with 70 basis points being due to fund managers' stock-picking skills and the rest being due to the stocks' risk premiums. However, funds underperformed the market index by 1% per year on a net return basis. The 2.3% difference between gross and net returns is due to the relatively low returns on fund non-stock holdings (0.7%), the expense ratios (0.8%) and the transaction costs (0.8%). Thus, a positive abnormal return earned by active mutual funds is more than offset by their expenses and transaction costs.

Edelen (1999) argues that the previously found negative performance of mutual funds may be explained by the costs of providing liquidity to fund investors (open-end funds are obliged to buy and sell their shares at the net asset value). In his sample of 166 randomly selected open-end funds in 1985-1990, approximately one-half of the average fund's assets are redeemed in the course of the year and over two-thirds of the average fund's assets arrived as new inflow in the previous year.

The author estimates that a unit of liquidity-motivated trading induced by investor flows, defined as an annual rate of trading equal to 100% of fund assets, is associated with a 1.5–2% decline in risk-adjusted returns. Controlling for this liquidity cost changes the average Jensen's alpha from a statistically significant -1.6% per year to a statistically insignificant -0.2% per year.

Although Carhart (1997) provides strong evidence that mutual funds as a group have negative or neutral estimated performance adjusted for risk and expenses, this does not imply that consumers should avoid all mutual funds. For example, during the time Peter Lynch was the fund manager of the Fidelity Magellan fund from 1977 to 1990, the fund had grown from $18 million to more than $14 billion in assets with more than 1,000 individual stock positions. During this period, the Magellan fund averaged a 29.2% return. Was Peter Lynch a "star" stock-picker, or was he simply endowed with stellar luck? Marcus (1990) concludes that the prolonged superior performance of the Magellan fund is difficult to explain as a purely random outcome. In addition, the Schroder Ultra Fund topped the field of 6,000 funds (across all investment objective categories) with a return of 107% per year over the three years ending in 2001. This fund closed to new investors in 1998 due to overwhelming demand, presumably because investors credited the fund manager with having extraordinary skills. These examples suggest that there probably exists a subset of funds that are able consistently to earn superior risk-adjusted returns. Investors would clearly like to identify such funds and invest in them. Therefore, after Carhart (1997), there are many studies trying to identify consistent performance differences across funds and forecast fund performance.

Numerous studies examine whether past fund performance is indicative of future fund performance, i.e. whether there are differences in fund performance that persist over time. For instance, Tonks (2005) measures the abnormal return generated by fund management houses in managing the equity portfolios of UK pension funds over the period 1983–1997. He finds evidence of significant persistence in the performance of fund managers at the one-year time horizon using a number of different consistency tests. The returns on a zero investment portfolio of a long position in a portfolio of fund managers who performed well over the previous 12 months and a short position in a portfolio of fund managers who performed poorly would have yielded an annualized abnormal return of 1.56%.

Teo and Woo (2001) examine persistence in style-adjusted fund returns (fund returns in excess of the returns of the average fund in their Morningstar style category). They argue that most funds with high raw returns are clustered into well-performing styles and that a large year-to-year variation in style returns may preclude finding persistence in raw returns. Sorting funds on the basis of lagged three-year style-adjusted returns, they find significant spreads between Carhart's four-factor Jensen's alphas of funds from top and bottom deciles. These spreads are larger than those based on raw returns and persist for up to six years. This evidence suggests that some managers do have greater ability than others.

Fletcher and Forbes (2002) study the persistence of UK unit trust performance using monthly returns of 724 trusts between January 1982 and December 1996. They employ the methods of Brown and Goetzmann (1995) and Carhart (1997) to evaluate the performance persistence. Evidence of significant persistence is found in the relative rankings of unit trusts. This persistence, however, is driven by underperformance based on risk-adjusted performance. In addition, consistent with Carhart (1997), the "hot hand" effect is eliminated using the Carhart model.

Several studies investigate other factors that can explain mutual fund performance. Using a sample of US stock and bond funds in the period 1990–1999, Elton, Gruber and Blake (2003) examine performance differences between funds using incentive fees (fees dependent on the fund's benchmark-adjusted return) and other funds using solely fraction-of-funds fees (fees proportional to the fund's assets). They find that funds with incentive fees earn, on average, a (insignificantly) positive multi-factor alpha of 58 basis points per year, which is higher than the average alpha of other funds. Note, however, that this difference appears to be almost entirely due to the differential expenses of these two classes of funds. Funds using incentive fees have an average expense ratio of 56 basis points per year lower than the expense ratios of similar funds with no incentive fees. Among funds with incentive fees, the risk-adjusted performance seems to be higher when managers are hired internally by the fund family.

Chevalier and Ellison (1999a) study the relationship between fund performance and the characteristics of fund managers that may indicate ability, knowledge or effort. Their sample consists of 492 managers of growth and growth-and-income funds in the period 1988–1994. They find significant differences between the raw returns of fund managers with different characteristics including the manager's age, the average SAT score at the manager's undergraduate institution and whether the manager has an MBA. However, most of these return differences are attributed to the differences in managers' investment styles and to the selection biases. After adjusting for these, the authors find that managers who attended higher-SAT undergraduate institutions have higher risk-adjusted performance.

The beliefs of investors manifested in money flows to mutual funds also seem to contain some information about future fund performance. Gruber (1996) finds that US stock funds receiving more money subsequently perform significantly better than funds losing money. Using a sample of US equity funds in the period 1970–1993, Zheng (1999) shows that this "smart money" effect is short-lived and is largely but not completely explained by investors chasing past winners. She demonstrates that the smart money effect is not due to macroeconomic information or a style effect, which suggests that investors use fund-specific information when choosing between funds. The smart money effect is most pronounced in the subset of small funds, whose lagged flows may be used to form the strategy beating the market.

Several studies use a Bayesian approach for performance evaluation, which combines investors' prior beliefs about the fund performance with the information in the data and produces a posterior distribution of fund alphas. Baks, Metrick and Wachter (2001) show that even some extremely sceptical prior beliefs about the skill of fund managers lead to economically significant allocations to some active diversified equity funds, based on the posterior expectation of the Fama-French (1993) three-factor alpha. Pastor and Stambaugh (2002) develop a framework in which investors' prior beliefs can distinguish managerial skill from inaccuracy of the pricing model (CAPM, the three-factor model of Fama-French, 1993, and the four-factor model of Carhart, 1997). Using a sample of US domestic equity funds, they demonstrate that optimal portfolios of mutual funds are influenced substantially by both types of prior belief. Portfolios with the highest Sharpe ratios are constructed when prior beliefs have some confidence in a pricing model. However, investing in equity funds may be optimal even for sceptical investors who rule out the accuracy of pricing models as well as managerial skill.

Recently, Kosowski *et al.* (2006) demonstrate that, in contrast to earlier work (e.g. Carhart, 1997), certain growth-oriented fund managers earn positive abnormal returns due to genuine skill rather than good luck. The data set consists of monthly returns on 2,118 US domestic equity mutual funds that existed during the period from 31 January 1975 to 31 December 2002. Since 48% of the distributions of individual fund residuals generated by the Carhart (1997) four-factor model are rejected in the normality test, standard t- and F-tests are not appropriate to assess the significance of the alphas, i.e. the mutual fund performance. Therefore, a bootstrap method is used to reconstruct the distribution of alphas, and that distribution is used to assess the significance of the alphas.

Kosowski *et al.* (2006) find that some fund managers have superior talent in picking stocks. The bootstrap method is applied to the monthly returns of the 1,788 mutual funds in their sample that exist for at least 5 years. Their results show that, by luck alone, there would be nine funds expected to exhibit an estimated alpha greater than 10% per year (net of costs, except load charges and taxes) over (at least) a 5-year period. But 29 funds exceed this level of alpha in fact, which implies the superior talent of fund managers.

Moreover, they find that growth-oriented fund managers exhibit superior performance due to genuine skill rather than good luck.[9] There is strong evidence that performance persists among the top decile of funds, ranked on their past 3-year four-factor alphas. Since the observed superior performance and performance persistence among growth-oriented funds cannot be explained by sampling variability, the observed superior performance should be attributable to genuine skill rather than good luck. However, this superior performance holds mainly for growth-oriented funds, not for income funds. Their findings indicate that seemingly well-performing income fund managers are merely lucky. All these results are consistent with prior evidence that the average manager of a growth-oriented fund can pick stocks that beat his benchmark, while the average manager of an income-oriented fund cannot (Chen, Jegadeesh, and Wermers, 2000)

Kosowski *et al.* (2006) also show that the funds with real skill contribute significantly to the wealth of fund shareholders. The funds that exceed an alpha of 4% per year (through skill alone) generate about $1.2 billion per year in wealth, which is in excess of benchmark returns, expenses, and trading costs. On the other hand, underperforming mutual funds destroy at least $1.5 billion per year in investor wealth. Nevertheless, the huge growth in new funds over the past decade has apparently been driven by a growth in the number of active managers without talent.

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[9] Fama and French (2009) attempt to identify the presence of skill via bootstrap simulations. They limit the tests to 1984-2006 and to US equity funds that reach the equivalent of five million 2006 dollars in assets under management. The simulation results for gross returns produce hints of the existence of managers with skill that enhances expected returns. But there is no evidence of fund managers with skill sufficient to cover costs.

2.5. Skills Fund Managers Employ to Earn Abnormal Returns

If mutual fund managers are able to earn abnormal returns, what skills do they use to achieve superior performance? Studies on the skills of mutual fund managers are related to the debate about whether mutual fund managers can earn abnormal returns. Generally speaking, before Carhart (1997) provided strong evidence against the existence of skilled or informed mutual fund managers, many believed that they were capable of earning abnormal returns and the study of mutual fund managers' skills attracted considerable research interest. After Carhart (1997), few studies discussed mutual fund managers' skills, and most of these concluded that they do not possess special skills. The following introduces the relevant studies concerning the skills that mutual fund managers employ to earn abnormal returns.

In brief, the skill fund managers employ is the ability to forecast the price movements of one investment target relative to another. For example, Fama (1972) states that selection and timing skills are two of the main attributes that mutual fund managers need to earn abnormal returns. Selection is concerned with the ability to forecast the price movements of individual investment targets, such as stocks, relative to other targets in the same market. Since investment targets are usually stocks, selection skill is frequently called "stock-selection" or "stock-picking". Timing is concerned with the ability to forecast the price movements of one investment set relative to another set, and is an investment strategy based on the outlook for an aggregate market rather than for a particular financial asset. For example, market timing is the best known timing strategy.

Many methods have been proposed to measure the skills of mutual fund managers and can be classified into two types: return-based and holdings-based. The return-based method compares mutual fund returns with certain benchmarks to identify evidence that mutual fund managers successfully forecast the price movements of one benchmark relative to another. For example, Treynor and Mazuy (1966) and Henriksson and Merton (1981) use market excess returns to identify information about market timing ability from mutual fund returns. In addition, various revised forms of the Treynor and Mazuy (1966) and Henriksson and Merton (1981) models have been used in the literature to test mutual fund timing ability, such as Kon (1983), Chang and Lewellen (1984), Henriksson (1984), Cumby and Glen (1990), Fletcher (1995), Ferson and Shadt (1996), Kryzanowski, Lalancette, and To (1996), Becker, Ferson, Myers, and Schill (1999), and Jiang (2003), Byrne, Fletcher, and Ntozi (2006).

The return-based method, however, is usually criticised for potential over- or under-estimation of timing ability. Jagannathan and Korajczyk (1986) show that returns of certain stocks have option-like features and hence demonstrate "passive timing" ability. They first show that the portfolio strategy of buying call options (calls on the market) will exhibit positive timing performance and negative security selection even though there is no market forecasting or security-specific forecasting being carried out. Applying the analysis of Henriksson and Merton (1981) to their case in which one invests in call options, positive market timing is obtained, but the return is reduced by the premium paid for the option (leading to negative security selection). Thus they predict negative cross-sectional correlation between measures of timing and security selection if managers are purchasing options or option-like securities such as the common stock of highly levered firms. Moreover, Jagannathan and Korajczyk (1986) note that the market proxy (the value-weighted NYSE stock index) is a portfolio of stocks that are, to a greater or lesser extent, options (due to their varying levels of risky debt). In this case the sign of the "artificial" market-timing performance of a given mutual fund will depend on whether the "average" stock held by the fund has more or less of an option effect than the "average" stock in the index used. Thus funds that tend to invest in stocks with little or no risky debt will show negative-timing performance, while funds that invest in small, highly levered stocks will show positive-timing performance. These two reasons above may result in an over- or under-estimation of timing ability.

Goetzmann, Ingersoll, and Ivkovich (2000) argue that the return-based measures are biased downwards when funds engage in active timing and trade between the observation dates of fund returns. For example, the return-based method using monthly fund returns tend to underestimate timing ability when funds engage in daily market timing.

The holdings-based method analyses mutual fund portfolio holdings to estimate the returns earned by forecast ability. Unlike the return-based method that relies on ex post realized returns to estimate beta shifting, the holdings-based method uses only ex ante information on portfolio holdings. Hence, the holdings-based method does not have any bias induced by subsequent trading activities during a holding period. Mutual fund portfolio holdings are used in a number of existing studies to evaluate fund performance, notably, Grinblatt and Titman (1989, 1993), Grinblatt, Titman, and Wermers (1995), Daniel, Grinblatt, Titman, and Wermers (1997), Wermers

(1999, 2000, 2004), and Ferson and Khang (2002).

The return-based measure is more common in previous studies than the holdings-based method. Although the holdings-based method is able to obtain a more precise measurement of fund managers' skills than the return-based method, the holdings-based method, however, requires data of mutual fund portfolio holdings which are usually not available. On the contrary, the return-based method needs only data of mutual fund returns.

Most existing studies relating to the skills of mutual fund managers focus on their market timing ability and evidence is mixed.[10] Several studies of mutual fund timing skill generally find little evidence of it. In an early study, Treynor and Mazuy (1966), for example, develop a test of market timing and find significant ability in only one fund out of 57 in their sample. Henriksson (1984) uses the market timing test of Henriksson and Merton (1981) and finds that only three funds out of 116 exhibit significant positive market timing ability. Ferson and Schadt (1996) find some evidence of market timing skill when macroeconomic conditions are taken into account. Graham and Harvey (1997) analyse the allocation between equity and cash suggested by investment newsletters, thereby measuring explicitly the ex post performance of timing strategies. Again, they find no evidence of timing ability. Busse (1999) examines the daily data of US domestic equity funds and finds that mutual funds decrease market exposure when market volatility is high. Bollen and Busse (2001) demonstrate that using daily rather than monthly fund return data

[10] See Kon (1983), Chang and Lewellen (1984), Lehmann and Modest (1987), Grinblatt and Titman (1989), (1994), Daniel, Grinblatt, Titman, and Wermers (1997).

changes inferences regarding the market timing ability of mutual fund managers, and that the standard regression-based tests have more power to detect significant timing activity. Jiang (2003) applies a non-parametric analysis to large sample of mutual funds that have different benchmark indices but does not find superior timing ability among actively managed domestic equity funds. Byrne, Fletcher, and Ntozi (2006) also find no evidence of superior conditional market timing performance for UK unit trusts. Based on a bootstrapping procedure which explicitly takes into account the cross-fund correlation and the finite-sample properties of timing measures, Jiang, Yao, and Yu (2007) find that actively managed U.S. domestic equity funds have positive market timing ability for the holdings-based method but not for the return-based method.

The most puzzling aspect of the empirical evidence is that the average timing measures across mutual funds are negative and that those funds that do exhibit significant timing performance show negative performance more often than positive performance (Volkman, 1999). Fletcher (1995) finds that, on average, both UK unit trusts and passive strategies exhibit positive selectivity performance and the average negative timing performance. Also, Kon (1983) and Henriksson (1984) find that there is a negative correlation between measures of security selection ability and market timing. Henriksson (1984) suggests a number of potential explanations for these results, including error-in-variables bias, misspecification of the market portfolio and the use of a single-factor rather than a multifactor asset-pricing model.

Market timing is not the only investment strategy that could be employed by active fund managers. A manager can generate additional performance if size, book-to-market or momentum strategies have timing-varying expected returns that can be used by changing portfolio weights to exploit these styles when they will be profitable. Also, some fund managers can be active with regard to sector rotation and try to anticipate and tilt their portfolios toward the sector or sectors they expect to lead the market in future periods.

Some researchers do demonstrate other fund manager skills. For example, Lu (2005) develops two style timing models by applying the methods of Treynor and Mazuy (1966) and Henriksson and Merton (1981) to Carhart's (1997) four-factor model. In addition to market timing, the style timing models are able to measure size timing, growth timing and momentum timing concurrently. Specifically, size timing is to adjust exposure between small and big capitalization companies; growth timing involves modifying exposure along the value/growth continuum; momentum timing rotates between momentum investing and contrarian investing strategies. He investigates the timing behaviour of 2,791 US domestic equity funds existing from June 1992 to July 2002. He finds evidence of growth timing ability among his sample funds, especially in aggressive growth funds, and size timing among small funds. However, there is little evidence of market timing and momentum timing abilities. He notices that timing ability is fund specific and is difficult to predict by systematic factors. He also finds that timing aggressiveness is affected significantly by fund characteristics. For example, funds with a previous extreme performance record implement timing strategies more aggressively than those with moderate performance, and high turnover funds implement timing strategies more aggressively than their low turnover counterparts.

Swinkels and Tjong-A-Tjoe (2007) examine daily data of 153 US midcap-blend equity mutual funds from January 2001 to December 2005 to study the four timing abilities, i.e. market timing, size timing, book-to-market timing and momentum-strategy timing, as well. Unlike the style timing models of Lu (2005) which consider four timing ability at the same time in one model, their timing models consider only one timing ability in each model. They find evidence that mutual fund managers demonstrate market timing, book-to-market timing and momentum-strategy timing abilities, but no size timing ability. Moreover, their results suggest that fund managers are able to predict the direction of return changes but not the magnitude. They also indicate that the evidence of momentum timing ability is slightly weaker than that of growth timing because of relatively high transaction costs for momentum stocks.

It is noticeable that there are fewer studies concerning fund managers' skills after 1997 when Carhart provided strong evidence that mutual fund managers do not earn abnormal returns. This phenomenon is understandable: since fund managers' skills are defined as the ability to earn abnormal returns, it is meaningless to discuss those skills if fund managers are not able to earn abnormal returns. Although Bollen and Busse (2001) and Swinkels and Tjong-A-Tjoe (2007) show evidence for the timing ability of mutual fund managers, they use daily data rather than the monthly data used in most studies, including Carhart (1997). Therefore, their results do not challenge Carhart's (1997) conclusion.

This situation may change, as Kosowski *et al.* (2006) find, based on Carhart's (1997) model, that certain growth-oriented fund managers do earn abnormal returns persistently. However, they do not explore why or identify the skills that these fund managers possess.

2.6. Growth vs. Value

This section discusses the definition of growth-oriented funds, which this study focuses on. Since growth-oriented funds are expected to invest primarily in growth stocks, the characteristics of growth stocks and value stocks are first introduced. Given that mutual fund portfolio holdings are usually not fully disclosed, how to assess whether a mutual fund invests primarily in growth stocks rather than value stocks is then discussed.

Generally speaking, growth stocks are the stocks of companies that are believed to have a strong earnings growth potential, enjoy sustainable competitive advantages in their marketplaces and are reasonably valued at the time of purchase. These companies often have new products, technologies, distribution channels or other opportunities, or have a strong industry or market position.

Value stocks are viewed by companies that have one or more of the following characteristics: (1) valuable fixed assets; (2) valuable consumer or commercial franchises or potentially valuable transportation routes; (3) are selling at a low market valuation of assets relative to the securities market in general, or companies that may currently be earning a very low return on assets but which have the potential to earn higher returns if conditions in the industry improve; (4) are undervalued in relation to their potential for growth in earnings, dividends and book value; or (5) have recently changed management or control and have the potential for a "turnaround" in earnings.[11]

According to the descriptions above, growth and value stocks are not mutually exclusive. “Growth” describes a company’s prospects, while “Value” is reflected in its stock price. When a growth stock is undervalued or a value (underpriced) stock creates a new business with growth potential, it could be a “growth and value” stock. These examples show that growth and value stocks are not opposite, although the situation described rarely happens.

The Standard & Poor's (S&P) definitions of growth and value stocks are consistent with the above. S&P defines growth stocks as stocks with a high five-year earnings per share growth rate, a high five-year sales per share growth rate and a high five-year internal growth rate (= ROE x Earnings Retention Rate), and defines value stocks as those with a high book value to price ratio, a high cash flow to price ratio, a high sales to price ratio and a high dividend yield.

Growth and value stocks, however, usually have opposite characteristics. Both Fidelity Investments and Vanguard observe that growth stocks tend to be those with higher than average price-to-book (P/B) or price-to-earnings (P/E) ratios, and that characteristics of value stocks include a relatively low P/B or P/E ratio. Therefore, Fama and French (1992, 2007) use the book-to-market (B/M) ratio, the inverse of

[11] These characteristics are summarised from the mutual fund prospectuses of Fidelity Investments and Vanguard, two of the world's largest investment management companies, providing a large family of mutual funds, distributors and investment advisors. For more details see https://www.fidelity.com/ and http://www.vanguard.com/.

price-to-book (P/B), to differentiate growth (low B/M) and value (high B/M) stocks.

When the details of mutual fund portfolio holdings are not available, how to judge whether a mutual fund invests primarily in growth stocks is an important question for mutual fund classification. There are two systems to solve this problem. The first system is to make a judgement based on anything claimed by fund, such as the fund’s name, mandate, prospectus, etc. Although this is a common method to classify mutual funds, it is not completely reliable. Cooper, Gulen and Rau (2005) observe the inconsistency between fund name and investment style. They report that flows to a fund increase dramatically when the fund changes its name to look more (less) like the current popular (unpopular) return style. This is despite the fund not materially adjusting its holdings to reflect the style implied by the new name.

The second system analyses the fund’s performance. For example, S&P uses Returns-Based Style Analysis derived from Sharpe (1992) to compare the historical performance of each fund with a series of index benchmarks to determine which benchmark (or combination of benchmarks) most closely describes the fund's actual returns. In recent years, this system has become the dominant method used to classify mutual funds in S&P mutual fund reports.

2.7. Summary

The measurement of mutual fund performance is crucial for evaluating fund manager skill. Past performance of a mutual fund influences both managerial compensation and the decision to retain, promote or fire the manager. The central question in recent studies as regards mutual fund performance is: "Can mutual fund manager beat the market?" If the answer is negative, consumers may be better off investing in low-cost index funds and avoiding expensively managed active funds.

Two approaches have been used in the literature to measure the risk-adjusted performance of mutual funds: return-based (e.g. Carhart, 1997) and holdings-based (e.g. Daniel *et al.*, 1997). The former approach employs fund returns, while the latter uses fund portfolio composition in order to construct a passive benchmark replicating the risk characteristics of the fund's portfolio. The difference between the fund's return and the benchmark return indicates whether the manager has superior knowledge or skills that allow him to outperform the benchmark.

The existing empirical evidence suggests that mutual funds, on average, have negative or, at best, neutral risk-adjusted performance after costs. However, several studies examine whether there are consistent differences between the performance of various types of mutual fund that can be forecast. It has been found that there is a significant year-to-year persistence in raw returns, i.e. funds with the highest (lowest) raw returns over the last year are likely to be winners (losers) next year as well (e.g. Brown and Goetzmann, 1995). However, most of this persistence appears to be due to the differences in fund fees and exposure to the common risk factors (Carhart, 1997). Lesmond *et al.* (2004) find that the returns associated with momentum strategies do not exceed trading costs. Nevertheless, several studies demonstrate that it is possible to identify funds with inferior as well as superior risk-adjusted performance (e.g. Kosowski *et al.*, 2007) and that even investors sceptical about the existence of managerial skill may include the latter funds in their optimal portfolios

(Baks *et al.*, 2001).

As with fund performance measurement, many methods have been proposed to measure mutual fund managers' skills. These include methods that analyse fund portfolio holdings, as proposed by Daniel *et al.* (1997), and methods that find evidence based on fund returns, as proposed by Treynor and Mazuy (1966) and Henriksson and Merton (1981). Most studies, however, focus on market timing and do not reach a consistent conclusion. Kon and Jen (1979), Kon (1983), Chang and Lewellen (1984), Lee and Rahman (1990), Busse (1999), Bollen and Busse (2001), Jiang, Yao, and Yu (2007), and Swinkels and Tjong-A-Tjoe (2007) find evidence of successful market timing activity, whereas contrary evidence is provided by Treynor and Mazuy (1966), Henriksson (1984), Chen, Lee and Rahman (1992), Jiang (2003), and Cuthbertson, Nitzsche and O'Sullivan (2008). Nevertheless, market timing is not the only investment strategy that could be employed by active fund managers, but few studies (e.g. Swinkels and Tjong-A-Tjoe, 2007) discuss these other skills employed by fund managers.

There has been little research on fund managers' skills after 1997 when Carhart provided strong evidence that mutual fund managers do not earn abnormal returns. It is pointless discussing these skills if they are unable to earn abnormal returns. This situation, however, may change, as Kosowski *et al.* (2006) find that even based on the Carhart (1997) four-factor model, certain growth-oriented fund managers do earn abnormal returns persistently. Therefore, what skills "growth-oriented" fund managers possess is open for discussion.

This thesis conducts a comprehensive investigation into this question – what skills do growth-oriented fund managers possess?

CHAPTER 3

METHODOLOGY AND RESEARCH QUESTIONS

3.1. Introduction

This chapter describes the methodology used in this thesis, and then sets up specific research questions and corresponding testable hypotheses for addressing the research gaps identified in the last chapter. It is organized as follows: Sections 3.2 to 3.7 describe the test methods employed. The key research questions and the testable hypotheses are introduced in Section 3.8. Section 3.9 summarizes the chapter.

3.2. Mutual Fund Performance

Most studies evaluating the performance of fund managers employ an evaluation paradigm based on Jensen's (1968) model. Jensen recognizes the importance of evaluating a fund manager's performance based on the fund's systematic risk and employs the CAPM. He assumes that returns on a fund have a multivariate normal distribution and the systematic risk of the managed portfolio is stationary over the evaluation period. Given joint normality of returns, Jensen decomposes a fund's excess return, $R_{i,t}$, into a constant, α_i; a market-related component, β_i; and a conditional mean zero residual, $\varepsilon_{i,t}$:

$$R_{i,t} = \alpha_i + \beta_i RMRF + \varepsilon_{i,t} \tag{3.1}$$

where RMRF is the excess market return and $\varepsilon_{i,t}$ is assumed to follow a Brownian motion white noise series.

Although Jensen's (1968) model is the standard used in evaluating mutual fund performance, several researchers note that cross-sectional average returns show little correlation with the systematic risk parameters estimated using the CAPM (Breeden, Gibbons and Litzenberger, 1989), while other researchers suggest that other systematic factors may influence cross-sectional abnormal performance (Fama and French, 1993; Carhart, 1997). Fama and French (1993) note that alone the CAPM systematic risk parameter β_i has little explanatory power for cross-sectional returns. It is asserted that other systematic factors, such as high- versus low-beta stocks, large- versus small-market capitalization stocks and value versus growth stocks affect average equity performance. Fama and French (1993) develop a three-factor loading model to explain cross-sectional variability in equity returns.

$$R_{i,t} = \alpha_i + \beta_i RMRF_t + s_i SMB_t + h_i HML_t + \varepsilon_{i,t} \tag{3.2}$$

where SMB and HML are returns on value-weighted, zero-investment, factor-mimicking portfolios for size and book-to-market equity in stock returns.

However, Fama and French's (1993) three-factor model is not able to explain cross-sectional variation in momentum-sorted portfolio returns (Fama and French, 1996). Hendricks, Patel and Zeckhauser (1993), Goetzmann and Ibbotson (1994), Brown and Goetzmann (1995) and Wermers (1996) find evidence of persistence in mutual fund performance over short-term horizons of one to three years, and attribute the persistence to "hot-hands" or common investment strategies. Grinblatt and Titman (1992), Elton, Gruber, Das and Hlavka (1993) and Elton, Gruber, Das and Blake (1996) document mutual fund return predictability over longer horizons of five to ten years, and attribute this to manager differential information or stock-picking talent. Chan, Jegadeesh and Lakonishok (1996) suggest that the momentum anomaly is a market inefficiency due to slow reaction to information. However, the effect is robust to time-periods (Jegadeesh and Titman, 1993) and countries (Asness, Liew and Stevens, 1997).

Carhart (1997) finds that Jegadeesh and Titman's (1993) one-year momentum in stock returns accounts for Hendricks, Patel and Zeckhauser's (1993) "hot-hands" effect in mutual fund performance and thus incorporates a fourth systematic factor capturing Jegadeesh and Titman's (1993) one-year momentum anomaly. Specifically, Carhart employs the following four-factor loading model to analyse abnormal fund performance:

$$R_{i,t} = \alpha_i + \beta_i RMRF_t + s_i SMB_t + h_i HML_t + p_i MOM_t + \varepsilon_{i,t} \qquad (3.3)$$

where MOM is returns on equal-weighted, zero-investment, factor-mimicking portfolios for one-year momentum in stock returns.

3.3. Style Timing Models

This section introduces the style timing models used in this study. How Treynor and

Mazuy (1966) and Henriksson and Merton (1981) measure market timing is first explained followed by how to extend their methods to measure style timing abilities with respect to Carhart's (1997) four factors, i.e. market timing, size timing, growth timing and momentum timing abilities.

3.3.1. Treynor and Mazuy (1966) and Henriksson and Merton (1981)

Various methodologies have been employed to explore the timing activities of fund managers. Timing strategy refers to the dynamic allocation of capital among broad classes of investment. The successful timer allocates funds among different classes of assets to catch market (or subsets of the market) ascendancy and/or to avoid market downturns.[12] If we could observe the portfolio composition of mutual funds at the same frequency as we observe their returns, their timing activities can be tested by examining whether their exposures to the relevant markets properly adjust prior to market changes on average (Merton, 1981; Cumby and Modest, 1987; Ferson and Khang, 2002). In reality, obtaining a mutual fund's detailed portfolio composition on a timely basis and at a reasonable high frequency is difficult.[13] Analysis of the timing activity of mutual funds based on less frequent portfolio holdings data may not provide a true picture of the timing behaviour of fund managers. In fact, if a timer could trade several times within each reporting period, a lower reporting frequency may fail to capture the contribution of a manager's timing activities to fund returns, because decisions regarding portfolio risk exposures are likely to be made more frequently for most funds. Further, the classification of

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[12] Theoretical work includes studies by Merton (1981) and Cumby and Modest (1987).

[13] The current practice in the industry is that fund companies are only required to show what assets they hold in their portfolios on a semi-annual basis. More timely and more frequent disclosure is on a voluntary basis for each fund.

individual securities into slots based on stock characteristics can involve considerable judgement.[14] Hence, we concentrate on the returns of funds and benchmark portfolios only, as in Treynor and Mazuy (1966) and Henriksson and Merton (1981). Their methods need only ex post returns of funds and some benchmark returns. The market timing models of Treynor and Mazuy (1966) and Henriksson and Merton (1981) will be explained after discussing the distinctive characteristic of market timing activity.

The distinctive characteristic of successful market timing activity is a convex function of market excess return. Market timing involves forecasting whether the stock market will produce better returns than investing in a risk-free asset, such as Treasury bills. Since successful market timers increase their portfolio exposure to the better market beforehand, they earn more excess returns, as the difference between stock and bond market returns is larger. Thus, the excess return earned by successful market timing is a convex function of market excess return, i.e. the difference between stock and bond market returns.

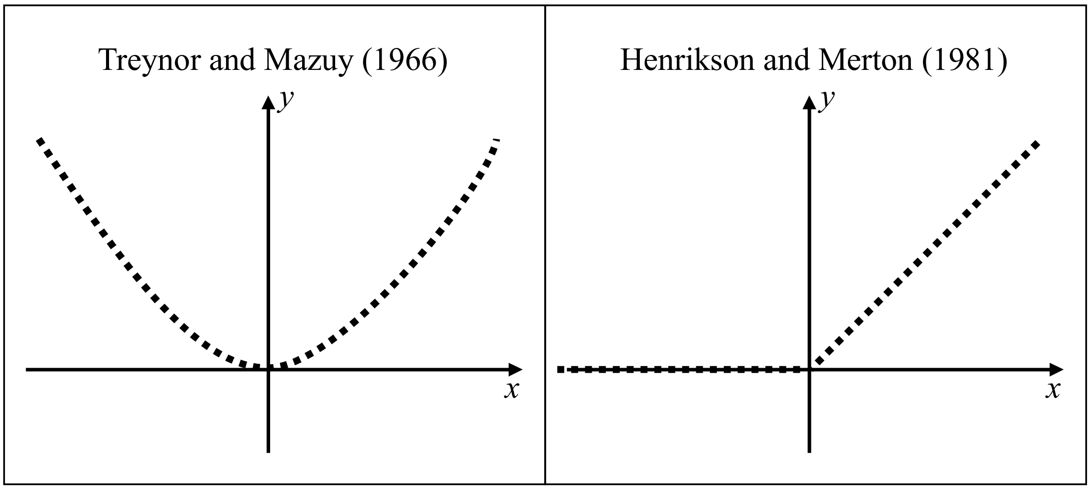
In order to describe the convex function, Treynor and Mazuy (1966) use a “U” shape and Henriksson and Merton (1981) adopt a “V” shape. Treynor and Mazuy (1966) depict the convex function by introducing a quadratic market excess return, which

[14] For example, a conglomerate firm would typically have operations in several different sectors of the economy and it may be difficult to identify how much of the firm is represented by each sector. Another problem arises from simply calculating portfolio characteristics based on portfolio holdings. A domestic equity mutual fund investing in domestic stocks that derive a majority of their revenue from sales abroad will clearly be influenced by trends in foreign economies. If the overseas economies go into recession, the fund will be affected. In this way, the fund, although domestic, responds to factors in external markets in a manner similar to an international equity fund. Simply examining fund portfolio holdings data may not reflect the fact that the fund manager is indeed timing the factors in overseas markets, since all his/her holdings are domestic equities.

looks like a "U" in Figure 4-2-A. The convex function proposed by Henriksson and Merton (1981) is the product of the market excess return and an indicator function, which equals one if the market excess return is positive and zero otherwise, and looks like a left-tilting "V" shape in Figure 4-2-B.[15]

Figure 3-1: Convex functions of Treynor and Mazuy (1966) and Henriksson and Merton (1981)

This figure illustrates the convex functions used to capture market timing. The x-axis shows the market excess return, i.e. market return minus risk-free rate of return, and the y-axis shows the excess return earned by market timers. The dashed lines in Panel A and B are the convex functions of Treynor and Mazuy (1966) and Henriksson and Merton (1981) respectively.



(A) (B)

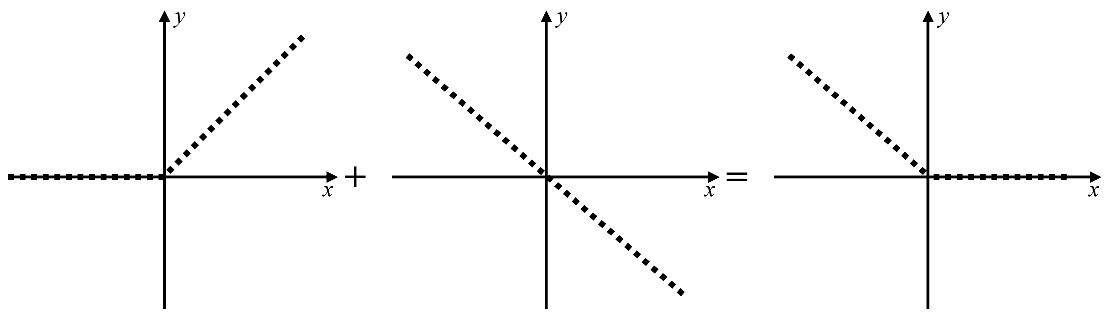
In most cases, the actual market timing convex function is neither symmetric like the "U" of Treynor and Mazuy (1966) nor tilting like the "V" of Henriksson and Merton (1981). In order to capture various convex functions we need to include a linear

[15] The left-hand side of the "U" Shape proposed by Treynor and Mazuy (1966) implies that successful market timers are able to short sell stocks when bond market outperforms stock market. On the contrary, the flat left-hand side of the left-tilting "V" shape used by Henriksson and Merton (1981) infers a "no short-selling" constraint. However, this constraint could be released by the linear function introduced latter.

function of market excess return so that the direction of the "U" or "V" function can be adjusted. For example, if we use the left-tilting "V" convex function of Henriksson and Merton (1981) but the actual convex function is a right-tilting "V" function, including a negative linear function of market excess return turns the left-tilting "V" function into a right-tilting "V" function, as shown in Figure 4-3.

Figure 3-2: How to use a linear function to turn a convex function

The x-axis shows the market excess return, i.e. market return minus risk-free rate of return, and the y-axis shows the excess return earned by market timers. The left dashed line is the convex function of Henriksson and Merton (1981), and the central dashed line is a linear function with negative slope. Combining these two functions produces the right dashed line.



Treynor and Mazuy (1966) and Henriksson and Merton (1981) propose different market timing models by adding different convex functions to the CAPM, which is a linear function of market excess return, as follows:

The Treynor and Mazuy (1966) market timing model is:

$$r_{i,t} = \alpha_i + \beta_i \cdot RMRF_t + \gamma_i \cdot RMRF_t^2 + \varepsilon_{i,t} \tag{3.4}$$

The Henriksson and Merton (1981) market timing model is:

$$r_{i,t} = \alpha_i + \beta_i \cdot RMRF_t + \gamma_i \cdot RMRF_t^* + \varepsilon_{i,t}$$

$$RMRF_t^* = I\{RMRF_t > 0\} \cdot RMRF_t \tag{3.5}$$

$$I\{RMRF_t > 0\} = \begin{cases} 1 & if \ RMRF_t > 0 \\ 0 & if \ RMRF_t \leq 0 \end{cases}$$

where $r_{i,t}$ is the excess return of investor *i* at time *t*; $RMRF_t$ is the market excess return at time *t*; $RMRF_t^2$ and $RMRF_t^*$ are the convex function of the market excess return; α_i is the abnormal return; β_i is the original CAPM-beta and the coefficient of the linear function for controlling the direction of the convex function; and γ_i is the market timing measure. A positive γ_i means that the excess return earned by the investor contains a convex function of the market excess return, which is evidence for successful market timing.

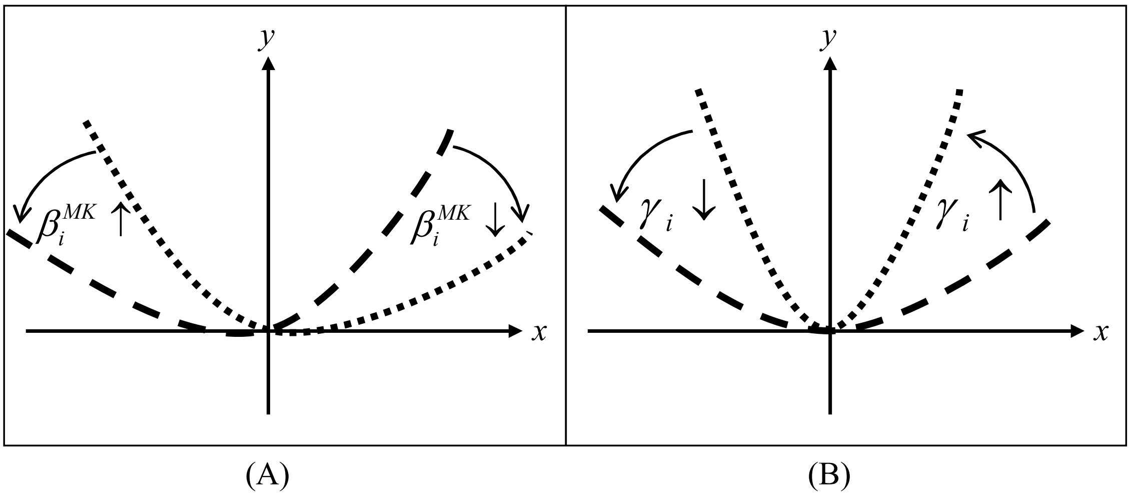
By adjusting β_i and γ_i, these two market timing models can depict various convex functions of the market excess return. For example, the Treynor and Mazuy (1966) market timing model can be decomposed as follows.

$$r_{i,t} = \alpha_i + \beta_i^{CAPM} \cdot RMRF_t + \beta_i^{MK} \cdot RMRF_t + \gamma_i \cdot RMRF_t^2 + \varepsilon_{i,t} \tag{3.6}$$

where β_i^{CAPM} is the original CAPM-beta; β_i^{MK} and γ_i are the coefficients of the linear and convex functions for describing the convex function of successful market timing respectively. As shown in Figure 4-4, β_i^{MK} controls the direction of the convex function and γ_i adjusts the angle of the convex function. The Treynor and Mazuy (1966) market timing model can describe every possible quadratic "U"-shape convex function and can identify various convex functions of the market excess return as evidence of successful market timing ability.

Figure 3-3: The relationship between model coefficients and the convex function

This figure shows how the model coefficients, β_i^{MK} and γ_i, control the shape of the convex function in model (3) which is used to capture market timing. The *x*-axis shows the market excess return and the *y*-axis shows the excess return earned by market timers. Panels A and B illustrate the influence of β_i^{MK} and γ_i respectively on the convex function using two dashed lines in each case.



The coefficients of these two market timing models essentially measure the expected convexity in the funds' relationship to the market return, which reflects both the probability (related to information quality) and the magnitude (related to risk aversion). A fund manager's market timing performance depends on both the quality of his/her private information (ability) and the aggressiveness with which the manager reacts to his/her information (response). Therefore, the magnitude of these timing coefficients (the absolute value) could be more or less considered as a proxy for the aggressiveness of fund timing strategies.

Note that both the market timing models, equations (3.4) and (3.5), are based on the classic Sharpe-Lintner-Mossin CAPM (Sharpe, 1964; Lintner, 1965; Mossin, 1966). The CAPM itself and its use in performance measurement have been subjected to strong objections on theoretical grounds (Roll, 1978; Mayers and Rice, 1979; Admati and Ross, 1985; Dybvig and Ross, 1985). Empirical studies have uncovered risk factors (other than the market) relevant in explaining cross-sectional variation of average asset returns, thus questioning the validity of the CAPM. Among these, size and book-to-market ratio have been studied extensively (Banz, 1981; Rosenberg, Reid and Lanstein, 1985; Fama and French, 1992, 1993, 1996). A multi-factor asset pricing model that, in addition to the market, includes risk factors accounting for size and the book-to-market ratio, as indicated above, has been proposed by Fama and French (1993) and has gained acceptance by academics and practitioners alike. Indeed, any plausible multi-factor asset pricing model can be readily utilized instead of the CAPM. For example, Connor and Korajcyzk (1991) extend the Henriksson and Merton (1981) model to an Arbitrage Pricing Theory (APT) framework. The original market timing models are robust to the choice of the underlying asset pricing model. Bollen and Busse (2001) and Volkman (1999) propose the following revised version of the Treynor and Mazuy (1966) and Henriksson and Merton (1981) market timing models by incorporating Carhart's (1997) four-factor model.

The Carhart's (1997) four-factor Treynor and Mazuy (1966) market timing model is:

$$r_{i,t} = \alpha_i + \beta_i RMRF_t + s_i SMB_t + h_i HML_t + p_i MOM_t + \gamma_i RMRF_t^2 + \varepsilon_{i,t} \tag{3.7}$$

The Carhart's (1997) four-factor Henriksson and Merton (1981) market timing model is:

$$r_{i,t} = \alpha_i + \beta_i RMRF_t + s_i SMB_t + h_i HML_t + p_i MOM_t + \gamma_i RMRF_t^* + \varepsilon_{i,t}$$

$$RMRF_t^* = I\{RMRF_t > 0\} \cdot RMRF_t \tag{3.8}$$

$$I\{RMRF_t > 0\} = \begin{cases} 1 & if\ RMRF_t > 0 \\ 0 & if\ RMRF_t \le 0 \end{cases}$$

Bollen and Busse (2001) find that the magnitude of the average timing coefficient is smaller under the Carhart's (1997) four-factor Treynor and Mazuy (1966) market timing model than under the Carhart's (1997) four-factor Henriksson and Merton (1981) market timing model (less positive or less negative). Similarly, Jiang (2003) suggests that the market timing coefficient of the Henriksson and Merton (1981) market timing model caters more for the information quality side of market timing while the market timing coefficient of the Treynor and Mazuy (1966) market timing model basically reflects the intensity of the manager's reaction. Hence, more aggressive funds can show up as better (or worse if the information is incorrect) market timers with a higher (more negative) Henriksson and Merton (1981) -based market timing coefficient.

Swinkels and Tjong-A-Tjoe (2007) also extend the timing models of Treynor and Mazuy (1966) and Henriksson and Merton (1981) to examine four timing abilities with respect to Carhart's four factors. Like Busse (2001) and Volkman (1999), they also use the models given by equations (3.7) and (3.8) to estimate the market timing ability of fund manages. In addition, the following models are used to measure size timing, growth timing and momentum timing.

The Carhart's (1997) four-factor Treynor and Mazuy (1966) size timing model:

$$r_{i,t} = \alpha_i + \beta_i RMRF_t + s_i SMB_t + h_i HML_t + p_i MOM_t + \gamma_i SMB_t^2 + \varepsilon_{i,t} \qquad (3.9)$$

The Carhart's (1997) four-factor Henriksson and Merton (1981) size timing model:

$$r_{i,t} = \alpha_i + \beta_i RMRF_t + s_i SMB_t + h_i HML_t + p_i MOM_t + \gamma_i SMB_t^* + \varepsilon_{i,t}$$

$$SMB_t^* = I\{SMB_t > 0\} \cdot SMB_t \qquad (3.10)$$

$$I\{SMB_t > 0\} = \begin{cases} 1 & if\ SMB_t > 0 \\ 0 & if\ SMB_t \leq 0 \end{cases}$$

The Carhart's (1997) four-factor Treynor and Mazuy (1966) growth timing model:

$$r_{i,t} = \alpha_i + \beta_i RMRF_t + s_i SMB_t + h_i HML_t + p_i MOM_t + \gamma_i HML_t^2 + \varepsilon_{i,t} \qquad (3.11)$$

The Carhart's (1997) four-factor Henriksson and Merton (1981) growth timing model:

$$r_{i,t} = \alpha_p + \beta_i RMRF_t + s_i SMB_t + h_i HML_t + p_i MOM_t + \gamma_i HML_t^* + \varepsilon_{i,t}$$

$$HML_t^* = I\{HML_t > 0\} \cdot HML_t \qquad (3.12)$$

$$I\{HML_t > 0\} = \begin{cases} 1 & if\ HML_t > 0 \\ 0 & if\ HML_t \leq 0 \end{cases}$$

The Carhart's (1997) four-factor Treynor and Mazuy (1966) momentum timing model:

$$r_{i,t} = \alpha_i + \beta_i RMRF_t + s_i SMB_t + h_i HML_t + p_i MOM_t + \gamma_i MOM_t^2 + \varepsilon_{i,t} \qquad (3.13)$$

The Carhart's (1997) four-factor Henriksson and Merton (1981) momentum timing model:

$$r_{i,t} = \alpha_i + \beta_i RMRF_t + s_i SMB_t + h_i HML_t + p_i MOM_t + \gamma_i MOM_t^* + \varepsilon_{i,t}$$

$$MOM_t^* = I\{MOM_t > 0\} \cdot MOM_t \qquad (3.14)$$

$$I\{MOM_t > 0\} = \begin{cases} 1 & if\ MOM_t > 0 \\ 0 & if\ MOM_t \leq 0 \end{cases}$$

3.3.2. The development of style timing models

The previous section explains the methods of Treynor and Mazuy (1966) and Henriksson and Merton (1981) in an intuitive way, and their extended versions are also introduced. However, previous models include only one timing measure and hence do not consider the correlation between different timing activities. The style timing models, first proposed by and Lu (2005), can solve this problem by incorporating all style timing activities, i.e. market timing, size timing, growth timing and momentum timing, in one model. The following derives and explains the style timing models from an econometric viewpoint.

Timing ability on the part of a fund manager traditionally refers to the ability to enhance portfolio performance by using information about the future realizations of the common factors in security returns. Treynor and Mazuy (1966) assume that a fund manager observes a private signal (y_t), which equals the future market excess return ($RMRF_{t+1}$), plus an independent noise term (η_t):

$$y_t = RMRF_{t+1} + \eta_t \tag{3.15}$$

This assumption can be applied to the Capital Asset Pricing Model (CAPM) with a dynamic beta:

$$r_{i,t+1} = \alpha_i + \hat{\beta}_i RMRF_{t+1} + \varepsilon_{i,t+1} \tag{3.16}$$

$$\hat{\beta}_i = \beta_i + \gamma_i y_t = \beta_i + \gamma_i \left(RMRF_{t+1} + \eta_t \right) \tag{3.17}$$

where $r_{i,t+1}$ is the excess return on a portfolio at time t+1, $RMRF_{t+1}$ is the excess return on the market and γ_i is the magnitude of the market exposure (β_i) adjustment in response to the private signal (y_t).

Equations (3.16) and (3.17) reflect the essence of market timing in that the beta increases in response to the timing signal. The market timer will increase allocation to stocks when the timing signal implies a better market return and vice versa. Substituting (3.17) into (3.16) and including noise η_t in the error term, we obtain the Treynor and Mazuy (1966) market timing model (3.18):

$$r_{i,t+1} = \alpha_i + \beta_i RMRF_{t+1} + \gamma_i RMRF_{t+1}^2 + \varepsilon_{i,t+1} \qquad (3.18)$$

Superior timing ability corresponds to the fact that the variance of the noise term is finite. The manager with a constant absolute risk aversion (CARA) preference will respond to the signal by making the portfolio beta a linear function of the signal (Admati, Bhattacharya, Pfleiderer and Ross, 1986), which in turn makes the portfolio return a quadratic function of the market return, as in equation (3.18). Thus, a significantly positive coefficient γ_i represents superior market timing performance.

The multifactor model is combined with the Treynor and Mazuy (1966) timing model to investigate the style timing activities of fund managers. Assume that the fund manager observes private signals, i.e. $y_{RMRF,t}$, $y_{SMB,t}$, $y_{HML,t}$ and $y_{MOM,t}$, on Carhart's (1997) four factors respectively. Each private signal then equals the future factor index return plus an independent noise term (η):

$$
\begin{aligned}
y_{RMRF,t} &= RMRF_{t+1} + \eta_{RMRF,t} \\
y_{SMB,t} &= SMB_{t+1} + \eta_{SMB,t} \\
y_{HML,t} &= HML_{t+1} + \eta_{HML,t} \\
y_{MOM,t} &= MOM_{t+1} + \eta_{MOM,t}
\end{aligned}
\tag{3.19}
$$

A Treynor and Mazuy (1966) style timing model can then be derived based on Carhart's (1997) four-factor model with dynamic betas:

$$r_{i,t+1} = \alpha_i + \hat{\beta}_i RMRF_{t+1} + \hat{s}_i SMB_{t+1} + \hat{h}_i HML_{t+1} + \hat{p}_i MOM_{t+1} + \varepsilon_{i,t+1} \tag{3.20}$$

where, $\hat{\beta}_i = \beta_i + \gamma_{1,i} y_{RMRF,t} = \beta_i + \gamma_{1,i}\left(RMRF_{t+1} + \eta_{RMRF,t}\right)$ (3.21)

$$\hat{s}_i = s_i + \gamma_{2,i} y_{SMB,t} = s_i + \gamma_{2,i}\left(SMB_{t+1} + \eta_{SMB,t}\right) \tag{3.22}$$

$$\hat{h}_i = h_i + \gamma_{3,i} y_{HML,t} = h_i + \gamma_{3,i}\left(HML_{t+1} + \eta_{HML,t}\right) \tag{3.23}$$

$$\hat{p}_i = p_i + \gamma_{4,i} y_{MOM,t} = p_i + \gamma_{4,i}\left(MOM_{t+1} + \eta_{MOM,t}\right) \tag{3.24}$$

and $\gamma_{1,i}$, $\gamma_{2,i}$, $\gamma_{3,i}$, and $\gamma_{4,i}$ are the respective magnitudes of the corresponding factor exposure adjustment in response to the private signals, $y_{RMRF,t}$, $y_{SMB,t}$, $y_{HML,t}$, and $y_{MOM,t}$.

Equations (3.21)–(3.24) reflect the essence of style timing, which is that the factor coefficients of equation (3.20), i.e. $\hat{\beta}_i$, $\hat{s}_i$, $\hat{h}_i$, and $\hat{p}_i$, increase in response to the timing signal. The factor timer will increase his/her portfolio exposure to a specific factor when the timing signal implies a better factor index return and vice versa. Substituting (3.21)–(3.24) into (3.20) and including noise η_t in the error term, we obtain the Carhart (1997) four-factor Treynor and Mazuy (1966) style timing model (CTM).

$$\begin{aligned} r_{i,t+1} = \alpha_i + \beta_i RMRF_{t+1} + s_i SMB_{t+1} + h_i HML_{t+1} + p_i MOM_{t+1} \\ + \gamma_{1,i} RMRF_{t+1}^2 + \gamma_{2,i} SMB_{t+1}^2 + \gamma_{3,i} HML_{t+1}^2 + \gamma_{4,i} MOM_{t+1}^2 + \varepsilon_{i,t+1} \end{aligned} \quad (3.25)$$

If a mutual fund manger increases (decreases) his/her portfolio's risk exposure to a specific factor prior to the factor index increase (decrease), then the portfolio's return will be a convex function of the factor index's return, and the corresponding style timing coefficient, γ, will be positive.

Henriksson and Merton (1981) develop a different test of market timing. In their model the mutual fund manager allocates capital between equities and risk-free assets, such as cash, Treasury bills and bonds, based on forecasts of the future market return, as before. They define market timing ability as the superior ability of a fund manager to set a higher target beta when the excess return on the market portfolio is greater than zero. Therefore, they assume that a fund manager's private signal (y_t) concerning the future market excess return ($RMRF_{t+1}$) can be described as follows:

$$y_t = I\{RMRF_{t+1} > 0\} + \eta_t \quad (3.26)$$

where $I\{RMRF_{t+1} > 0\}$ is an indicator function that equals one when $RMRF_{t+1}$ is positive and zero otherwise. η_t is an independent noise term.

This assumption can be applied to the Capital Asset Pricing Model (CAPM) with a dynamic beta:

$$r_{i,t+1} = \alpha_i + \hat{\beta}_i RMRF_{t+1} + \varepsilon_{i,t+1} \tag{3.27}$$

$$\hat{\beta}_i = \beta_i + \gamma_i y_t = \beta_i + \gamma_i \left(I\{RMRF_{t+1} > 0\} + \eta_t \right) \tag{3.28}$$

where $r_{i,t+1}$ is the excess return on a portfolio at time t+1, $RMRF_{t+1}$ is the excess return on the market and γ_i is the magnitude of the market exposure (β_i) adjustment in response to the private signal (y_t).

Equation (3.27) reflects the essence of market timing in that the beta responds to the timing signal. The market timer will expand (or reduce) allocation to stocks when the timing signal implies a better (or worse) market return. Substituting (3.28) into (3.27) and including noise η_t in the error term, we obtain the Henriksson and Merton (1981) market timing model:

$$\begin{aligned} r_{i,t+1} &= \alpha_i + \beta_i RMRF_{t+1} + \gamma_i RMRF^*_{t+1} + \varepsilon_{i,t+1} \\ RMRF^*_{t+1} &= I\{RMRF_{t+1} > 0\} RMRF_{t+1} \end{aligned} \tag{3.29}$$

where $I\{RMRF_{t+1} > 0\}$ is an indicator function that equals one when $RMRF_{t+1}$ is positive and zero otherwise. The coefficient on $RMRF_{t+1}^{*}$ becomes the value added by effective timing, which is equivalent to a call option on the market portfolio where the exercise price equals the risk-free rate.

Similarly, we can apply the theory of Henriksson and Merton (1981) to Carhart's (1997) four-factor model to measure the market timing, size timing, growth timing and momentum timing activities of mutual fund managers. Assume that the fund manager observes private signals, i.e. $y_{RMRF,t}$, $y_{SMB,t}$, $y_{HML,t}$ and $y_{MOM,t}$, on Carhart's (1997) four factors respectively. Each private signal reflects the expectation concerning the future factor index return plus an independent noise term as follows:

$$
\begin{aligned}
y_{RMRF,t} &= I\{RMRF_{t+1} > 0\} + \eta_{RMRF,t} \\
y_{SMB,t} &= I\{SMB_{t+1} > 0\} + \eta_{SMB,t} \\
y_{HML,t} &= I\{HML_{t+1} > 0\} + \eta_{HML,t} \\
y_{MOM,t} &= I\{MOM_{t+1} > 0\} + \eta_{MOM,t}
\end{aligned}
\qquad (3.30)
$$

where $I\{condition\}$ is an indicator function that equals one when the condition is true and zero otherwise.

A Henriksson and Merton (1981) style timing model can be derived based on Carhart's (1997) four-factor model with dynamic betas as follows:

$$r_{i,t+1} = \alpha_i + \hat{\beta}_i RMRF_{t+1} + \hat{s}_i SMB_{t+1} + \hat{h}_i HML_{t+1} + \hat{p}_i MOM_{t+1} + \varepsilon_{i,t+1} \quad (3.31)$$

where, $$\hat{\beta}_i = \beta_i + \gamma_{1,i} y_{RMRF,t} = \beta_i + \gamma_{1,i}\left(I\{RMRF_{t+1} > 0\} + \eta_{RMRF,t}\right) \quad (3.32)$$

$$\hat{s}_i = s_i + \gamma_{2,i} y_{SMB,t} = s_i + \gamma_{2,i}\left(I\{SMB_{t+1} > 0\} + \eta_{SMB,t}\right) \quad (3.33)$$

$$\hat{h}_i = h_i + \gamma_{3,i} y_{HML,t} = h_i + \gamma_{3,i}\left(I\{HML_{t+1} > 0\} + \eta_{HML,t}\right) \quad (3.34)$$

$$\hat{p}_i = p_i + \gamma_{4,i} y_{MOM,t} = p_i + \gamma_{4,i}\left(I\{MOM_{t+1} > 0\} + \eta_{MOM,t}\right) \quad (3.35)$$

where $\gamma_{1,i}$, $\gamma_{2,i}$, $\gamma_{3,i}$, and $\gamma_{4,i}$ are the respective magnitudes of the corresponding factor exposure adjustment in response to the private signals, $y_{RMRF,t}$, $y_{SMB,t}$, $y_{HML,t}$, and $y_{MOM,t}$.

Equations (3.32)–(3.35) reflect the essence of style timing, which is that the factor coefficients of equation (3.31), i.e. $\hat{\beta}_i$, $\hat{s}_i$, $\hat{h}_i$, and $\hat{p}_i$, relate to the timing signal regarding future states of the factor. The factor timer will target a higher portfolio exposure to a specific factor when the timing signal implies an up market for the factor. Substituting (3.32)–(3.35) into (3.31) and including noise η_t in the error term, we obtain the Carhart (1997) four-factor Henriksson and Merton (1981) style timing model (CHM):

$$\begin{aligned} r_{i,t+1} = \alpha_i &+ \beta_i RMRF_{t+1} + s_i SMB_{t+1} + h_i HML_{t+1} + p_i MOM_{t+1} \\ &+ \gamma_{1,i} RMRF^*_{t+1} + \gamma_{2,i} SMB^*_{t+1} + \gamma_{3,i} HML^*_{t+1} + \gamma_{4,i} MOM^*_{t+1} + \varepsilon_{i,t+1} \end{aligned} \quad (3.36)$$

where $$RMRF^*_{t+1} = I\{RMRF_{t+1} > 0\} RMRF_{t+1} \quad (3.37)$$

$$SMB_{t+1}^{*} = I\{SMB_{t+1} > 0\}SMB_{t+1} \tag{3.38}$$

$$HML_{t+1}^{*} = I\{HML_{t+1} > 0\}HML_{t+1} \tag{3.39}$$

$$MOM_{t+1}^{*} = I\{MOM_{t+1} > 0\}MOM_{t+1} \tag{3.40}$$

The magnitudes of the γs in equation (3.36) are positive for a fund manager who successfully times the corresponding factor. Notably, these style timing abilities are measured as the change in risk from a down- to an up-market condition. $I\{condition\}$ is an indicator function that equals one if the condition is true and zero otherwise. Other symbols are defined above.

To sum up, $\gamma_{1,i}$, $\gamma_{2,i}$, $\gamma_{3,i}$, and $\gamma_{4,i}$ measure market timing, size timing, growth timing and momentum timing coefficients respectively for both the Carhart (1997) four-factor Treynor and Mazuy (1966) style timing model (CTM), given by equation (3.25), or the Carhart (1997) four-factor Henriksson and Merton (1981) style timing model (CHM), given by equation (3.36). Significantly positive $\gamma_{1,i}$ means successful timing between the stock market and cash/bonds, i.e. market timing. Similarly, significantly positive $\gamma_{2,i}$ represents successful timing activity between small and big capitalization companies, i.e. size timing. Since growth (value) stocks tend to be stocks with lower (higher) than average book-to-market (B/M) ratios, Fama and French (1992, 2007) use the book-to-market ratio to differentiate between growth and value stocks.[16] Thus, significantly positive $\gamma_{3,i}$ captures timing on the basis of the book-to-market ratio, termed growth timing in this study. Finally, since MOM represents the returns of past winners minus past losers, significantly positive $\gamma_{4,i}$ indicates successful timing activity between momentum investing and contrarian investing strategies, i.e. momentum timing.

α_i is the abnormal return that cannot be explained by the model. α_i contains information about stock selection and timing abilities except for the four timing abilities above. Since α_i may contain unknown abilities and we are not able to specify what proportion of α_i is attributable to stock selection ability, α_i is not treated as being stock selection ability and, therefore, stock selection ability is not discussed in this study.

The style timing models developed in this section (equations 4.34 and 4.45) estimate four timing abilities at the same time, but Swinkels and Tjong-A-Tjoe (2007) use different timing models (equations 4.16 to 4.23) to measure the four timing abilities. That is, their models do not consider the correlation between the four timing parameters. However, as shown in Panel B of Table 4-2, the correlation between SMB^2 and HML^2 is not low. If there is only the size (growth) timing parameter in the model, it is likely to misidentify growth (size) timing ability as size (growth) timing ability. This may lead to a biased conclusion. Section 7.3 gives an example to demonstrate this problem, a problem which the style timing models, equations (3.25)

[16] For example, both Fidelity Investments and Vanguard observe that growth stocks tend to be stocks with higher than average price-to-book (P/B) or price-to-earnings (P/E) ratios, and the characteristics of value stocks include a relatively low P/B or P/E ratio. For more details see https://www.fidelity.com/ and http://www.vanguard.com/ respectively.

and (3.36), can resolve.

3.4. Synthetic Fund Construction

Synthetic funds are used in this study for two main reasons. First, as Jagannathan and Korajczyk (1986) argue, significant timing ability may arise because mutual fund returns are more or less option-like than the market proxy. As shown in Table 4-3, the relative degree of non-normality in the mutual funds and the factor indices may explain some of the timing results. Second, it is possible that a mutual fund manager has no skill but appears to have timing ability due to good luck. To avoid the possibility of these spurious results, corresponding synthetic funds that mimic the holdings of the actual funds but do not incorporate any skill are constructed, and the test results of the actual funds are then compared with the results of the synthetic funds.

Table 3-1: Summary statistics of fund returns and Carhart's four factors

This table shows average summary statistics of the sample fund excess return and the factor indices, i.e. market excess return, SMB, HML, and MOM, of the Carhart (1997) four-factor model. The sample period is January 1993 to December 2006, a total of 168 months.

Mean, μ, and standard deviation, σ, are sample estimates. Skewness, *S*, is computed as

$$S = \frac{\left[\mathrm{E}(X-\mu)^3\right]^2}{\left[\mathrm{E}(X-\mu)^2\right]^3}$$

and kurtosis, *K*, is computed as

$$K = \frac{\mathrm{E}(X-\mu)^4}{\left[\mathrm{E}(X-\mu)^2\right]^2}$$

The Jarque-Bera (JB) test for normality is given by

$$JB = \frac{\mathrm{N}}{6}\left[S^2 + \frac{(K-3)^2}{4}\right] \sim \chi^2_{(2)}$$

	μ	σ	S	K	JB
Mutual Funds	0.683%	4.628%	-0.348	40.852	197.186
Factor Indices					
Market	0.639%	4.120%	-0.799	4.223	28.371
SMB	0.201%	3.831%	0.831	10.335	395.929
HML	0.502%	3.524%	0.016	5.559	45.829
MOM	0.808%	5.000%	-0.667	8.375	214.665

There are three principles in the construction of synthetic funds. First, they should exhibit the same time-series characteristics as the original funds. Sharpe's (1992) style analysis is used to determine the original fund's exposure to a number of asset classes. The synthetic fund's portfolio is then required to have the same exposures so that the original funds and the synthetic funds have similar asset class betas. Second, the exposures of the portfolios are fixed to ensure that the synthetic fund does not have timing ability to adjust its exposures to the asset classes. Finally, the securities in the portfolio are randomly chosen to avoid any stock selection ability.

First of all, Sharpe's (1992) style analysis, which is necessary for synthetic fund construction, is described in detail. In fact, Sharpe's (1992) style analysis is a special case of the generic factor model. The style analysis tries to replicate the performance of a managed portfolio over a specified time period with a number of passively managed style benchmark index portfolios. The two important differences when compared to factor models are: (1) every factor is a return on a particular style benchmark index portfolio, and (2) the weights assigned to the factors sum to unity. Sharpe's (1992) style analysis model can be expressed as:

$$r_t = \left[\delta_1 X_{1t} + \delta_2 X_{2t} + \ldots + \delta_n X_{nt}\right] + \varepsilon_t \tag{3.41}$$

where r_t represents the managed portfolio return at time t and $X_{1t}, X_{2t}, \ldots, X_{nt}$ are the returns on style benchmark index portfolios. The coefficients $\delta_1, \delta_2, \ldots, \delta_n$ represent the managed portfolio average allocation among the different style benchmark index portfolios – or asset classes during the relevant time period. The sum of the terms in the square brackets is that part of the managed portfolio return that can be explained by its exposure to the different style benchmarks and is termed the style of the manager. The residual component of the portfolio return (ε_t) reflects the manager's decision to depart from the benchmark composition within each style benchmark class.

In order to obtain coefficient estimates that closely reflect the fund's actual investment policy, it is important to incorporate restrictions on the style benchmark weights. For example, the following two restrictions are typically imposed:

$$\delta_j \geq 0 \ \forall j \in \{1,2,\ldots,n\} \tag{3.42}$$

$$\sum_{j=1}^{n} \delta_j = 1 \tag{3.43}$$

The first restriction corresponds to the constraint that the fund manager is not allowed to take short positions in securities, which is standard for pension funds and mutual funds. The second restriction imposes the requirement which approximates the managed fund return as closely as possible to the return on a portfolio of passive style benchmark indices.

The objective of the analysis is to select a set of coefficients that minimizes the "unexplained" variation in returns, i.e. the variance of ε_t, subject to the stated constraints, which is a quadratic programming problem. The presence of inequality constraints in (3.42) requires the use of quadratic programming, since standard regression analysis packages typically do not allow for the imposition of such a restriction.

Since mutual funds are usually not fully invested but typically hold anywhere from 5% to 10% of their total net assets in cash-like securities, each synthetic fund portfolio is given an allocation of 91.7% equity and 8.3% cash, which is the same as the average market exposure of the sample funds. In the following, the 91.7% equity portfolio of a synthetic fund is created as in Busse (1999).

For each fund in the sample, Sharpe's (1992) style analysis is applied to determine the fund's exposure to eight style benchmark asset classes: the six intersections of the two equally weighted size and the three equally weighted book-to-market indices, the equally weighted momentum index and the equally weighted contrarian index.[17] Specifically, quadratic programming is used to solve the following style analysis model:

$$r_t = \sum_{j=1}^{8} b_j F_{j,t} + \varepsilon_t \tag{3.44}$$

$$b_j \geq 0 \; \forall j \in \{1,2,\ldots,8\} \tag{3.45}$$

$$\sum_{j=1}^{8} b_j = 1 \tag{3.46}$$

where r_t is the fund return in month *t*; $F_{j,t}$ is the return on style benchmark asset

[17] These eight asset classes are proposed by Fama and French (1993) and Carhart (1997) to construct SMB, HML, and MOM factors. See section 4.2.3 for more details. Since CRSP already provides the market exposure data for each fund, there is no need to estimate fund exposures to stock market and risk-free assets. In fact, as mentioned, the market exposures of the synthetic funds are fixed to be 91.7%.

class *j* in month *t*; b_j are determined by minimizing the variance of ε_t, subject to the non-negativity (equation 4.54) and unity-summation (equation 4.55) constraints on the b_j.[18]

The whole test period is divided into sub-periods to estimate the exposures (b_j) for each fund, and the corresponding synthetic fund portfolio is constructed based on the exposures (b_j) in every sub-period. Normally, the sub-period length used in the thesis is 36 months. However, in sensitivity tests, different sub-period lengths, such as 168 months, are used to construct synthetic funds so as to check whether this setting affects the results.

Given a fund's exposures (b_j) during a particular sub-period, the corresponding synthetic fund portfolio is constructed as follows. First, at the beginning of the sub-period, the synthetic fund portfolio is constructed by randomly selecting 100 stocks chosen from the different style benchmark asset classes so as to match the fund's exposures, i.e. b_j. For example, if the fund exposure to the "small and high book-to-market stock" asset class is 17%, the synthetic fund portfolio will contains 17 stocks (=17%*100) randomly picked from the small and high-book-to-market stocks. The returns of the synthetic fund portfolio are computed based on security proportions that are initially equally weighted (i.e. each has an initial weight of

[18] All the necessary data are obtained from CRSP. The stocks used to construct the synthetic funds include all stocks listed on NYSE, AMEX and NASDAQ. The monthly returns, book values and market values of all stocks are required. Monthly equity returns are adjusted for dividends and capital changes.

1/100). The portfolio is held for one month, and then the portfolio return of the month can be calculated.

Second, at the beginning of the next month, the synthetic fund portfolio is adjusted by randomly replacing stocks in the portfolio with other stocks in the same asset class. One constraint, however, should be satisfied: each stock is in the portfolio for an average of one year, roughly consistent with the 86% average annual turnover of the mutual fund sample. In addition, the weights evolve according to a buy-and-hold investment strategy. In order to maintain the synthetic fund's exposures to different asset classes is consistent with the fund's exposures (b_j), the synthetic fund portfolio is rebalanced annually. The adjusted portfolio is held for one month and its return calculated. This procedure is repeated until the end of the given sub-period.

The whole procedure above is designed to satisfy the three principles of synthetic fund construction. First, the synthetic fund portfolio has the same exposure to each style benchmark asset class and annual turnover ratio as the actual fund. This means that the synthetic fund will exhibit similar time-series characteristics to the original funds. Second, the synthetic fund's exposures to the eight style benchmark asset classes do not change, which means that there is timing activity between these asset classes. (Timing activity is achieved by changing exposures to different asset classes). In other words, the synthetic fund does not have any size timing, growth timing and momentum timing skill. In addition, since the market exposure of the synthetic fund is fixed to be 91.7% as mentioned, no market timing activity is involved in the synthetic fund construction. Finally, since the securities in the synthetic portfolio are randomly chosen, the synthetic fund does not contain any stock selection ability.

In summary, a synthetic fund with these characteristics is like a modified fund whose stock selection and timing abilities are removed. Therefore, a synthetic fund is a good control for an actual fund. The resulting random control sample consists of 3,181 synthetic fund portfolios, i.e. there is one synthetic fund portfolio for each fund in the mutual fund sample.

We can remove a particular timing ability from an actual fund to construct the corresponding synthetic fund by fixing the particular exposures of the synthetic fund. For example, market timing ability can be removed when market exposure is fixed during the synthetic fund construction. In other words, if a synthetic fund is constructed under the constraints of the fixed exposures to stock market and risk-free asset (market timing), small and large size companies (size timing), and past-winners and past-losers (momentum timing) and under the constraint of having the same exposure changes between high and low book-to-market ratio stocks (growth timing) with the original funds, this synthetic fund will not possess stock selection, market timing, size timing, or momentum timing skills, but will maintain part of the growth timing ability of the actual fund.[19]

3.5. Baseline Bootstrap Method of Kosowski *et al.* (2006)

The bootstrap method of Kosowski *et al.* (2006) is used in place of the standard

[19] Such a synthetic fund will be used in Section 7.4.

t-statistics to test the significance of coefficients. Kosowski *et al.* (2006) analyse the distribution of individual fund residuals generated by many commonly used performance models, such as Jensen's (1968) model, the Fama-French (1993) three-factor model, and Carhart's (1997) four-factor model. They find that normality is rejected for 48% of funds when using these performance models. This strong finding of non-normal residuals challenges the validity of standard t- and F-tests, which are based on the assumption of normally distributed residuals. Therefore, according to the evidence provided by Kosowski *et al.* (2006), it is inappropriate to use standard t- or F-tests to judge the significance level of performance model coefficients for mutual funds. In order to solve this problem they propose a baseline bootstrap method to replace standard t- and F-tests.

The basic concept of the bootstrap method is to reconstruct the distribution of the coefficients and then to use this distribution to assess their significance. There are many versions of the bootstrap method. They differ in how the distribution of the coefficients is constructed. The following example illustrates how to use the bootstrap method of Kosowski *et al.* (2006) to test the significance of alpha in the Carhart (1997) four-factor model.

To prepare for the bootstrap procedure, ordinary least squares (OLS)-estimated alphas, factor loadings and residuals of the Carhart (1997) four-factor model are computed using the time series of monthly excess returns for fund *i*:

$$r_{i,t} = \hat{\alpha}_i + \hat{\beta}_i \cdot RMRF_t + \hat{s}_i \cdot SMB_t + \hat{h}_i \cdot HML_t + \hat{p}_i \cdot MOM_t + \hat{\tau}_{i,t} \tag{3.47}$$

For fund *i*, the coefficient estimates, $\{\hat{\alpha}_i, \hat{\beta}_i, \hat{s}_i, \hat{h}_i, \hat{p}_i\}$, as well as the time series of estimated residuals, $\{\hat{\tau}_{i,t}, \quad t = T_{i1}, \cdots, T_{id}\}$, are saved, where T_{i1} and T_{id} are the dates of the first and last monthly returns available for fund *i* respectively.[20]

A sample with replacement is now drawn from the fund residuals saved in the first step above. This creates a pseudo-time series of resampled residuals, $\{\hat{\tau}^b_{i,t^b}, \quad t^b = s^b_{T_{i1}}, \cdots, s^b_{T_{id}}\}$, where *b* is an index for the bootstrap number (so $b = 1$ for bootstrap resample number 1) and where each of the time indices $s^b_{T_{i1}}, \cdots, s^b_{T_{id}}$ are drawn randomly from $[T_{i1}, \cdots, T_{id}]$ in such a way that the original sample of $T_{id} - T_{i1} + 1$ residuals for fund *i* are reordered.

A time series of pseudo-monthly excess returns for fund *i* is then constructed, imposing the null hypothesis of zero true performance, i.e. $\alpha_i = 0$

$$\{r^b_{i,t} = \hat{\beta}_i \cdot RMRF_t + \hat{s}_i \cdot SMB_t + \hat{h}_i \cdot HML_t + \hat{p}_i \cdot MOM_t + \hat{\tau}^b_{i,t^b}\}, \tag{3.48}$$

for $t = T_{i1}, \cdots, T_{id}$ and $t^b = s^b_{T_{i1}}, \cdots, s^b_{T_{id}}$. As equation (3.47) indicates, this sequence of artificial returns has a true alpha that is zero by construction. However, when the returns are regressed for a given bootstrap sample, *b*, on the Carhart factors, a

[20] The period length from T_{i1} to T_{id} (sub-period length) is an important setting in the proportion test discussed in Section 3.6 on page 74. In the primary tests of this thesis, the periods from T_{i1} to T_{id} are longer than or equal to 3 years.

positive (negative) estimated alpha (and *t*-statistic) may result in a particular draw if there is an abnormally high number of positive (negative) residuals.

Repeating the above steps across all funds, $i = 1, \cdots, N$, a draw from the cross-section of bootstrapped alphas is obtained. Repeating this for all bootstrap iterations, $b = 1, \cdots, 1000$, I then build the distribution of these cross-sectional draws of alphas, $\{\hat{\alpha}_i^b, \quad i = 1, \cdots, N\}$, or their *t*-statistics, $\{\hat{t}_{\hat{\alpha}_i}^b, \quad i = 1, \cdots, N\}$, which result purely from sampling variation while imposing the null of a true alpha that is equal to zero. For example, the distribution of alphas (or *t*-statistics) for the top fund is constructed as being the distribution of the maximum alpha (or, maximum *t*-statistic) generated across all bootstraps. If it is found that the bootstrap iterations generate far fewer extreme positive values of $\hat{\alpha}_i$ (or $\hat{t}_{\hat{\alpha}}^b$) compared to those observed in the actual data, we conclude that sampling variation (luck) is not the sole source of high alphas and that genuine stock-picking skills exist.

The bootstrap method introduced above is used to test the significance of each coefficient of each model used in this thesis. This method is able to test the significance of only one coefficient at once. In other words, if more than one coefficient in a model needs testing for significance, equation (3.48) will be revised according to each null hypothesis and then the whole procedure will be run for each coefficient. Since the whole procedure requires a huge amount of calculation (at least 1001 regressions for each coefficient) and there is no commercial software designed for this procedure, C and C# languages are used to develop computer programmes to do the calculations.

3.6. Proportion Test

A proportion test is used to assess whether superior performing fund managers, who earn abnormal returns, possess timing skill.[21] Since there are a large number (3,181) of sample funds, even if no manager has timing skill, some funds may appear to demonstrate significant timing ability by chance (Lo and MacKinlay (1990) and Jiang et al. (2007)), or due to option-like returns distributions (Jagannathan and Korajczyk (1986)). In other words, we cannot judge whether a significantly positive timing coefficient is attributable to real skill, chance, or spurious statistics. The synthetic funds of Busse (1999) are designed to solve this problem, and the proportion test is an application of synthetic funds for testing whether superior performing fund managers have real timing skill.

In the test procedure, four fund groups are examined: all funds, superior performing funds, all synthetic funds and superior performing synthetic funds. “All funds” is the group of 3,181 US growth-oriented funds in the sample. The method of Busse (1999) is followed to construct one corresponding synthetic fund for each sample fund. “Synthetic funds” are the artificial funds that exhibit the same time-series characteristics as the actual funds but do not incorporate any skill. “Superior performing (synthetic) funds” are the (synthetic) funds that earn abnormal returns on

[21] Although the phrase “fund managers” is used throughout, the thesis focuses on funds, as a group, not on any specific manager.

the basis of the Carhart (1997) four-factor model.[22]

The fundamental rationale underlying proportion testing in this context is that superior performing fund managers exhibit a particular style timing skill, such as market timing, if they have a significantly higher proportion of demonstrating such timing ability than the other three fund groups: all sample funds, all synthetic funds and superior performing synthetic funds. If the fund managers who earn significant abnormal returns manifest better market timing skill, for example, than all fund managers, there are four possible explanations. First, these superior performing fund managers have real market timing skill. Second, they do not have any market timing skill but average fund managers do even worse with regard to market timing. Third, significant market timing ability arises because mutual fund returns are more or less option-like than the market proxy (Jagannathan and Korajczyk, 1986). Fourth, if the superior performance is due to good luck, and superior performing funds are the funds whose managers have better luck than others, this good luck may increase the proportion of demonstrating market timing ability. Since all synthetic funds are random portfolios, the second and third reasons are rejected if superior performing fund managers have better market timing skill than synthetic funds. As regards the final reason, the superior performing synthetic funds have a higher proportion of demonstrating market timing ability, similar to the superior performing fund managers. Therefore, this explanation is rejected if superior performing fund

[22] "Superior performing" means "able to earn abnormal returns on the basis of the Carhart (1997) four-factor model". In other words, superior performing funds are the funds that demonstrate significantly positive Carhart alpha, and superior performing synthetic funds are the synthetic funds that demonstrate significantly positive Carhart alpha. People may argue that superior performing funds have better luck than all funds and all synthetic funds. In order to avoid this possibility, superior performing synthetic funds are used as controls. The period length used to measure abnormal returns is an important test setting of proportion test, which is introduced in Section 3.6.1, p.77.

managers have a significantly higher proportion of demonstrating market timing skill than the superior performing synthetic funds. If the last three reasons are rejected, superior performing fund managers must possess substantial market timing skill.

In brief, there are two steps in a proportion test. First, calculate the proportion of demonstrating the examined timing ability for each of the four fund groups. Second, compare the proportion demonstrated by superior performing funds with the proportions demonstrated by the other three fund groups. If superior performing funds demonstrate a statistically significantly higher proportion than the other three fund groups, this is evidence that superior performing fund managers, as a group, have substantial skill to achieve successfully the examined timing activity. The following section gives a more detailed explanation of each step.

3.6.1. How to calculate proportion of demonstrating a timing ability

The first step in the proportion test is to calculate the proportion of demonstrating a particular timing ability. The whole test period is divided into sub-periods and each fund in each sub-period is defined as a fund instance. If there are enough observations for a fund instance, the timing coefficient for it is estimated and the bootstrap method of Kosowski *et al.* (2006) is applied to examine its significance. The total number of fund instances with enough observations and the number of the fund instances with significant positive timing ability are counted.[23] The proportion

[23] A fund instance with significant positive timing ability means that the given fund demonstrates a statistically significant positive coefficient on the examined timing variable (market timing, size timing, growth timing, or momentum timing) during the given sub-period.

of demonstrating timing ability is then calculated as:

$$\text{Probability} = \frac{\text{The number of fund instances with significant positive timing ability}}{\text{The number of total fund instances with enough observations}} \quad (3.49)$$

The main proportion tests conducted in this thesis follow the above procedure to compute the proportions under six different settings of sub-period lengths and minimum observation numbers for each of the four fund groups. The sub-period lengths used include three, five and nine years, and the sub-periods are established on 1 January every year. For example, since the whole data period length is 14 years (January 1993 to December 2006), there are six sub-periods of nine years in length: 1993/01/01 to 2001/12/31, 1994/01/01 to 2002/12/31 … 1998/01/01 to 2006/12/31. In addition, it is required that there are sufficient observations for the test, with the minimum observation numbers used being 36, 60 and 108 months. Therefore, there are six different settings for the sub-period length and the minimum observation number, i.e. (3 years, 36 months), (5 years, 36 months), (5 years, 60 months), (9 years, 36 months), (9 years, 60 months) and (9 years, 108 months).[24] Figure 3-4 illustrates an example of proportion calculation under the setting of (3 years, 36 months).

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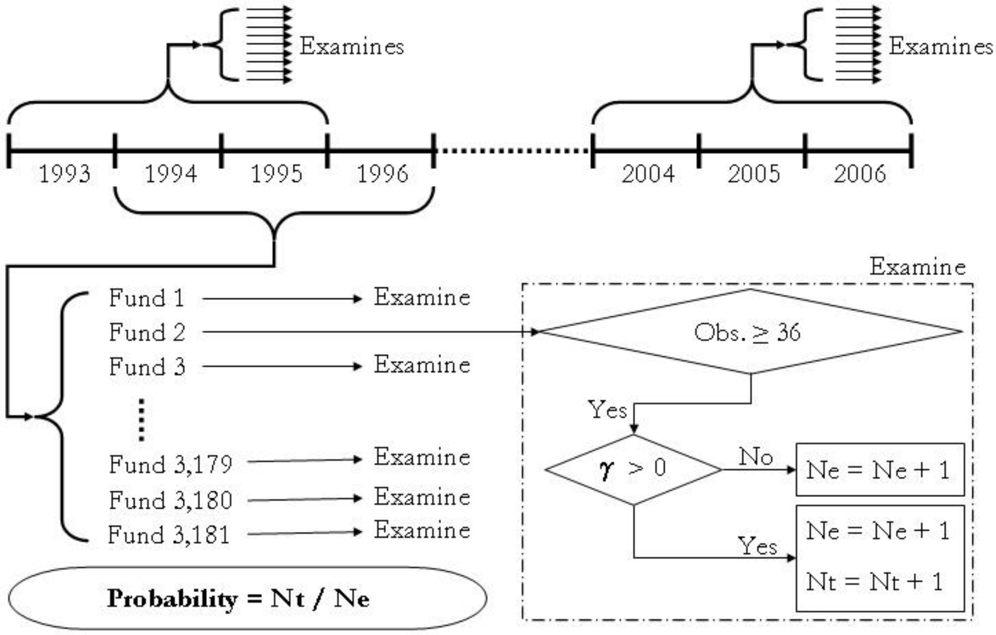
[24] Only funds that have a minimum of 36 monthly net return observations are included to maintain enough degrees of freedom to generate more precise regression parameter estimates. Therefore, the minimum sub-period length is 3 years. In Kosowski *et al.* (2006), the minimum data requirement is 60 observations. Hence, the test results of a five-year sub-period are also examined. In addition, since the longer sub-period length means fewer fund instances, in order to examine the test results for a "long" sub-period, a nine-year sub-period length is chosen under which the sub-period is long but fund instances do not decrease seriously. The 180 minimum observation requirement is used to examine the test results of long-lived funds. Concerning the start date of sub-periods, using 1st January of every year allows the most sub-periods to be established. In the sensitivity tests, the test results under other settings of sub-period lengths, minimum observation numbers and the start dates of sub-periods are also examined.

Figure 3-4: Proportion calculation

This figure illustrates how to calculate the proportion of demonstrating a particular timing ability under the setting of (3 years, 36 months) for “All funds”.



As shown in Figure 3-4, since the setting of sub-period length is three years, every fund in “All funds” is examined in every three-year sub-period over the whole test period, 1993–2006. A fund in a sub-period is called a fund instance. A flowchart within Figure 3-4 demonstrates how to examine a fund instance (fund 2 in the sub-period 1994–1996). First, we examine whether the minimum number of observations requirement is satisfied (36 month observations). If this is the case, we examine whether this fund instance demonstrates a particular timing ability by examining the corresponding timing coefficient (γ) of the style timing model introduced in Section 3.3.2. If the timing coefficient is significantly positive, a fund instance with significant positive timing ability is found. So Nt (the number of fund instances with significant positive timing ability) increases by one as well as Ne (the number of fund instances examined). Otherwise, only Ne increases by one. Finally, the proportion of demonstrating a particular timing ability for "All funds", as a group, is equal to Nt divided by Ne.

3.6.2. A statistical method used to compare two proportions

This section introduces a common statistical method used to compare two proportions. Since it is possible to over- or under-estimate the timing ability demonstrated by a fund, the proportion of a fund group demonstrating a particular timing ability may also be over- or under-estimated. This means that it is not appropriate to compare the proportions of two fund groups by number. For example, if the proportion of superior performing funds is 10.3% but the proportion of all funds is 10.2%, it is not appropriate to conclude that 10.3% is larger than 10.2% and hence superior performing funds demonstrate higher proportion. A more convincing method is required to compare two proportions. Such a method is explained below.

When comparing the proportions of two fund groups, the permutation test principle is applied to obtain the corresponding p-value of the statistical significance test of the null hypothesis that one proportion is less than or equal to another proportion. For example, the null hypothesis that superior performing fund managers have a lower proportion of demonstrating market timing ability than all synthetic funds is tested. The numerator and denominator of equation (3.49) for superior performing funds are denoted by N_s and D_s. The test procedure is as follows. First, all fund instances of superior performing funds and all synthetic funds are pooled. D_s fund instances are then randomly picked from the pooled fund instances and the number of fund instances with significant positive timing ability, denoted by N_p, are counted. The above process is repeated 1000 times and P is defined as the number of times that N_s is less than N_p. The p-value of the test on the null hypothesis is equal to $P/1000$. If superior performing funds are compared with all funds, the test procedure is similar but the fund instances are randomly picked from all fund instances of all funds instead of the pooled fund instances, because superior performing funds are a subset of all funds.

3.7. Persistence Test

The persistence test is used to double check that the observed timing skill is attributable to the substantial skill of fund managers rather than their good luck. Although the proportion test already excludes the possibility that the observed timing skill is due to good luck, the persistence test is still used to double check the existence of skill. There are two main reasons. First, the persistence test reinforces the test results obtained in the proportion test. Second, the persistence test is used in previous studies, and therefore using it enables the results to be compared with those of the other studies.

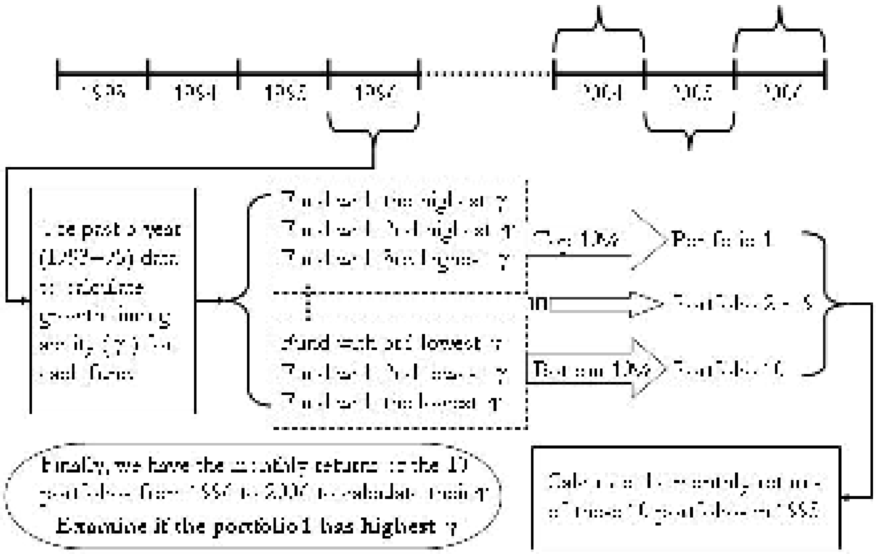
The fundamental concept of the persistence test is that fund managers possess a certain skill if they can demonstrate the skill persistently; otherwise they do not have substantial skill but good luck. Hendricks, Patel and Zeckhauser (1993) apply this concept and propose a methodology to show the "hot-hand" effect in mutual fund performance. Their method is used by Carhart (1997) and Kosowski *et al.* (2006)

and is used in this study to examine whether the observed timing skill is attributable to the substantial skill or good luck of fund managers.

The test rationale is that fund managers demonstrate certain skill persistently if the fund portfolio with good (bad) skill in the past demonstrates good (bad) skill in the future. Based on this concept, the detailed procedure is as follows. On 1 January each year during the test period, the sample funds are sorted into decile portfolios based on a skill measure over the prior P years, and the portfolios are held for F years. If the high-ranked portfolios demonstrate better skill than the low-ranked portfolios, this is evidence that fund managers demonstrate skill persistently, which implies that fund managers possess skill. In the standard persistence test of this thesis, the default setting of P is three years, and that of F is one year. Figure 3-5 illustrates an example of the persistence test for growth timing ability.

Figure 3-5: Persistence test

This figure illustrates an example of the persistence test for growth timing ability.



As shown in Figure 3-5, the test period is 14 years from January 1993 to December 2006. Since a three-year past performance period is required to estimate fund performance (growth timing ability in this case), the test starts from the beginning of 1996. At the beginning of 1996, fund growth timing ability (γ) is estimated according to the data from 1993 to 1995, and then funds are sorted into decile portfolios based on their growth timing ability. That is, Portfolio 1 consists of the best 10% of funds, and Portfolio 10 consists of the worst of 10% funds. These ten portfolios are held for one year and the portfolio returns are calculated monthly. The above procedure is repeated to calculate the monthly returns of the ten portfolios for the following years until the end of 2006. Finally, we estimate to what extent these ten portfolios demonstrate growth timing ability according to their monthly returns from 1996 to 2006. If the observed growth timing ability is attributable to fund managers' real skill, portfolio 1 which is composed of the best funds with growth timing skill should also demonstrate best growth timing ability compared to the other nine portfolios. Otherwise, the observed growth timing ability is a random result and is likely to be due to good luck.

In the test procedure, management expenses are considered but the sale charges are not. The persistence of the observed growth timing ability is considered, not whether fund investors can profit from this measure. Management expenses, such as management and administrative charges, 12b-1 fees and other operating costs, arise from the activity of fund managers and are considered as part of fund performance.[25] On the other hand, sale charges, such as front-end or deferred loads and redemption fees, are due to the activity of fund investors and are not counted in the analysis.

3.8. Research Questions and Testable Hypotheses

This section sets up specific research questions and corresponding testable hypotheses for addressing the research gaps identified in the last chapter. Studying the historical development of asset pricing models reveals that when a new market anomaly is discovered, this often leads to the discovery of a new systematic risk factor that improves the asset pricing model. Based on the Capital Asset Pricing Model (CAPM), various anomalies, e.g. the weekend effect, monthly effect, January effect, P/B, P/E or price effect and size effect, resulted in Fama and French's (1992) discovery of the size and book-to-market factors. Based on Fama and French's

[25] Monthly returns of mutual funds are calculated based on the funds' net asset value (NAV) from which management and administrative charges, 12b-1 fees and other costs have automatically been deducted.

(1993) three-factor model, the "hot-hand" effect proposed by Hendricks, Patel and Zeckhauser's (1993) is explained by Jegadeesh and Titman's (1993) momentum factor and led to the development of Carhart's (1997) four-factor model. Recently, based on Carhart's (1997) four-factor model, Kosowski *et al.* (2006) find the new anomaly that certain growth-oriented funds can earn abnormal returns persistently. However, the source of this superior performance has not yet been explored. This thesis concentrates on the timing skills possessed by superior performing growth-oriented fund managers.

The research can be classified into three topics:

(1) Skills of superior performing growth-oriented fund managers

This research tries to identify the skills possessed by superior performing fund managers. Specifically, four style timing skills are examined – market timing, size timing, growth timing and momentum timing skills. Since timing skills are used to earn abnormal returns, the focus is on the superior performing growth-oriented fund managers, shown by Kosowski *et al.* (2006) to have the skills to earn abnormal returns, and investigate what timing skills they possess.

(2) Timing skills of different fund groups

The objective of this work is to investigate the origins of the timing skills observed in the first topic. Specifically, the sample funds are separated into different groups and the timing skills demonstrated by the superior performing fund managers in these groups are examined. The difference in the timing skills possessed by these fund group managers will reveal what kind of fund characteristic is conducive to the successful timing activity identified in the first topic.

(3) Further investigation of the observed timing skills

A number of issues are discussed including persistence, misidentification and the importance of the skills. In particular, the extent to which the abnormal returns identified by Kosowski *et al*. (2006) can be explained by the observed timing skills is discussed.

The following three sections build the detailed research questions and the corresponding hypotheses for each topic.

3.8.1. Skills of Superior Performing Growth-Oriented Fund Managers

The key research question of this section is what skills superior performing growth-oriented fund managers possess. Kosowski *et al.* (2006) reveal that certain growth-oriented fund managers possess genuine skill to earn abnormal returns. The source of those fund managers' superior performance is explored by extracting information about timing ability from the abnormal returns. Specifically, four style timing abilities are examined – market timing, size timing, growth timing and momentum timing. Market timing relates to the ability to forecast future market states and weight equity exposure accordingly. However, fund managers have other style timing opportunities apart from market timing, such as size timing, growth timing and momentum timing. Size timers adjust exposure between small and big capitalization companies; growth timers modify exposure along the value/growth continuum; momentum timers choose between momentum investing and contrarian investing strategies.

The research question and the corresponding hypotheses are:

Q1: What timing skills do superior performing growth-oriented fund managers possess?

$H1a_0$: *Superior performing growth-oriented fund managers do not possess market timing skill.*

$H1b_0$: *Superior performing growth-oriented fund managers do not possess size timing skill.*

$H1c_0$: *Superior performing growth-oriented fund managers do not possess growth timing skill.*

$H1d_0$: *Superior performing growth-oriented fund managers do not possess momentum timing skill.*

Before the test, a number of problems mentioned in previous studies are first discussed. First, According to the evidence presented by Kosowski *et al.* (2006), it is inappropriate to use standard t- or F-tests to judge the significance level of performance model coefficients for mutual funds. Kosowski *et al.* (2006) analyse the distribution of individual fund residuals generated by many commonly used performance models, such as Jensen's (1968) model, the Fama-French (1993) three-factor model and Carhart's (1997) four-factor model. They find that normality is rejected for 48% of funds when using these performance models. This strong finding of non-normal residuals challenges the validity of standard t- and F-tests, which are based on the assumption of normally distributed residuals.

The problem revealed by Kosowski *et al.* (2006) may also exist in my sample. Therefore, I test whether it is inappropriate to use standard t- or F-tests to judge the significance level of performance model coefficients for my sample funds. Like Kosowski *et al.* (2006), the distribution of individual fund residuals generated by Jensen's (1968) model, the Fama-French (1993) three-factor model and Carhart's (1997) four-factor model are examined.

The second potential problem documented by previous studies is an inverse relationship between the fund managers' market timing performance and their stock selection performance. The intercept obtained from a timing model is often regarded as representing a fund manager's stock selection ability. Kon (1983) and Henriksson (1984) document a negative correlation between regression intercepts and timing coefficients. Both find that most mutual funds in their respective samples exhibit positive intercepts and negative timing coefficients. Sahu *et al.* (1998) specifically test the relationship between the stock selection and market timing abilities of bank funds by utilising meta-analysis to eliminate study artefacts such as sampling and measurement errors. Their findings suggest that the managers of bank equity investment funds possess superior stock selection abilities and somewhat negative timing skills. Volkman (1999) investigates the relationship between a fund's timing and selectivity performance and finds a negative correlation. He suggests that mutual fund managers attempt to maximize selectivity performance at the expense of timing performance.

Jagannathan and Korajczyk (1986) show theoretically and empirically that this inverse relationship arises because mutual fund returns are more or less option-like than the market proxy. Specifically, when the proxy for the market portfolio contains option-like securities, portfolios with greater (lower) concentration in option-like securities will show positive (negative) market timing performance and negative (positive) selectivity.[26] Bollen and Busse (2001) find that the average intercept for funds with negative timing coefficients is much higher than the corresponding average for funds with positive timing coefficients, as predicted by Jagannathan and Korajczyk (1986).

To examine whether the problem identified by Jagannathan and Korajczyk (1986) also exists in this study, I test whether the inverse relationship identified by Jagannathan and Korajczyk (1986) also exists between the sample funds' alphas and timing coefficients. Since this study uses two style timing models and each model estimates four timing abilities, there are eight (=2*4) relationships between the sample funds' alphas and timing coefficients to be examined.

Whether the sample of growth-oriented funds demonstrates persistent abnormal returns is then examined. Kosowski *et al.* (2006) find strong evidence of superior performance and performance persistence among certain growth-oriented funds, which means that these growth-oriented fund managers have substantial skills to earn abnormal returns. Therefore, the focus will be on growth-oriented fund managers and their timing skills. Nevertheless, the test period of this study is different from that of Kosowski *et al.* (2006), and hence the samples are different. In

[26] Option-like securities include options and common stocks of highly leveraged firms.

order to make sure that there is also persistent superior performance among the growth-oriented funds of my sample, the persistence test used in Kosowski *et al.* (2006) is carried out.

Moreover, it is possible that fund managers achieve abnormal returns due to good luck. Therefore, synthetic funds are constructed as a control for the potential good luck of fund managers. Since the synthetic funds are designed not to possess any skill, this characteristic could be confirmed by checking the superior performance persistence of the synthetic funds.

3.8.2. Timing Skills of Different Fund Groups

This section explores the characteristics of the observed timing skills. The research question is:

Q2: What are the characteristics of the observed timing skills?

The sample funds are separated into different groups and the timing skills demonstrated by the superior performing fund managers in each of these groups examined. There are two systems used to classify funds: Standard & Poor's investment objective and Standard & Poor's Returns-Based Style Analysis. As regards the investment objective, the sample funds are classified into four fund groups, i.e. Equity Aggressive Growth funds, Equity Growth funds, Equity Growth-and-Income funds and Equity Income-and-Growth funds. Returns-Based Style Analysis groups the sample funds into Growth funds, Blend funds and Value funds.

First, the timing skills possessed by superior performing fund managers are examined for the four fund groups with different investment objectives: Equity Aggressive Growth funds, Equity Growth funds, Equity Growth-and-Income funds and Equity Income-and-Growth funds. Specifically, whether superior performing fund managers possess market timing, size timing, growth timing or momentum timing skill for each fund group is tested.

The timing skills possessed by superior performing fund managers are then examined for Growth, Blend and Value funds (the Standard & Poor's Returns-Based Style Analysis classification). In other words, whether superior performing fund managers possess market timing, size timing, growth timing or momentum timing skill for each fund group is tested.

Finally, I overview the timing skills of different fund groups with different growth-orientation levels. The characteristic of the observed growth timing ability will be revealed by comparing the difference in the timing skills of those fund groups.

3.8.3. Further Investigation of Growth Timing Skill

The observed growth timing skill is now related to previous studies by considering a number of issues. As we will see, the results of the previous topics indicate that superior performing growth-oriented fund managers possess growth timing skill if they concentrate on growth stock investment, but they do not possess any of the other three timing skills. Therefore, the focus will be on growth timing skill. Issues concerning the observed growth timing skill that will be examined include persistence, misidentification and its importance. Most importantly, to what extent can the abnormal returns identified by Kosowski *et al*. (2006) be explained by growth timing skill? The research questions and hypotheses are addressed after their background is briefly introduced.

The persistence of observed growth timing ability is first examined. If fund managers have substantial skill to outperform the market, their superior performance should persist. Both Carhart (1997) and Kosowski *et al.* (2006) apply this concept to test whether the superior performance of fund managers is attributable to substantial skills or good luck. The persistence test of Carhart (1997) and Kosowski *et al.* (2006) is therefore applied to confirm that the growth timing skill observed in prior sections is attributable to the substantial skill of superior performing growth-oriented fund managers. Specifically, the following research question is studied:

Q3: Do superior performing growth-oriented fund managers achieve successful growth timing persistently?

Next, it is shown that growth timing skill is easily misidentified as market timing skill. Since market timing is the best-known timing skill, and famous timing models, such as Treynor and Mazuy (1966) and Henriksson and Merton (1981), have been developed to measure market timing ability, most studies tend to focus on market timing but ignore other timing skills. This, however, may lead to a false conclusion because other timing skills are likely to be misidentified as market timing skill. For example, when the Dot-Com bubble bursted, the stock market as a whole fell and the growth stocks also went out of fashion at the same time. Just before this happened, a market timer should have gone liquid while a growth timer should have switched into value stocks. So they would have reacted to the same event at the same time. Thus, successful growth timing might be taken as evidence for market timing ability if researchers try to measure market timing ability but ignore growth timing ability. In addition, the correlation between the timing skills is not small enough to be ignored and may lead to spurious results if it is ignored. This thesis demonstrates an empirical example of this misidentification problem by studying the following research question:

Q4: Is it possible that growth timing ability is misidentified as another timing ability?

The question of how much of the abnormal returns earned by superior performing growth-oriented fund managers is attributable to fund managers' growth timing skill is then considered. In other words, the following research question is studied:

Q5: How much of the abnormal returns earned by superior performing growth-oriented fund managers is attributable to the fund managers' growth timing skill?

Consideration of the previous research questions suggests that growth timing is an important skill for superior performing growth-oriented fund managers. An investigation is therefore carried out to assess whether the superior performance demonstrated by growth-oriented fund managers still persists after growth timing ability is taken into account. Thus, the growth timing parameter is added to Carhart's (1997) four-factor model and the persistence test used by Kosowski *et al.* (2006) is carried out to examine whether the superior performance demonstrated by growth-oriented fund managers still persists based on the new model.

Q6: Do superior performing growth-oriented fund managers still demonstrate persistent superior performance after growth timing ability is added to Carhart's (1997) four-factor model?

3.9. Summary

Kosowski *et al.* (2006) show that superior performing growth-oriented fund managers possess substantial skills to earn abnormal returns. As the source of this superior performance has not yet been explored, this thesis investigates the timing skills possessed by superior performing growth-oriented fund managers.

The style timing models of Lu (2005) were developed by applying the methods of Treynor and Mazuy (1966) and Henriksson and Merton (1981) to Carhart's (1997) four-factor model. In addition to market timing, the style timing models are able to measure size timing, growth timing and momentum timing concurrently. Furthermore, the method of Busse (1999) is used to construct a set of synthetic funds for each sample fund to control for spurious results (Jagannathan and Korajczyk, 1986). The innovative bootstrap statistical technique proposed by

Kosowski *et al.* (2006) is introduced and used to replace standard t- and F-tests to judge the significance level of model coefficients. A proportion test method is then proposed which is able to judge whether superior performing fund managers possess a particular timing skill. In the empirical analysis, the proportion test method is the main approach used to investigate what timing skill superior performing fund managers possess. Finally, the persistence test method of Hendricks, Patel and Zeckhauser (1993) is explained. This is used to check the persistence of the observed timing skill to double check that the observed timing skill found in the proportion tests is attributable to the real skill of fund managers and not to their good luck.

A series of testable research questions and hypotheses are then developed to investigate the timing behaviour of superior performing growth-oriented fund managers. The work can be divided into three topics. The first tries to identify the skills possessed by superior performing fund managers. Four timing skills are examined, i.e. market timing, size timing, growth timing and momentum timing skills. The second topic explores the origins of the timing skills observed in the first topic. Different fund groups are examined to reveal what kind of fund characteristic is conducive to the successful timing activity. In the last topic, the observed timing skills are related to previous studies by discussing their persistence, misidentification and importance in addition to the extent to which the abnormal returns identified by Kosowski *et al.* (2006) can be explained by the skills.

CHAPTER 4

DATA

4.1. Introduction

This chapter describes the data used in this thesis. It is organized as follows: Section 4.2 describes the data, Section 4.3 describes the sample selection procedure, and Section 4.4 summarizes the chapter.

4.2. Data

The data collected can be classified into three groups: fund returns, equity data and market systematic factors. The following describes these three data groups.

4.2.1. Fund returns

Monthly fund returns are obtained from the Center for Research in Security Prices (CRSP) mutual fund database. The CRSP database provides survivor-bias-free net returns for each share-class of every US open-end mutual fund since 1 January 1962.[27]

Monthly returns are calculated as a change in net asset value (NAV) including reinvested dividends from one period to the next. The published returns account for management, administrative, 12b-1 fees and other costs that are automatically taken

[27] For more details see http://www.crsp.chicagogsb.edu/

out of fund assets (NAV) but are not adjusted for sale charges (such as front-end or deferred loads and redemption fees), which would give a clearer picture of the fund manager's investment ability and strategy.

The split and cash dividends distributed to fund investors are also considered when fund returns are calculated. The distribution of a split dividend or a cash dividend causes a decrease in NAV, which should not be attributable to fund managers' poor performance. Therefore, the calculation of fund returns should be adjusted for the influence of splits or cash dividends. Specifically, fund returns are calculated as follows.

$$R_t = \left[\frac{NAV_t * cumfact}{NAV_{t-1}} \right] - 1 \tag{4.1}$$

A cumulative factor, $cumfact$, summarizes all the adjustments for the return period (one month in this case). $cumfact$ starts with a value of 1 and is calculated as follows. For each day in the holding period,

$$cumfact = cumfact * totadj \tag{4.2}$$

The total adjustment factor, $totadj$, starts at 1 for a given day and is then modified depending on the types of dividend (split or cash) found for that fund and day:

If there is cash dividend then the $totadj = totadj + adj$ (4.3)

$$\text{where } adj = dis\_amt / reinvest\_nav \quad (4.4)$$

adj = Adjustment Factor

dis_amt = Distribution amount

$reinvest\_nav$ = Reinvestment amount of monthly NAV

If there is split dividend then $totadj = totadj * adj$ (4.5)

$$\text{where } adj = \frac{1}{spl\_ratio} \quad (4.6)$$

adj = Adjustment Factor

spl_ratio = Split Ratio

The dividend file is sorted into distribution-type order, which implies that when splits and cash dividends occur on the same day, the cash dividends are processed first. Each adjustment factor, adj, is calculated as follows.

4.2.2. Equity data

Equity data include the monthly return, share price, the number of outstanding shares and the book value of all stocks listed in NYSE, AMEX and NASDAQ. All these data are collected from CRSP. The monthly equity returns are adjusted for dividends and capital changes. Book value is taken as the CRSP book value of shareholders' equity plus balance sheet deferred taxes and investment tax credit, minus the book value of preferred stock. The book value of preferred stock is taken to be the redemption, liquidation or par value (in that order) on CRSP.

In addition, the market values and book-to-market ratios of stocks are calculated. The end of month market value of the common equity of the company is calculated as the number of shares as of the end of the month multiplied by the end of the month CRSP share price. The end of month book-to-market ratio is defined as the book value of equity divided by the market value of equity in that month. To ensure that accounting information is available at the time of portfolio formation, a three-month lag between fiscal year end data and the reporting date is assumed. This will minimize the look-ahead bias. So, for the portfolio formed in August of year t, the book value of equity is obtained from the latest available financial statements with the fiscal year end before February of year t. The market value of equity is as at the end of August of year t.

4.2.3. Market systematic factors

Market systematic factors include the risk-free rate of return and Carhart's four market systematic factors, i.e. the market excess return (RMRF), SMB, HML and MOM. The risk-free rate of return is collected from CRSP, while the data for Carhart's four market systematic factors are collected from the website of Kenneth R. French.[28]

The one-month US Treasury bill rate is used as the return on the risk-free asset (RF). The market excess return (RMRF) is the value-weighted return on all NYSE, AMEX and NASDAQ stocks minus the one-month Treasury bill rate.[29]

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[28] The website of Kenneth R. French is http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/index.html

[29] Fama and French (1993), Carhart (1997), and Kosowski *et al.* (2006) all use value-weighted monthly returns on all NYSE, AMEX and NASDAQ stocks.

The procedures adopted to produce SMB, HML and MOM are as follows. To begin with, all firms listed in NYSE, AMEX and NASDAQ are divided into two groups: big (B) and small (S), where the big group includes all firms greater than or equal to the median market capitalization of all firms. All firms are also divided into three groups: high book-to-market (H), medium book-to-market (M) and low book-to-market (L), depending on each firm's book-to-market relative to the 70th and 30th percentiles of all firms. The book-to-market ratio for June of year t is the book equity for the last fiscal year end in t-1 divided by market value for December of t-1.

As shown in Figure 4.1, combining the two market capitalization groups with the three book-to-market groups results in six groups of firms: one that includes big firms with high book-to-market ratios, one with big firms and medium book-to-market ratios, one with big firms and low book-to-market ratios, and an analogous set of three groups of small capitalization firms. A return index is computed for each of the six groups by weighting their constituent firm returns by market capitalization.

Figure 4-1: Six portfolios for constructing SMB and HML

This figure illustrates Fama and French's classification of six portfolios for constructing SMB and HML factors. All firms listed in NYSE, AMEX, and NASDAQ are divided into two groups, big and small, where the big group includes all firms greater than or equal to the median market capitalisation of all firms. In addition, all firms are classified into three groups, high book-to-market, medium book-to-market, and low book-to-market, depending on each firm's book-to-market (B/M) relative to the 70^{th} and 30^{th} percentiles of all firms.

Median market capitalisation

	Small Value	Big Value
70^{th} B/M percentile		
	Small Neutral	Big Neutral
30^{th} B/M percentile		
	Small Growth	Big Growth

SMB and HML, proposed by Fama and French (1993), are constructed using the six value-weighted portfolios formed on size and book-to-market. SMB (Small minus Big) is the average return on three small portfolios minus the average return on three big portfolios. HML (High minus Low) is the average return on two value portfolios minus the average return on two growth portfolios.

$$\text{SMB} = 1/3\ (\text{Small Value} + \text{Small Neutral} + \text{Small Growth}) - 1/3\ (\text{Big Value} + \text{Big Neutral} + \text{Big Growth}) \quad (4.7)$$

$$\text{HML} = 1/2\ (\text{Small Value} + \text{Big Value}) - 1/2\ (\text{Small Growth} + \text{Big Growth}) \quad (4.8)$$

MOM proposed by Carhart (1997) is constructed as the equal-weight average of firms with the highest 30 percent eleven-month returns lagged one month

(Momentum portfolio, Rmom) minus the equal-weight average of firms with the lowest 30 percent eleven-month returns lagged one month (Contrarian portfolio, Rcon). The portfolios include all NYSE, AMEX and NASDAQ stocks and are reformed monthly. To be included in a portfolio for month t (formed at the end of the month t-1), a stock must have a price for the end of month t-13 and a return for t-2. Each included stock must also have a market value for the end of t-1. The monthly size breakpoint is the median NYSE market value. The monthly prior (2-12) return breakpoints are the 30^{th} and 70^{th} NYSE percentiles.

$$MOM = Rmom - Rcon \qquad (4.9)$$

4.3. Sample Selection and Statistics

The sample contains fund-level monthly net return data for 3,181 US open-end growth-oriented domestic equity funds that existed for at least a portion of the period from January 1993 to December 2006. Like Kosowski *et al.* (2006), sample funds are selected according to investment objective. Data for investment objective, however, are available only from the beginning of 1993. Hence the test period of observation starts from January 1993 to December 2006. The sample of growth-oriented funds consists of Equity USA Aggressive Growth funds (150), Equity USA Growth funds (1,956), Equity USA Growth-and-Income funds (856) and Equity USA Income-and-Growth funds (219). The final database contains 3,181 US equity mutual funds, and 330,188 fund-level monthly net returns.

According to the CRSP database, during the test period, 10,493 domestic equity mutual funds existed and the sample accounts for 30.31% (=3,181/10,493) of all equity funds. The sample of Kosowski *et al.* (2006) consists of 2,118 US growth-oriented equity mutual funds, which includes 285 aggressive growth funds, 1,227 growth funds, 396 growth-and-income funds and 210 balanced or income funds. Although the test period for Kosowski *et al.* (2006), January 1975 to December 2002, is longer than for this study, the mutual fund sample (3,181) in this study is much larger than their sample (2,118) because many new mutual funds have been created in the past decade. According to the *2008 Investment Company Fact Book*, published by the Investment Company Institute (http://www.ici.org/), there were 2,811 active mutual funds in 1995, but the number had increased to 12,021 by 2006.

In addition to the investment objective classification, the sample funds are separately classified according to Standard & Poor's (S&P) Returns-Based Style Analysis as Growth funds (1,470), Blend funds (428) and Value funds (1,283). S&P develop their Returns-Based Style Analysis, based on Sharpe (1992), to estimate the types of stock in which a mutual fund mainly invests according to its observed returns pattern. Growth (Value, Blend) funds are funds that primarily invest in growth (value, blend) stocks. S&P defines growth stocks as stocks with a high five-year earnings per share growth rate, high five-year sales per share growth rate and high five-year internal growth rate (= ROE x Earnings Retention Rate), and defines value stocks as those with a high book value to price ratio, a high cash flow to price ratio, a high sales to price ratio and a high dividend yield. Blend stocks lie between growth and value stocks.[30]

Table 4-1 shows the distribution of sample funds in the cross-sectional classifications. The more growth-oriented the investment objective, the larger the proportion of funds classified as Growth funds. For example, 87% (=131/150) of Equity Aggressive Growth funds are Growth funds, while only 16% (=134/856) of Equity Growth-and-Income funds are Growth funds. Table 4-1 also reveals that the more growth-oriented the investment objective (or style), the higher the average turnover ratio. For example, Equity Aggressive Growth funds have a higher average turnover ratio than Equity Growth-and-Income funds, and the average turnover ratio of Growth funds is higher than that of Value funds.

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[30] For more details see "Standard & Poor's: S&P U.S. Style Indices", http://www2.standardandpoors.com/spf/pdf/index/SP_US_Style_Indices_Methodology_Web.pdf

Table 4-1: Number of sample funds and turnover ratios

This table reports summary statistics for 20 different classifications of the 3,181 sample funds. The classifications are: the four investment objectives i.e. Equity Aggressive Growth, Equity Growth, Equity Growth-and-Income, and Equity Income-and-Growth subdivided into the three S&P Returns-Based styles i.e. Growth, Blend, and Value; the three S&P Returns-Based styles without sub-division; and the whole sample. For each classification, panel A reports the number of funds and the corresponding percentage of all sample funds (in parentheses). Panel B reports the mean and standard deviation (in parentheses) of pooled annual turnover ratios.

S&P Returns-Based Style	S&P Investment Objective				All
	Equity Aggressive Growth	Equity Growth	Equity Growth-and-Income	Equity Income-and-Growth	
Panel A: Number of sample funds					
Growth	131 (4.12%)	1,205 (37.88%)	134 (4.21%)	0 (0.00%)	1,470 (46.21%)
Blend	11 (0.35%)	229 (7.20%)	186 (5.85%)	2 (0.06%)	428 (13.45%)
Value	8 (0.25%)	522 (16.41%)	536 (16.85%)	217 (6.82%)	1,283 (40.33%)
All	150 (4.72%)	1,956 (61.49%)	856 (26.91%)	219 (6.88%)	3,181 (100%)
Panel B: Turnover ratio					
Growth	1.380 (1.538)	1.039 (1.004)	0.828 (0.623)	--- (---)	1.053 (1.047)
Blend	2.144 (1.442)	0.808 (0.938)	0.725 (0.688)	0.413 (0.348)	0.797 (0.871)
Value	0.698 (0.644)	0.726 (0.617)	0.623 (0.618)	0.529 (0.400)	0.648 (0.591)
All	1.389 (1.518)	0.931 (0.923)	0.675 (0.639)	0.528 (0.400)	0.856 (0.887)

Table 4-1 suggests that the investment objective claimed by mutual funds may not be consistent with their investment style in practice. For example, 27% (=522/1,956) of Equity Growth funds seem to invest in value stocks more than in growth stocks. Similarly, Cooper, Gulen and Rau (2005) observe the inconsistency between fund name and investment style. They report that flows to a fund increase dramatically when the fund changes its name to look more (less) like the current positive (negative) return style. This is despite the fund not materially adjusting its holdings to reflect the style implied by the new name.

It is possible to argue that Equity Income-and-Growth funds are not growth-oriented funds. Table 4-1 supports this proposition using the S&P Returns-Based Style Analysis. As shown in the 4th column of Panel A, among 219 Equity Income-and-Growth funds, 217 are classified as Value funds. Nevertheless, they are still included in the sample because growth-oriented funds are chosen according to investment objective and "Equity Income-and-Growth" implies the possibility of growth stock investment.[31]

The S&P Returns-Based Style Analysis shows that about 90% of the sample funds invest mainly in large capitalization firms and the remaining 10% of funds belong to all capitalization funds.[32] Mutual funds that invest mainly in middle or small capitalization firms are classified by S&P as Equity Midcaps funds and Equity Small

[31] Since Equity Income-and-Growth funds account for a small proportion of sample funds (only 7%), whether or not these funds are included does not affect the results of the analysis according to an unreported robustness test.
[32] The large capitalization funds and all capitalization funds are also tested separately. Both test results are consistent with the result for all sample funds.

Companies funds respectively, but not as growth-oriented funds. Since we do not know whether Equity Midcaps and Equity Small Companies funds also have a growth-oriented objective, these are removed from the sample to ensure that all funds are growth-oriented.

The sample funds invest on average over 90% of their assets in the stock market and adjust their market exposure only slightly. CRSP provides data of mutual funds' exposure to common stocks. The average market exposure of the sample funds is 91.7% with an average standard deviation of 5.6%. In fact, the Securities and Exchange Commission (SEC) issued new rules in January 2001 to crack down on the use of misleadingly named mutual funds. Those funds having a name indicating a certain investment type (e.g. stocks) will have to invest at least 80% of their assets in such investments.[33] Since all the sample funds are "equity" funds, which should invest most of their assets in the stock market, it is not surprising that the market exposures of the sample funds are so high and change slightly. This suggests that any evidence of market timing ability in the sample will be muted at best.

At first sight, the sample funds' consistently high exposures to the stock market suggests that fund managers do not significantly switch between stock and bond/cash markets, and hence there will be little market timing. However, we cannot exclude the possibility that equity fund managers adjust exposure to the market by switching between high- and low-beta stocks. Therefore, it is still necessary to examine whether fund managers possess market timing skill.

[33] Securities and Exchange Commission press release, January 2001.

There are 168 months in the test period. In these 168 months there are 107 positive RMRFs, 83 positive SMBs, 101 positive HMLs and 105 positive MOMs. As regards 'turning points', when a factor changes from positive (negative) to negative (positive), there are 76 such points for RMRF, 83 for SMB, 78 for HML and 76 for MOM.

Summary statistics for Carhart's (1997) four factors are reported in Table 4-2 together with the equivalents for the CTM and CHM models. Variances of Carhart's four factors are relatively high compared with mean returns. In addition, most of the correlations between factors or timing parameters are fairly low. This implies that multicollinearity does not substantially affect the estimated coefficients.

Table 4-2: Summary statistics for the parameters of the two style timing models

This table reports monthly data summary statistics for the parameters of the two style timing models, i.e. the Carhart (1997) four-factor Treynor and Mazuy (1966) style timing model (CTM) and the Carhart (1997) four-factor Henriksson and Merton (1981) style timing model (CHM), from Jan. 1993 – Dec. 2006. Both CTM and CHM models contain Carhart's (1997) four factors which include market excess return (RMRF), Fama and French's (1993) factor-mimicking portfolios for size (SMB) and book-to-market equity (HML), and Carhart's (1997) a factor-mimicking portfolio for one-year return momentum (MOM). The CTM four timing parameters, i.e. $RMRF^2$, SMB^2, HML^2, and MOM^2, are the squares of Carhart's four factors. The CHM four timing parameters, i.e. $RMRF^*$, SMB^*, HML^*, and MOM^*, are equal to the respective Carhart factors when the factor ≥ 0 and 0 otherwise. Columns 2 and 3 of panel A report the means and standard deviations of the time-series data for each of Carhart's four factors. The stars (*) denote the significance level of rejecting the hypothesis that the mean is equal to zero. The last four columns of panels A, B and C respectively report the cross-correlations of Carhart's (1997) four factors, the CTM four timing parameters, and the CHM four timing parameters. Carhart's four factors are collected from the website of Kenneth R. French, http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/index.html.

Factor or Parameter	Monthly returns		Cross-correlations			
	Mean	Std. Dev.				
Panel A: Carhart's (1997) four factors						
			RMRF	SMB	HML	PR1YR
RMRF	0.639%**	4.120%	1.000			
SMB	0.201%	3.831%	0.211	1.000		
HML	0.502%*	3.524%	-0.522	-0.494	1.000	
MOM	0.808%**	5.000%	-0.195	0.180	-0.037	1.000

***, **, and * represent significance levels of 0.01, 0.05, and 0.1 respectively.

Table 4-2: Summary statistics for the parameters of the two style timing models – continued

Factor or Parameter	Monthly returns: Mean	Monthly returns: Std. Dev.	Cross-correlations			
Panel B: The CTM four timing parameters						
			$RMRF^2$	SMB^2	HML^2	MOM^2
$RMRF^2$			1.000			
SMB^2			0.051	1.000		
HML^2			0.338	0.538	1.000	
MOM^2			0.187	0.472	0.438	1.000
Panel C: The CHM four timing parameters						
			$RMRF^*$	SMB^*	HML^*	MOM^*
$RMRF^*$			1.000			
SMB^*			0.156	1.000		
HML^*			-0.349	-0.202	1.000	
MOM^*			0.026	0.427	0.145	1.000

4.4. Summary

The data used in this study and the data sources employed have been described in this chapter. The data collected can be classified into three groups: fund returns, equity data and market systematic factors. Monthly fund returns are obtained from the Center for Research in Security Prices (CRSP) mutual fund database. Since this study focuses on the ability of fund managers, the fund returns used in this thesis account for management, administrative, and 12b-1 fees, but are not adjusted for sale charges (such as front-end or deferred loads and redemption fees). Equity data include the monthly return, share price, the number of outstanding shares and the book value of all stocks listed on NYSE, AMEX and NASDAQ. All these data are also collected from CRSP. Market systematic factors include the risk-free rate of return and Carhart's four market systematic factors, i.e. the market excess return (RMRF), SMB, HML and MOM. The risk-free rate of return is collected from CRSP, and the other three factors are collected from the website of Kenneth R. French.

The sample contains fund-level monthly net return data for 3,181 US open-end growth-oriented domestic equity funds that existed for at least a portion of the period from January 1993 to December 2006. Like Kosowski *et al.* (2006), sample funds are selected according to investment objective, which includes Equity USA Aggressive Growth funds (150), Equity USA Growth funds (1,956), Equity USA Growth-and-Income funds (856) and Equity USA Income-and-Growth funds (219). The final database contains 3,181 US equity mutual funds, and 330,188 fund-level monthly net returns.

CHAPTER 5

SKILLS OF SUPERIOR PERFORMING GROWTH-ORIENTED FUND MANAGERS

5.1. Introduction

This chapter explores the superior performance identified by Kosowski *et al.* (2006) by answering the research question: What skills do superior performing growth-oriented fund managers possess? Based on the theories of Treynor and Mazuy (1966) and Henriksson and Merton (1981), integrated style timing models are developed to extract information about style timing abilities from fund managers' superior performance. The style timing abilities examined in this study include market timing, size timing, growth timing and momentum timing. The rationale of the test methodology is that if superior performing growth-oriented fund managers have an abnormally high proportion of demonstrating a particular skill, this is evidence that they possess that skill.

The rest of this chapter is organized as follows. Section 5.2 examines whether it is necessary to adopt the bootstrap method of Kosowski *et al.* (2006) in this study. Section 5.3 introduces the models and settings used to measure mutual fund performance and style timing skills, and reports the statistics of these measures. Section 5.4 discusses the relationship between timing coefficients and intercepts of style timing models. Section 5.5 constructs synthetic funds and reports their relevant statistics. Section 5.6 applies the persistence test used by Kosowski *et al.* (2006) to examine whether sample fund managers in the current study demonstrate substantial skill to earn abnormal returns. Section 5.7 applies proportion tests to reveal the timing skill possessed by superior performing growth-oriented fund managers. Section 5.8 describes the sensitivity tests conducted. Section 5.9 sets out the conclusion.

5.2. Sample Fund Return and Bootstrap Method

According to the evidence presented by Kosowski *et al.* (2006), it is inappropriate to use standard t- or F-tests to judge the significance level of performance model coefficients for mutual funds. Kosowski *et al.* (2006) analyse the distribution of individual fund residuals generated by many commonly used performance models, such as Jensen's (1968) model, the Fama-French (1993) three-factor model and Carhart's (1997) four-factor model. They find that normality is rejected for 48% of funds when using these performance models. This strong finding of non-normal residuals challenges the validity of standard t- and F-tests, which are based on the assumption of normally distributed residuals. In order to solve this problem, they propose a baseline bootstrap method, which is discussed in Section 3.5, to replace standard t- and F-tests.

Like Kosowski *et al.* (2006), the distribution of individual fund residuals generated by Jensen's (1968) model, the Fama-French (1993) three-factor model and Carhart's (1997) four-factor model are examined. Specifically, the following hypotheses are tested to answer this question:

The Jarque-Bera normality test is conducted on the 3,181 sample fund residuals generated by Jensen's (1968) model, the Fama-French (1993) three-factor model and Carhart's (1997) four-factor model. Table 5-1 reports the test results. The last three columns report the results based on Jensen's (1968) model, the Fama-French (1993) three-factor model and Carhart's (1997) four-factor model respectively. The last three rows report the percentages of the sample funds whose residuals are found not to have a normal distribution by the Jarque-Bera normality test at the significance level of 0.01, 0.05 and 0.1 respectively. The normality of individual fund returns and excess returns are also examined, as shown in columns 2 and 3. In addition, Table 5-1 lists the summary statistics of skewness (S), kurtosis (K) as well as the Jarque-Bera values.

[See APPENDIX for Table 5-1]

The normality hypothesis is rejected for at least one-third of the sample funds. As shown in the last three rows of the last column of Table 5-1, the normality of residuals is rejected for 36.4% (45.7% and 52.1%) of the sample funds at the significance level of 0.01 (0.05 and 0.1) based on Carhart's (1997) four-factor model, which is the primary mutual fund performance model used in this study. That is, normality hypothesis of individual fund residuals generated by Carhart's (1997) four-factor model is rejected for more than 36.4% of the sample funds. Similarly, the last three rows of column 4 and 5 of Table 5-1 show that at the significance level of 0.01 (0.05 and 0.1) there are 55.5% (61.9%, 65.3%) of the sample funds whose residuals generated by Jensen's (1968) model are found not to have a normal distribution, while 37.8% (46.9%, 53.9%) of the sample funds do not demonstrate normal distributed residuals based on the Fama-French (1993) three-factor model. In other words, normality hypotheses of individual fund residuals generated by Jensen's (1968) model and Fama-French (1993) three factor model are also rejected for more than 55.5% and 37.8% of the sample funds respectively.

These findings are similar to those of Kosowski *et al.* (2006) and strongly challenge the validity of standard t- and F-tests, which assume that model residuals are normally distributed. In other words, the bootstrap method is necessary for judging the significance level of a coefficient. Specifically, the bootstrap method is used to construct the distribution of the coefficient, which can be used to calculate the p-value for the coefficient.

5.3. Performance and Timing Coefficients

This thesis uses Carhart's (1997) four-factor model to measure mutual fund performance and uses the Carhart (1997) four-factor Treynor and Mazuy (1966) style timing model and the Carhart (1997) four-factor Henriksson and Merton (1981) style timing model to measure fund managers' style timing abilities, i.e. market timing, size timing, growth timing and momentum timing. First, these models are briefly reviewed and the test settings required to use these models are explained. The statistics of sample fund performance and timing coefficients under different test settings are then reported.

5.3.1. Performance and timing models

Carhart's (1997) four-factor model is used to measure mutual fund performance:

$$r_{i,t} = \alpha_i + \beta_i \cdot RMRF_t + s_i \cdot SMB_t + h_i \cdot HML_t + p_i \cdot MOM_t + \varepsilon_{i,t} \quad (5.1)$$

where α_i is the abnormal returns earned by mutual fund *i*, i.e. mutual fund performance; $r_{i,t}$ is the month *t* excess return of mutual fund *i* (net return minus one-month Treasury bill return); $RMRF_t$ is month *t* excess return on a value-weighted aggregate market proxy portfolio; SMB_t, HML_t and MOM_t are returns on value-weighted, zero-investment factor-mimicking portfolios for size, book-to-market equity and one-year momentum in stock returns respectively.

Four style timing abilities of fund managers are estimated using the following two style timing models developed in Section 3.3.

a. CTM – the Carhart (1997) four-factor Treynor and Mazuy (1966) style timing model:

$$\begin{aligned} r_{i,t} = {} & \alpha_i + \beta_i \cdot RMRF_t + s_i \cdot SMB_t + h_i \cdot HML_t + p_i \cdot MOM_t \\ & + \gamma_{1,i} \cdot RMRF_t^2 + \gamma_{2,i} \cdot SMB_t^2 + \gamma_{3,i} \cdot HML_t^2 + \gamma_{4,i} \cdot MOM_t^2 + \varepsilon_{i,t} \end{aligned} \quad (5.2)$$

b. CHM – the Carhart (1997) four-factor Henriksson and Merton (1981) style timing model:

$$r_{i,t} = \alpha_i + \beta_i \cdot RMRF_t + s_i \cdot SMB_t + h_i \cdot HML_t + p_i \cdot MOM_t + \gamma_{1,i} \cdot RMRF_t^* + \gamma_{2,i} \cdot SMB_t^* + \gamma_{3,i} \cdot HML_t^* + \gamma_{4,i} \cdot MOM_t^* + \varepsilon_{i,t}$$

$$\begin{aligned} RMRF_t^* &= I\{RMRF_t > 0\} \cdot RMRF_t \\ SMB_t^* &= I\{SMB_t > 0\} \cdot SMB_t \\ HML_t^* &= I\{HML_t > 0\} \cdot HML_t \\ MOM_t^* &= I\{MOM_t > 0\} \cdot MOM_t \end{aligned} \tag{5.3}$$

where significantly positive $\gamma_{1,i}$, $\gamma_{2,i}$, $\gamma_{3,i}$ and $\gamma_{4,i}$ represent successful market timing, size timing, growth timing and momentum timing activities respectively. $I\{condition\}$ is an indicator function that equals one if the condition is true and zero otherwise. Other symbols are defined above.

5.3.2. Test settings

The fund performance (α_i of Carhart's (1997) four-factor model) and style timing abilities ($\gamma_{1,i}$, $\gamma_{2,i}$, $\gamma_{3,i}$ and $\gamma_{4,i}$) are estimated for each fund in various sub-periods. Each fund in each sub-period is defined as a fund instance. The sub-periods are defined by start date and length. For example, a nine-year sub-period which starts on 1993/01/01 means 1993/01/01 to 2001/12/31. The bootstrap method of Kosowski *et al.* (2006) is used to examine the significance level of estimated coefficients. There is a minimum observation requirement to ensure a sufficient degree of freedom for regressions.

The following test settings are used: the sub-period lengths include three, five and nine years; the sub-periods are established on 1 January of every year; minimum observation numbers include 36, 60 and 108 months. Only funds that have a minimum of 36 monthly net return observations are included to maintain a sufficient degree of freedom in order to generate more precise regression parameter estimates. Therefore, the minimum sub-period length is three years. In Kosowski *et al.* (2006), the minimum data requirement is 60 observations. Hence, the test results of a five-year sub-period are also examined. In addition, since the longer sub-period length means fewer fund instances, in order to examine the test results of the "long" sub-period, a nine-year sub-period length is chosen, under which the sub-period is long but fund instances do not decrease significantly. The 108 minimum observation requirement is used to examine the test results of long-lived funds. Using 1 January of every year as the start date creates the most sub-periods.

To sum up, there are six main test settings: (3, 36), (5, 36), (5, 60), (9, 36), (9, 60), (9, 108), in which the first number is the sub-period length (years) and the second number is the minimum observation number (months). The sensitivity tests also examine the test results under other settings of sub-period lengths, minimum observation numbers and start dates of sub-periods.

5.3.3. Statistics of performance and timing coefficients

Table 5-2 reports the fractions and means of the intercept and coefficients of Carhart's (1997) four-factor model of the 3,181 sample funds. Only a small part of the fund instances demonstrates abnormal returns based on Carhart's (1997) four-factor model. As shown in panel A, only 10–15% of the intercepts are significantly positive and their abnormal returns are distributed between 30 basis points per month (0.003) and 60 basis points per month (0.006), i.e. equivalently between 3.66% per year and 7.44% per year. Conversely, about 2/3 (67.8%) of the intercepts are negative and more than 1/3 (37.1%) are significantly negative.

[See APPENDIX for Table 5-2]

The RMRF coefficients reflect the funds' high market exposures. Panel B shows that over 99% of the RMRF coefficients are significantly positive and that their mean is around 0.98. This suggests that most of the sample funds invest primarily in the stock market. In fact, as revealed in Section 4.3, the market exposure of the sample funds is over 90% and exhibits less than 5% standard deviation, which explains the statistics of the RMRF coefficients.

The fractions of significant coefficients reflect the development history of Carhart's (1997) four-factor models. As discussed in Section 2.4, the RMRF factor is first included in the CAPM model. Then Fama and French (1993) observe SMB and HML. Finally, Carhart (1997) considers MOM, i.e. the momentum effect of Jegadeesh and Titman (1993), in his model. According to the fractions of significant coefficients shown in panel B of Table 5-2, the RMRF fractions are all higher than 99%; the SMB (HML) fractions are usually distributed between 40~60% (50%~80%) in panel C (D); In panel E, the MOM fractions are less than 15%. In other words, it is easier to find the relationship between fund excess returns and RMRF than the relationship between fund excess returns and SMB (and HML), and the relationship between fund excess returns and MOM is the most difficult to find.

Table 5-3 reports the fractions and means of the intercept and coefficients of the Carhart (1997) four-factor Treynor and Mazuy (1966) style timing model (CTM) of the 3,181 sample funds, while Table 5-4 reports the summary statistics for the Carhart (1997) four-factor Henriksson and Merton (1981) style timing model (CHM).

[See APPENDIX for Tables 5-3 and 5-4]

The fractions of the significant intercepts of CTM and CHM are obviously smaller than those of Carhart's four-factor model. The fractions of the significantly positive (negative) intercepts shown in Table 5-3 are distributed from 0.71% (14.24%) to 2.93% (21.33%), while those in Table 5-4 are distributed from 0.29% (10.22%) to 1.84% (11.18%). However, Carhart's significantly positive (negative) intercepts shown in Table 5-2 are distributed from 10.79% (37.10%) to 14.15% (52.15%). These statistics imply that the timing parameters in CTM and CHM explain part of the abnormal returns that could not be explained by Carhart's (1997) four factors.

All the fractions of the significant timing coefficients of CTM and CHM are less than 15%, and most of them are even lower than 5%. Such low fractions imply the difficulty of demonstrating timing ability, whether positive or negative. In other words, few fund managers are able to demonstrate successful timing activity. In fact, Kosowski *et al.* (2006) show that only a sizable minority of fund managers demonstrate genuine skills to earn abnormal returns, and panel A of Table 5-2 shows that only 10.79% of the fund instances demonstrate significantly positive intercepts.

Therefore, the low fractions observed in Table 5-3 and 5-4 are to be expected.

5.4. The Relationship between Intercept and Timing Coefficients

Jagannathan and Korajczyk (1986) find that an observed market timing ability may be attributable to a spurious statistical result rather than real skill. The characteristic of this problem is an inverse relationship between timing coefficients and intercepts in timing regressions. The relevant studies are now briefly reviewed and then whether this inverse relationship exists based on the style timing models is examined.

Previous studies have documented an inverse relationship between fund managers' market timing performance and their stock selection performance. The intercept obtained from a timing model is often regarded as representing a fund manager's stock selection ability. Kon (1983) and Henriksson (1984) document a negative correlation between regression intercepts and timing coefficients. Both find that most mutual funds in their respective samples exhibit positive intercepts and negative timing coefficients. Sahu *et al.* (1998) specifically test the relationship between bank funds' stock selection and market timing abilities by utilising meta-analysis to eliminate such study artefacts as sampling and measurement errors. Their findings suggest that the managers of bank equity investment funds possess superior stock selection abilities and somewhat negative timing skills. Volkman (1999) investigates the relationship between a fund's timing and selectivity performance and finds a negative correlation. He suggests that mutual fund managers attempt to maximize selectivity performance at the expense of timing performance.

Jagannathan and Korajczyk (1986) show theoretically and empirically that this inverse relationship arises because mutual fund returns are more or less option-like than the market proxy. Specifically, when the proxy for the market portfolio contains option-like securities, portfolios with greater (lower) concentration in option-like securities will show positive (negative) market timing performance and negative (positive) selectivity.[34] Bollen and Busse (2001) find that the average intercept for funds with negative timing coefficients is much higher than the corresponding average for funds with positive timing coefficients, as predicted by Jagannathan and Korajczyk (1986).

To examine whether the problem identified by Jagannathan and Korajczyk (1986) also exists in this study, this study examines eight (= 2 style timing models * 4 four timing abilities) relationships between the sample funds' alphas and timing coefficients. Pearson's correlation coefficient and Spearman's rank correlation coefficient are calculated. Table 5-5 and 5-6 report the correlation coefficients between intercept and timing coefficients for the Carhart (1997) four-factor Treynor and Mazuy (1966) style timing model (CTM) and the Carhart (1997) four-factor Henriksson and Merton (1981) style timing model (CHM) respectively for the 3,181 sample funds.

[See APPENDIX for Tables 5-5 and 5-6]

[34] Option-like securities include options and common stocks of highly levered firms.

There are significant inverse relationships between timing coefficients and intercept. Based on Pearson's correlation coefficients, all the timing coefficients exhibit a significantly negative relationship with the model intercept, as shown in columns 2 and 3 of Table 5-5 and 5-6. Columns 4 and 5 show that Spearman's rank correlation coefficient also demonstrates a similar phenomenon. In other words, these results confirm the inverse relationship between timing coefficients and intercept argued in previous studies, e.g. Kon (1983), Henriksson (1984) and Jagannathan and Korajczyk (1986). Moreover, this inverse relationship can be observed according to the percentages of fund instances with a significant intercept (α) and timing coefficient (γ) shown in the last four columns of Table 5-5 and 5-6. The total percentages of ($\alpha>0$, $\gamma<0$) and ($\alpha<0$, $\gamma>0$) are obviously larger than those of ($\alpha>0$, $\gamma>0$) and ($\alpha<0$, $\gamma<0$) under each test setting. In summary, the negative correlation suggests that managers may focus on one source of performance at the expense of another, which probably leads to the over- or underestimation of the timing ability of fund managers. In order to solve this problem, the method of Busse (1999) is applied in the next section.

5.5. Synthetic Funds

This section constructs synthetic funds and reports their statistics. Synthetic funds are the artificial funds that exhibit the same exposure characteristics as the actual funds but do not incorporate any skill. Since actual funds and synthetic funds have the same exposure characteristics, the problem identified by Jagannathan and Korajczyk (1986) should have a similar impact on them. If actual fund managers significantly outperform synthetic fund managers in timing activities, this cannot be due to the inverse relationship between timing coefficients and intercept. That is, the problem discussed in the last section can be solved by comparing the test results of actual funds with those of synthetic funds. In addition, since synthetic funds are portfolios of randomly picked stocks, they do not incorporate any skill but rely on good luck just as much as actual funds. Hence, they are also used to eliminate the possibility that an observed timing ability is attributable to the good luck of fund managers. The following section reviews the synthetic fund construction and describes the settings used. Then the relevant statistics of the synthetic funds are reported.

5.5.1. Synthetic fund construction

One synthetic fund is constructed for each sample fund based on the method of Busse (1999). Sharpe's (1992) style model is used to determine a fund's exposures to eight style benchmark asset classes:

$$\min_{b_1, b_2, \ldots, b_k} \left[\operatorname{var}\left(R_{i,t} - \sum_{j=1}^{8} b_j R_{j,t} \right) \right] \qquad \sum_{j=1}^{8} b_j = 1 \tag{5.4}$$

where $R_{i,t}$ is the total return of fund *i* in month *t*; b_j is the non-negative exposure of fund *i* to style benchmark asset class *j* and $R_{j,t}$ is the total return of style benchmark asset class *j* in month *t*. Eight benchmark asset classes are used: six intersections of the two value-weighted size and three value-weighted book-to-market indices and the equally weighted momentum and contrarian indices.[35]

Given the weights of the asset classes, a synthetic fund portfolio is constructed by randomly selecting 100 stocks chosen from the different asset classes to match the fund's exposure, b_j.[36] Stocks are then replaced by other stocks in the same asset class at random. Each stock is in the portfolio for an average of one year, roughly consistent with the 86% average annual turnover of the mutual fund sample. Since mutual funds are usually not fully invested but typically hold anywhere from 5% to 10% of their total net assets in cash-like securities, each random portfolio is given an allocation of 91.7% equity and 8.3% cash, the same as the average market exposure of the sample funds.

The returns of the synthetic fund portfolio are computed based on security proportions that are initially equally weighted (i.e. each has an initial weight of 1/100). The weights evolve according to a buy-and-hold investment strategy. Since the synthetic fund portfolio holds individual securities for an average of one year before replacement, this random sample mimics a buy-and-hold strategy with annual rebalancing.

There are high correlation coefficients between the synthetic fund returns and the sample fund returns. Figure 5-1 shows the histogram of 3,181 correlation

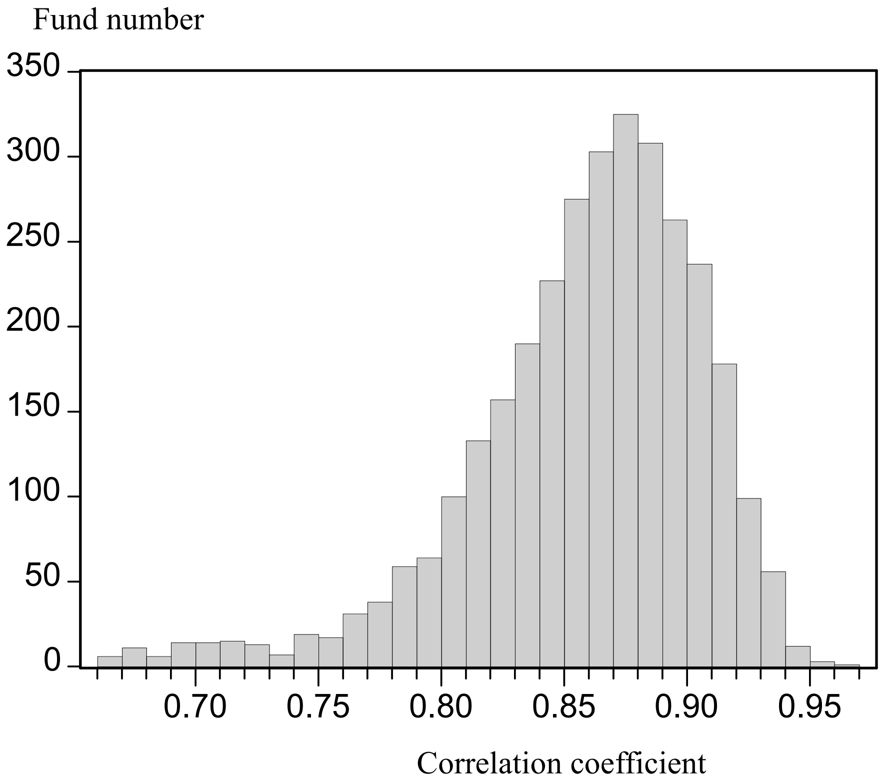
[35] These eight asset classes are defined by Fama-French (1993) and Carhart (1997).

[36] All the necessary data are obtained from CRSP. The stocks used to construct my synthetic funds include all stocks listed on NYSE, AMEX and NASDAQ. Monthly returns, book values and market values of all stocks are required. Monthly equity returns are adjusted for dividends and capital changes.

coefficients between the sample fund returns and the corresponding synthetic fund returns. The maximum correlation coefficient is 0.968, while the minimum correlation coefficient is 0.663. The mean and median of these correlation coefficients are 0.859 and 0.867 and their standard deviation is 0.047.

Figure 5-1: Histogram of correlation coefficients between sample fund returns and synthetic fund returns

This figure shows the histogram of 3,181 correlation coefficients between the sample fund returns and the corresponding synthetic fund returns. The x-axis is correlation coefficient and the y-axis is fund number.



5.5.2. The statistics of performance and timing coefficients

Table 5-7 reports the fractions and means of the intercept and coefficients of

Carhart's (1997) four-factor model of the 3,181 synthetic funds. The synthetic funds present higher proportions of demonstrating abnormal returns than the sample funds. As shown in panel A of Table 5-7, over 60% (27%) of the synthetic fund instances exhibit (significantly) positive Carhart (1997) alphas, whereas less than 33% (15%) of the sample fund instances present significantly positive Carhart alphas, shown in panel A of Table 5-2. In addition, the average abnormal returns earned by the synthetic funds are distributed between 30 basis points per month (0.003) and 50 basis points per month (0.005), i.e. equivalently between 3.66% per year and 6.17% per year.

[See APPENDIX for Table 5-7]

The RMRF coefficients reflect synthetic funds' high market exposures. Panel B of Table 5-7 shows that over 99% of the RMRF coefficients are significantly positive, with a mean of around 0.95. This suggests that most of the synthetic funds invest primarily in the stock market. Since the synthetic funds are constructed according to the exposure of the sample funds, the high market exposure of the synthetic funds are expected because of the high market exposure of the sample funds, discussed in Sections 4.3 and 5.3.3.

The SMB coefficients reflect synthetic funds' investment style focusing on large capitalization companies. As shown in panel C of Table 5-7, over 89% of the SMB coefficients are significantly negative. That is, most of the synthetic funds have high exposure to large capitalization companies and losw exposure to small capitalization companies. In fact, it is also found, using the S&P Returns-Based Style Analysis, that over 90% of growth-oriented funds in the sample invest primarily in large capitalization companies.[37] Since the synthetic funds are constructed according to the exposures of the sample funds, the SMB coefficients of the synthetic fund instances present similar exposure characteristics to those of the sample fund instances, i.e. high exposures to large capitalization companies.

The difference between the HML coefficients of the sample and synthetic fund instances implies that the sample fund managers may implement special skills when investing in growth stocks. As shown in Panel D of Table 5-7, more than 70% (35%) of the HML coefficients of the synthetic fund instances are (significantly) positive, whereas less than 30% (6%) of them are (significantly) negative. However, concerning the HML coefficients of the sample fund instances shown in panel D of Table 5-2, 52-60% (40-48%) are (significantly) positive and 30-50% (25-32%) are (significantly) negative. Since the synthetic funds are designed to remove fund manager skill from the fund returns, these statistics suggest that the sample fund exposures to low book-to-market stocks (negative HML) are abnormally high, which provides evidence of skill in the sample funds' investment in low book-to-market stocks, i.e. growth stocks.

Concerning the MOM coefficients, both the sample funds and the synthetic funds demonstrate similar characteristics. As shown in panel E of Table 5-2 and 5-7, half of their MOM coefficients are positive (negative). In addition, both sample funds and synthetic funds have a small proportion (less than 10%) of demonstrating

[37] Standard & Poor's uses Returns-Based Style Analysis derived from Sharpe (1992) to compare the historical performance of each fund with a series of index benchmarks to determine which benchmark (or combination of benchmarks) most closely describes the fund's actual returns.

significantly positive or significantly negative MOM coefficients.

Table 5-8 reports the fractions and means of the intercept and coefficients of the Carhart (1997) four-factor Treynor and Mazuy (1966) style timing model (CTM) of the 3,181 synthetic funds under six test settings, while Table 5-9 reports the summary statistics for the Carhart (1997) four-factor Henriksson and Merton (1981) style timing model (CHM).

[See APPENDIX for Tables 5-8 and 5-9]

The characteristics of the style timing model coefficients for the synthetic funds are similar to those of the sample funds. The fractions of the significant intercepts of CTM and CHM are obviously smaller than those of Carhart's four-factor model. The fractions of the significantly positive (negative) intercepts shown in Table 5-8 are distributed from 0.65% (2.49%) to 7.08% (4.22%), while those in Table 5-9 are distributed from 0.17% (2.96%) to 4.75% (7.03%). However, significantly positive (negative) intercepts shown in Table 5-7 are distributed from 27.44% (11.27%) to 35.88% (16.28%). These statistics imply that the timing parameters in CTM and CHM explain part of the abnormal returns that could not be explained by Carhart's (1997) four factors. In addition, all the fractions of the significant timing coefficients of CTM and CHM are less than 12% and most of them are even lower than 5%. Such low fractions indicate the difficulty of demonstrating timing ability, whether positive or negative. In fact, these characteristics are consistent with those shown by the sample funds in Tables 5-3 and 5-4.

5.5.3. The relationship between intercept and timing coefficients

Tables 5-10 and 5-11 report the correlation coefficients between the intercept and timing coefficients of the Carhart (1997) four-factor Treynor and Mazuy (1966) style timing model (CTM) and the Carhart (1997) four-factor Henriksson and Merton (1981) style timing model (CHM) respectively for the 3,181 synthetic funds under six test settings.

[See APPENDIX for Tables 5-10 and 5-11]

Based on Pearson's correlation coefficients, all the timing coefficients exhibit a significantly negative relationship with the model intercept. Spearman's rank correlation coefficient also demonstrates a similar phenomenon. In other words, these results indicate the inverse relationship between timing coefficients and intercept identified in previous studies, e.g. Kon (1983), Henriksson (1984) and Jagannathan and Korajczyk (1986). Moreover, this inverse relationship can be observed from the percentages of fund instances with a significant intercept (α) and timing coefficient (γ). The total percentages of ($\alpha>0$, $\gamma<0$) and ($\alpha<0$, $\gamma>0$) are obviously larger than those of ($\alpha>0$, $\gamma>0$) and ($\alpha<0$, $\gamma<0$).

5.6. Persistent Abnormal Returns

This section applies the method used in Kosowski *et al.* (2006) to test whether the sample growth-oriented funds demonstrate persistent abnormal returns. Kosowski *et al.* (2006) find strong evidence of superior performance and performance persistence among growth-oriented funds, which means that certain growth-oriented fund managers have substantial skills to earn abnormal returns. Therefore, the focus is on growth-oriented funds and their timing skills. But the test period of this study is different from that of Kosowski *et al.* (2006), hence the sample is not the same. To test whether there is persistent superior performance among the funds in the sample, the persistence test used in Kosowski *et al.* (2006) is applied.

The persistence test first proposed by Hendricks, Patel and Zeckhauser (1993) is applied to test the hypothesis. The rationale is that fund managers possess a certain skill if they can demonstrate it persistently; otherwise they do not have substantial skill but good luck. This method is used by many researchers, such as Carhart (1997) and Kosowski *et al.* (2006).

The test procedure is as follows. On 1 January each year (from 1996 to 2006) during the test period, the sample funds are sorted into decile portfolios based on Carhart (1997) alphas over the prior three years, and the portfolios are held for one year. A minimum of 36 monthly net return observations is required for each estimate. For funds that have missing observations during the prior three years, observations from the 12 months preceding the three-year window are added to obtain 36 observations. The portfolios are equally weighted monthly, so the weights are readjusted whenever a fund disappears. If the high-ranked portfolio demonstrates better skill than the low-ranked portfolio, this is evidence that fund managers demonstrate persistent abnormal returns, which implies that they possess substantial skill to earn abnormal returns. Table 5-12 reports the results of the persistence tests on the 3,181 sample of growth-oriented funds.

[See APPENDIX for Table 5-12]

The sample growth-oriented funds do earn persistent abnormal returns. As shown in Table 5-12, the portfolios of the top fund and the top-1% funds exhibit significant positive Carhart alphas, but the other portfolios do not. In other words, at least 1% of the sample funds exhibit the ability to earn abnormal returns persistently, which is consistent with the findings of Kosowski *et al.* (2006). This is evidence for the existence of substantial skills to earn abnormal returns. In the next section, the source of these abnormal returns are explored, specifically the timing skills possessed by superior performing growth-oriented fund managers.

The sample funds show persistent underperformance. As shown in Table 5-12, except for the portfolios of the top-10% funds, the other portfolios present a significantly negative Carhart alpha, i.e. persistent underperformance. In addition, funds with worse Carhart alphas in the past three years usually demonstrate a worse Carhart alpha in the following year. For example, the Carhart alpha of 10.dec is less than that of 9.dec, and all the Carhart alphas of Top-minus-Bottom (T-B), 1-99, 5-95 and 10-90 are significantly positive. Carhart (1997) also finds this result.

Whether the synthetic funds demonstrate persistent abnormal returns is also examined. Since the synthetic funds are designed to possess no skill, this characteristic could be confirmed by checking superior performance persistence of the synthetic funds. Table 5-13 reports the results of the persistence tests on the synthetic funds.

[See APPENDIX for Table 5-13]

As was expected, the synthetic funds do not exhibit persistent outperformance or underperformance. Since the synthetic funds are the portfolios of randomly picked stocks, they do not contain any real skill and hence should not be able to demonstrate persistent abnormal returns. The test result shown in Table 5-13 supports this. According to Table 5-7, about 30% of synthetic fund instances demonstrate a significant Carhart alpha. However, top-30% funds in the past three years do not demonstrate a significantly positive Carhart alpha. That is, there is no persistent outperformance among the synthetic funds. Similarly, synthetic funds do not demonstrate persistent underperformance. In addition, the Carhart alphas of T-B, 1-99, 5-95 and 10-90 are not significantly different from zero. This suggests that there is no difference between the performances of portfolios constructed with superior and inferior performing funds. This is to be expected for random portfolios such as the synthetic funds.

5.7. Skills of Superior Performing Growth-Oriented Fund Managers

This section investigates the key research question of this chapter – what skills do superior performing growth-oriented fund managers possess? Kosowski *et al.* (2006) reveal that certain growth-oriented fund managers possess genuine skill to earn abnormal returns. The focus will therefore be on growth-oriented fund managers who earn abnormal returns, and the source of their superior performance is explored by extracting information about timing ability from the abnormal returns.

Specifically, two style timing models, the Carhart (1997) four-factor Treynor and Mazuy (1966) style timing model (CTM) and the Carhart (1997) four-factor Henriksson and Merton (1981) style timing model (CHM), are developed to measure four style timing abilities, i.e. market timing, size timing, growth timing and momentum timing. Proportion tests, introduced in Section 3.6, are carried out on the monthly data of the 3,181 US growth-oriented equity mutual funds from January 1993 to December 2006 to investigate what timing skills superior performing growth-oriented fund managers possess.

This section deals with the following research question and corresponding hypotheses:

Q1: What timing skills do superior performing growth-oriented fund managers possess?

$H1a_0$: *Superior performing growth-oriented fund managers do not possess market timing skill.*

$H1b_0$: *Superior performing growth-oriented fund managers do not possess size timing skill.*

$H1c_0$: *Superior performing growth-oriented fund managers do not possess growth timing skill.*

$H1d_0$: *Superior performing growth-oriented fund managers do not possess momentum timing skill.*

Before discussing the timing ability of mutual fund managers, we need to know whether style timing is potentially profitable. Only then will mutual fund managers be motivated to implement a particular style timing strategy. For example, in terms of the four Carhart (1997) factors, market timing, that is timing with respect to market excess return (RMRF), is potentially profitable if there are periods of both positive and negative market excess returns. That is, sometimes equity market returns are higher than the risk-free return (one-month Treasury bill rate) and sometimes the risk-free return is higher than equity market returns. There are 168 months in the test period from January 1993 to December 2006. In these months there are 107 positive RMRFs, 83 positive SMBs, 101 positive HMLs and 105 positive MOMs. As regards "turning points", when a factor changes from positive (negative) to negative (positive), there are 76 for RMRF, 83 for SMB, 78 for HML and 76 for MOM.[38] Therefore, style timing with respect to all these factors is potentially profitable.

The fundamental concept of the proportion test is that superior performing fund managers have a particular timing skill, e.g. market timing, if they have a significantly higher proportion of demonstrating it than the other three fund groups: all sample funds, superior performing funds, all synthetic funds and superior synthetic funds.[39] The superior performing growth-oriented (synthetic) funds are defined as the sample (synthetic) funds with a significantly positive Carhart alpha.

Table 5-14 reports the results of the proportion tests on monthly return data of 3,181 US growth-oriented equity mutual funds from January 1993 to December 2006.

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[38] Data are collected from the website of Kenneth R. French: http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/index.html

[39] The reasons for using these three fund groups are discussed in Section 3.6.

Table 5-14: Proportion tests of fund manager timing skills: full sample

This table reports the results of proportion tests on monthly return data of 3,181 US growth-oriented equity mutual funds from Jan. 1993 to Dec. 2006. Panel A refers to market timing, panel B size timing, panel C growth timing, and panel D momentum timing abilities. The proportion tests examine whether superior performing funds (Sup) have a higher proportion of demonstrating the respective timing ability than all mutual funds (All), superior performing synthetic funds (Ssy), or all synthetic funds (Asy). Column 1 reports the test setting of sub-period length (years) and minimum observation number (months). Column 2 shows the style timing model used to measure timing ability, i.e. the Carhart (1997) four-factor Treynor and Mazuy (1966) style timing model (CTM) or the Carhart (1997) four-factor Henriksson and Merton (1981) style timing model (CHM). Columns 3 to 6 report the proportion of demonstrating the respective timing abilities for Sup, All, Ssy, and Asy. The following three columns report the p-values and significance of the permutation tests of the three hypotheses relating to the proportion of Sup ≤ the proportions of All, Ssy, or Asy respectively. The last column (Sig) summarizes the results of these permutation tests by reporting the minimum significance level of superior performing growth-oriented funds (Sup) having a higher proportion of demonstrating the respective timing ability than the other three fund groups.

Setting	Model	Sup (%)	All (%)	Ssy (%)	Asy (%)	Sup ≤ All	Sup ≤ Ssy	Sup ≤ Asy	Sig
Panel A: Market Timing									
(3, 36)	CTM	1.61	4.18	1.26	2.31	1.000	0.221	0.979	
	CHM	1.96	3.91	1.31	2.48	1.000	0.069*	0.905	
(5, 36)	CTM	1.52	3.08	0.84	1.86	1.000	0.015**	0.874	
	CHM	1.26	2.25	1.18	2.08	1.000	0.442	0.998	
(5, 60)	CTM	1.26	2.21	0.80	1.35	1.000	0.118	0.587	
	CHM	1.09	1.69	0.69	1.51	0.988	0.135	0.905	
(9, 36)	CTM	0.71	1.70	0.36	0.78	1.000	0.092*	0.607	
	CHM	0.97	1.76	0.76	0.96	1.000	0.309	0.500	
(9, 60)	CTM	0.82	1.35	0.38	0.58	0.981	0.073*	0.163	
	CHM	1.07	1.41	0.88	0.69	0.888	0.369	0.057*	
(9, 108)	CTM	0.95	0.58	0.36	0.27	0.124	0.120	0.002***	
	CHM	0.95	0.64	1.07	0.35	0.149	0.500	0.010***	

***, **, and * represent significance levels of 0.01, 0.05, and 0.1 respectively.

Table 5-14: Proportion tests of fund manager timing skills: full sample – continued

Setting	Model	Sup (%)	All (%)	Ssy (%)	Asy (%)	Sup ≤ All	Sup ≤ Ssy	Sup ≤ Asy	Sig
Panel B: Size Timing									
(3, 36)	CTM	3.67	4.76	6.08	4.28	0.995	1.000	0.892	
	CHM	3.37	4.59	3.12	2.74	0.997	0.352	0.055*	
(5, 36)	CTM	3.92	4.86	6.32	4.85	0.990	1.000	0.976	
	CHM	3.33	3.64	2.57	2.21	0.804	0.071*	0.001***	
(5, 60)	CTM	4.12	3.57	6.29	3.60	0.111	0.998	0.141	
	CHM	3.49	2.60	2.52	1.60	0.016**	0.055*	0.000***	*
(9, 36)	CTM	4.58	5.73	8.20	7.39	0.987	1.000	1.000	
	CHM	2.50	4.08	2.24	2.93	1.000	0.335	0.862	
(9, 60)	CTM	4.27	4.69	8.22	6.06	0.782	1.000	0.999	
	CHM	2.26	3.26	2.20	2.40	0.994	0.500	0.590	
(9, 108)	CTM	4.02	2.38	8.28	3.24	0.002***	1.000	0.114	
	CHM	1.66	1.69	2.84	1.44	0.550	0.924	0.336	
Panel C: Growth timing									
(3, 36)	CTM	10.05	6.41	4.67	4.00	0.000***	0.000***	0.000***	***
	CHM	8.59	5.87	4.52	3.70	0.000***	0.000***	0.000***	***
(5, 36)	CTM	16.55	10.19	7.79	7.27	0.000***	0.000***	0.000***	***
	CHM	10.57	6.97	5.81	5.27	0.000***	0.000***	0.000***	***
(5, 60)	CTM	16.41	7.58	7.49	5.42	0.000***	0.000***	0.000***	***
	CHM	10.23	5.16	5.60	3.85	0.000***	0.000***	0.000***	***
(9, 36)	CTM	22.01	12.17	10.09	9.86	0.000***	0.000***	0.000***	***
	CHM	16.81	7.95	8.35	7.29	0.000***	0.000***	0.000***	***
(9, 60)	CTM	22.54	9.88	10.23	7.99	0.000***	0.000***	0.000***	***
	CHM	17.39	6.45	8.66	5.93	0.000***	0.000***	0.000***	***
(9, 108)	CTM	23.43	5.23	8.99	4.26	0.000***	0.000***	0.000***	***
	CHM	18.34	3.25	8.05	2.99	0.000***	0.000***	0.000***	***
Panel D: Momentum timing									
(3, 36)	CTM	2.61	2.76	5.98	4.35	0.658	1.000	1.000	
	CHM	1.56	1.79	6.63	3.85	0.814	1.000	1.000	
(5, 36)	CTM	2.27	3.92	6.57	4.64	1.000	1.000	1.000	
	CHM	1.56	2.11	7.37	4.45	0.981	1.000	1.000	
(5, 60)	CTM	2.23	2.93	6.63	3.42	0.962	1.000	0.997	
	CHM	1.77	1.54	7.38	3.33	0.228	1.000	0.999	
(9, 36)	CTM	2.70	7.04	5.50	5.66	1.000	1.000	1.000	
	CHM	0.82	3.19	6.06	4.62	1.000	1.000	1.000	
(9, 60)	CTM	2.57	5.79	5.96	4.64	1.000	1.000	1.000	
	CHM	0.69	2.67	6.47	3.80	1.000	1.000	1.000	
(9, 108)	CTM	2.01	2.90	8.28	2.49	0.957	1.000	0.777	
	CHM	0.24	1.29	8.99	2.18	1.000	1.000	1.000	

Table 5-14 provides strong evidence that superior performing growth-oriented fund managers possess growth timing skill (timing along the value/growth continuum). Panel C shows that no matter what test setting and model are used, the proportions of superior performing funds (Sup) demonstrating growth timing skill in column 3 are larger than those for the other three fund groups (all growth-oriented funds – All; all superior performing synthetic funds – Ssy; all synthetic funds – Asy) reported in columns 4–6. The last column of panel C shows that at the 0.01 significance level, superior performing growth-oriented fund managers have a significantly higher proportion of demonstrating growth timing ability than the other three groups (All, Ssy and Asy). As discussed in Section 3.6, this abnormally high proportion of demonstrating growth timing ability suggests that superior performing growth-oriented fund mangers possess growth timing skill.

Importantly, the third column of panel C of Table 5-14 shows that superior performing growth-oriented fund managers have between an 8% and 24% proportion of demonstrating growth timing ability. However, all growth-oriented funds and random portfolios, such as all synthetic funds and superior performing synthetic funds, show a 3–13% proportion of demonstrating growth timing ability (columns 4–6 of panel C of Table 3). Thus, the managers of about 6–10% of superior performing growth-oriented funds have substantial growth timing skill.

No evidence, however, is found for the existence of market timing, size timing or momentum timing skills among superior performing growth-oriented funds. Table 5-14, panel A, which concerns market timing skill, shows in column 3 the proportion of a superior performing growth-oriented fund manager demonstrating market timing skill, which ranges from 0.82% to 1.96%, whereas the proportions for the other three fund groups (All, Ssy and Asy), shown in columns 4–6, are between 0.27% and 4.18%. Therefore, superior performing growth-oriented fund managers do not have an abnormally high proportion of demonstrating market timing skill; hence, there are no stars shown in the last column of panel A. Panels B and D provide similar results for size timing and momentum timing respectively. That is, we cannot reject the possibility that the observed market timing, size timing and momentum timing abilities of superior performing fund managers are due to good luck or are spurious (Jagannathan and Korajczyk, 1986).

5.8. Sensitivity Analysis

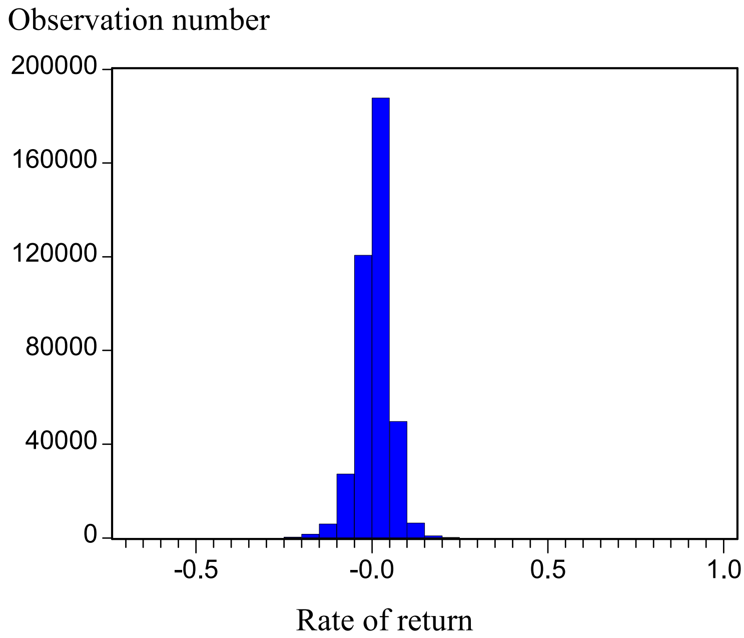
The previous section shows that superior performing growth-oriented mutual fund managers possess growth timing skill but not market timing, size timing or momentum timing skill. To ensure that these findings are not due to sampling variability and are not spurious, various sensitivity tests are now carried out.

5.8.1. Extreme returns

The style timing models use convex functions to capture timing ability, so extreme large or small fund returns may increase the proportion of observing significant timing ability. To ensure that the observed timing ability is not due to extreme returns, a robustness test is carried out, which repeats the test discussed in Section 5.7 but without extreme large or small fund returns. As shown in Figure 5-2, since most monthly returns are within the range -0.2 to 0.2, the robustness test uses fund returns between -0.2 and 0.2. The results are unchanged.

Figure 5-2: Histogram of monthly returns of the sample funds

This figure shows the distribution of the 330,188 fund-level monthly net returns of the 3,181 sample funds. The x-axis is the rate of return and the y-axis is the observation number.



5.8.2. Synthetic funds with different beta-adjusting frequency

Since the proportion tests compare superior performing funds with all synthetic funds and with superior performing synthetic funds, the parameters used in constructing synthetic funds would influence the results. In the procedure for constructing synthetic funds, the most important parameter is the beta-adjusting frequency, which decides how frequently synthetic funds’ exposure to asset classes is re-estimated and adjusted. If the frequency is high (low), the synthetic funds will be similar to the original mutual funds (random portfolios). The standard synthetic funds are constructed with high beta-adjusting frequency (once per year). The tests discussed in Section 5.7 are therefore repeated but with the synthetic funds constructed with low beta-adjusting frequency (once every 14 years). The results are consistent with those in Section 5.7.

5.8.3. The survivorship bias of short-lived funds

Short-lived funds tend to generate more extreme timing estimates than long-lived funds. This leads to nontrivial heteroskedasticity in the cross section of timing estimates. To correct for this effect, a minimum of 36 observations is imposed so as to exclude short-lived funds. However, this minimum observation requirement may impose a survivorship bias on the results.

To test whether the results are biased because of this, the requirement to include funds that have at least 12 and 24 months of observations is varied. This lower minimum observation requirement also allows us to use a shorter sub-period length. Tests are conducted with four different settings for sub-period length and minimum number of observation months: (2 years, 12 months), (2 years, 24 months), (3 years, 12 months) and (3 years, 24 months). The test results confirm that fund survivorship bias does not affect the conclusions.

5.8.4. Other test settings

Whether the proportion test results are sensitive to the test settings is now considered. There are three main parameters in the proportion tests: sub-period length, minimum observation number of months and start dates of the sub-periods. The primary tests are conducted under only six settings of these three parameters. In this sensitivity analysis, all the proportion tests are repeated under other settings: four, six, seven and eight-year sub-period lengths; 48, 72, 84 and 96 minimum number of monthly observations; and sub-period start dates ranging from 1 February to 1 December. All the results are very similar to those reported in Section 5.7 and lead to identical conclusions.

5.8.5. Different test periods

Finally, whether the findings are sensitive to different test periods is examined. Analyses are conducted on six nine-year test periods rather than across the original whole 14-year test period, January 1993 to December 2006. The six test periods are January 1993 to December 2001, January 1994 to December 2002, January 1995 to December 2003, January 1996 to December 2004, January 1997 to December 2005 and January 1998 to December 2006. Parallel tests are also conducted on the periods before and after 2002 to explore whether the technology bubble impacts adversely on the results. The findings for all sub-periods are consistent with those for the whole test period.

5.9. Summary

A series of tests to investigate the timing ability of superior performing growth-oriented fund managers are carried out in this chapter, using monthly return data for 3,181 US growth-oriented equity mutual funds from January 1993 to

December 2006. Carhart's (1997) four-factor model is used to measure mutual fund performance, and the superior performing funds are those that can earn abnormal returns, i.e. a significantly positive Carhart alpha. The Carhart (1997) four-factor Treynor and Mazuy (1966) style timing model (CTM) and the Carhart (1997) four-factor Henriksson and Merton (1981) style timing model (CHM) are used to examine four style timing abilities of fund managers, i.e. market timing, size timing, growth timing and momentum timing.

Two important problems relating to the models are first examined. The first problem, raised by Kosowski *et al.* (2006), is that the distribution of individual fund residuals generated Carhart's (1997) four-factor model is not normal. That is, it is inappropriate to use standard t- or F-tests to judge the significance level of model coefficients for mutual funds. This problem is confirmed in the current study and therefore the baseline bootstrap method suggested by Kosowski *et al.* (2006) is used instead. The second problem, raised by Jagannathan and Korajczyk (1986), is that there is an inverse relationship between timing coefficients and intercepts in timing regressions, which implies that it is likely to over- (under-) estimate the timing abilities at the expense of under- (over-) estimating the timing model intercept. In order to avoid this problem leading to spurious results, the method of Busse (1997) is used to construct a corresponding synthetic fund for each sample fund as a control.

The timing parameters of the style timing models can explain part of the abnormal returns that cannot be explained by Carhart's (1997) four factors. In addition, the sample funds demonstrate abnormally higher exposures to low book-to-market stocks than the synthetic funds.

Before investigating the timing skills, it is necessary to ensure that the sample funds do demonstrate evidence of skill. The persistence test adopted in Kosowski *et al.* (2006) is used to show that superior performing growth-oriented funds in the sample generate persistent abnormal returns. In other words, managers of the sample funds demonstrate substantial skill.

The main finding of this chapter is that superior performing growth-oriented fund managers possess growth timing skill but not market timing, size timing or momentum timing skill. The proportion tests developed in Section 3.6 are applied to examine four style timing abilities of fund managers estimated by the style timing models. There is strong evidence that the superior performing growth-oriented fund managers have an abnormally high proportion of demonstrating growth timing ability.

To ensure that the findings are not due to sampling variability and are not spurious, various sensitivity tests are carried out. The results indicate that the growth timing ability results are robust to extreme returns, different synthetic fund constructions, fund survivorship bias, different sub-periods and different test settings.

CHAPTER 6

TIMING SKILLS OF DIFFERENT FUND GROUPS

6.1. Introduction

In some states of the market, growth stocks tend to do well; in other states they do not. If growth stocks are forecast as likely to go out-of-favour, shrewd growth-oriented fund managers will temporarily reduce exposure to high growth stocks. When high growth stocks are forecast as likely to return to favour, they will then increase exposure to high growth stocks. That is, they engage in growth timing activity. In contrast, the rationale for value investing is to evaluate the fundamental value of stocks and then to buy-and-hold the under-priced stocks until their full value is realized. Value investing is therefore unlikely to involve much timing activity.

To test the inference above, the sample funds are separated into different groups and the timing abilities demonstrated by the superior performing fund managers in these groups are examined. Two classifications of the sample funds are used: investment objective and investment style. According to investment objective, the sample funds are classified into four fund groups: Equity Aggressive Growth funds, Equity Growth funds, Equity Growth-and-Income funds and Equity Income-and-Growth funds. Standard & Poor's Returns-Based Style Analysis groups the sample funds into three different investment styles: Growth funds, Blend funds and Value funds. The timing skills superior performing fund managers of these fund groups are first assessed and then compared across the groups. We might expect to observe that the more growth-oriented the investment objective or style, the stronger the evidence of growth timing ability.

The rest of this chapter is organized as follows. Section 6.2 examines the four fund groups with different investment objectives, while Section 6.3 examines the three fund groups classified by Standard & Poor's Returns-Based Style Analysis. In each of these sections, the statistics of the fund performance and style timing coefficients are discussed for each fund group and the timing skills observed are investigated further. Section 6.4 analyses the source of the growth timing skill identified in the last chapter. Section 6.5 is a summary.

6.2. Different Investment Objectives

To comply with the Investment Company Act of 1940, each mutual fund must declare an investment objective, such as aggressive growth, growth-and-income, global equities, global bonds, municipal bonds, corporate bonds and so forth. This tells the investor what the fund concentrates on and allows the investor to integrate a particular fund with his or her own needs. The CRSP Survivor-Bias-Free US Mutual Fund Database provides data of S&P detailed objective codes and names from March 1993 onwards, which include 193 different investment objectives. Like Kosowski *et al.* (2006), we will concentrate on “growth-oriented” “equity” mutual funds which include Equity Aggressive Growth funds (150), Equity Growth funds (1,956), Equity Growth-and-Income funds (856) and Equity Income-and-Growth funds (219). Each of these four types of fund are examined individually to test what skill they possess.

6.2.1. Statistics for performance and timing coefficients

Tables 6-1 to 6-4 report the fractions and means of the intercept and coefficients of Carhart's (1997) four-factor model for the four types of fund. Funds with a greater growth-oriented investment objective demonstrate a higher proportion of earning (significantly) positive abnormal returns. As shown in panel A of Table 6-1, the fractions of Equity Aggressive Growth fund instances with (significantly) positive intercepts are between 44–60% (19–36%). Concerning Equity Growth, the fractions of fund instances with (significantly) positive intercepts are between 30–34% (11–17%), as shown in panel A of Table 6-2. Panel A of Table 6-3 reports that the fractions of Equity Growth-and-Income fund instances with (significantly) positive intercepts lie between 18–28% (6–10%), while the fractions are between 7%–25% (1–8%) for Equity Income-and-Growth funds, shown in panel A of Table 6-4.

[See APPENDIX for Tables 6-1 to 6-4]

The RMRF coefficients reflect funds' high market exposure. Panel B of Tables 6-1 to 6-4 show that over 96% of the RMRF coefficients are significantly positive, with a mean of around 1 (between 0.862 and 1.067). The whole sample also demonstrates a similar phenomenon to that discussed in Section 5.3.3. In fact, as revealed in Section 4.3, the market exposure of the sample funds is over 90% and has less than a standard deviation of 5%.

The SMB coefficients imply that Equity Aggressive Growth funds invest primarily in small companies, whereas the other three fund groups invest mainly in large companies. As shown in panel C of Table 6-1, 80–87% (45–61%) of the SMB coefficients are (significantly) positive. In other words, Equity Aggressive Growth funds are likely to have higher exposure to small firms than to big firms. Conversely, as shown in panel C of Tables 6-2 to 6-4, the fractions of fund instances with (significantly) negative SMB coefficients are much larger than those of fund instances with (significantly) positive SMB coefficients. That is, most of these funds appear to hold the big capitalization companies and/or to sell the small capitalization companies. Since there are only 150 Equity Aggressive Growth funds among the sample of 3,181 funds, these statistics are consistent with the fact that, using the S&P Returns-Based Style Analysis, over 90% of growth-oriented funds in the sample invest primarily in large capitalization companies.

Funds with a more growth-oriented investment objective demonstrate higher exposure to growth stocks. As shown in panel D of Tables 6-1 and 6-2, 84–89% (48–79%) of Equity Aggressive Growth fund instances exhibit a (significantly) negative HML coefficient, and 56-61% (34-43%) of Equity Growth fund instances exhibit a (significantly) negative HML coefficient. However, panel D of Tables 6-3 and 6-4 shows that the fractions of Equity Growth-and-Income fund instances with (significantly) negative HML coefficients are between 15–24% (6–9%), while the fractions lie between 0–3% (0–1%) for Equity Income-and-Growth funds. This implies that funds with a higher growth-oriented investment objective have higher exposure to low book-to-market stocks, i.e. growth stocks.

Equity Aggressive Growth funds tend to be contrarians. Panel E of Table 6-1 shows that 70–80% of Equity Aggressive Growth fund instances demonstrate a negative MOM coefficient. As shown in panel E of Table 6-2, 56–59% of Equity Growth fund instances have a negative HML coefficient. Panel E of Tables 6-3 and 6-4 shows that the fractions of Equity Growth-and-Income fund instances with negative MOM coefficients are between 35–41%, while the fractions lie between 27–38% for Equity Income-and-Growth funds. That is, funds with a more growth-oriented investment objective have a higher proportion of demonstrating a negative MOM coefficient, which implies that they tend to be contrarians. However, except for Equity Aggressive Growth funds, the fractions of fund instances with significant MOM coefficients are usually less than 5%. That is, most of the sample funds are neutral to momentum-based or contrarian-based investment. Conversely, there are 9–31% (0–2%) of Equity Aggressive Growth fund instances demonstrating significantly negative (positive) MOM coefficients, which means that Equity Aggressive Growth funds tend to use a contrarian investment strategy.

Tables 6-5 to 6-8 report the fractions and means of the intercept and coefficients of the Carhart (1997) four-factor Treynor and Mazuy (1966) style timing model (CTM) of Equity Aggressive Growth funds, Equity Growth funds, Equity Growth-and-Income funds and Equity Income-and-Growth funds under six test settings, while Tables 6-9 to 6-12 report the summary statistics for the Carhart (1997) four-factor Henriksson and Merton (1981) style timing model (CHM).

[See APPENDIX for Tables 6-5 to 6-12]

The fractions of fund instances with a significantly positive CTM or CHM intercept are smaller than those of Carhart's (1997) four-factor model. For example, concerning Equity Aggressive Growth funds, the fractions of significantly positive CTM intercepts range only from 1% to 6% in panel A of Table 6-5, while the fractions of significantly positive CHM intercepts are between 0% and 4% in panel A of Table 6-9. However, as shown in panel A of Table 6-1, 19–36% of Equity Aggressive Growth fund instances demonstrate significantly positive Carhart alphas. The other three fund groups also exhibit a similar phenomenon, i.e. fewer fund instances demonstrate abnormal returns based on CTM or CHM than on Carhart's (1997) four-factor model. In other words, the timing parameters of CTM and CHM explain the part of the abnormal returns which cannot be explained by Carhart's (1997) four factors.

Funds with a more growth-oriented investment objective have a higher proportion of demonstrating growth timing ability. As shown in panel D of Tables 6-5 to 6-8, based on CTM, 5–26% of Equity Aggressive Growth fund instances and 6–17% of Equity Growth fund instances demonstrate a significantly positive growth timing coefficient, i.e. growth timing ability. However, the fractions are only between 7% and 13% for Equity Growth-and-Income funds and between 0% and 6% for Equity Income-and-Growth funds. Similarly, the statistics of CHM growth timing coefficients listed in panel D of Tables 6-9 to 6-12 present the same trend. The fractions of Equity Aggressive Growth fund instances with positive growth timing coefficients range from 4% to 21%, and the fractions of Equity Growth fund instances with positive growth timing coefficients lie between 6% and 12%. However, only 5–9% of Equity Growth-and-Income fund instances and 0–3% of

Equity Income-and-Growth fund instances are significantly positive.

These four fund groups seldom demonstrate successful market timing, size timing or momentum timing ability. As shown in panels B, C and E of Tables 6-5 to 6-12, the fractions of fund instances with significantly positive market timing, size timing or momentum timing coefficients are all less than 9%, and most of these fractions are even less than 5%. We observe little by way of successful market timing, size timing or momentum timing activity, whether among Equity Aggressive Growth, Equity Growth, Equity Growth-and-Income or Equity Income-and-Growth fund instances.

6.2.2. Timing skills of funds with different investment objectives

This section investigates the timing ability of the four fund groups with different investment objectives, i.e. Equity Aggressive Growth funds, Equity Growth funds, Equity Growth-and-Income funds and Equity Income-and-Growth funds. Specifically, whether superior performing fund managers possess market timing, size timing, growth timing or momentum timing skill is examined for each fund group.

Proportion tests are carried out on Equity Aggressive Growth funds, Equity Growth funds, Equity Growth-and-Income funds and Equity Income-and-Growth funds from January 1993 to December 2006. The test results are reported in Tables 6-13 to 6-16. Panel A refers to market timing, panel B to size timing, panel C to growth timing and panel D to momentum timing abilities. The proportion tests examine whether superior performing funds (Sup) have a higher proportion of demonstrating the respective timing ability than all mutual funds (All), superior performing synthetic funds (Ssy) or all synthetic funds (Asy).

Table 6-13: Proportion tests of fund manager timing skills: Equity Aggressive Growth funds

This table reports the results of proportion tests on monthly return data of 150 Equity Aggressive Growth funds from Jan. 1993 to Dec. 2006. Panel A refers to market timing, panel B size timing, panel C growth timing, and panel D momentum timing abilities respectively. The proportion tests examine whether superior performing funds (Sup) have a higher proportion of demonstrating the respective timing ability than all mutual funds (All), superior performing synthetic funds (Ssy), or all synthetic funds (Asy). Column 1 reports the test setting of sub-period length (years) and minimum observation number (months). Column 2 shows the style timing model used to measure timing ability, i.e. the Carhart (1997) four-factor Treynor and Mazuy (1966) style timing model (CTM) or the Carhart (1997) four-factor Henriksson and Merton (1981) style timing model (CHM). Columns 3 to 6 report the proportion of demonstrating the respective timing abilities for Sup, All, Ssy, and Asy. The following three columns report the p-values and significance of the permutation tests of the three hypotheses relating to the proportion of Sup ≤ the proportions of All, Ssy, or Asy respectively. The last column (Sig) summarizes the results of these permutation tests by reporting the minimum significance level of superior performing growth-oriented funds (Sup) having a higher proportion of demonstrating the respective timing ability than the other three fund groups.

Setting	Model	Sup (%)	All (%)	Ssy (%)	Asy (%)	Sup ≤ All	Sup ≤ Ssy	Sup ≤ Asy	Sig
Panel A: Market Timing									
(3, 36)	CTM	2.11	5.15	1.05	1.54	0.990	0.346	0.377	
	CHM	2.63	5.87	0.53	1.24	0.992	0.100*	0.090	*
(5, 36)	CTM	3.85	6.66	0.43	1.23	0.979	0.008***	0.006	***
	CHM	3.85	4.92	0.43	0.51	0.828	0.009***	0.000	***
(5, 60)	CTM	1.73	4.51	0.58	0.72	0.989	0.316	0.181	
	CHM	1.16	3.18	0.58	0.10	0.981	0.500	0.038	**
(9, 36)	CTM	1.27	4.28	0.00	0.80	0.996	0.132	0.363	
	CHM	2.12	4.68	0.00	0.40	0.986	0.032**	0.009	***
(9, 60)	CTM	1.66	2.94	0.00	0.67	0.909	0.119	0.172	
	CHM	2.21	3.21	0.00	0.27	0.847	0.066*	0.009	***
(9, 108)	CTM	0.00	0.80	0.00	0.00	1.000	0.500	0.500	
	CHM	0.00	1.07	0.00	0.13	1.000	0.500	0.500	

***, **, and * represent significance levels of 0.01, 0.05, and 0.1 respectively.

Table 6-13: Proportion tests of fund manager timing skills: Equity Aggressive Growth funds – continued

Setting	Model	Sup (%)	All (%)	Ssy (%)	Asy (%)	Sup ≤ All	Sup ≤ Ssy	Sup ≤ Asy	Sig
Panel B: Size Timing									
(3, 36)	CTM	4.21	3.50	11.58	6.08	0.377	0.996	0.801	
	CHM	2.11	1.44	3.16	2.57	0.296	0.627	0.603	
(5, 36)	CTM	5.13	4.51	11.97	9.73	0.376	0.992	0.988	
	CHM	3.42	1.74	2.56	2.66	0.054*	0.392	0.326	
(5, 60)	CTM	5.78	3.48	13.87	7.58	0.069*	0.993	0.780	
	CHM	4.05	1.43	2.31	1.84	0.014**	0.272	0.047**	
(9, 36)	CTM	4.66	6.15	12.71	17.78	0.863	0.998	1.000	
	CHM	1.69	2.81	2.54	5.35	0.917	0.625	0.992	
(9, 60)	CTM	4.42	5.08	11.60	13.64	0.714	0.987	1.000	
	CHM	2.21	2.41	2.76	3.61	0.640	0.500	0.820	
(9, 108)	CTM	3.08	1.47	15.38	7.09	0.239	0.984	0.857	
	CHM	1.54	1.07	6.15	1.60	0.509	0.830	0.500	
Panel C: Growth timing									
(3, 36)	CTM	11.05	5.77	3.68	2.78	0.006***	0.008***	0.000***	***
	CHM	8.42	4.43	4.74	2.47	0.013**	0.102	0.000***	
(5, 36)	CTM	18.38	9.12	4.27	3.79	0.000***	0.000***	0.000***	***
	CHM	11.11	5.53	3.42	2.66	0.000***	0.001***	0.000***	***
(5, 60)	CTM	20.23	7.79	4.62	2.66	0.000***	0.000***	0.000***	***
	CHM	10.98	4.30	2.89	1.74	0.000***	0.003***	0.000***	***
(9, 36)	CTM	18.22	12.17	2.54	5.48	0.005***	0.000***	0.000***	***
	CHM	15.25	11.10	1.27	3.07	0.032**	0.000***	0.000***	**
(9, 60)	CTM	20.44	9.89	3.31	4.01	0.000***	0.000***	0.000***	***
	CHM	17.68	8.96	1.66	1.87	0.000***	0.000***	0.000***	***
(9, 108)	CTM	32.31	4.68	3.08	1.74	0.000***	0.000***	0.000***	***
	CHM	24.62	4.01	1.54	0.67	0.000***	0.000***	0.000***	***
Panel D: Momentum timing									
(3, 36)	CTM	0.53	1.34	9.47	5.87	0.917	1.000	0.999	
	CHM	0.00	1.03	7.89	5.25	1.000	1.000	0.999	
(5, 36)	CTM	1.28	1.23	9.40	5.12	0.552	1.000	0.995	
	CHM	0.00	0.51	6.84	4.61	1.000	1.000	1.000	
(5, 60)	CTM	1.16	0.61	8.09	3.59	0.264	0.999	0.955	
	CHM	0.00	0.31	6.36	2.87	1.000	1.000	0.984	
(9, 36)	CTM	1.69	1.60	8.90	4.68	0.501	1.000	0.969	
	CHM	0.00	0.80	8.05	4.14	1.000	1.000	1.000	
(9, 60)	CTM	2.21	1.20	9.94	3.61	0.178	0.999	0.805	
	CHM	0.00	0.53	8.84	3.21	1.000	1.000	0.991	
(9, 108)	CTM	0.00	0.13	9.23	0.94	1.000	0.989	0.674	
	CHM	0.00	0.00	6.15	0.53	1.000	0.941	0.500	

***, **, and * represent significance levels of 0.01, 0.05, and 0.1 respectively.

Table 6-14: Proportion tests of fund manager timing skills: Equity Growth funds

This table reports the results of proportion tests on monthly return data of 1,956 Equity Growth funds from Jan. 1993 to Dec. 2006. Panel A refers to market timing, panel B size timing, panel C growth timing, and panel D momentum timing abilities respectively. The proportion tests examine whether superior performing funds (Sup) have a higher proportion of demonstrating the respective timing ability than all mutual funds (All), superior performing synthetic funds (Ssy), or all synthetic funds (Asy). Column 1 reports the test setting of sub-period length (years) and minimum observation number (months). Column 2 shows the style timing model used to measure timing ability, i.e. the Carhart (1997) four-factor Treynor and Mazuy (1966) style timing model (CTM) or the Carhart (1997) four-factor Henriksson and Merton (1981) style timing model (CHM). Columns 3 to 6 report the proportion of demonstrating the respective timing abilities for Sup, All, Ssy, and Asy. The following three columns report the p-values and significance of the permutation tests of the three hypotheses relating to the proportion of Sup ≤ the proportions of All, Ssy, or Asy respectively. The last column (Sig) summarizes the results of these permutation tests by reporting the minimum significance level of superior performing growth-oriented funds (Sup) having a higher proportion of demonstrating the respective timing ability than the other three fund groups.

Setting	Model	Sup (%)	All (%)	Ssy (%)	Asy (%)	Sup ≤ All	Sup ≤ Ssy	Sup ≤ Asy	Sig
Panel A: Market Timing									
(3, 36)	CTM	1.96	5.07	2.04	2.31	1.000	0.500	0.757	
	CHM	2.35	4.64	1.49	2.46	1.000	0.081*	0.569	
(5, 36)	CTM	1.82	3.29	0.82	1.70	0.999	0.012**	0.381	
	CHM	1.32	2.53	1.07	1.86	1.000	0.325	0.934	
(5, 60)	CTM	1.64	2.37	0.90	1.32	0.973	0.062*	0.214	
	CHM	1.39	1.90	1.31	1.36	0.923	0.500	0.500	
(9, 36)	CTM	0.75	2.15	0.45	0.90	1.000	0.230	0.664	
	CHM	0.98	2.16	0.83	1.00	1.000	0.430	0.500	
(9, 60)	CTM	0.46	1.60	0.46	0.70	1.000	0.500	0.790	
	CHM	0.83	1.67	0.92	0.77	0.996	0.500	0.433	
(9, 108)	CTM	0.17	0.70	0.51	0.29	0.989	0.683	0.643	
	CHM	0.34	0.79	1.01	0.31	0.939	0.872	0.500	

***, **, and * represent significance levels of 0.01, 0.05, and 0.1 respectively.

Table 6-14: Proportion tests of fund manager timing skills: Equity Growth funds – continued

Setting	Model	Sup (%)	All (%)	Ssy (%)	Asy (%)	Sup ≤ All	Sup ≤ Ssy	Sup ≤ Asy	Sig
Panel B: Size Timing									
(3, 36)	CTM	2.98	4.59	5.73	4.31	1.000	1.000	0.991	
	CHM	2.75	4.00	3.06	2.73	0.993	0.626	0.500	
(5, 36)	CTM	3.32	5.31	6.02	5.19	1.000	1.000	1.000	
	CHM	3.07	3.91	2.51	2.19	0.970	0.192	0.017**	
(5, 60)	CTM	3.19	3.74	6.14	3.78	0.860	1.000	0.837	
	CHM	3.44	2.88	2.37	1.58	0.123	0.072*	0.000***	
(9, 36)	CTM	4.74	6.71	8.43	8.16	0.999	1.000	1.000	
	CHM	2.03	4.37	2.56	3.06	1.000	0.790	0.981	
(9, 60)	CTM	4.78	5.15	9.10	6.73	0.756	1.000	0.993	
	CHM	1.65	3.30	2.85	2.50	1.000	0.961	0.949	
(9, 108)	CTM	6.08	2.62	9.97	3.61	0.000***	0.989	0.003***	
	CHM	1.86	1.69	3.55	1.32	0.416	0.946	0.180	
Panel C: Growth timing									
(3, 36)	CTM	10.75	6.19	4.78	3.92	0.000***	0.000***	0.000***	***
	CHM	8.71	6.27	4.63	3.60	0.000***	0.000***	0.000***	***
(5, 36)	CTM	17.38	10.26	7.03	6.65	0.000***	0.000***	0.000***	***
	CHM	10.73	7.26	5.96	5.16	0.000***	0.000***	0.000***	***
(5, 60)	CTM	17.35	7.72	7.36	4.82	0.000***	0.000***	0.000***	***
	CHM	10.72	5.54	6.14	3.66	0.000***	0.000***	0.000***	***
(9, 36)	CTM	22.67	13.56	9.86	9.39	0.000***	0.000***	0.000***	***
	CHM	17.55	9.14	8.58	7.59	0.000***	0.000***	0.000***	***
(9, 60)	CTM	21.97	10.92	9.47	7.17	0.000***	0.000***	0.000***	***
	CHM	17.10	7.34	8.73	5.90	0.000***	0.000***	0.000***	***
(9, 108)	CTM	21.62	5.72	7.43	3.53	0.000***	0.000***	0.000***	***
	CHM	15.88	3.66	7.26	3.07	0.000***	0.000***	0.000***	***
Panel D: Momentum timing									
(3, 36)	CTM	2.35	2.11	6.27	4.22	0.284	1.000	1.000	
	CHM	2.35	1.61	6.82	3.81	0.020**	1.000	0.997	
(5, 36)	CTM	2.13	3.08	6.78	4.34	0.992	1.000	1.000	
	CHM	1.38	1.72	7.03	4.14	0.889	1.000	1.000	
(5, 60)	CTM	1.80	2.31	6.96	3.10	0.901	1.000	0.992	
	CHM	1.15	1.24	7.28	3.10	0.626	1.000	1.000	
(9, 36)	CTM	1.81	4.96	3.99	4.72	1.000	1.000	1.000	
	CHM	0.83	2.10	4.89	4.10	1.000	1.000	1.000	
(9, 60)	CTM	1.47	3.97	4.32	3.80	1.000	1.000	1.000	
	CHM	0.55	1.73	5.06	3.25	1.000	1.000	1.000	
(9, 108)	CTM	0.84	1.82	3.89	1.64	0.983	1.000	0.928	
	CHM	0.51	0.86	4.56	1.47	0.890	1.000	0.963	

***, **, and * represent significance levels of 0.01, 0.05, and 0.1 respectively.

Table 6-15: Proportion tests of fund manager timing skills: Equity Growth-and-Income funds

This table reports the results of proportion tests on monthly return data of 856 Equity Growth-and-Income funds from Jan. 1993 to Dec. 2006. Panel A refers to market timing, panel B size timing, panel C growth timing, and panel D momentum timing abilities respectively. The proportion tests examine whether superior performing funds (Sup) have a higher proportion of demonstrating the respective timing ability than all mutual funds (All), superior performing synthetic funds (Ssy), or all synthetic funds (Asy). Column 1 reports the test setting of sub-period length (years) and minimum observation number (months). Column 2 shows the style timing model used to measure timing ability, i.e. the Carhart (1997) four-factor Treynor and Mazuy (1966) style timing model (CTM) or the Carhart (1997) four-factor Henriksson and Merton (1981) style timing model (CHM). Columns 3 to 6 report the proportion of demonstrating the respective timing abilities for Sup, All, Ssy, and Asy. The following three columns report the p-values and significance of the permutation tests of the three hypotheses relating to the proportion of Sup ≤ the proportions of All, Ssy, or Asy respectively. The last column (Sig) summarizes the results of these permutation tests by reporting the minimum significance level of superior performing growth-oriented funds (Sup) having a higher proportion of demonstrating the respective timing ability than the other three fund groups.

Setting	Model	Sup (%)	All (%)	Ssy (%)	Asy (%)	Sup ≤ All	Sup ≤ Ssy	Sup ≤ Asy	Sig
Panel A: Market Timing									
(3, 36)	CTM	0.87	2.57	1.09	2.31	0.998	0.500	0.978	
	CHM	0.87	2.35	1.09	2.67	0.994	0.500	0.991	
(5, 36)	CTM	0.00	1.55	0.63	1.96	1.000	0.875	0.999	
	CHM	0.00	1.23	1.05	2.70	1.000	0.970	1.000	
(5, 60)	CTM	0.00	1.36	0.26	1.34	1.000	0.500	0.987	
	CHM	0.00	0.94	0.77	2.09	1.000	0.867	0.998	
(9, 36)	CTM	0.00	0.30	0.30	0.45	1.000	0.500	0.801	
	CHM	0.00	0.37	1.51	0.92	1.000	0.972	0.952	
(9, 60)	CTM	0.00	0.27	0.37	0.40	1.000	0.500	0.787	
	CHM	0.00	0.35	1.11	0.70	1.000	0.865	0.884	
(9, 108)	CTM	0.00	0.10	0.00	0.15	1.000	0.500	0.500	
	CHM	0.00	0.20	0.60	0.22	1.000	0.500	0.500	

***, **, and * represent significance levels of 0.01, 0.05, and 0.1 respectively.

Table 6-15: Proportion tests of fund manager timing skills: Equity Growth-and-Income funds – continued

Setting	Model	Sup (%)	All (%)	Ssy (%)	Asy (%)	Sup ≤ All	Sup ≤ Ssy	Sup ≤ Asy	Sig
Panel B: Size Timing									
(3, 36)	CTM	3.05	4.98	4.58	3.97	0.986	0.843	0.807	
	CHM	2.61	5.53	2.61	2.71	0.998	0.500	0.500	
(5, 36)	CTM	3.99	3.87	5.67	3.41	0.449	0.863	0.261	
	CHM	3.78	3.76	2.52	2.28	0.514	0.174	0.025**	
(5, 60)	CTM	4.38	3.16	5.41	2.59	0.109	0.695	0.024**	
	CHM	3.61	3.11	2.58	1.67	0.330	0.269	0.007***	
(9, 36)	CTM	2.71	3.36	4.52	4.45	0.766	0.843	0.926	
	CHM	2.41	3.21	1.51	2.29	0.841	0.287	0.500	
(9, 60)	CTM	2.59	2.81	4.07	3.75	0.659	0.764	0.811	
	CHM	2.22	2.71	1.11	1.89	0.768	0.248	0.416	
(9, 108)	CTM	1.80	1.62	2.99	2.29	0.488	0.648	0.593	
	CHM	1.20	1.52	0.00	0.97	0.732	0.246	0.500	
Panel C: Growth timing									
(3, 36)	CTM	8.50	7.57	5.01	4.54	0.261	0.026**	0.000***	
	CHM	8.06	6.53	3.27	3.88	0.113	0.001***	0.000***	
(5, 36)	CTM	14.92	11.56	10.08	8.97	0.017**	0.019**	0.000***	**
	CHM	11.97	7.53	6.51	6.06	0.001***	0.001***	0.000***	***
(5, 60)	CTM	14.95	9.18	9.28	7.09	0.001***	0.011**	0.000***	**
	CHM	12.37	6.29	6.19	4.87	0.000***	0.005***	0.000***	***
(9, 36)	CTM	24.10	11.59	14.76	11.41	0.000***	0.001***	0.000***	***
	CHM	16.57	6.91	12.35	7.73	0.000***	0.076*	0.000***	*
(9, 60)	CTM	23.70	9.70	15.56	9.75	0.000***	0.014**	0.000***	**
	CHM	17.41	5.79	12.59	6.51	0.000***	0.068*	0.000***	*
(9, 108)	CTM	20.36	5.94	14.37	6.19	0.000***	0.093*	0.000***	*
	CHM	14.97	3.38	11.38	4.10	0.000***	0.207	0.000***	
Panel D: Momentum timing									
(3, 36)	CTM	3.49	3.77	4.58	4.60	0.656	0.744	0.844	
	CHM	0.65	2.35	5.45	4.03	0.996	1.000	1.000	
(5, 36)	CTM	3.15	6.10	6.09	4.85	0.998	0.977	0.947	
	CHM	2.10	3.11	7.77	4.95	0.916	1.000	0.996	
(5, 60)	CTM	3.61	5.04	6.70	3.89	0.930	0.962	0.599	
	CHM	2.58	2.55	8.51	3.93	0.547	1.000	0.901	
(9, 36)	CTM	4.52	11.44	5.42	6.84	1.000	0.631	0.951	
	CHM	2.41	5.69	5.42	4.80	1.000	0.964	0.977	
(9, 60)	CTM	4.44	9.60	6.30	5.69	1.000	0.785	0.774	
	CHM	2.22	4.65	6.30	4.00	0.990	0.988	0.937	
(9, 108)	CTM	4.79	5.20	8.98	3.33	0.677	0.916	0.194	
	CHM	1.20	2.31	8.98	2.31	0.896	1.000	0.786	

***, **, and * represent significance levels of 0.01, 0.05, and 0.1 respectively.

Table 6-16: Proportion tests of fund manager timing skills: Equity Income-and-Growth funds

This table reports the results of proportion tests on monthly return data of 219 Equity Income-and-Growth funds from Jan. 1993 to Dec. 2006. Panel A refers to market timing, panel B size timing, panel C growth timing, and panel D momentum timing abilities respectively. The proportion tests examine whether superior performing funds (Sup) have a higher proportion of demonstrating the respective timing ability than all mutual funds (All), superior performing synthetic funds (Ssy), or all synthetic funds (Asy). Column 1 reports the test setting of sub-period length (years) and minimum observation number (months). Column 2 shows the style timing model used to measure timing ability, i.e. the Carhart (1997) four-factor Treynor and Mazuy (1966) style timing model (CTM) or the Carhart (1997) four-factor Henriksson and Merton (1981) style timing model (CHM). Columns 3 to 6 report the proportion of demonstrating the respective timing abilities for Sup, All, Ssy, and Asy. The following three columns report the p-values and significance of the permutation tests of the three hypotheses relating to the proportion of Sup ≤ the proportions of All, Ssy, or Asy respectively. The last column (Sig) summarizes the results of these permutation tests by reporting the minimum significance level of superior performing growth-oriented funds (Sup) having a higher proportion of demonstrating the respective timing ability than the other three fund groups.

Setting	Model	Sup (%)	All (%)	Ssy (%)	Asy (%)	Sup ≤ All	Sup ≤ Ssy	Sup ≤ Asy	Sig
Panel A: Market Timing									
(3, 36)	CTM	2.44	2.92	1.22	3.22	0.682	0.500	0.617	
	CHM	2.44	2.32	2.44	3.00	0.574	0.500	0.500	
(5, 36)	CTM	1.11	4.02	1.11	2.40	0.970	0.500	0.743	
	CHM	1.11	2.32	3.33	2.86	0.865	0.698	0.733	
(5, 60)	CTM	1.35	3.55	1.35	1.93	0.921	0.500	0.500	
	CHM	1.35	1.93	4.05	2.32	0.738	0.699	0.643	
(9, 36)	CTM	0.00	1.26	0.00	0.63	1.000	0.500	0.500	
	CHM	0.00	0.94	0.00	0.63	1.000	0.500	0.500	
(9, 60)	CTM	0.00	1.05	0.00	0.63	1.000	0.500	0.500	
	CHM	0.00	0.73	0.00	0.63	1.000	0.500	0.500	
(9, 108)	CTM	0.00	0.63	0.00	0.42	1.000	0.500	0.500	
	CHM	0.00	0.31	0.00	0.42	1.000	0.500	0.500	

***, **, and * represent significance levels of 0.01, 0.05, and 0.1 respectively.

Table 6-16: Proportion tests of fund manager timing skills: Equity Income-and-Growth funds – continued

Setting	Model	Sup (%)	All (%)	Ssy (%)	Asy (%)	Sup ≤ All	Sup ≤ Ssy	Sup ≤ Asy	Sig
Panel B: Size Timing									
(3, 36)	CTM	10.98	6.97	2.44	3.30	0.126	0.027**	0.002***	
	CHM	7.32	7.34	2.44	3.22	0.560	0.134	0.034**	
(5, 36)	CTM	13.33	4.02	3.33	3.01	0.000***	0.014**	0.000***	**
	CHM	10.00	3.09	3.33	2.01	0.002***	0.063*	0.000***	*
(5, 60)	CTM	12.16	2.78	1.35	2.32	0.000***	0.011**	0.000***	**
	CHM	9.46	2.24	1.35	1.55	0.001***	0.030**	0.002***	**
(9, 36)	CTM	11.86	6.60	5.08	4.30	0.087*	0.174	0.010***	
	CHM	10.17	3.56	3.39	2.62	0.015**	0.129	0.005***	
(9, 60)	CTM	13.21	5.24	5.66	3.77	0.024**	0.163	0.002***	
	CHM	11.32	2.62	3.77	2.41	0.003***	0.132	0.000***	
(9, 108)	CTM	14.00	3.67	6.00	2.94	0.001***	0.164	0.001***	
	CHM	12.00	1.78	4.00	1.78	0.000***	0.129	0.001***	
Panel C: Growth timing									
(3, 36)	CTM	7.32	2.85	7.32	4.72	0.028**	0.500	0.139	
	CHM	9.76	2.47	8.54	4.27	0.001***	0.500	0.021**	
(5, 36)	CTM	6.67	4.02	13.33	8.73	0.168	0.890	0.726	
	CHM	4.44	2.24	10.00	4.95	0.147	0.873	0.500	
(5, 60)	CTM	6.76	3.32	12.16	7.11	0.102	0.777	0.500	
	CHM	4.05	1.85	12.16	4.40	0.140	0.929	0.500	
(9, 36)	CTM	0.00	0.94	8.47	10.69	1.000	0.965	0.995	
	CHM	0.00	0.84	0.00	5.97	1.000	0.500	0.965	
(9, 60)	CTM	0.00	0.52	9.43	9.22	1.000	0.972	0.993	
	CHM	0.00	0.42	0.00	5.14	1.000	0.500	0.946	
(9, 108)	CTM	0.00	0.21	10.00	5.45	1.000	0.966	0.955	
	CHM	0.00	0.10	0.00	2.94	1.000	0.500	0.807	
Panel D: Momentum timing									
(3, 36)	CTM	4.88	3.82	4.88	4.42	0.358	0.500	0.500	
	CHM	0.00	1.05	7.32	3.45	1.000	0.987	0.952	
(5, 36)	CTM	4.44	3.55	7.78	5.80	0.417	0.737	0.682	
	CHM	0.00	2.24	6.67	4.95	1.000	0.983	0.987	
(5, 60)	CTM	4.05	2.86	9.46	4.64	0.345	0.835	0.500	
	CHM	0.00	1.55	8.11	4.02	1.000	0.983	0.942	
(9, 36)	CTM	6.78	11.22	16.95	11.22	0.904	0.922	0.805	
	CHM	0.00	5.14	10.17	7.34	1.000	0.986	0.985	
(9, 60)	CTM	7.55	9.85	16.98	9.96	0.787	0.887	0.683	
	CHM	0.00	4.82	9.43	6.39	1.000	0.970	0.972	
(9, 108)	CTM	8.00	7.13	14.00	6.08	0.480	0.733	0.367	
	CHM	0.00	2.73	6.00	3.35	1.000	0.881	0.863	

***, **, and * represent significance levels of 0.01, 0.05, and 0.1 respectively.

Among Equity Aggressive Growth, Equity Growth and Equity Growth-and-Income funds, superior performing fund managers demonstrate significant growth timing ability but no market timing, size timing or momentum timing ability. As shown in Table 6-13, the last column of panel C shows that superior performing Equity Aggressive Growth fund managers possess significant growth timing skill under all test settings based on CTM and CHM, except for the test setting (3, 36) based on CHM. This is strong evidence for the existence of growth timing skill among superior performing Equity Aggressive Growth fund managers. However, as shown in the last columns of panels A, B and D of Table 6-13, there is no significant evidence that superior performing Equity Aggressive Growth fund managers demonstrate superior market timing, size timing or momentum timing ability. The last column of Table 6-14 and 6-15 reports a similar result for Equity Growth funds and Equity Growth-and-Income funds respectively.

The proportion of demonstrating growth timing is much greater than the proportion of demonstrating market timing, size timing and momentum timing for superior performing Equity Aggressive Growth, Equity Growth and Equity Growth-and-Income fund managers. As shown in panel C, column 3 of Table 6-13, superior performing Equity Aggressive Growth fund managers exhibit an 8–33% proportion of demonstrating growth timing ability. However, panels A, B and D, column 3 of Table 6-13 show that superior performing Equity Aggressive Growth fund managers have only a 0–4%, 1–6% and 0–3% proportion of demonstrating market timing, size timing and momentum timing abilities respectively. Similarly, as shown in panels A to D, column 3 of Table 6-14, the proportions of demonstrating growth timing ability (8-23%) are obviously greater than those of demonstrating market timing (0–3%), size timing (1–5%) and momentum timing (0–3%) abilities for superior performing Equity Growth fund managers. Concerning superior performing Equity Growth-and-Income fund managers, column 3 of Table 6-15 exhibits a similar phenomenon.

Unlike the other three fund groups, superior performing Equity Income-and-Growth fund managers do not demonstrate growth timing skills but do show a little size timing ability. As shown in the last columns of panels A, C and D of Table 6-13, there is no significant evidence that superior performing Equity Aggressive Growth fund managers possess market timing, growth timing or momentum timing skill. However, the last column of panel B of Table 6-13 shows that superior performing Equity Income-and-Growth fund managers significantly possess growth timing skill under the test settings (5, 36) and (5, 60). Although $H9b_0$ (the null hypothesis for size timing) is not significantly rejected in the other test settings, column 3 of panel B shows that superior performing Equity Income-and-Growth fund managers have a 7–14% proportion of demonstrating size timing ability, higher than that of all Equity Income-and-Growth fund managers (1–8%), all the corresponding synthetic fund managers (1–5%) and superior performing synthetic fund managers (1–7%), reported in columns 4-6.

6.3. Different Investment Styles

According to Standard & Poor's (S&P) Returns-Based Style Analysis, sample funds can be classified into three fund groups with different styles: Growth funds (1,470), Blend funds (428) and Value funds (1,283). In this section, the Standard & Poor's (S&P) Returns-Based Style Analysis is first introduced. The three fund groups are then examined separately and tested to see what skill each possesses.

6.3.1. Standard & Poor's Returns-Based Style Analysis

Standard & Poor's uses the returns-based style analysis of Sharpe (1992) to compare the historical performance of each fund with a series of index benchmarks to determine which benchmark (or combination of benchmarks) most closely describes the fund's actual returns. Sharpe’s (1992) style analysis model can be expressed as:

$$
\begin{aligned}
& r_t = \left[\delta_1 X_{1t} + \delta_2 X_{2t} + \ldots + \delta_n X_{nt}\right] + \varepsilon_t \\
& \quad \delta_j \geq 0 \ \forall j \in \{1,2,\ldots,n\} \\
& \quad \sum_{j=1}^{n} \delta_j = 1
\end{aligned}
\tag{6.1}
$$

where r_t represents the managed portfolio return at time t and $X_{1t}, X_{2t}, \ldots, X_{nt}$ are the returns on style benchmark index portfolios. The slope coefficients $\delta_1, \delta_2, \ldots, \delta_n$ represent the managed portfolio average allocation among the different style benchmark index portfolios – or asset classes during the relevant time period. ε_t is the residual component of the portfolio return. The objective of the analysis is to select a set of coefficients that minimizes the variation of ε_t subject to the stated constraints. The presence of inequality constraints requires the use of quadratic programming. It is important to understand that the “style” identified in such an analysis represents an average combination of style benchmarks over the period covered.

Standard & Poor's (S&P) Returns-Based Style Analysis classifies each domestic equity mutual fund into one of 11 investment styles: Large-Cap Growth, Large-Cap Blend, Large-Cap Value, Mid-Cap Growth, Mid-Cap Blend, Mid-Cap Value, Small-Cap Growth, Small-Cap Blend, Small-Cap Value, All-Cap Growth and All-Cap Value. Figure 6-1 lists the style benchmark indices for each investment style. Specifically, the 11 investment styles are the cross combination of four sizes and three styles. The four sizes are Large-Cap, Mid-Cap, Small-Cap and All-Cap, whose benchmark indices are S&P 500, S&P MidCap 400, S&P SmallCap 600 and S&P Composite 1500 respectively. For each benchmark index, S&P further classifies the stocks that compose the index into one of three styles: Growth, Blend and Value.

Figure 6-1: Equity mutual fund classification of Standard & Poor's Returns-Based Style Analysis

	Growth	Blend	Value
Large-Cap	S&P 500/ Citigroup Value	S&P 500	S&P 500/ Citigroup Growth
Mid-Cap	S&P Mid-Cap 400/ Citigroup Value	S&P Mid-Cap 400	S&P Mid-Cap 400/ Citigroup Growth
Small-Cap	S&P Small-Cap 600/ Citigroup Value	S&P Small-Cap 600	S&P Small-Cap 600/ Citigroup Growth
All-Cap	S&P Composite 1500/ Citigroup Value		S&P Composite 1500/ Citigroup Growth

The S&P 500 is widely regarded as the best single gauge of the US equity market. The index includes a representative sample of 500 leading companies in leading industries of the US economy. Although the S&P 500 focuses on the large-cap segment of the market, with about 75% coverage of US equities, it is also an ideal proxy for the total market. The S&P MidCap 400 covers approximately 7% of the US equities market value and demonstrates considerably different risk/reward profiles from both large-cap and small-cap. The S&P SmallCap 600 covers approximately 3% of the US equities market value. The S&P Composite 1500 combines the S&P 500, S&P MidCap 400 and S&P SmallCap 600 indices and represents about 85% of US equities. This combination addresses the needs of investors wanting broader exposure beyond the S&P 500.

Standard & Poor's defines growth stocks as stocks with high 5-year earnings per share growth rate, high 5-year sales per share growth rate and a high 5-year internal growth rate (= ROE x Earnings Retention Rate), and defines value stocks as those with a high book value to price ratio, a high cash flow to price ratio, a high sales to price ratio and a high dividend yield. Blend stocks lie between growth and value stocks.[40]

6.3.2. Statistics of performance and timing coefficients

Tables 6-17 to 6-19 report the fractions and means of the intercept and coefficients of Carhart's (1997) four-factor model of Growth funds, Blend funds and Value funds.

[See APPENDIX for Tables 6-17 to 6-19]

[40] For more details, see "Standard & Poor's: S&P U.S. Style Indices", http://www2.standardandpoors.com/spf/pdf/index/SP_US_Style_Indices_Methodology_Web.pdf

Growth funds demonstrate the highest proportion of earning (significantly) positive abnormal returns, whereas Value funds have the lowest proportion. As shown in panel A of Table 6-17, the fractions of Growth fund instances with (significantly) positive intercepts are between 32–40% (12–21%). Concerning Blend Growth, Panel A of Table 6-18 shows that the fractions of fund instances with (significantly) positive intercepts are between 26–31% (10–15%). However, the fractions of Value fund instances lie between 13–29% (4–10%) in Panel A of Table 6-19.

The RMRF coefficients reflect funds' high market exposure. Panel B of Tables 6-17 to 6-19 shows that over 99% of the RMRF coefficients are significantly positive, with a mean of around 1, i.e. between 0.950 and 1.007. This suggests that most of the funds in each fund group invest primarily in the stock market. This just reflects funds' high market exposure, which, as described in Section 4.3, is over 90% on average but exhibits less than 5% standard deviation.

The SMB coefficients imply that all three fund groups invest primarily in large companies. As shown in panel C of Table 6-19, 72–81% (31–47%) of SMB coefficients are (significantly) negative. In other words, Value funds are likely to have higher exposure to large companies than to small companies. Similarly, Panel C of Table 6-18 reports that the fractions of Blend fund instances with (significantly) negative SMB coefficients are between 72% (43%) and 84% (67%). As shown in panel C of Table 6-17, the fractions of Growth fund instances with (significantly) negative SMB coefficients are usually larger than the fractions of Growth fund instances with (significantly) positive SMB coefficients. That is, both Blend and

Growth funds also tend to hold large-capitalization stocks. In fact, these statistics are consistent with the fact that, using the S&P Returns-Based Style Analysis, over 90% of growth-oriented funds in my sample invest primarily in large capitalization companies.

The HML coefficients of Growth, Blend and Value funds reflect the characteristic of these three fund groups. As shown in panel D of Table 6-17, 80–83% (48–63%) of Growth fund instances exhibit a (significantly) negative HML coefficient, but only 17–20% (3–8%) of them are (significantly) positive. Conversely, panel D of Table 6-19 shows that over 93% (66%) of Value fund instances have (significantly) positive HML coefficients. These reflect the fact that Growth funds have higher exposure to stocks with low book-to-market ratios, i.e. growth stocks, while Value funds invest primarily in stocks with high book-to-market ratios, i.e. value stocks. Concerning Blend funds, shown in panel D of Table 6-18, 58–75% (21–49%) of the fund instances demonstrate (significantly) positive HML coefficients, while 25–42% (8–11%) of them have (significantly) negative HML coefficients. That is, concerning the exposure to growth or value stocks, the statistics of Blend funds are between those of Growth funds and Value funds.

The MOM coefficients suggest that Growth funds tend to use contrarian investment, whereas Value funds tend to follow a momentum investing strategy. Panel E of Table 6-17 shows that 65–72% (7–19%) of Growth fund instances demonstrate (significantly) negative MOM coefficients, but only 28–35% (1–2%) of them have (significantly) positive MOM coefficients. This suggests that Growth fund managers apply a contrarian investing strategy more often than a momentum investing strategy.

Conversely, as shown in panel E of Table 6-19, 63–73% (4–7%) of Value fund instances exhibit (significantly) positive MOM coefficients, but only 27–37% (0–2%) of them have (significantly) negative MOM coefficients. Concerning Blend funds, 53–57% (3–8%) of their MOM coefficients, shown in panel E of Table 6-18, are (significantly) positive and 43–47% (2–4%) are (significantly) negative. That is, there is no obvious tendency toward a momentum or contrarian investing strategy.

Tables 6-20 to 6-22 report the fractions and means of the intercept and coefficients of the Carhart (1997) four-factor Treynor and Mazuy (1966) style timing model (CTM) of Growth funds, Blend funds and Value funds under six test settings respectively, while Tables 6-23 to 6-25 report the summary statistics for the Carhart (1997) four-factor Henriksson and Merton (1981) style timing model (CHM).

[See APPENDIX for Tables 6-20 to 6-25]

The timing parameters used in CTM and CHM explain a substantial part of the abnormal returns that cannot be explained by Carhart's (1997) four factors. The fractions of fund instances with significantly positive intercepts of CTM and CHM are smaller than those of Carhart's (1997) four-factor model. For example, concerning Growth funds, the fractions of significantly positive CTM intercepts range only from 1% to 4% in panel A of Table 6-20, while the fractions of significantly positive CHM intercepts are between 0% and 3% in panel A of Table 6-23. However, as shown in panel A of Table 6-17, 12–21% of Equity Aggressive Growth fund instances demonstrate significantly positive Carhart alphas. The other two fund groups, i.e. Blend and Value funds, also exhibit a similar phenomenon, i.e.

fewer fund instances demonstrate abnormal returns based on CTM or CHM than on Carhart's (1997) four-factor model.

Growth and Blend funds obviously have a higher proportion of demonstrating growth timing ability than Value funds. As shown in panel D of Tables 6-20 to 6-22, based on CTM, 6–22% of Growth fund instances and 10–21% of Blend fund instances demonstrate a significantly positive growth timing coefficient, i.e. growth timing ability. However, the fractions of Value funds are only between 4% and 10% and are all less than those of Growth and Blend funds. Similarly, the statistics of CHM growth timing coefficients reported in panel D of Tables 6-23 to 6-25 present the same trend. The fractions of Growth fund instances with positive growth timing coefficients range from 5% to 16%, and the fractions of Blend fund instances with positive growth timing coefficients lie between 8% and 12%. However, only 2–7% of Value fund instances are significantly positive.

Growth and Blend fund managers have a higher proportion of demonstrating successful growth timing ability than demonstrating successful market timing, size timing or momentum timing ability. For example, panels B and D of Table 6-20 show that Growth fund managers have a 0–6% proportion of demonstrating successful market timing activity, but have a 5–16% proportion of demonstrating successful growth timing activity. Similarly, the proportions of demonstrating size timing and momentum timing, shown in panels C and E, are less than the proportion of demonstrating growth timing in every test setting. This phenomenon also exists in Tables 6-21, 6-23 and 6-24. That is, it is more difficult to observe successful market timing, size timing or momentum timing activity than to observe successful growth timing activity in Growth and Blend fund instances.

From the long-term (nine-year) viewpoint, Value fund managers show a higher proportion of demonstrating successful momentum timing ability than the proportions of demonstrating successful market timing, size timing or growth timing ability. As shown in the last column of Table 6-22, 19.61% of Value fund instances have significantly positive momentum timing coefficients under the test setting of (9, 108). However, only 0.26%, 1.83% and 4.9% of Value fund instances exhibit significantly positive market timing, size timing and growth timing coefficients respectively. There is a similar phenomenon under the test settings of (9, 36) and (9, 60), shown in Table 6-22, and under the test settings with a nine-year sub-period length, shown in Table 6-25.

6.3.3. Timing skills of funds with different investment styles

This section investigates the timing ability that superior performing Growth, Blend and Value fund managers possess. Specifically, whether superior performing fund managers possess market timing, size timing, growth timing or momentum timing skill for each fund group is examined.

Proportion tests are carried out on Growth funds, Blend funds and Value funds from January 1993 to December 2006. The test results are reported in Tables 6-26 to 6-28.

Table 6-26: Proportion tests of fund manager timing skills: Growth funds

This table reports the results of proportion tests on monthly return data of 1,470 Growth funds from Jan. 1993 to Dec. 2006. Panel A refers to market timing, panel B size timing, panel C growth timing, and panel D momentum timing abilities respectively. The proportion tests examine whether superior performing funds (Sup) have a higher proportion of demonstrating the respective timing ability than all mutual funds (All), superior performing synthetic funds (Ssy), or all synthetic funds (Asy). Column 1 reports the test setting of sub-period length (years) and minimum observation number (months). Column 2 shows the style timing model used to measure timing ability, i.e. the Carhart (1997) four-factor Treynor and Mazuy (1966) style timing model (CTM) or the Carhart (1997) four-factor Henriksson and Merton (1981) style timing model (CHM). Columns 3 to 6 report the proportion of demonstrating the respective timing abilities for Sup, All, Ssy, and Asy. The following three columns report the p-values and significance of the permutation tests of the three hypotheses relating to the proportion of Sup ≤ the proportions of All, Ssy, or Asy respectively. The last column (Sig) summarizes the results of these permutation tests by reporting the minimum significance level of superior performing growth-oriented funds (Sup) having a higher proportion of demonstrating the respective timing ability than the other three fund groups.

Setting	Model	Sup (%)	All (%)	Ssy (%)	Asy (%)	Sup ≤ All	Sup ≤ Ssy	Sup ≤ Asy	Sig
Panel A: Market Timing									
(3, 36)	CTM	2.61	5.79	1.62	1.95	1.000	0.079*	0.071*	
	CHM	2.61	5.63	1.44	2.23	1.000	0.036**	0.241	
(5, 36)	CTM	2.03	4.29	0.98	1.58	1.000	0.018**	0.107	
	CHM	1.47	3.24	0.98	1.46	1.000	0.153	0.500	
(5, 60)	CTM	2.14	3.16	1.03	1.22	0.982	0.030**	0.010***	
	CHM	1.49	2.43	1.12	1.13	0.984	0.293	0.186	
(9, 36)	CTM	0.57	2.59	0.41	0.83	1.000	0.389	0.807	
	CHM	0.73	2.54	0.81	0.79	1.000	0.500	0.563	
(9, 60)	CTM	0.59	2.05	0.39	0.67	1.000	0.370	0.579	
	CHM	0.78	2.03	0.59	0.56	1.000	0.397	0.177	
(9, 108)	CTM	0.66	0.83	0.66	0.39	0.734	0.500	0.264	
	CHM	0.66	0.80	0.99	0.28	0.711	0.622	0.058*	

***, **, and * represent significance levels of 0.01, 0.05, and 0.1 respectively.

Table 6-26: Proportion tests of fund manager timing skills: Growth funds – continued

Setting	Model	Sup (%)	All (%)	Ssy (%)	Asy (%)	Sup ≤ All	Sup ≤ Ssy	Sup ≤ Asy	Sig
Panel B: Size Timing									
(3, 36)	CTM	3.61	4.41	8.48	4.96	0.923	1.000	0.974	
	CHM	2.98	3.34	4.06	2.43	0.785	0.883	0.155	
(5, 36)	CTM	3.77	5.31	9.01	6.69	0.997	1.000	1.000	
	CHM	2.80	3.55	2.94	2.39	0.956	0.551	0.198	
(5, 60)	CTM	3.82	3.81	8.39	4.98	0.500	1.000	0.948	
	CHM	2.89	2.63	2.80	1.68	0.316	0.500	0.003***	
(9, 36)	CTM	5.52	7.44	11.44	11.79	0.996	1.000	1.000	
	CHM	2.19	4.41	3.17	3.84	1.000	0.911	0.999	
(9, 60)	CTM	5.29	6.05	10.49	9.48	0.858	1.000	1.000	
	CHM	1.96	3.65	3.04	3.29	1.000	0.920	0.985	
(9, 108)	CTM	6.44	3.11	9.90	5.30	0.000***	0.985	0.129	
	CHM	2.31	1.93	3.14	1.70	0.293	0.753	0.173	
Panel C: Growth timing									
(3, 36)	CTM	12.35	6.04	4.87	3.83	0.000***	0.000***	0.000***	***
	CHM	10.10	5.85	3.70	3.44	0.000***	0.000***	0.000***	***
(5, 36)	CTM	19.71	9.96	6.71	6.29	0.000***	0.000***	0.000***	***
	CHM	12.37	7.04	5.17	5.06	0.000***	0.000***	0.000***	***
(5, 60)	CTM	19.85	7.59	7.18	4.77	0.000***	0.000***	0.000***	***
	CHM	12.40	5.36	5.22	3.83	0.000***	0.000***	0.000***	***
(9, 36)	CTM	23.05	14.44	8.77	8.91	0.000***	0.000***	0.000***	***
	CHM	18.91	9.86	7.87	7.67	0.000***	0.000***	0.000***	***
(9, 60)	CTM	22.75	11.62	8.63	7.18	0.000***	0.000***	0.000***	***
	CHM	18.82	8.02	8.33	6.21	0.000***	0.000***	0.000***	***
(9, 108)	CTM	24.42	6.01	9.08	3.40	0.000***	0.000***	0.000***	***
	CHM	18.98	4.03	9.08	3.16	0.000***	0.000***	0.000***	***
Panel D: Momentum timing									
(3, 36)	CTM	1.08	1.23	7.12	4.14	0.685	1.000	1.000	
	CHM	0.99	1.03	6.85	3.87	0.567	1.000	1.000	
(5, 36)	CTM	0.91	1.12	7.41	3.85	0.776	1.000	1.000	
	CHM	0.63	0.49	7.83	3.95	0.258	1.000	1.000	
(5, 60)	CTM	1.12	0.97	6.99	2.81	0.332	1.000	1.000	
	CHM	0.84	0.43	8.01	2.78	0.047**	1.000	1.000	
(9, 36)	CTM	0.49	1.18	4.14	3.02	0.998	1.000	1.000	
	CHM	0.00	0.31	5.28	3.00	1.000	1.000	1.000	
(9, 60)	CTM	0.39	0.91	4.22	2.37	0.989	1.000	1.000	
	CHM	0.00	0.22	5.39	2.41	1.000	1.000	1.000	
(9, 108)	CTM	0.33	0.32	3.80	0.94	0.566	1.000	0.919	
	CHM	0.00	0.06	4.62	1.07	1.000	1.000	0.990	

***, **, and * represent significance levels of 0.01, 0.05, and 0.1 respectively.

Table 6-27: Proportion tests of fund manager timing skills: Blend funds

This table reports the results of proportion tests on monthly return data of 428 Blend funds from Jan. 1993 to Dec. 2006. Panel A refers to market timing, panel B size timing, panel C growth timing, and panel D momentum timing abilities respectively. The proportion tests examine whether superior performing funds (Sup) have a higher proportion of demonstrating the respective timing ability than all mutual funds (All), superior performing synthetic funds (Ssy), or all synthetic funds (Asy). Column 1 reports the test setting of sub-period length (years) and minimum observation number (months). Column 2 shows the style timing model used to measure timing ability, i.e. the Carhart (1997) four-factor Treynor and Mazuy (1966) style timing model (CTM) or the Carhart (1997) four-factor Henriksson and Merton (1981) style timing model (CHM). Columns 3 to 6 report the proportion of demonstrating the respective timing abilities for Sup, All, Ssy, and Asy. The following three columns report the p-values and significance of the permutation tests of the three hypotheses relating to the proportion of Sup ≤ the proportions of All, Ssy, or Asy respectively. The last column (Sig) summarizes the results of these permutation tests by reporting the minimum significance level of superior performing growth-oriented funds (Sup) having a higher proportion of demonstrating the respective timing ability than the other three fund groups.

Setting	Model	Sup (%)	All (%)	Ssy (%)	Asy (%)	Sup ≤ All	Sup ≤ Ssy	Sup ≤ Asy	Sig
Panel A: Market Timing									
(3, 36)	CTM	1.90	4.78	1.52	2.43	0.993	0.500	0.671	
	CHM	1.52	4.15	1.14	2.56	0.992	0.500	0.800	
(5, 36)	CTM	0.33	2.71	0.66	1.93	0.999	0.500	0.977	
	CHM	0.00	2.09	1.32	2.38	1.000	0.939	0.996	
(5, 60)	CTM	0.00	2.05	0.47	1.35	1.000	0.500	0.943	
	CHM	0.00	1.72	0.95	1.56	1.000	0.752	0.964	
(9, 36)	CTM	1.15	1.84	0.38	0.61	0.866	0.314	0.200	
	CHM	1.53	1.48	3.44	1.48	0.539	0.872	0.500	
(9, 60)	CTM	0.93	1.54	0.47	0.46	0.844	0.500	0.311	
	CHM	1.40	1.23	4.21	1.18	0.480	0.937	0.500	
(9, 108)	CTM	0.00	0.46	0.00	0.10	1.000	0.500	0.500	
	CHM	0.00	0.20	4.20	0.51	1.000	0.972	0.671	

***, **, and * represent significance levels of 0.01, 0.05, and 0.1 respectively.

Table 6-27: Proportion tests of fund manager timing skills: Blend funds – continued

Setting	Model	Sup (%)	All (%)	Ssy (%)	Asy (%)	Sup ≤ All	Sup ≤ Ssy	Sup ≤ Asy	Sig
Panel B: Size Timing									
(3, 36)	CTM	3.42	3.90	5.32	4.03	0.679	0.799	0.629	
	CHM	2.28	4.03	2.28	2.35	0.956	0.500	0.500	
(5, 36)	CTM	4.95	4.97	4.29	3.94	0.522	0.421	0.224	
	CHM	4.29	3.78	1.65	2.22	0.367	0.047**	0.017**	
(5, 60)	CTM	4.27	3.36	4.74	2.79	0.287	0.500	0.149	
	CHM	4.27	2.46	0.95	1.35	0.074*	0.031**	0.002***	*
(9, 36)	CTM	2.67	4.76	4.20	4.81	0.976	0.767	0.918	
	CHM	3.44	3.38	0.38	2.51	0.519	0.010***	0.210	
(9, 60)	CTM	2.80	3.74	4.21	3.94	0.799	0.717	0.750	
	CHM	2.80	2.66	0.47	1.95	0.509	0.072*	0.209	
(9, 108)	CTM	1.68	1.74	4.20	1.48	0.633	0.782	0.500	
	CHM	1.68	0.97	0.00	0.36	0.322	0.250	0.041**	
Panel C: Growth timing									
(3, 36)	CTM	7.60	9.52	6.84	5.62	0.889	0.442	0.098*	
	CHM	4.94	8.34	6.46	5.49	0.988	0.701	0.621	
(5, 36)	CTM	18.48	15.10	10.89	10.46	0.077*	0.005***	0.001***	*
	CHM	9.90	10.01	6.60	8.25	0.532	0.111	0.201	
(5, 60)	CTM	20.85	11.49	10.90	7.88	0.000***	0.005***	0.000***	***
	CHM	11.85	7.88	6.16	6.36	0.031**	0.025**	0.002***	**
(9, 36)	CTM	31.30	18.54	12.98	13.72	0.000***	0.000***	0.000***	***
	CHM	14.89	10.60	8.40	10.55	0.019**	0.016**	0.018**	**
(9, 60)	CTM	28.97	14.08	14.02	10.96	0.000***	0.000***	0.000***	***
	CHM	12.15	7.99	8.88	8.40	0.021**	0.163	0.030**	
(9, 108)	CTM	26.89	6.20	17.65	5.84	0.000***	0.061*	0.000***	*
	CHM	8.40	3.23	10.08	4.30	0.005***	0.589	0.024**	
Panel D: Momentum timing									
(3, 36)	CTM	3.42	3.73	5.70	3.65	0.656	0.857	0.565	
	CHM	2.66	2.43	7.22	3.82	0.481	0.990	0.821	
(5, 36)	CTM	0.99	3.94	5.61	3.82	1.000	0.998	0.994	
	CHM	0.99	1.52	7.59	4.39	0.836	1.000	0.998	
(5, 60)	CTM	1.42	3.24	6.16	2.71	0.958	0.993	0.818	
	CHM	0.95	1.19	9.00	3.45	0.707	1.000	0.962	
(9, 36)	CTM	1.91	3.64	4.96	2.87	0.953	0.943	0.786	
	CHM	1.15	1.48	4.96	2.87	0.740	0.988	0.926	
(9, 60)	CTM	2.34	2.76	4.67	2.15	0.716	0.872	0.500	
	CHM	1.40	1.13	5.14	2.30	0.409	0.977	0.775	
(9, 108)	CTM	3.36	1.38	5.88	1.13	0.075*	0.717	0.032**	
	CHM	1.68	0.46	6.72	1.13	0.104	0.945	0.331	

***, **, and * represent significance levels of 0.01, 0.05, and 0.1 respectively.

Table 6-28: Proportion tests of fund manager timing skills: Value funds

This table reports the results of proportion tests on monthly return data of 1,283 Value funds from Jan. 1993 to Dec. 2006. Panel A refers to market timing, panel B size timing, panel C growth timing, and panel D momentum timing abilities respectively. The proportion tests examine whether superior performing funds (Sup) have a higher proportion of demonstrating the respective timing ability than all mutual funds (All), superior performing synthetic funds (Ssy), or all synthetic funds (Asy). Column 1 reports the test setting of sub-period length (years) and minimum observation number (months). Column 2 shows the style timing model used to measure timing ability, i.e. the Carhart (1997) four-factor Treynor and Mazuy (1966) style timing model (CTM) or the Carhart (1997) four-factor Henriksson and Merton (1981) style timing model (CHM). Columns 3 to 6 report the proportion of demonstrating the respective timing abilities for Sup, All, Ssy, and Asy. The following three columns report the p-values and significance of the permutation tests of the three hypotheses relating to the proportion of Sup ≤ the proportions of All, Ssy, or Asy respectively. The last column (Sig) summarizes the results of these permutation tests by reporting the minimum significance level of superior performing growth-oriented funds (Sup) having a higher proportion of demonstrating the respective timing ability than the other three fund groups.

Setting	Model	Sup (%)	All (%)	Ssy (%)	Asy (%)	Sup ≤ All	Sup ≤ Ssy	Sup ≤ Asy	Sig
Panel A: Market Timing									
(3, 36)	CTM	1.13	2.29	0.81	2.62	0.983	0.388	0.985	
	CHM	1.30	1.61	1.13	2.92	0.766	0.500	0.991	
(5, 36)	CTM	1.55	1.82	0.62	2.10	0.712	0.089*	0.805	
	CHM	0.93	1.26	0.93	2.60	0.824	0.500	0.996	
(5, 60)	CTM	1.71	1.33	0.64	1.51	0.286	0.113	0.425	
	CHM	0.85	0.93	0.64	1.92	0.634	0.500	0.947	
(9, 36)	CTM	0.86	0.55	0.22	0.73	0.218	0.174	0.379	
	CHM	0.86	0.53	0.22	1.10	0.228	0.189	0.666	
(9, 60)	CTM	0.78	0.46	0.00	0.51	0.266	0.124	0.354	
	CHM	0.78	0.44	0.26	0.85	0.232	0.313	0.500	
(9, 108)	CTM	0.47	0.18	0.00	0.14	0.333	0.500	0.139	
	CHM	0.47	0.20	0.47	0.44	0.340	0.500	0.500	

***, **, and * represent significance levels of 0.01, 0.05, and 0.1 respectively.

Table 6-28: Proportion tests of fund manager timing skills: Value funds – continued

Setting	Model	Sup (%)	All (%)	Ssy (%)	Asy (%)	Sup ≤ All	Sup ≤ Ssy	Sup ≤ Asy	Sig
Panel B: Size Timing									
(3, 36)	CTM	3.73	5.72	2.43	3.58	0.988	0.119	0.452	
	CHM	3.57	6.15	1.13	3.20	0.998	0.002***	0.317	
(5, 36)	CTM	5.26	4.47	1.85	2.85	0.179	0.001***	0.000***	
	CHM	5.41	3.74	1.24	2.04	0.021**	0.000***	0.000***	**
(5, 60)	CTM	4.06	3.10	1.71	2.07	0.145	0.021**	0.005***	
	CHM	5.13	2.58	0.85	1.44	0.001***	0.001***	0.000***	***
(9, 36)	CTM	3.45	3.78	1.94	2.82	0.679	0.111	0.249	
	CHM	3.23	3.66	1.29	1.86	0.724	0.038**	0.027**	
(9, 60)	CTM	4.17	3.02	2.34	2.33	0.095*	0.109	0.016**	
	CHM	3.65	2.86	1.56	1.63	0.207	0.057*	0.004***	
(9, 108)	CTM	3.32	1.58	2.84	1.37	0.046**	0.500	0.019**	
	CHM	4.27	1.47	1.42	0.98	0.006***	0.070*	0.000***	*
Panel C: Growth timing									
(3, 36)	CTM	7.46	6.05	4.21	3.95	0.098*	0.011**	0.001***	*
	CHM	7.62	4.99	4.21	3.39	0.002***	0.006***	0.000***	***
(5, 36)	CTM	9.89	8.43	9.27	7.64	0.105	0.396	0.022**	
	CHM	8.50	5.82	7.11	4.65	0.001***	0.215	0.000***	
(5, 60)	CTM	9.19	6.39	8.55	5.69	0.011**	0.402	0.002***	
	CHM	7.69	4.15	6.62	3.49	0.000***	0.302	0.000***	
(9, 36)	CTM	13.15	7.17	10.34	9.34	0.000***	0.102	0.005***	
	CHM	11.85	4.72	9.05	5.61	0.000***	0.106	0.000***	
(9, 60)	CTM	14.84	5.75	11.72	7.78	0.000***	0.114	0.000***	
	CHM	12.76	3.76	10.42	4.78	0.000***	0.171	0.000***	
(9, 108)	CTM	20.85	3.02	14.22	5.27	0.000***	0.046**	0.000***	**
	CHM	18.01	1.85	13.74	3.07	0.000***	0.137	0.000***	
Panel D: Momentum timing									
(3, 36)	CTM	4.70	4.12	4.05	4.78	0.292	0.338	0.500	
	CHM	2.43	2.52	4.54	3.78	0.593	0.965	0.951	
(5, 36)	CTM	5.87	7.22	7.57	5.89	0.910	0.866	0.500	
	CHM	3.40	4.24	6.80	5.33	0.879	0.996	0.975	
(5, 60)	CTM	6.20	5.24	7.69	4.18	0.195	0.779	0.020**	
	CHM	3.85	3.13	7.48	3.88	0.202	0.986	0.500	
(9, 36)	CTM	7.97	15.21	10.34	9.85	1.000	0.876	0.901	
	CHM	3.88	7.28	7.76	7.01	0.998	0.989	0.995	
(9, 60)	CTM	8.33	12.53	9.90	8.04	0.996	0.734	0.432	
	CHM	4.43	5.95	7.55	5.70	0.914	0.956	0.854	
(9, 108)	CTM	9.95	7.12	13.74	4.65	0.085*	0.866	0.000***	
	CHM	6.64	3.37	10.90	3.39	0.010***	0.924	0.009***	

***, **, and * represent significance levels of 0.01, 0.05, and 0.1 respectively.

For Growth and Blend funds, superior performing fund managers demonstrate significant growth timing ability but not market timing, size timing or momentum timing ability. As shown in Table 6-26, the last column of panel C shows that superior performing Growth fund managers possess significant growth timing skill in all test settings based on CTM and CHM. This is strong evidence for the existence of growth timing skill among superior performing Growth fund managers. However, as shown in the last columns of panels A, B and D of Table 6-26, there is no significant evidence that superior performing Growth fund managers possess significantly market timing, size timing or momentum timing skill. Concerning Blend funds, Table 6-27 shows that superior performing fund managers also demonstrate significant growth timing ability in some test settings, but no market timing, size timing or momentum timing ability.

The proportion of demonstrating growth timing is much greater than the proportion of demonstrating market timing, size timing and momentum timing for superior performing Growth and Blend fund managers. As shown in panel C, column 3 of Table 6-26, superior performing Growth fund managers exhibit a 10–25% proportion of demonstrating growth timing ability. However, the 3rd columns of panels A, B and D of Table 6-26 show that superior performing Growth fund managers have only a 0–2%, 1–6% and 0–2% proportion of demonstrating market timing, size timing and momentum timing abilities respectively. Similarly, as shown in panels A to D, column 3 of Table 6-27, the proportion of demonstrating growth timing ability (4–32%) is obviously larger than the proportions of demonstrating market timing (0–2%), size timing (1–5%) and momentum timing (0–4%) abilities for superior performing Equity Growth fund managers.

There is little evidence for the existence of size timing and growth timing skill among superior performing Value fund managers. As shown in Table 6-28, the last column of panel B shows that $H12b_0$ (the null hypothesis for size timing) is significantly rejected in the test settings of (5, 36), (5, 60) and (9, 108) based on CHM. The last column of panel C shows that $H12c_0$ (the null hypothesis for growth timing) is significantly rejected in the test settings of (3, 36) and (9, 108) based on CTM and (3, 36) based on CHM. In other words, superior performing Value fund managers demonstrate size timing and growth skill in these test settings. Since these test settings are only a small part of the whole, it is insufficient evidence to consider that superior performing Value fund managers possess size timing and growth timing skill.

6.4. Characteristic of Growth Timing Ability

This section tries to answer the key research question of this chapter:

Q2: What are the characteristics of the observed timing skills?

In other words, this section analyses the essential characteristic of the growth timing ability identified in Chapter 5. Specifically, the timing skills of different fund groups with different growth-orientation levels are overviewed. Then the characteristic of the observed growth timing ability will be revealed by comparing the difference in the timing skills of those fund groups.

According to S&P Returns-Based Style Analysis, about 40% of growth-oriented funds have value fund return characteristics as shown in Table 4-1. This enables us to test the expectation, outlined in the introduction, that successful growth stock investment involves growth timing skill but successful value stock investment does not. If funds that invest primarily in value stocks do not possess growth timing skill but the other funds which invest primarily in growth stocks do, then this is strong evidence in favour of my expectation. Specifically, we expect funds with a higher degree of growth-orientation in their investment objective (or style) to demonstrate more significant growth timing skill.

In the last two sections, proportion tests were conducted to investigate the style timing ability of seven fund groups, which are defined according to investment objective or the S&P Returns-Based Style Analysis from January 1993 to December 2006 under six test settings. As regards investment objective, my sample funds consist of Equity USA Aggressive Growth funds (150), Equity USA Growth funds (1,956), Equity USA Growth-and-Income funds (856) and Equity USA Income-and-Growth funds (219). According to S&P Returns-Based Style Analysis, the sample funds are classified into Growth funds (1,470), Blend funds (428) and Value funds (1,283). Table 6-29 summarizes the test results and reports the timing ability demonstrated by these fund groups.

Table 6-29: Proportion test on investment objective and S&P style

This table reports the results of proportion tests on monthly return data of 3,181 US growth-oriented equity mutual funds from Jan. 1993 to Dec. 2006 broken down by fund objective and S&P style category. Investment objectives are Equity Aggressive Growth (AG), Equity Growth (GR), Equity Growth-and-Income (GI), and Equity Income-and-Growth (IG). Funds are also separately classified by S&P Returns-Based Style Analysis into Growth funds (Growth), Blend funds (Blend), and Value funds (Value). Panels A to D give the examined style timing skill. Column 1 provides the joint setting of sub-period length and minimum observation number. Column 2 shows the style timing model used in my analysis, i.e. the Carhart (1997) four-factor Treynor and Mazuy (1966) style timing model (CTM) or the Carhart (1997) four-factor Henriksson and Merton (1981) style timing model (CHM). The subsequent 7 columns provide test results in the form of the significance level of rejecting the null hypothesis that superior performing fund managers of the respective group do not possess the corresponding timing skill.

Setting	Model	Investment Objective				S&P Style		
		AG	GR	GI	IG	Growth	Blend	Value
		Panel A: Market Timing						
(3, 36)	CTM							
	CHM							
(5, 36)	CTM							
	CHM							
(5, 60)	CTM							
	CHM							
(9, 36)	CTM							
	CHM							
(9, 60)	CTM							
	CHM							
(9, 108)	CTM							
	CHM							

***, **, and * represent significance levels of 0.01, 0.05, and 0.1 respectively.

Table 6-29: Proportion test on investment objective and S&P style – continued

Setting	Model	Investment Objective				S&P Style		
		AG	GR	GI	IG	Growth	Blend	Value
Panel B: Size Timing								
(3, 36)	CTM							
	CHM							
(5, 36)	CTM				**			
	CHM				*			**
(5, 60)	CTM				**			
	CHM				**		*	***
(9, 36)	CTM							
	CHM							
(9, 60)	CTM							
	CHM							
(9, 108)	CTM							
	CHM							*
Panel C: Growth Timing								
(3, 36)	CTM	***	***			***		*
	CHM	*	***			***		***
(5, 36)	CTM	***	***	**		***	*	
	CHM	***	***	***		***		
(5, 60)	CTM	***	***	**		***	***	
	CHM	***	***	***		***	**	
(9, 36)	CTM	***	***	***		***	***	
	CHM	**	***	*		***	**	
(9, 60)	CTM	***	***	**		***	***	
	CHM	***	***	*		***		
(9, 108)	CTM	***	***	*		***	*	**
	CHM	***	***			***		
Panel D: Momentum Timing								
3, 36)	CTM							
	CHM							
(5, 36)	CTM							
	CHM							
(5, 60)	CTM							
	CHM							
(9, 36)	CTM							
	CHM							
(9, 60)	CTM							
	CHM							
(9, 108)	CTM							
	CHM							

***, **, and * represent significance levels of 0.01, 0.05, and 0.1 respectively.

The test results suggest that growth timing is a distinctive characteristic of successful growth stock investment. Considering first the results for the four investment objectives shown in Table 6-29, we see that superior performing Equity Aggressive Growth fund managers and superior performing Equity Growth fund managers have highly significant growth timing ability. Superior performing Equity Growth-and-Income fund managers also have growth timing ability in some settings. However, superior performing Equity Income-and-Growth fund managers do not demonstrate growth timing ability but do have size-timing ability in some settings. Focusing on growth timing ability, it can be seen that the more growth-oriented the investment objective, the stronger the evidence for growth timing ability.

Concerning the test results of the three groups classified by S&P Returns-Based Style Analysis, if a fund is classified as a Growth (Value) fund, this means that, according to its returns, it seems to invest most of its assets in growth (value) stocks. A Blend fund stands between Value and Growth funds. Columns 7–9 of Table 6-29 clearly shows that superior performing Growth fund managers have highly significant growth timing ability, superior performing Blend fund managers also have growth timing ability in many settings, but there is little evidence of growth timing ability for Value fund managers. Again, these results suggest that the more growth-oriented the investment style, the stronger the evidence of growth timing skill.

However, the test results for Equity Income-and-Growth funds differ from those of Equity Aggressive Growth funds, Equity Growth funds and Equity

Growth-and-Income funds, but are similar to those of Value funds. S&P Returns-Based Style Analysis also suggests that most Equity Income-and-Growth funds are value-oriented rather than growth-oriented. Nevertheless, the results of the tests on the whole sample in Section 5.7 are unaffected because Equity Income-and-Growth funds account for only 7% of total sample funds as shown in Table 4-1.

6.5. Summary

Funds with a higher degree of growth-orientation in their investment objective (or style) are expected to demonstrate more significant growth timing skill. To test this hypothesis, the sample funds are separated into different groups with different growth-orientation levels and the timing ability demonstrated by the superior performing fund managers in these groups examined. There are two systems used to classify the sample funds: investment objective and investment style. According to investment objective, the sample funds are classified into four fund groups: Equity Aggressive Growth funds, Equity Growth funds, Equity Growth-and-Income funds and Equity Income-and-Growth funds. Standard & Poor's Returns-Based Style Analysis groups the sample funds into three different investment styles: Growth funds, Blend funds and Value funds.

Fund performance and timing ability of these fund groups is first discussed by examining the Carhart alphas and style timing coefficients of their fund instances. Funds with a more growth-oriented investment objective are found to demonstrate a higher exposure to growth stocks and have a higher proportion of demonstrating growth timing ability. Concerning funds with different investment styles, Growth funds have higher exposure to growth stocks, while Value funds invest primarily in value stocks. The growth stock exposure of Blend funds is between those of Growth funds and Value funds. In addition, Growth and Blend funds obviously have a higher proportion of demonstrating growth timing ability than Value funds.

Proportion tests are then carried out to investigate the timing skills demonstrated by superior performing fund managers of these fund groups. The timing skills possessed by different fund groups are compared to reveal what kind of fund characteristic leads to the successful growth timing activity identified in the last chapter.

The evidence suggests that the use of growth timing skill is confined to those “growth” fund managers who actually invest primarily in growth stocks. On studying our sample funds’ investment objectives (which include aggressive growth, growth, growth-and-income and income-and-growth), we find that the more growth-oriented the investment objective, the stronger the evidence of growth timing ability. Moreover, according to the S&P Returns-Based Style Analysis, 1,283 (40%) of the 3,181 “growth-oriented” funds in our sample invest primarily in value stocks rather than growth stocks. We find little evidence of growth timing skill for such funds. In contrast, there is strong evidence of growth timing skill for superior performing funds invested mainly in growth stocks. In other words, growth timing skill is specific to those managers who invest primarily in growth stocks.

CHAPTER 7

FURTHER INVESTIGATION OF GROWTH TIMING SKILL

7.1. Introduction

A number of issues are discussed in this chapter which relate to the identified growth timing skill of the previous studies. The persistence of the observed growth timing ability is first examined. If fund managers have substantial skill to outperform the market, their superior performance should persist. Next, it is revealed that growth timing skill is easily misidentified as market timing skill if researchers focus only on market timing ability while ignoring growth timing ability in their analysis. Then the question of how much of the abnormal returns earned by superior performing growth-oriented fund managers are attributable to their growth timing skill is considered.

Most importantly, whether superior performance demonstrated by growth-oriented fund managers still persists after taking account of growth timing ability is investigated. The results discussed in prior sections indicate that growth timing is an important attribute. Therefore, in the final section a growth timing parameter is added to Carhart's (1997) four-factor model and the persistence test used by Kosowski *et al.* (2006) conducted to examine whether superior performance demonstrated by growth-oriented fund managers still persists based on the new model.

The rest of this chapter is organized as follows. Section 7.2 tests the persistence of the observed growth timing ability. Section 7.3 discusses the misidentification problem among timing activities. Section 7.4 evaluates the importance of growth timing skill for superior performing growth-oriented fund managers. Finally, Section 7.5 examines whether the observed growth timing skill can explain the persistent superior performance of growth-oriented fund managers demonstrated by Kosowski *et al.* (2006). Section 7.6 summarises the chapter.

7.2. Persistence of Growth Timing Ability

If fund managers have substantial skill to outperform the market, their superior performance should persist; otherwise it is unlikely that persistent superior performance will be observed. Both Carhart (1997) and Kosowski *et al.* (2006) apply this concept to test whether superior performance of fund managers is attributable to skill or good luck. The persistence test of Carhart (1997) and Kosowski *et al.* (2006) is applied to confirm that the growth timing skill observed in prior sections is attributable to the substantial skill of superior performing growth-oriented fund managers. Although the proportion test already excludes the possibility that the observed growth timing skill is due to good luck, this section provides another approach to confirm the results.

Specifically, this section discusses the following research question and the corresponding hypothesis:

Q3: Do superior performing growth-oriented fund managers have real growth timing skill?

$H3_0$: *Superior performing growth-oriented fund managers do not achieve successful growth timing persistently.*

The focus is confined to growth timing skill because the previous tests do not find evidence for the existence of the other three style timing skills. The following two growth timing models are used:

a. The Carhart (1997) four-factor Treynor and Mazuy (1966) growth timing model (CTM_GT):

$$r_{i,t} = \alpha_i + \beta_i \cdot RMRF_t + s_i \cdot SMB_t + h_i \cdot HML_t + p_i \cdot MOM_t + \gamma_i \cdot HML_t^2 + \varepsilon_{i,t} \qquad (7.1)$$

b. The Carhart (1997) four-factor Henriksson and Merton (1981) growth timing model (CHM_GT):

$$r_{i,t} = \alpha_i + \beta_i \cdot RMRF_t + s_i \cdot SMB_t + h_i \cdot HML_t + p_i \cdot MOM_t + \gamma_i \cdot HML_t^* + \varepsilon_{i,t} \qquad (7.2)$$

where γ_i is the growth timing coefficient and a significantly positive γ_i means that the mutual fund manager demonstrates successful growth timing ability; $HML_t^* = I\{HML_t > 0\} \cdot HML_t$, where $I\{HML_t > 0\}$ is an indicator function that equals one if HML_t is positive and zero otherwise.

To test whether growth fund managers who demonstrate growth timing skill during the past three years also continue to exhibit such skill in the following year, the superior performing growth-oriented funds are sorted on 1 January each year (from 1996 until 2006) into decile portfolios based on the prior three-year growth timing ability (γ_i). Portfolios are subsequently held for one year. A minimum of 36 monthly net return observations are required for estimating growth timing coefficients. For funds with missing return data, observations from the 12 months preceding the three-year window are added to obtain 36 observations. This means that funds with missing observations are not excluded. On average, there are 164 superior performing growth-oriented funds examined every year during the test period.[41] The portfolios are equally weighted monthly, so the weights are readjusted whenever a fund disappears. If the high-ranked portfolio demonstrates better growth timing ability than the low-ranked portfolio, this is evidence that fund managers demonstrate persistent superior growth timing ability, which implies that fund managers possess substantial growth timing skill.

In addition, as discussed in Section 3.7, the study concerns whether the observed growth timing ability is persistent, not whether fund investors can profit from this measure. Therefore, management expenses (such as management and administrative charges, 12b-1 fees and other operating costs) but not sale charges (such as front-end

[41] On average there are 1,573 growth-oriented funds examined every year during the test period and 10% (=164/1,573) of them are superior performing growth-oriented funds which demonstrate a significant positive Carhart (1997) alpha.

or deferred loads and redemption fees) are considered in the test procedure.[42]

Tables 7-1 and 7-2 report the results of persistence tests on the 3,181 sample growth-oriented funds based on the Carhart (1997) four-factor Treynor and Mazuy (1966) growth timing model (CTM_GT) and the Carhart (1997) four-factor Henriksson and Merton (1981) growth timing model (CHM_GT) respectively.

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[42] Mutual fund monthly returns are calculated based on change in fund net asset value (NAV) from which management and administrative charges, 12b-1 fees and other costs are deducted. To control for the possibility that our results may be biased by funds trading off front-end load fees against higher 12b-1 fees, in unreported tests we remove all 12b-1 fees from the calculation of mutual fund performance. However, this does not affect our results.

Table 7-1: Persistence of growth timing ability measured by the Carhart (1997) four-factor Treynor and Mazuy (1966) growth timing model

This table reports the results of tests on the persistence of growth timing ability measured by the Carhart (1997) four-factor Treynor and Mazuy (1966) growth timing model (CTM_GT) based on monthly return data of 3,181 US growth-oriented equity mutual funds from Jan. 1993 to Dec. 2006. The sample funds are sorted on January 1 each year (from 1996 until 2006) into decile portfolios based on their growth timing coefficient (γ_i) estimated over the prior three years. For funds that have missing observations during these prior three years, observations from the 12 months preceding the three-year window are added to obtain 36 observations. The portfolios are equally weighted monthly. Funds with the highest three-year γ_i comprise 1.dec, and funds with the lowest comprise 10.dec. "Top" ("Bottom") is the portfolio of the fund with the best (worst) γ_i. The "1%ile" ("5%ile") portfolio is an equally weighted portfolio of the top-1% (top-5%) funds, while the "99%ile" ("95%ile") is an equally weighted portfolio of the worst-1% (worst-5%) funds. The last four rows represent the portfolios which hold "Top" and sell "Bottom" (T-B), hold 1%ile and sell 99%ile (1-99), hold 5%ile and sell 95%ile (5-95) and hold 1.dec and sell 10.dec (10-90) respectively. Columns 2 and 3 are the mean and standard deviation of the portfolio excess returns. Columns 4-6 show the portfolios' intercept (α_i), the growth timing coefficient (γ_i), and the bootstrapped p-value of γ_i respectively. The following four columns present the coefficients of Carhart's four factors. The last column reports the adjusted R-squared of CTM_GT.

Fractile	E.Ret (%)	Stdev (%)	α_i (%)	γ_i	BS. p-val	RMRF	SMB	HML	MOM	Adj. R^2
Top	0.59	6.16	-0.03	2.107	0.032	0.884	0.185	-0.431	-0.527	0.741
1%ile	0.50	6.26	-0.03	1.619	0.081	0.906	0.165	-0.479	-0.496	0.776
5%ile	0.52	5.68	-0.12	2.172	0.000	0.979	0.038	-0.418	-0.522	0.908
1.dec	0.45	5.56	-0.13	1.874	0.000	0.945	0.067	-0.431	-0.598	0.926
2.dec	0.32	5.32	-0.19	0.666	0.129	0.959	0.122	-0.255	-0.193	0.929
3.dec	0.20	5.07	-0.25	0.269	0.503	0.940	0.082	-0.214	-0.082	0.936
4.dec	0.42	5.43	-0.07	0.572	0.226	0.965	0.107	-0.263	0.006	0.916
5.dec	0.35	4.95	-0.10	0.337	0.309	0.953	0.008	-0.185	0.112	0.952
6.dec	0.39	4.96	-0.14	0.466	0.177	1.008	-0.019	-0.108	0.005	0.949
7.dec	0.45	4.57	-0.09	0.402	0.135	0.952	0.007	-0.037	0.123	0.961
8.dec	0.51	4.50	-0.07	0.687	0.031	0.947	-0.024	-0.009	0.222	0.946
9.dec	0.34	4.76	-0.17	0.324	0.481	0.924	0.075	-0.077	0.119	0.902
10.dec	0.49	4.92	-0.17	0.299	0.484	1.036	0.124	0.061	-0.184	0.921

Table 7-1: Persistence of growth timing ability measured by the Carhart (1997) four-factor Treynor and Mazuy (1966) growth timing model – continued

Fractile	E.Ret (%)	Stdev (%)	α_i (%)	γ_i	BS. p-val	RMRF	SMB	HML	MOM	Adj. R^2
95%ile	0.30	5.19	-0.37	0.017	0.978	1.053	0.189	0.126	0.013	0.856
99%ile	0.00	6.43	-0.48	-0.900	0.403	1.034	0.349	-0.061	-0.105	0.713
Bottom	0.01	6.52	-0.16	-2.556	0.016	0.979	0.376	-0.138	-0.156	0.727
T-B	0.59	4.32	0.13	4.663	0.000	-0.095	-0.191	-0.293	-0.371	0.116
1-99	0.49	4.06	0.45	2.519	0.034	-0.128	-0.184	-0.418	-0.391	0.090
5-95	0.21	3.09	0.25	2.155	0.007	-0.074	-0.152	-0.544	-0.535	0.297
10-90	-0.04	2.51	0.04	1.575	0.008	-0.091	-0.057	-0.492	-0.414	0.405

Table 7-2: Persistence of growth timing ability measured by the Carhart (1997) four-factor Henriksson and Merton (1981) growth timing model

This table reports the results of tests on the persistence of growth timing ability measured by the Carhart (1997) four-factor Henriksson and Merton (1981) growth timing model (CHM_GT) based on monthly return data of 3,181 US growth-oriented equity mutual funds from Jan. 1993 to Dec. 2006. The sample funds are sorted on January 1 each year (from 1996 until 2006) into decile portfolios based on their growth timing coefficient (γ_i) estimated over the prior three years. For funds that have missing observations during these prior three years, observations from the 12 months preceding the three-year window are added to obtain 36 observations. The portfolios are equally weighted monthly. Funds with the highest three-year γ_i comprise 1.dec, and funds with the lowest comprise 10.dec. "Top" ("Bottom") is the portfolio of the fund with the best (worst) γ_i. The "1%ile" ("5%ile") portfolio is an equally weighted portfolio of the top-1% (top-5%) funds, while the "99%ile" ("95%ile") is an equally weighted portfolio of the worst-1% (worst-5%) funds. The last four rows represent the portfolios which hold "Top" and sell "Bottom" (T-B), hold 1%ile and sell 99%ile (1-99), hold 5%ile and sell 95%ile (5-95) and hold 1.dec and sell 10.dec (10-90) respectively. Columns 2 and 3 are the mean and standard deviation of the portfolio excess returns. Columns 4-6 show the portfolios' intercept (α_i), the growth timing coefficient (γ_i), and the bootstrapped p-value of γ_i respectively. The following four columns present the coefficients of Carhart's four factors. The last column reports the adjusted R-squared of CHM_GT.

Fractile	E.Ret (%)	Stdev (%)	α_i (%)	γ_i	BS. p-val	RMRF	SMB	HML	MOM	Adj. R^2
Top	0.64	5.74	-0.26	0.423	0.030	0.857	0.145	-0.590	-0.284	0.757
1%ile	0.51	5.85	-0.23	0.330	0.078	0.886	0.114	-0.585	-0.350	0.785
5%ile	0.50	5.59	-0.27	0.316	0.011	0.966	0.044	-0.534	-0.363	0.896
1.dec	0.37	5.56	-0.40	0.300	0.002	0.973	0.089	-0.530	-0.502	0.938
2.dec	0.33	5.11	-0.16	0.069	0.405	0.942	0.072	-0.280	-0.228	0.938
3.dec	0.29	5.46	-0.39	0.193	0.103	0.944	0.176	-0.360	-0.063	0.903
4.dec	0.34	5.21	-0.08	0.029	0.757	0.953	0.050	-0.266	-0.057	0.933
5.dec	0.39	4.91	-0.04	-0.037	0.619	0.979	0.052	-0.060	0.162	0.951
6.dec	0.35	4.79	-0.23	0.075	0.328	0.961	0.048	-0.107	0.179	0.947
7.dec	0.39	4.94	-0.04	-0.048	0.510	0.981	0.093	-0.072	-0.163	0.953
8.dec	0.42	4.61	-0.21	0.140	0.066	0.947	-0.042	-0.157	0.059	0.947
9.dec	0.42	4.52	-0.19	0.126	0.144	0.913	-0.029	-0.125	0.234	0.919
10.dec	0.61	4.93	-0.12	0.120	0.147	1.019	0.114	-0.074	-0.221	0.939

Table 7-2: Persistence of growth timing ability measured by the Carhart (1997) four-factor Henriksson and Merton (1981) growth timing model – continued

Fractile	E.Ret (%)	Stdev (%)	α_i (%)	γ_i	BS. p-val	RMRF	SMB	HML	MOM	Adj. R^2
95%ile	0.41	5.44	-0.24	0.093	0.513	0.994	0.204	-0.182	-0.455	0.863
99%ile	0.17	6.37	0.19	-0.318	0.116	0.980	0.255	-0.138	-0.320	0.786
Bottom	-0.16	6.68	0.04	-0.472	0.038	1.040	0.237	-0.051	-0.708	0.758
T-B	0.79	4.57	-0.29	0.894	0.002	-0.183	-0.092	-0.540	0.425	0.095
1-99	0.34	4.01	-0.42	0.648	0.013	-0.094	-0.141	-0.447	-0.030	0.037
5-95	0.08	2.60	-0.04	0.223	0.193	-0.027	-0.160	-0.352	0.092	0.059
10-90	-0.25	1.94	-0.28	0.180	0.073	-0.046	-0.025	-0.456	-0.281	0.410

The observed growth timing ability persists. In both tables, the top ranked portfolio has the highest growth timing coefficient and the lowest bootstrapped p-value. In other words, the fund managers who demonstrate the top 10% growth timing skill among superior performing growth-oriented fund managers in the past three years are able to demonstrate the best growth timing skill in the following year. This finding is consistent with the results reported in Section 5.7, i.e. only the top decile of superior performing growth-oriented fund managers demonstrate growth timing skill, but additionally provides empirical evidence that the observed growth timing ability is persistent.

In unreported work, the same persistence tests are applied to subgroups of the sample: Equity Growth funds, Equity Growth-and-Income funds, Growth funds and Value funds.[43] Equity Growth fund and Growth funds exhibit strong persistence of growth timing ability, while Equity Growth-and-Income funds exhibit little. Value funds show no persistence of growth timing ability. These results are consistent with the results of proportion tests on the subgroups in prior sections and again suggest that growth timing skill is demonstrated only by successful fund managers who actually invest in growth stocks.

In summary, the persistence of the observed growth timing ability confirms that superior performing growth-oriented fund managers possess substantial growth timing skill. Both proportion and persistence tests show strong evidence of growth

[43] There are not sufficient funds to implement persistence tests for Equity Aggressive Growth funds, Equity Income-and-Growth funds and Blend funds.

timing skill. Observed growth timing skill, however, is only attributable to a small portion of growth-oriented fund managers. This finding is similar to the conclusion of Kosowski *et al.* (2006) that a sizable minority of growth-oriented fund managers have the ability to earn abnormal returns.

7.3. Misidentification of Growth Timing Ability

This section shows that growth timing skill is easily misidentified as market timing skill. Since market timing is the best-known timing skill and timing models, such as Treynor and Mazuy (1966) and Henriksson and Merton (1981), have been developed to measure market timing ability, most studies tend to focus on market timing and ignore other timing skills. This, however, may lead to a false conclusion because other timing skills are likely to be misidentified as market timing skill. For example, when the Dot-Com bubble burst, the stock market fell and growth stocks went out of fashion at the same time. Just before this happened, a market timer will go liquid while a growth timer would switch to value or less-growth stocks. So they both react to the same event at the same time. Thus, the performance of the successful growth timer is likely to be treated as evidence for market timing ability if researchers measure market timing ability but ignore growth timing ability. In addition, the correlation between the timing skills is not small enough to be ignored and hence may lead to spurious statistical results if this correlation is not considered. The following demonstrates an empirical example with the sample funds by studying the following research question.

Q4: Is it possible that growth timing ability is misidentified as another timing ability?

To study this question, the tests conducted in Section 5.7 are repeated with single style timing models instead of the style timing models used in Section 5.7. When considering four style timing abilities at the same time in one model, the test results of previous sections provide strong evidence of growth timing skill but no evidence of market timing, size timing, and momentum timing skills. This section now examines what will happen if a timing model does not consider growth timing skill. Therefore, unlike the style timing models which consider four style timing at the same time, single style timing models measure only one style timing ability in each model.

For example, the following models are the single timing models used to measure only market timing ability:

a. The Carhart (1997) four-factor Treynor and Mazuy (1966) market timing model (CTM_MT):

$$r_{i,t} = \alpha_i + \beta_i RMRF_t + s_i SMB_t + h_i HML_t + p_i MOM_t + \gamma_i RMRF_t^2 + \varepsilon_{i,t} \qquad (7.3)$$

b. The Carhart (1997) four-factor Henriksson and Merton (1981) market timing model (CHM_MT):

$$r_{i,t} = \alpha_i + \beta_i RMRF_t + s_i SMB_t + h_i HML_t + p_i MOM_t + \gamma_i RMRF_t^* + \varepsilon_{i,t} \quad (7.4)$$

where γ_i is the market timing coefficient and a significantly positive γ_i means that the mutual fund manager successfully times the market; $RMRF_t^* = I\{RMRF_t > 0\} RMRF_t$, where $I\{RMRF_t > 0\}$ is an indicator function that equals one if $RMRF_t$ is positive and zero otherwise.

Similarly, if the market timing parameters, i.e. $RMRF_t^2$ and $RMRF_t^*$, are replaced with size timing parameters, i.e. SMB_t^2 and SMB_t^*, the revised single style timing models are able to measure only size timing ability. Similarly, growth timing and momentum timing abilities can be measured with single style timing models. In fact, these single style timing models are the models used by Swinkels and Tjong-A-Tjoe (2007). Specifically, the single style timing models used to measure size timing, growth timing and momentum timing abilities are shown as follows.

The Carhart (1997) four-factor Treynor and Mazuy (1966) size timing model (CTM_ST):

$$r_{i,t} = \alpha_i + \beta_i RMRF_t + s_i SMB_t + h_i HML_t + p_i MOM_t + \gamma_i SMB_t^2 + \varepsilon_{i,t}$$

The Carhart (1997) four-factor Henriksson and Merton (1981) size timing model (CHM_ST):

$$r_{i,t} = \alpha_i + \beta_i RMRF_t + s_i SMB_t + h_i HML_t + p_i MOM_t + \gamma_i SMB_t^* + \varepsilon_{i,t}$$

The Carhart (1997) four-factor Treynor and Mazuy (1966) growth timing model (CTM_GT):

$$r_{i,t} = \alpha_i + \beta_i RMRF_t + s_i SMB_t + h_i HML_t + p_i MOM_t + \gamma_i HML_t^2 + \varepsilon_{i,t}$$

The Carhart (1997) four-factor Henriksson and Merton (1981) growth timing model (CHM_GT):

$$r_{i,t} = \alpha_i + \beta_i RMRF_t + s_i SMB_t + h_i HML_t + p_i MOM_t + \gamma_i HML_t^* + \varepsilon_{i,t}$$

The Carhart (1997) four-factor Treynor and Mazuy (1966) momentum timing model (CTM_MT):

$$r_{i,t} = \alpha_i + \beta_i RMRF_t + s_i SMB_t + h_i HML_t + p_i MOM_t + \gamma_i MOM_t^2 + \varepsilon_{i,t}$$

The Carhart (1997) four-factor Henriksson and Merton (1981) momentum timing model (CHM_MT):

$$r_{i,t} = \alpha_i + \beta_i RMRF_t + s_i SMB_t + h_i HML_t + p_i MOM_t + \gamma_i MOM_t^* + \varepsilon_{i,t}$$

Table 7-3 reports the results of proportion tests on monthly return data of 3,181 US growth-oriented equity mutual funds from January 1993 to December 2006 based on the single style timing models.

Table 7-3: Proportion tests of fund manager timing skills based on single style timing model: full sample

Table 7-3 reports the results of proportion tests on monthly return data of 3,181 US growth-oriented equity mutual funds from Jan. 1993 to Dec. 2006 based on the single style timing models. The single style timing models used in panels A-D measure market timing, size timing, growth timing, and momentum timing abilities respectively. The proportion tests examine whether superior performing funds (Sup) have a higher proportion of demonstrating the respective timing ability than all mutual funds (All), superior performing synthetic funds (Ssy), or all synthetic funds (Asy). Column 1 reports the test setting of sub-period length (years) and minimum observation number (months). Column 2 shows the single style timing model, which is derived from the Carhart (1997) four-factor Treynor and Mazuy (1966) style timing model (CTM) or the Carhart (1997) four-factor Henriksson and Merton (1981) style timing model (CHM). Columns 3 to 6 report the proportion of demonstrating the respective timing abilities for Sup, All, Ssy, and Asy. The following three columns report the p-values and significance of the permutation tests of the three hypotheses relating to the proportion of Sup ≤ the proportions of All, Ssy, or Asy respectively. The last column (Sig) summarizes the results of these permutation tests by reporting the minimum significance level of superior performing growth-oriented funds (Sup) having a higher proportion of demonstrating the respective timing ability than the other three fund groups.

Setting	Model	Sup (%)	All (%)	Ssy (%)	Asy (%)	Sup ≤ All	Sup ≤ Ssy	Sup ≤ Asy	Sig
Panel A: Market Timing									
(3, 36)	CTM	1.30	2.55	0.85	1.36	1.000	0.106	0.586	
	CHM	2.00	2.47	1.00	1.15	0.924	0.007***	0.000***	
(5, 36)	CTM	2.27	1.99	0.67	1.46	0.193	0.000***	0.002***	
	CHM	1.97	1.55	0.63	1.24	0.057*	0.000***	0.002***	*
(5, 60)	CTM	1.95	1.43	0.61	1.11	0.042**	0.000***	0.000***	**
	CHM	1.95	1.17	0.61	0.93	0.004***	0.000***	0.001***	***
(9, 36)	CTM	1.58	1.56	0.15	0.54	0.487	0.000***	0.000***	
	CHM	1.73	1.48	0.31	0.94	0.097*	0.000***	0.001***	*
(9, 60)	CTM	1.48	1.24	0.12	0.41	0.207	0.000***	0.000***	
	CHM	1.54	1.16	0.25	0.73	0.082*	0.000***	0.000***	*
(9, 108)	CTM	1.47	0.61	0.11	0.20	0.002***	0.001***	0.000***	***
	CHM	1.58	0.53	0.23	0.39	0.000***	0.005***	0.000***	***

***, **, and * represent significance levels of 0.01, 0.05, and 0.1 respectively.

Table 7-3: Proportion tests of fund manager timing skills based on single style timing model: full sample – continued

Setting	Model	Sup (%)	All (%)	Ssy (%)	Asy (%)	Sup ≤ All	Sup ≤ Ssy	Sup ≤ Asy	Sig
Panel B: Size Timing									
(3, 36)	CTM	5.90	5.17	6.30	3.39	0.089*	0.669	0.000***	
	CHM	5.05	4.90	3.30	2.21	0.389	0.005***	0.000***	
(5, 36)	CTM	10.03	7.08	7.84	4.93	0.000***	0.006***	0.000***	***
	CHM	7.89	5.96	4.57	3.34	0.000***	0.000***	0.000***	***
(5, 60)	CTM	9.86	5.31	7.96	3.84	0.000***	0.030**	0.000***	**
	CHM	7.85	4.52	4.29	2.54	0.000***	0.001***	0.000***	***
(9, 36)	CTM	12.18	8.63	10.19	7.07	0.000***	0.025**	0.000***	**
	CHM	7.49	7.21	5.45	4.55	0.337	0.004***	0.000***	
(9, 60)	CTM	11.80	7.03	10.13	5.82	0.000***	0.068*	0.000***	*
	CHM	7.04	5.83	5.68	3.71	0.029**	0.067*	0.000***	*
(9, 108)	CTM	10.51	3.63	11.64	3.35	0.000***	0.760	0.000***	
	CHM	6.33	3.15	7.46	2.12	0.000***	0.810	0.000***	
Panel C: Growth timing									
(3, 36)	CTM	11.99	7.92	2.90	3.29	0.000***	0.000***	0.000***	***
	CHM	9.90	6.41	1.70	2.12	0.000***	0.000***	0.000***	***
(5, 36)	CTM	19.25	12.43	5.08	5.54	0.000***	0.000***	0.000***	***
	CHM	14.64	9.28	3.52	3.41	0.000***	0.000***	0.000***	***
(5, 60)	CTM	18.71	9.14	5.29	4.18	0.000***	0.000***	0.000***	***
	CHM	13.98	6.67	3.34	2.55	0.000***	0.000***	0.000***	***
(9, 36)	CTM	25.17	14.78	6.62	5.99	0.000***	0.000***	0.000***	***
	CHM	21.29	11.32	4.28	4.73	0.000***	0.000***	0.000***	***
(9, 60)	CTM	23.59	11.74	6.98	4.85	0.000***	0.000***	0.000***	***
	CHM	19.33	8.84	4.45	3.74	0.000***	0.000***	0.000***	***
(9, 108)	CTM	21.92	6.09	7.91	2.63	0.000***	0.000***	0.000***	***
	CHM	17.29	4.50	4.63	1.99	0.000***	0.000***	0.000***	***
Panel D: Momentum timing									
(3, 36)	CTM	2.95	3.59	4.10	3.12	0.935	0.975	0.661	
	CHM	1.90	2.18	3.60	2.19	0.824	0.999	0.787	
(5, 36)	CTM	3.94	4.72	6.67	3.79	0.959	1.000	0.360	
	CHM	2.85	3.37	6.25	3.61	0.920	1.000	0.962	
(5, 60)	CTM	3.62	3.52	6.51	2.74	0.427	1.000	0.018**	
	CHM	2.62	2.47	6.18	2.65	0.351	1.000	0.500	
(9, 36)	CTM	4.02	6.38	5.60	4.44	1.000	0.989	0.802	
	CHM	2.75	4.73	5.45	4.35	1.000	1.000	0.999	
(9, 60)	CTM	3.71	5.00	5.37	3.49	0.994	0.989	0.325	
	CHM	2.53	3.72	5.37	3.49	0.996	1.000	0.980	
(9, 108)	CTM	3.84	2.63	4.41	1.73	0.030**	0.680	0.000***	
	CHM	3.05	2.07	4.75	1.71	0.018**	0.959	0.003***	

***, **, and * represent significance levels of 0.01, 0.05, and 0.1 respectively.

Panel A of Table 7-3 shows that superior performing growth-oriented fund managers appear to possess market timing skill. However, if superior performing growth-oriented fund managers really possess market timing skill, this should have been observed in prior sections, but it is not. In fact, panels B and C of Table 4-2 show a significant level of correlation (0.338 and -0.349) between market timing and growth timing factors, which implies that growth timing ability is likely to be misidentified as market timing ability if there is no specific growth timing factor in the timing model used.

As shown in panel B of Table 7-3, there is evidence for the existence of size timing under some test settings. This is likely due to the high correlation coefficient (0.538) between the size timing and growth timing parameters of Treynor and Mazuy (1966), shown in panel B of Table 4-2. Furthermore, as discussed in Sections 6.2 and 6.3, Equity Income-and-Growth funds and Value funds demonstrate size timing ability under some test settings. Although the correlation between the Henriksson and Merton (1981) size timing and growth timing parameters shown in panel C of Table 4-2 is not high (-0.202), this can still enhance the evidence for size timing by misidentifying part of growth timing ability as size timing ability.

Misidentification is not only due to a high correlation between timing parameters. As shown in panel B of Table 4-2, the correlation coefficient between the market timing and growth timing parameters (0.338) is less than the correlation coefficient between the momentum timing and growth timing parameters (0.438). However, panels A and D of Table 7-3 exhibit evidence for market timing but not for momentum timing. This implies that a high correlation between timing parameters is not the only reason for misidentification.

The style timing models used in the analysis resolves the problem above. The models measure market timing, size timing, growth timing and momentum timing abilities at the same time, and are able to distinguish them appropriately because the correlation between these four style timing parameters is considered. Furthermore, the problem above indicates that it is inappropriate to focus on only one timing ability, especially market timing ability, without good reason. Previous studies that focus only on market timing are likely to lead to misleading conclusions.

7.4. Importance of Growth Timing Ability

This section tries to answer the question of how much of the abnormal returns earned by superior performing growth-oriented fund managers are attributable to their growth timing skill. In other words, the following research question is considered:

Q5: How much of the abnormal returns earned by superior performing growth-oriented fund managers are attributable to the fund managers' growth timing skill?

The abnormal returns earned by superior performing growth-oriented fund managers can be classified into three parts: fund managers' good luck, growth timing skill and other skills. In order to analyse how much of abnormal returns are attributable to these three parts, two controls are designed based on the method of Busse (1999). As explained in Section 3.4, the method of Busse (1999) can remove the influence of skills from fund performance. The first control is superior performing random portfolios which are constructed by removing the influence of all skills from the performance of superior performing growth-oriented funds. In other words, the abnormal returns demonstrated by superior performing random portfolios represent the abnormal returns earned by good luck.

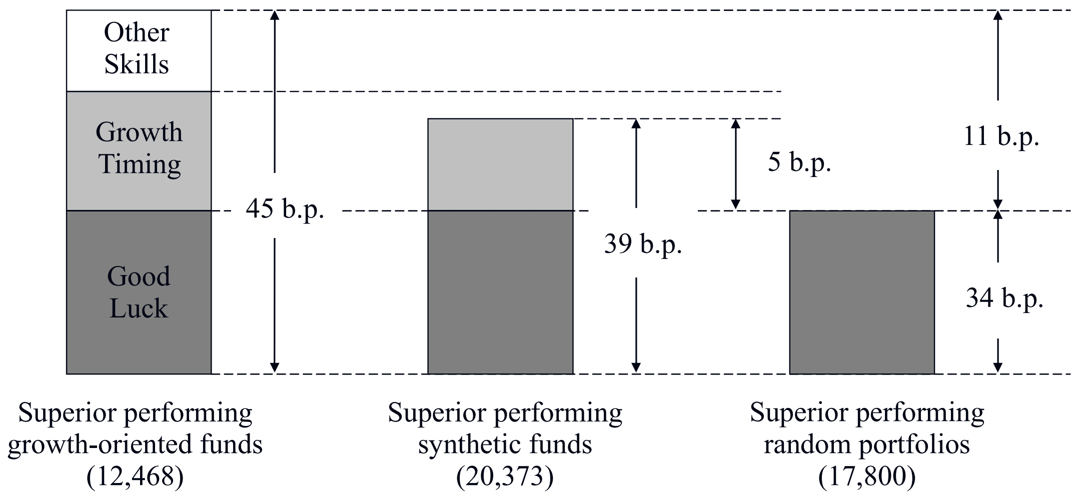
The second control is superior performing synthetic funds which are constructed by removing the influence of all other skills except for growth timing skill, from the performance of superior performing growth-oriented funds. The method of Busse (1999) is used to construct these funds according to the sample funds' exposure to growth and value stocks. Thus, the synthetic funds here retain part of the growth timing ability of superior performing sample funds and the abnormal returns demonstrated by these funds can be attributable partly to good luck and partly to the superior performing fund managers' growth timing skill.

Figure 7-1 illustrates the components of the average abnormal return, i.e. Carhart alpha, earned by these three fund groups: superior performing growth-oriented funds, superior performing synthetic funds and superior performing random portfolios. It shows that the observed growth timing skill accounts for at least 45% of the abnormal returns earned by superior performing growth-oriented fund managers. There are 12,468 superior performing fund instances and, as shown in Figure 7-1, their average Carhart alpha is 45 basis points per month (i.e. 5.54% per year).[44] Superior performing random portfolios demonstrate an average Carhart alpha of 34 basis points per month. Therefore, superior performing fund managers earn additional returns of 11 (=45-34) basis points per month (i.e. 1.33% per year). Furthermore, although superior performing synthetic funds maintain part of the growth timing ability of actual funds, they do not possess other timing skills. The average Carhart alpha of these superior performing synthetic funds is 39 basis points per month. Therefore, at least 5 (=39-34) basis points per month, i.e. 45% (=5/11) of the abnormal returns earned by skill, are attributable to the observed growth timing skill.

[44] As discussed in Section 3.6, the sub-period lengths used in the tests include 3, 5 and 9 years, and hence there are 12, 10 and 6 sub-periods respectively over my 14-year test period from January 1993 to December 2006. Theoretically, since there are 3,181 funds in my sample and there are 28 (=12+10+6) sub-periods for each fund, there are at most 89,068 (=3,181*28) fund instances. Since some funds do not exist for the whole test period or do not have enough observations to estimate Carhart (1997) alpha, I have only 71,604 fund instances in total. Accordingly, the proportion of observing superior performing funds that produce a significant positive Carhart (1997) alpha is about 17.41% (=12,468/71,604).

Figure 7-1: Abnormal returns earned by the growth timing skill of superior performing growth-oriented fund managers

This figure illustrates the components of the average abnormal return, i.e. Carhart alpha, earned by the three fund groups: superior performing growth-oriented funds, superior performing synthetic funds, and superior performing random portfolios. The abnormal returns earned by superior performing growth-oriented fund managers are attributable to fund managers' good luck, the growth timing skill observed in this study, and other unidentified skills. The method of Busse (1999) is applied to construct the synthetic funds according to the sample funds' exposures to growth and value stocks so that the synthetic funds here retain part of the growth timing ability of the sample funds. Therefore, the abnormal returns demonstrated by superior performing synthetic funds could be attributable to good luck and part of the growth timing ability of the sample funds. Since the random portfolios are constructed by randomly picked stocks, the abnormal returns demonstrated by superior performing random portfolios are completely attributable to good luck. The number of fund instances used to estimate the average abnormal return for each fund group is shown in parentheses. The unit of the abnormal return is basis point (b.p.) per month.



7.5. Review of Persistent Superior Performance

This section examines whether the superior performance demonstrated by growth-oriented fund managers still persists after considering growth timing ability. That is, growth timing is added into Carhart's (1997) four-factor model and the persistence test used by Kosowski *et al.* (2006) is adopted to examine whether the superior performance demonstrated by growth-oriented fund managers still persists.

Q6: Do superior performing growth-oriented fund managers still demonstrate persistent superior performance after growth timing ability is added to Carhart's (1997) four-factor model?

$H6_0$: *Superior performing growth-oriented fund managers do not demonstrate persistent superior performance if a growth timing ability is added to Carhart's (1997) four-factor model.*

Adding a growth timing parameter into Carhart's (1997) four-factor model, we obtain:

a. The Carhart (1997) four-factor Treynor and Mazuy (1966) growth timing model (CTM_GT):

$$r_{i,t} = \alpha_i + \beta_i \cdot RMRF_t + s_i \cdot SMB_t + h_i \cdot HML_t + p_i \cdot MOM_t + \gamma_i \cdot HML_t^2 + \varepsilon_{i,t} \quad (7.5)$$

b. The Carhart (1997) four-factor Henriksson and Merton (1981) growth timing model (CHM_GT):

$$r_{i,t} = \alpha_i + \beta_i \cdot RMRF_t + s_i \cdot SMB_t + h_i \cdot HML_t + p_i \cdot MOM_t + \gamma_i \cdot HML_t^* + \varepsilon_{i,t} \qquad (7.6)$$

where $r_{i,t}$ is the month *t* excess return of mutual fund *i* (net return minus T-bill return); $RMRF_t$ is month *t* excess return on a value-weighted aggregate market proxy portfolio; SMB_t, HML_t and MOM_t are returns on value-weighted, zero-investment factor-mimicking portfolios for size, book-to-market equity and one-year momentum in stock returns respectively; the intercept, α_i, is abnormal returns earned by the fund managers, i.e. fund performance; γ_i is the growth timing coefficient and a significantly positive γ_i means that the mutual fund manager demonstrates successful growth timing ability; $HML_t^* = I\{HML_t > 0\} \cdot HML_t$, where $I\{HML_t > 0\}$ is an indicator function that equals one if HML_t is positive and zero otherwise.

The persistence test of Kosowski *et al.* (2006) is used to examine whether growth-oriented fund managers demonstrate persistent superior performance based on CTM_GT or CHM_GT. Growth-oriented funds are sorted on 1 January each year (from 1996 until 2006) into portfolios based on fund performance (α_i) over the prior three years, and the portfolios are held for one year. A minimum of 36 monthly net return observations are required for estimating α_i. For funds that have missing return data, observations from the 12 months preceding the three-year window are added to obtain 36 observations. On average, there are 1,573 growth-oriented funds examined every year during the test period. In addition, management expenses (such as management and administrative charges, 12b-1 fees and other operating costs) but not sale charges (such as front-end or deferred loads and redemption fees) are considered in the test procedure. The portfolios are equally weighted monthly, so the weights are readjusted whenever a fund disappears. If growth-oriented fund managers can earn abnormal returns persistently, at least the top portfolio should demonstrate abnormal returns, i.e. significantly positive α_i ; otherwise, the hypothesis that growth-oriented fund managers are not able to demonstrate persistent superior performance based on CTM_GT or CHM_GT cannot be rejected. Tables 7-4 and 7-5 report the results of persistence tests on the 3,181 sample growth-oriented funds based on the Carhart (1997) four-factor Treynor and Mazuy (1966) growth timing model (CTM_GT) and the Carhart (1997) four-factor Henriksson and Merton (1981) growth timing model (CHM_GT) respectively.

Table 7-4: Persistence of fund performance measured by the Carhart (1997) four-factor Treynor and Mazuy (1966) growth timing model

This table reports the results of tests on the persistence of fund performance measured by the Carhart (1997) four-factor Treynor and Mazuy (1966) growth timing model (CTM_GT) based on monthly return data of 3,181 US growth-oriented equity mutual funds from Jan. 1993 to Dec. 2006. The sample funds are sorted on January 1 each year (from 1996 until 2006) into decile portfolios based on their performance (α_i) estimated over the prior three years. For funds that have missing observations during these prior three years, observations from the 12 months preceding the three-year window are added to obtain 36 observations. The portfolios are equally weighted monthly. Funds with the highest three-year α_i comprise 1.dec, and funds with the lowest comprise 10.dec. "Top" ("Bottom") is the portfolio of the fund with the best (worst) α_i. The "1%ile" ("5%ile") portfolio is an equally weighted portfolio of the top-1% (top-5%) funds, while the "99%ile" ("95%ile") is an equally weighted portfolio of the worst-1% (worst-5%) funds. The last four rows represent the portfolios which hold "Top" and sell "Bottom" (T-B), hold 1%ile and sell 99%ile (1-99), hold 5%ile and sell 95%ile (5-95) and hold 1.dec and sell 10.dec (10-90) respectively. Columns 2 and 3 are the mean and standard deviation of the portfolio excess returns. Columns 4 and 5 show the portfolios' performance (α_i) and the bootstrapped p-value. The following five columns present the growth timing coefficient (γ_i) and the coefficients of Carhart's four factors. The last column reports the adjusted R-squared of CTM_GT.

Fractile	E.Ret (%)	Stdev (%)	α_i (%)	BS p-val	γ_i	RMRF	SMB	HML	MOM	Adj. R^2
Top	-0.14	8.68	-0.36	0.149	-2.082	1.247	0.302	-0.331	1.016	0.723
1%ile	0.49	6.64	-0.03	0.813	0.437	1.109	0.217	-0.370	0.010	0.912
5%ile	0.43	5.38	-0.14	0.016	0.451	1.049	0.097	-0.153	-0.009	0.961
1.dec	0.41	4.94	-0.15	0.001	0.350	1.026	0.023	-0.065	0.037	0.975
2.dec	0.43	4.32	-0.21	0.000	0.777	0.964	-0.029	0.035	-0.019	0.989
3.dec	0.46	4.27	-0.20	0.000	0.837	0.975	-0.052	0.074	-0.050	0.985
4.dec	0.38	4.20	-0.22	0.000	0.425	0.973	-0.085	0.111	-0.021	0.986
5.dec	0.42	4.23	-0.20	0.000	0.501	0.979	-0.082	0.102	-0.056	0.988
6.dec	0.39	4.21	-0.22	0.000	0.424	0.976	-0.094	0.114	-0.030	0.984
7.dec	0.35	4.28	-0.24	0.000	0.332	0.982	-0.082	0.105	0.025	0.984
8.dec	0.31	4.26	-0.30	0.000	0.164	0.985	-0.052	0.141	-0.011	0.976
9.dec	0.29	4.37	-0.30	0.000	0.047	0.998	-0.045	0.123	-0.109	0.962
10.dec	0.39	4.53	-0.28	0.000	0.706	1.012	-0.013	0.049	-0.204	0.968

Table 7-4: Persistence of fund performance measured by the Carhart (1997) four-factor Treynor and Mazuy (1966) growth timing model – continued

Fractile	E.Ret (%)	Stdev (%)	α_i (%)	BS p-val	γ_i	RMRF	SMB	HML	MOM	Adj. R^2
95%ile	0.36	4.78	-0.29	0.000	0.705	1.024	0.041	-0.017	-0.247	0.965
99%ile	0.31	5.74	-0.29	0.000	0.503	1.113	0.093	-0.167	-0.219	0.932
Bottom	-0.04	10.05	-0.78	0.020	2.537	1.108	0.499	-0.714	-0.058	0.615
T-B	-0.10	7.60	0.42	0.283	-4.618	0.139	-0.198	0.383	1.074	0.074
1-99	0.17	2.60	0.26	0.038	-0.066	-0.005	0.124	-0.203	0.228	0.174
5-95	0.06	1.63	0.15	0.048	-0.255	0.025	0.056	-0.135	0.238	0.213
10-90	0.02	1.33	0.13	0.042	-0.356	0.014	0.036	-0.114	0.241	0.205

Table 7-5: Persistence of fund performance measured by the Carhart (1997) four-factor Henriksson and Merton (1981) growth timing model

This table reports the results of tests on the persistence of fund performance measured by the Carhart (1997) four-factor Henriksson and Merton (1981) growth timing model (CHM_GT) based on monthly return data of 3,181 US growth-oriented equity mutual funds from Jan. 1993 to Dec. 2006. The sample funds are sorted on January 1 each year (from 1996 until 2006) into decile portfolios based on their performance (α_i) estimated over the prior three years. For funds that have missing observations during these prior three years, observations from the 12 months preceding the three-year window are added to obtain 36 observations. The portfolios are equally weighted monthly. Funds with the highest three-year α_i comprise 1.dec, and funds with the lowest comprise 10.dec. "Top" ("Bottom") is the portfolio of the fund with the best (worst) α_i. The "1%ile" ("5%ile") portfolio is an equally weighted portfolio of the top-1% (top-5%) funds, while the "99%ile" ("95%ile") is an equally weighted portfolio of the worst-1% (worst-5%) funds. The last four rows represent the portfolios which hold "Top" and sell "Bottom" (T-B), hold 1%ile and sell 99%ile (1-99), hold 5%ile and sell 95%ile (5-95) and hold 1.dec and sell 10.dec (10-90) respectively. Columns 2 and 3 are the mean and standard deviation of the portfolio excess returns. Columns 4 and 5 show the portfolios' performance (α_i) and the bootstrapped p-value. The following five columns present the growth timing coefficient (γ_i) and the coefficients of Carhart's four factors. The last column reports the adjusted R-squared of CHM_GT.

Fractile	E.Ret (%)	Stdev (%)	α_i (%)	BS p-val	γ_i	RMRF	SMB	HML	MOM	Adj. R^2
Top	-0.02	10.25	-0.35	0.541	-0.129	1.310	0.506	-0.503	0.616	0.696
1%ile	0.56	6.19	-0.24	0.198	0.202	1.122	0.167	-0.336	0.083	0.917
5%ile	0.43	5.17	-0.22	0.027	0.108	1.033	0.066	-0.176	-0.012	0.966
1.dec	0.44	4.80	-0.23	0.004	0.117	1.005	0.028	-0.114	-0.020	0.977
2.dec	0.44	4.22	-0.29	0.000	0.130	0.965	-0.047	0.030	-0.020	0.983
3.dec	0.42	4.27	-0.31	0.000	0.118	0.981	-0.043	0.040	-0.050	0.987
4.dec	0.42	4.22	-0.31	0.000	0.117	0.978	-0.035	0.055	-0.108	0.986
5.dec	0.42	4.24	-0.30	0.000	0.123	0.982	-0.072	0.048	-0.021	0.990
6.dec	0.37	4.25	-0.26	0.000	0.066	0.979	-0.087	0.079	0.050	0.985
7.dec	0.34	4.22	-0.30	0.000	0.052	0.980	-0.100	0.125	0.014	0.967
8.dec	0.32	4.38	-0.26	0.000	0.028	0.990	-0.057	0.059	-0.047	0.982
9.dec	0.27	4.43	-0.26	0.002	-0.025	1.001	-0.055	0.104	-0.100	0.968
10.dec	0.39	4.58	-0.35	0.000	0.135	1.009	0.004	-0.035	-0.163	0.965

Table 7-5: Persistence of fund performance measured by the Carhart (1997) four-factor Henriksson and Merton (1981) growth timing model – continued

Fractile	E.Ret (%)	Stdev (%)	α_i (%)	BS p-val	γ_i	RMRF	SMB	HML	MOM	Adj. R^2
95%ile	0.41	4.72	-0.35	0.000	0.158	1.001	0.060	-0.101	-0.285	0.957
99%ile	0.47	5.55	-0.27	0.154	0.191	0.980	0.227	-0.319	-0.674	0.882
Bottom	0.44	9.01	-0.41	0.418	0.561	0.868	0.383	-1.293	-1.145	0.693
T-B	-0.46	6.28	0.05	0.927	-0.690	0.442	0.124	0.790	1.761	0.160
1-99	0.08	2.57	0.04	0.879	0.011	0.143	-0.061	-0.017	0.756	0.116
5-95	0.01	1.53	0.13	0.372	-0.050	0.032	0.006	-0.075	0.273	0.114
10-90	0.05	1.26	0.12	0.324	-0.018	-0.004	0.025	-0.079	0.144	0.078

Growth-oriented fund managers do not demonstrate persistent superior performance after the growth timing parameter is considered in the Carhart's (1997) four-factor model. As shown in Tables 7-4 and 7-5, even the top portfolio cannot earn positive abnormal returns. That is, based on CTM_GT or CHM_GT, growth-oriented fund managers are not able to earn abnormal returns persistently. Conversely, as discussed in Section 5.6, Table 5-12 reveals that the portfolio with the top 1% Carhart alphas demonstrates a significantly positive Carhart alpha. That is, based on the Carhart's (1997) four-factor model, at least the top 1% growth-oriented funds exhibit persistent superior performance, which is consistent with the finding of Kosowski *et al.* (2006). These results suggest that the anomaly revealed by Kosowski *et al.* (2006) could be largely explained by fund managers' growth timing ability.

7.6. Summary

This chapter studies the persistence, misidentification and importance of growth timing skill, and, importantly, examines whether growth timing skill can explain the persistent superior performance revealed by Kosowski *et al.* (2006).

The persistence of the observed growth timing ability indicates that superior performing growth-oriented fund managers possess substantial growth timing skill. The observed growth timing skill, however, is only attributable to a small portion of growth-oriented fund managers. This finding is similar to the conclusion of Kosowski *et al.* (2006) that a sizable minority of growth-oriented fund managers have the ability to earn abnormal returns. It is then revealed that growth timing ability is likely to be misidentified as market timing ability if researchers focus only on market timing. The style timing models used in this thesis can distinguish growth timing ability from market timing ability. The misidentification problem turns out to be important despite being ignored in previous studies. Moreover, it is estimated that the observed growth timing skill accounts for at least 45% of abnormal returns earned by superior performing growth-oriented fund managers.

Growth-oriented fund managers do not demonstrate persistent superior performance after the growth timing parameter is considered in the Carhart (1997) four-factor model. This suggests that the anomaly revealed by Kosowski *et al.* (2006) can be largely explained by fund managers' growth timing ability.

CHAPTER 8

CONCLUSIONS AND LIMITATIONS

8.1. Introduction

This thesis studies the timing skill that growth-oriented fund managers use to earn abnormal returns. The institutional background and research literature are reviewed and then, drawing on this, testable hypotheses are developed from the research questions. The data and the methodologies used to test the hypotheses are then explained in detail. The empirical analysis includes a series of tests and can be separated into three successive topics. The first empirical chapter of the thesis, Chapter 5, aimed to identify the timing skill possessed by superior performing growth-oriented fund managers. Chapter 6 investigated the origin of the observed timing skill. Chapter 7 discussed a number of issues concerning the observed skill demonstrated by superior performing growth-oriented fund managers.

This final chapter summarizes the main empirical findings of the thesis and discusses the original contributions to theory and practice. The final section outlines possible future developments of my work.

8.2. Summary and Discussion

Based on Carhart's (1997) four-factor model, Kosowski *et al.* (2006) show that certain growth-oriented fund managers demonstrate genuine skill in earning abnormal returns. This work goes further to explore the timing abilities behind these superior returns. The monthly returns of 3,181 US growth-oriented funds are examined over the period 1993–2006, collected from the CRSP survivor-bias-free mutual fund database. Two style timing models are developed by applying the approach of Treynor and Mazuy (1966) and Henriksson and Merton (1981) to the Carhart (1997) four-factor model. These style timing models are used to extract information about timing abilities from the abnormal returns earned by growth-oriented fund managers. Specifically, market timing, size timing, growth timing and momentum timing skills are measured.

The results indicate that superior performing growth-oriented fund managers, who earn abnormal returns, have an abnormally high proportion of demonstrating growth timing ability. Growth timing accounts for at least 45% of the abnormal returns earned by the top decile of growth-oriented fund managers who demonstrate significant skill. In addition, the results indicate that the more growth oriented the fund, the greater the returns earned by the observed growth timing skill. In other words, growth timing skill is specific to those managers who invest primarily in growth stocks. Importantly, growth timing skill is found to be persistent.

However, there is no evidence that superior performing growth-oriented fund managers possess market timing, size timing or momentum timing skill. The result for market timing is consistent with the fact that all sample funds are “equity” funds which tend to remain fully invested. Managers could shift weight the market beta while still remaining fully invested, but there is no evidence for this. Similarly, since about 90% of the sample funds invest mainly in large capitalization stocks, it is not surprising to find no empirical support for the existence of size timing ability.

Moreover, Wermers (1999) finds evidence of fund manager herding and positive-feedback trading, which means that fund managers tend to adopt a momentum investing strategy rather than switch between momentum and contrarian investing strategies, i.e. momentum timing. Therefore, it is not surprising to observe no evidence of momentum timing skill.

Another finding is that growth timing ability is likely to be misidentified as market timing ability if researchers focus only on market timing ability. The style timing models used in this study make it possible to distinguish growth timing ability from market timing ability. This misidentification problem turns out to be important but is ignored in previous studies.

8.3. Contribution to Theory and Practice

The findings of this thesis make the following contributions to the study of fund performance evaluation and provide new insights into the practice of mutual fund timing strategies:

Provides an explanation of the persistent abnormal returns identified by Kosowski et al. (2006)

The most important finding is an explanation for the persistent abnormal returns identified by Kosowski *et al.* (2006). The growth timing skill of superior performing growth-oriented fund managers can account for more than half of the abnormal returns demonstrated by these fund managers.

This finding is an important contribution to mutual fund performance evaluation. Mutual fund performance evaluation is one of the most important topics in finance, because it improves asset pricing theories and provides useful evidence for debates concerning the efficient market hypothesis (EMH). Carhart's (1997) four-factor model is the up-to-date mutual fund performance evaluation model. Kosowski *et al.* (2006), however, demonstrate an anomaly: using the bootstrap method to estimate the coefficient significance, they find that growth-oriented fund managers can earn abnormal returns persistently, even based on Carhart's (1997) four-factor model. In other words, mutual fund performance is not perfectly explained by Carhart's four systematic factors, i.e. market, size, book-to-market and momentum factors. As shown in this thesis, this anomaly could be explained by growth timing skill, which indicates potentially the most fruitful direction for the next generation of mutual fund performance evaluation models.

Extends current studies on mutual fund timing activity

Most existing studies relating to the timing activity of mutual fund managers focus on market timing. Recently, more and more researchers, such as Daniel *et al.* (1997), Lu (2005), and Swinkels and Tjong-A-Tjoe (2007), have begun to investigate other timing activities in addition to market timing. However, Daniel *et al.* (1997) do not find evidence for successful timing activity. Although Lu (2005) and Swinkels and Tjong-A-Tjoe (2007) find that mutual fund managers have certain style timing abilities, they focus on the funds which, according to Carhart (1997), cannot earn abnormal returns persistently.

This study seeks to extend the existing mutual fund literature on market timing behaviour to a broader consideration of other timing strategies. Lu's (2005) style timing models, which can measure market timing, size timing, growth timing and momentum timing abilities, are adopted. Unlike the models of Swinkels and Tjong-A-Tjoe (2007), the style timing models used consider the inter-correlations between the timing parameters and hence are able to separate out the impact of each timing skill more precisely. Although these style timing models may not be correctly specified, the approach adopted, which uses the bootstrap statistical approach of Kosowski *et al.* (2006), is robust to possible misspecification. Unlike Lu (2005) and Swinkels and Tjong-A-Tjoe (2007), the focus is on superior performing growth-oriented funds, which can earn abnormal returns persistently according to Kosowski *et al.* (2006). In addition, the existence of growth timing skill is tested in three aspects: the proportion of demonstrating growth timing skill, growth timing persistence and superior performance persistence. All the above provide comprehensive and convincing results in the study of mutual fund timing activities in addition to market timing.

Originates new viewpoints for mutual fund management and investment

This thesis develops new viewpoints for mutual fund managers and investors. It can help fund managers evaluate the effectiveness of their timing strategies in improving their performance. The empirical results confirm the importance of growth timing skill for growth-oriented fund managers, which means that ways to improve growth timing ability is an important consideration in seeking to outperform competitors.

The investigation of fund timing activities is also important for potential mutual fund clients looking to allocate their funds efficiently. In particular, fund managers' growth timing ability should be carefully considered before investing in growth-oriented funds.

8.4. Future Research

In this section, a number of future research topics are suggested, which can be categorized into two areas. One is further study into growth timing skill, while the other is to search for other timing skills. These possible research topics are outlined in detail in the following.

Further analysis of growth timing skill

As discussed in the last section, growth timing skill is likely to contribute to the improvement of the mutual fund performance evaluation theory. In addition, since growth timing skill accounts for at least half of the abnormal returns earned by superior performing growth-oriented fund managers, both growth-oriented fund managers and investors should pay more attention to this skill. Therefore, further understanding of growth timing skill is necessary for both academic and practical application.

One of the most important topics is to study how/why superior performing growth-oriented fund managers successfully time across the value/growth continuum. This question could be studied in a number of ways. First, the fund portfolio holdings could be analysed. Since mutual fund portfolio holdings contain much more information than fund returns, a detailed examination of actual portfolio holdings could provide a more accurate picture of fund managers' timing behaviour. When CRSP was updated in mid-April 2008, it started to provide mutual fund portfolio holding data. This makes the analysis of mutual fund portfolio holdings possible in the future. Second, other techniques could be applied in the analysis. For example, the theory of Ferson and Schadt (1996) could be used to assess successful growth timing activity is due to superior analysis of public information or fund managers' superior private information by including lagged information variables and/or revised timing parameters which incorporate lagged information in the analysis of mutual fund performance evaluation.

Interviews with fund managers would be a direct and efficient method to investigate this question. This thesis provides a number of methods to identify the funds which truly demonstrate growth timing skill. Interviewing the managers of these funds could unearth the source of their successful growth timing behaviour. Studying the regulation of the mutual fund industry may also provide clues. For example, Bae and Yi (2008) find that the perverse timing ability documented in the previous literature is partly due to the "short-short rule," which requires that mutual funds derive less than 30 percent of their gross income from the sale of securities held for less than three months.

A longer test period could also reveal information concerning the practical application of growth timing skill. The data in this study currently covers a 14-year period (1993-2006), which includes the Dot-Com bubble (roughly 1995–2001) and the bull market before the sub-prime mortgage crisis. Although the sensitivity tests show that my conclusion is robust to the Dot-Com bubble, this test period is not as long as the 32-year (1962-1993) test period of Carhart (1997) or the 28-year (1975-2002) test period of Kosowski *et al.* (2006). Therefore, a longer period which covers several economic cycles could provide more reliable results and may reveal more information regarding fund managers' timing activities under different market conditions.

Search for other timing skills

Another direction for future study is to search for other timing skills. Although market timing attracts much research attention, other timing abilities, such as growth timing, are often ignored in previous studies. The existence of growth timing skill revealed in this thesis leads to the question of whether there are other timing skills which are also important in practice but ignored in academic analysis.

The literature suggests that other timing skills may be observed. First, different timing activities may exist during a shorter time period. In line with most other studies, this study uses monthly mutual fund return data to conduct timing tests. As discussed by Goetzmann, Ingersoll and Ivkovic (2000), monthly frequency may fail to capture the contribution of a manager's timing activities to fund returns when decisions regarding timing activities are made more frequently than monthly. Therefore, other mutual fund returns observation frequencies, such as semi-monthly, weekly or even daily, may yield results different to those obtained in this study.

Second, different timing activities may exist in different fund groups. As suggested by my test results, growth timing skill is used by growth-oriented fund managers for growth stock investment, while value stock investment does not require this skill and therefore no evidence of growth timing skill is found among the funds which invest primarily in value stocks. In other words, growth timing skill is likely to be a specific skill used mainly by growth-oriented fund managers. Similarly, other types of mutual funds may implement other unidentified timing skills because of certain characteristics of their investment targets. Therefore, it would be beneficial to identify unknown or ignored timing skills by investigating the timing activity of other types of mutual funds according to their investment characteristics. After all, the discovery of an unknown timing skill will not only enhance the understanding of the behaviour of mutual fund managers but also contribute to the development of asset pricing theory.

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APPENDIX

Table 5-1: Normality of fund residuals generated by commonly used performance models

This table shows average summary statistics of skewness (S), kurtosis (K) and Jarque-Bera (JB) of the 3,181 sample funds' returns, excess returns, residuals of Jensen's (1968) model, residuals of Fama-French (1993) three factor model (FF3), and residuals of Carhart's (1997) four-factor model. The sample period is January 1993 to December 2006, a total of 168 months.

S and K and are computed as follows:

$$S = \frac{\left[\mathrm{E}(X-\mu)^3\right]^2}{\left[\mathrm{E}(X-\mu)^2\right]^3} \qquad K = \frac{\mathrm{E}(X-\mu)^4}{\left[\mathrm{E}(X-\mu)^2\right]^2}$$

The Jarque-Bera (JB) test for normality is given by

$$JB = \frac{\mathrm{N}}{6}\left[S^2 + \frac{(K-3)^2}{4}\right] \sim \chi^2_{(2)}$$

	Fund Return	Excess Return	Jensen's Residual	FF3's Residual	Carhart's Residual
Max S	10.105	10.109	10.489	10.238	10.181
Min S	-3.672	-3.648	-10.352	-10.421	-10.322
% of S ≥ 0	11.1%	11.1%	53.2%	59.9%	61.9%
% of S < 0	88.9%	88.9%	46.8%	40.1%	38.1%
Max K	108.315	108.361	124.772	125.603	124.089
Min K	2.027	1.966	1.816	1.815	1.833
% of K ≥ 3	85.8%	85.9%	86.7%	82.6%	81.2%
% of K < 3	14.2%	14.1%	13.3%	17.4%	18.8%
Max JB	206,067	205,380	106,800	108,261	105,621
Min JB	0.004	0.002	0.000	0.002	0.001
% of JB ≤ 0.01	39.8%	40.1%	55.5%	37.8%	36.4%
% of JB ≤ 0.5	49.8%	50.2%	61.9%	46.9%	45.7%
% of JB ≤ 0.1	56.5%	56.9%	65.3%	53.9%	52.1%

Table 5-2: Summary statistics of fund instance coefficients of Carhart's (1997) four-factor model

This table reports the fractions and means of the coefficients of Carhart's (1997) four-factor model of the 3,181 sample funds under six test settings. Columns 2-7 show the statistics for six test settings, in which the first number is sub-period length (years) and the second number is minimum observation number (months). The number in parentheses below each test setting is the number of fund instances. Panels A to E show the statistics for the intercept and four coefficients of Carhart's (1997) four-factor model respectively. In each panel are the fractions (%) and means of the corresponding coefficients that are positive (>0), negative (≤0), significantly positive (>0***) and significantly negative (≤0***). *** means significance level of 0.01 based on the bootstrap method of Kosowski et al. (2006).

	3, 36 (18,474)	5, 36 (18,331)	5, 60 (12,476)	9, 36 (14,429)	9, 60 (10,599)	9, 108 (4,650)
Panel A: the intercept (alpha)						
%						
> 0	32.16	30.19	29.27	29.96	29.15	27.18
≤ 0	67.84	69.81	70.73	70.04	70.85	72.82
> 0***	10.79	12.97	12.62	13.55	14.15	12.86
≤ 0***	37.10	44.05	44.99	46.49	48.65	52.15
Mean						
> 0	0.003	0.003	0.002	0.002	0.002	0.002
≤ 0	-0.003	-0.003	-0.003	-0.002	-0.002	-0.002
> 0***	0.006	0.004	0.004	0.004	0.003	0.003
≤ 0***	-0.004	-0.004	-0.003	-0.003	-0.003	-0.003
Panel B: the coefficient of RMRF						
%						
> 0	99.94	99.95	99.98	99.97	99.97	100.00
≤ 0	0.06	0.05	0.02	0.03	0.03	0.00
> 0***	99.68	99.80	99.92	99.87	99.93	100.00
≤ 0***	0.01	0.01	0.00	0.01	0.00	0.00
Mean						
> 0	0.976	0.979	0.979	0.983	0.983	0.980
≤ 0	-0.051	-0.057	-0.104	-0.090	-0.107	---
> 0***	0.978	0.980	0.980	0.984	0.983	0.980
≤ 0***	-0.069	-0.066	---	-0.066	---	---

Table 5-2: Summary statistics of fund instance coefficients of Carhart's (1997) four-factor model – continued

	3, 36	5, 36	5, 60	9, 36	9, 60	9, 108
Panel C: the coefficient of SMB						
%						
> 0	39.46	35.58	34.96	31.78	30.24	29.10
≤ 0	60.54	64.42	65.04	68.22	69.76	70.90
> 0***	12.29	12.85	13.56	12.25	12.80	13.51
≤ 0***	27.95	33.87	34.44	41.29	43.94	45.38
Mean						
> 0	0.194	0.174	0.172	0.167	0.165	0.163
≤ 0	-0.146	-0.131	-0.126	-0.129	-0.125	-0.121
> 0***	0.397	0.335	0.323	0.311	0.297	0.281
≤ 0***	-0.217	-0.185	-0.179	-0.172	-0.165	-0.158
Panel D: the coefficient of HML						
%						
> 0	52.97	55.43	56.64	56.16	56.62	59.14
≤ 0	47.03	44.57	43.36	43.84	43.38	40.86
> 0***	30.66	39.25	41.66	42.95	45.45	49.25
≤ 0***	24.58	28.02	27.59	30.36	31.28	30.11
Mean						
> 0	0.275	0.300	0.308	0.322	0.337	0.346
≤ 0	-0.284	-0.282	-0.276	-0.279	-0.280	-0.271
> 0***	0.393	0.387	0.391	0.396	0.404	0.404
≤ 0***	-0.424	-0.386	-0.379	-0.360	-0.356	-0.344
Panel E: the coefficient of MOM						
%						
> 0	48.69	48.16	48.49	48.83	48.95	50.11
≤ 0	51.31	51.84	51.51	51.17	51.05	49.89
> 0***	2.57	2.85	2.86	3.71	4.07	4.41
≤ 0***	4.11	5.90	6.30	8.52	9.48	9.76
Mean						
> 0	0.334	0.304	0.297	0.299	0.290	0.268
≤ 0	-0.404	-0.385	-0.368	-0.403	-0.392	-0.364
> 0***	0.899	0.838	0.786	0.836	0.796	0.741
≤ 0***	-1.067	-0.976	-0.959	-0.950	-0.934	-0.878

Table 5-3: Summary statistics of fund instance coefficients of the Carhart (1997) four-factor Treynor and Mazuy (1966) style timing model

This table reports the fractions and means of the coefficients of the Carhart (1997) four-factor Treynor and Mazuy (1966) style timing model (CTM) of the 3,181 sample funds under six test settings. Columns 2-7 show the statistics for six test settings, in which the first number is sub-period length (years) and the second number is minimum observation number (months). The number in parentheses below each test setting is the number of fund instances. Panels A to E show the statistics for the intercept and four style timing coefficients of CTM respectively. In each panel are the fractions (%) and means of the corresponding intercepts or timing coefficients that are positive (>0), negative (≤0), significantly positive (>0***) and significantly negative (≤0***). *** means significance level of 0.01 based on the bootstrap method of Kosowski et al. (2006).

	3, 36 (18,474)	5, 36 (18,331)	5, 60 (12,476)	9, 36 (14,429)	9, 60 (10,599)	9, 108 (4,650)
Panel A: Intercept (alpha)						
%						
> 0	35.47	32.26	31.71	26.83	25.10	21.78
≤ 0	64.53	67.74	68.29	73.17	74.90	78.22
> 0***	2.93	1.85	1.49	1.30	1.17	0.71
≤ 0***	14.24	14.75	15.11	18.37	20.22	21.33
Mean						
> 0	0.004	0.003	0.003	0.003	0.002	0.002
≤ 0	-0.004	-0.003	-0.003	-0.003	-0.003	-0.003
> 0***	0.011	0.010	0.008	0.010	0.008	0.005
≤ 0***	-0.007	-0.006	-0.006	-0.005	-0.005	-0.005
Panel B: Market timing coefficient						
%						
> 0	50.58	45.42	44.65	43.59	42.26	40.24
≤ 0	49.42	54.58	55.35	56.41	57.74	59.76
> 0***	4.18	3.08	2.72	1.70	1.10	0.47
≤ 0***	2.83	2.39	2.28	2.62	2.48	2.58
Mean						
> 0	1.721	0.925	0.820	0.820	0.667	0.499
≤ 0	-1.331	-0.757	-0.682	-0.662	-0.543	-0.445
> 0***	4.942	2.898	2.538	3.314	2.944	2.117
≤ 0***	-3.763	-2.063	-1.759	-1.882	-1.479	-1.208

Table 5-3: Summary statistics of fund instance coefficients of the Carhart (1997) four-factor Treynor and Mazuy (1966) style timing model – continued

	3, 36	5, 36	5, 60	9, 36	9, 60	9, 108
Panel C: Size timing coefficient						
%						
> 0	48.72	46.97	46.52	47.90	46.63	45.31
≤ 0	51.28	53.03	53.48	52.10	53.37	54.69
> 0***	4.76	4.86	5.00	5.73	5.55	5.74
≤ 0***	4.23	3.70	4.06	5.29	6.35	7.94
Mean						
> 0	2.077	1.238	1.048	0.932	0.613	0.519
≤ 0	-2.174	-1.296	-1.180	-0.815	-0.583	-0.456
> 0***	4.278	2.611	2.266	2.092	1.508	1.354
≤ 0***	-6.174	-3.151	-2.816	-1.651	-1.272	-0.951
Panel D: Growth timing coefficient						
%						
> 0	54.15	59.68	61.32	66.49	70.53	71.81
≤ 0	45.85	40.32	38.68	33.51	29.47	28.19
> 0***	6.41	10.19	11.31	12.17	13.76	13.87
≤ 0***	3.77	3.99	4.24	2.28	2.23	2.17
Mean						
> 0	2.731	1.654	1.543	1.246	1.102	1.019
≤ 0	-3.960	-2.090	-1.789	-1.573	-0.914	-0.748
> 0***	4.742	2.865	2.698	2.258	2.108	2.127
≤ 0***	-9.615	-4.948	-4.330	-4.059	-2.410	-2.033
Panel E: Momentum timing coefficient						
%						
> 0	49.71	50.46	50.67	51.11	52.20	54.15
≤ 0	50.29	49.54	49.33	48.89	47.80	45.85
> 0***	2.76	3.92	3.82	7.04	7.87	8.88
≤ 0***	4.74	6.34	6.45	8.38	9.25	9.40
Mean						
> 0	41.391	33.145	30.598	30.493	28.824	27.938
≤ 0	-44.182	-37.041	-34.933	-37.055	-35.999	-33.008
> 0***	95.527	73.961	64.796	62.829	57.331	52.563
≤ 0***	-105.497	-84.620	-80.037	-81.564	-77.070	-71.014

Table 5-4: Summary statistics of fund instance coefficients of the Carhart (1997) four-factor Henriksson and Merton (1981) style timing model

This table reports the fractions and means of the coefficients of the Carhart (1997) four-factor Henriksson and Merton (1981) style timing model (CHM) of the 3,181 sample funds under six test settings. Columns 2-7 show the statistics for six test settings, in which the first number is sub-period length (years) and the second number is minimum observation number (months). The number in parentheses below each test setting is the number of fund instances. Panels A to E show the statistics for the intercept and four style timing coefficients of CHM respectively. In each panel are the fractions (%) and means of the corresponding intercepts or timing coefficients that are positive (>0), negative (≤0), significantly positive (>0***) and significantly negative (≤0***). *** means significance level of 0.01 based on the bootstrap method of Kosowski et al. (2006).

	3, 36 (18,474)	5, 36 (18,331)	5, 60 (12,476)	9, 36 (14,429)	9, 60 (10,599)	9, 108 (4,650)
Panel A: Intercept (alpha)						
%						
> 0	38.15	32.45	31.03	23.43	19.88	15.76
≤ 0	61.85	67.55	68.97	76.57	80.12	84.24
> 0***	1.84	1.39	1.39	0.42	0.29	0.15
≤ 0***	10.22	10.25	10.31	11.37	11.91	11.18
Mean						
> 0	0.006	0.004	0.004	0.004	0.003	0.002
≤ 0	-0.006	-0.005	-0.005	-0.005	-0.004	-0.004
> 0***	0.017	0.013	0.012	0.013	0.010	0.008
≤ 0***	-0.012	-0.010	-0.009	-0.009	-0.008	-0.007
Panel B: Market timing coefficient						
%						
> 0	53.22	52.47	52.92	53.00	53.58	55.72
≤ 0	46.78	47.53	47.08	47.00	46.42	44.28
> 0***	3.91	2.25	1.88	1.76	1.34	0.69
≤ 0***	2.24	1.09	0.86	1.07	0.75	0.37
Mean						
> 0	0.247	0.167	0.151	0.153	0.136	0.111
≤ 0	-0.202	-0.137	-0.123	-0.119	-0.100	-0.084
> 0***	0.694	0.546	0.469	0.575	0.544	0.470
≤ 0***	-0.578	-0.416	-0.374	-0.389	-0.336	-0.290

Table 5-4: Summary statistics of fund instance coefficients of the Carhart (1997) four-factor Henriksson and Merton (1981) style timing model – continued

	3, 36	5, 36	5, 60	9, 36	9, 60	9, 108
Panel C: Size timing coefficient						
%						
> 0	49.35	50.01	49.86	52.15	51.10	50.65
≤ 0	50.65	49.99	50.14	47.85	48.90	49.35
> 0***	4.59	3.64	3.53	4.08	3.62	3.18
≤ 0***	4.32	2.81	2.89	2.34	2.37	2.22
Mean						
> 0	0.261	0.191	0.169	0.171	0.142	0.125
≤ 0	-0.281	-0.200	-0.186	-0.159	-0.134	-0.117
> 0***	0.587	0.488	0.447	0.463	0.419	0.389
≤ 0***	-0.738	-0.541	-0.505	-0.470	-0.409	-0.334
Panel D: Growth timing coefficient						
%						
> 0	55.86	60.05	61.92	65.71	69.47	68.99
≤ 0	44.14	39.95	38.08	34.29	30.53	31.01
> 0***	5.87	6.97	7.65	7.95	8.72	8.77
≤ 0***	3.11	2.97	3.29	1.73	1.61	1.87
Mean						
> 0	0.314	0.254	0.246	0.229	0.217	0.202
≤ 0	-0.349	-0.244	-0.228	-0.198	-0.160	-0.138
> 0***	0.670	0.535	0.516	0.483	0.457	0.455
≤ 0***	-1.067	-0.708	-0.658	-0.581	-0.466	-0.378
Panel E: Momentum timing coefficient						
%						
> 0	47.55	47.69	47.81	48.62	50.03	51.53
≤ 0	52.45	52.31	52.19	51.38	49.97	48.47
> 0***	1.79	2.11	1.95	3.19	3.27	3.76
≤ 0***	3.90	4.73	4.75	5.35	5.69	5.76
Mean						
> 0	1.044	0.928	0.873	0.894	0.862	0.830
≤ 0	-1.191	-1.119	-1.080	-1.127	-1.112	-0.973
> 0***	2.878	2.700	2.438	2.271	2.029	1.735
≤ 0***	-3.068	-2.727	-2.541	-2.664	-2.511	-2.319

Table 5-5: The correlation between the intercept and timing coefficients of the Carhart (1997) four-factor Treynor and Mazuy (1966) style timing model

This table reports the correlation between intercept and timing coefficients of the Carhart (1997) four-factor Treynor and Mazuy (1966) style timing model (CTM) for the 3,181 sample funds under six test settings. Panels A to D examine the correlations between intercept and market timing, size timing, growth timing, and momentum timing coefficients respectively. Each panel examines six fund instance groups with different test settings: the first number is the sub-period length (years) and the second number is minimum observation number (months). Columns 2 and 3 report Pearson's correlation coefficients and the corresponding p-values. Columns 4 and 5 report Spearman's rank correlation coefficients and the corresponding p-values. The last four columns report the percentage of fund instances with significant intercept (α) and timing coefficient (γ) at the 0.1 significance level.

Test Setting	Pearson	p-val.	Spearman	p-val.	α>0 γ>0	α>0 γ<0	α<0 γ>0	α<0 γ<0
Panel A: Correlation between intercept and market timing coefficient								
(3, 36)	-0.307***	0.000	-0.307***	0.000	0.88	4.04	7.02	2.55
(5, 36)	-0.320***	0.000	-0.248***	0.000	0.83	3.06	6.43	3.29
(5, 60)	-0.349***	0.000	-0.239***	0.000	0.92	3.16	6.30	3.10
(9, 36)	-0.245***	0.000	-0.161***	0.000	1.26	2.60	5.93	3.74
(9, 60)	-0.197***	0.000	-0.104***	0.000	1.46	2.53	5.71	3.83
(9, 108)	-0.164***	0.000	-0.064***	0.000	2.20	2.79	5.92	3.52
Panel B: Correlation between intercept and size timing coefficient								
(3, 36)	-0.271***	0.000	-0.324***	0.000	0.81	4.54	8.25	2.04
(5, 36)	-0.294***	0.000	-0.331***	0.000	0.61	4.33	7.74	2.67
(5, 60)	-0.304***	0.000	-0.326***	0.000	0.62	4.70	7.38	2.91
(9, 36)	-0.294***	0.000	-0.268***	0.000	0.66	4.41	6.72	5.44
(9, 60)	-0.313***	0.000	-0.232***	0.000	0.68	4.79	5.91	6.59
(9, 108)	-0.375***	0.000	-0.261***	0.000	0.63	6.43	5.00	7.29

***, **, and * represent significance levels of 0.01, 0.05, and 0.1 respectively.

Table 5-5: The correlation between the intercept and timing coefficients of the Carhart (1997) four-factor Treynor and Mazuy (1966) style timing model – continued

Test Setting	Pearson	p val.	Spearman	p val.	α>0 γ>0	α>0 γ<0	α<0 γ>0	α<0 γ<0
Panel C: Correlation between intercept and growth timing coefficient								
(3, 36)	-0.152***	0.000	-0.115***	0.000	2.16	2.99	7.62	3.73
(5, 36)	-0.164***	0.000	-0.029***	0.000	2.24	2.23	8.65	4.24
(5, 60)	-0.228***	0.000	-0.030***	0.000	2.37	2.43	8.96	4.13
(9, 36)	-0.070***	0.000	0.000	0.486	2.45	2.01	9.21	4.35
(9, 60)	-0.111***	0.000	0.005	0.248	2.61	2.10	10.01	4.33
(9, 108)	-0.212***	0.000	-0.033***	0.001	2.81	2.79	8.82	4.10
Panel D: Correlation between intercept and momentum timing coefficient								
(3, 36)	-0.246***	0.000	-0.217***	0.000	0.85	3.08	6.60	3.09
(5, 36)	-0.300***	0.000	-0.240***	0.000	0.63	3.01	8.30	3.34
(5, 60)	-0.313***	0.000	-0.245***	0.000	0.77	3.16	8.21	3.32
(9, 36)	-0.303***	0.000	-0.283***	0.000	0.78	2.92	11.07	3.20
(9, 60)	-0.308***	0.000	-0.306***	0.000	0.93	3.09	12.07	3.38
(9, 108)	-0.301***	0.000	-0.299***	0.000	1.19	2.91	11.44	3.04

***, **, and * represent significance levels of 0.01, 0.05, and 0.1 respectively.

Table 5-6: The correlation between the intercept and timing coefficients of the Carhart (1997) four-factor Henriksson and Merton (1981) style timing model

This table reports the correlation between intercept and timing coefficients of the Carhart (1997) four-factor Henriksson and Merton (1981) style timing model (CHM) for the 3,181 sample funds under six test settings. Panels A to D examine the correlations between intercept and market timing, size timing, growth timing, and momentum timing coefficients respectively. Each panel examines six fund instance groups with different test settings: the first number is the sub-period length (years) and the second number is minimum observation number (months). Columns 2 and 3 report Pearson's correlation coefficients and the corresponding p-values. Columns 4 and 5 report Spearman's rank correlation coefficients and the corresponding p-values. The last four columns report the percentage of fund instances with significant intercept (α) and timing coefficient (γ) at the 0.1 significance level.

Test Setting	Pearson	p-val.	Spearman	p-val.	α>0 γ>0	α>0 γ<0	α<0 γ>0	α<0 γ<0
Panel A: Correlation between intercept and market timing coefficient								
(3, 36)	-0.431***	0.000	-0.378***	0.000	0.59	3.49	6.64	1.21
(5, 36)	-0.391***	0.000	-0.316***	0.000	0.63	2.46	5.85	1.40
(5, 60)	-0.410***	0.000	-0.319***	0.000	0.78	2.54	5.88	1.21
(9, 36)	-0.362***	0.000	-0.299***	0.000	0.49	1.96	6.28	1.35
(9, 60)	-0.345***	0.000	-0.281***	0.000	0.57	1.95	6.47	1.21
(9, 108)	-0.359***	0.000	-0.290***	0.000	0.62	2.44	6.80	1.00
Panel B: Correlation between intercept and size timing coefficient								
(3, 36)	-0.418***	0.000	-0.447***	0.000	0.46	4.54	8.30	1.18
(5, 36)	-0.458***	0.000	-0.454***	0.000	0.21	3.98	7.83	0.97
(5, 60)	-0.466***	0.000	-0.446***	0.000	0.25	4.18	7.26	1.00
(9, 36)	-0.437***	0.000	-0.400***	0.000	0.15	3.40	7.62	1.77
(9, 60)	-0.435***	0.000	-0.368***	0.000	0.17	3.32	6.92	2.10
(9, 108)	-0.469***	0.000	-0.349***	0.000	0.19	4.00	5.66	2.34

***, **, and * represent significance levels of 0.01, 0.05, and 0.1 respectively.

Table 5-6: The correlation between the intercept and timing coefficients of the Carhart (1997) four-factor Henriksson and Merton (1981) style timing model – continued

Test Setting	Pearson	p val.	Spearman	p val.	α>0 γ>0	α>0 γ<0	α<0 γ>0	α<0 γ<0
Panel C: Correlation between intercept and growth timing coefficient								
(3, 36)	-0.296***	0.000	-0.236***	0.000	1.10	3.19	7.94	1.76
(5, 36)	-0.300***	0.000	-0.195***	0.000	1.04	2.43	8.40	2.14
(5, 60)	-0.354***	0.000	-0.209***	0.000	1.04	2.62	8.71	2.08
(9, 36)	-0.189***	0.000	-0.149***	0.000	0.96	1.74	8.56	2.60
(9, 60)	-0.223***	0.000	-0.151***	0.000	0.95	1.71	9.18	2.75
(9, 108)	-0.306***	0.000	-0.176***	0.000	0.91	1.98	8.12	2.90
Panel D: Correlation between intercept and momentum timing coefficient								
(3, 36)	-0.308***	0.000	-0.269***	0.000	0.56	3.13	5.37	2.13
(5, 36)	-0.328***	0.000	-0.283***	0.000	0.34	3.09	6.06	2.76
(5, 60)	-0.351***	0.000	-0.283***	0.000	0.36	3.21	5.68	2.96
(9, 36)	-0.315***	0.000	-0.282***	0.000	0.29	2.46	8.24	2.89
(9, 60)	-0.317***	0.000	-0.288***	0.000	0.28	2.45	8.72	3.13
(9, 108)	-0.352***	0.000	-0.313***	0.000	0.38	2.59	8.80	2.53

***, **, and * represent significance levels of 0.01, 0.05, and 0.1 respectively.

Table 5-7: Summary statistics of synthetic fund instance coefficients of Carhart's (1997) four-factor model

This table reports the fractions and means of the coefficients of Carhart's (1997) four-factor model of the 3,181 synthetic funds under six test settings. Columns 2-7 show the statistics for six test settings, in which the first number is sub-period length (years) and the second number is minimum observation number (months). The number in parentheses below each test setting is the number of fund instances. Panels A to E show the statistics for the intercept and four coefficients of Carhart's (1997) four-factor model respectively. In each panel are the fractions (%) and means of the corresponding coefficients that are positive (>0), negative (≤0), significantly positive (>0***) and significantly negative (≤0***). *** means significance level of 0.01 based on the bootstrap method of Kosowski et al. (2006).

	3, 36 (18,474)	5, 36 (18,331)	5, 60 (12,476)	9, 36 (14,429)	9, 60 (10,599)	9, 108 (4,650)
Panel A: the intercept (alpha)						
%						
> 0	62.76	64.21	64.78	67.93	65.37	60.67
≤ 0	37.24	35.79	35.22	32.07	34.63	39.33
> 0***	27.44	33.92	35.39	36.54	35.88	32.11
≤ 0***	12.63	14.40	14.52	11.27	13.37	16.28
Mean						
> 0	0.003	0.003	0.003	0.002	0.002	0.002
≤ 0	-0.002	-0.002	-0.002	-0.001	-0.001	-0.001
> 0***	0.005	0.004	0.004	0.003	0.003	0.003
≤ 0***	-0.004	-0.003	-0.003	-0.002	-0.002	-0.002
Panel B: the coefficient of RMRF						
%						
> 0	100.00	100.00	100.00	100.00	100.00	100.00
≤ 0	0.00	0.00	0.00	0.00	0.00	0.00
> 0***	99.90	99.99	99.99	99.99	100.00	100.00
≤ 0***	0.00	0.00	0.00	0.00	0.00	0.00
Mean						
> 0	0.951	0.952	0.949	0.954	0.953	0.949
≤ 0	---	---	---	---	---	---
> 0***	0.951	0.952	0.949	0.954	0.953	0.949
≤ 0***	---	---	---	---	---	---

Table 5-7: Summary statistics of Carhart's (1997) four-factor model coefficients of synthetic funds − continued

	3, 36	5, 36	5, 60	9, 36	9, 60	9, 108
Panel C: the coefficient of SMB						
%						
> 0	0.12	0.03	0.03	0.01	0.00	0.00
≤ 0	99.88	99.97	99.97	99.99	100.00	100.00
> 0***	0.00	0.00	0.00	0.00	0.00	0.00
≤ 0***	89.03	95.58	96.02	96.54	97.92	99.05
Mean						
> 0	0.021	0.017	0.017	0.016	---	---
≤ 0	-0.362	-0.364	-0.363	-0.363	-0.363	-0.359
> 0***	---	---	---	---	---	---
≤ 0***	-0.389	-0.376	-0.374	-0.371	-0.368	-0.361
Panel D: the coefficient of HML						
%						
> 0	70.57	74.31	75.95	76.02	77.22	78.28
≤ 0	29.43	25.69	24.05	23.98	22.78	21.72
> 0***	35.41	48.22	51.47	54.65	58.86	61.89
≤ 0***	3.78	4.09	3.86	4.83	5.27	4.88
Mean						
> 0	0.275	0.311	0.321	0.343	0.361	0.375
≤ 0	-0.134	-0.124	-0.120	-0.121	-0.124	-0.116
> 0***	0.435	0.428	0.431	0.443	0.450	0.455
≤ 0***	-0.315	-0.284	-0.275	-0.259	-0.255	-0.236
Panel E: the coefficient of MOM						
%						
> 0	42.98	43.80	44.65	44.17	46.79	47.57
≤ 0	57.02	56.20	55.35	55.83	53.21	52.43
> 0***	2.32	1.94	1.87	1.95	2.13	2.32
≤ 0***	4.82	6.97	6.64	5.79	4.57	4.06
Mean						
> 0	0.389	0.325	0.311	0.272	0.255	0.245
≤ 0	-0.372	-0.341	-0.323	-0.315	-0.286	-0.257
> 0***	1.170	0.992	0.924	0.821	0.758	0.708
≤ 0***	-0.878	-0.720	-0.686	-0.740	-0.712	-0.660

Table 5-8: Summary statistics of synthetic fund instance coefficients of the Carhart (1997) four-factor Treynor and Mazuy (1966) style timing model

This table reports the fractions and means of the coefficients of the Carhart (1997) four-factor Treynor and Mazuy (1966) style timing model (CTM) of the 3,181 synthetic funds under six test settings. Columns 2-7 show the statistics for six test settings, in which the first number is sub-period length (years) and the second number is minimum observation number (months). The number in parentheses below each test setting is the number of fund instances. Panels A to E show the statistics for the intercept and four style timing coefficients of CTM respectively. In each panel are the fractions (%) and means of the corresponding intercepts or timing coefficients that are positive (>0), negative (≤0), significantly positive (>0***) and significantly negative (≤0***). *** means significance level of 0.01 based on the bootstrap method of Kosowski et al. (2006).

	3, 36 (18,474)	5, 36 (18,331)	5, 60 (12,476)	9, 36 (14,429)	9, 60 (10,599)	9, 108 (4,650)
Panel A: Intercept (alpha)						
%						
> 0	58.40	53.97	52.33	48.32	40.80	30.95
≤ 0	41.60	46.03	47.67	51.68	59.20	69.05
> 0***	7.08	3.77	3.07	3.45	1.96	0.65
≤ 0***	4.09	4.11	4.19	2.49	3.25	4.22
Mean						
> 0	0.004	0.003	0.002	0.002	0.002	0.001
≤ 0	-0.004	-0.003	-0.003	-0.002	-0.002	-0.002
> 0***	0.008	0.007	0.006	0.007	0.006	0.005
≤ 0***	-0.010	-0.007	-0.007	-0.005	-0.005	-0.005
Panel B: Market timing coefficient						
%						
> 0	50.95	51.09	51.82	44.33	43.37	41.85
≤ 0	49.05	48.91	48.18	55.67	56.63	58.15
> 0***	2.31	1.86	1.72	0.78	0.38	0.15
≤ 0***	1.93	1.00	0.88	0.94	0.75	0.84
Mean						
> 0	1.456	0.735	0.663	0.623	0.466	0.365
≤ 0	-1.338	-0.669	-0.605	-0.585	-0.495	-0.432
> 0***	4.402	2.307	2.048	2.974	2.100	1.469
≤ 0***	-4.222	-2.244	-1.988	-1.931	-1.433	-1.333

Table 5-8: Summary statistics of synthetic fund instance coefficients of the Carhart (1997) four-factor Treynor and Mazuy (1966) style timing model – continued

	3, 36	5, 36	5, 60	9, 36	9, 60	9, 108
Panel C: Size timing coefficient						
%						
> 0	52.60	50.44	50.91	46.70	45.23	44.00
≤ 0	47.40	49.56	49.09	53.30	54.77	56.00
> 0***	4.28	4.85	5.33	7.39	8.56	9.66
≤ 0***	3.11	3.56	3.26	6.23	6.94	7.59
Mean						
> 0	2.034	1.228	1.106	0.999	0.787	0.732
≤ 0	-1.930	-1.101	-0.934	-0.825	-0.596	-0.486
> 0***	4.571	2.537	2.271	2.022	1.811	1.732
≤ 0***	-5.023	-2.724	-2.169	-1.981	-1.469	-1.114
Panel D: Growth timing coefficient						
%						
> 0	43.65	54.51	56.40	63.01	67.93	68.30
≤ 0	56.35	45.49	43.60	36.99	32.07	31.70
> 0***	4.00	7.27	7.92	9.86	11.31	10.88
≤ 0***	5.51	4.59	4.31	2.72	2.04	2.15
Mean						
> 0	2.207	1.532	1.411	1.267	1.157	1.085
≤ 0	-4.706	-2.422	-1.999	-1.810	-0.852	-0.674
> 0***	4.519	3.243	3.015	2.584	2.429	2.305
≤ 0***	-11.938	-6.881	-5.905	-6.191	-2.784	-2.067
Panel E: Momentum timing coefficient						
%						
> 0	58.32	56.93	57.09	59.88	62.71	69.74
≤ 0	41.68	43.07	42.91	40.12	37.29	30.26
> 0***	4.35	4.64	4.48	5.66	6.38	8.26
≤ 0***	2.20	2.63	2.41	2.00	1.45	1.08
Mean						
> 0	53.568	40.120	37.531	29.886	28.279	28.337
≤ 0	-34.336	-26.875	-24.980	-24.134	-21.613	-19.950
> 0***	141.300	108.180	100.777	71.379	65.035	61.554
≤ 0***	-82.286	-65.576	-60.407	-68.789	-63.579	-60.043

Table 5-9: Summary statistics of synthetic fund instance coefficients of the Carhart (1997) four-factor Henriksson and Merton (1981) style timing model

This table reports the fractions and means of the coefficients of the Carhart (1997) four-factor Henriksson and Merton (1981) style timing model (CHM) of the 3,181 synthetic funds under six test settings. Columns 2-7 show the statistics for six test settings, in which the first number is sub-period length (years) and the second number is minimum observation number (months). The number in parentheses below each test setting is the number of fund instances. Panels A to E show the statistics for the intercept and four style timing coefficients of CHM respectively. In each panel are the fractions (%) and means of the corresponding intercepts or timing coefficients that are positive (>0), negative (≤0), significantly positive (>0***) and significantly negative (≤0***). *** means significance level of 0.01 based on the bootstrap method of Kosowski et al. (2006).

	3, 36 (18,474)	5, 36 (18,331)	5, 60 (12,476)	9, 36 (14,429)	9, 60 (10,599)	9, 108 (4,650)
Panel A: Intercept (alpha)						
%						
> 0	57.02	46.94	43.93	37.27	27.90	18.52
≤ 0	42.98	53.06	56.07	62.73	72.10	81.48
> 0***	4.75	1.75	1.14	1.51	0.57	0.17
≤ 0***	2.96	3.11	3.17	3.93	5.22	7.03
Mean						
> 0	0.005	0.004	0.003	0.003	0.002	0.002
≤ 0	-0.006	-0.005	-0.004	-0.004	-0.004	-0.004
> 0***	0.012	0.010	0.009	0.010	0.009	0.009
≤ 0***	-0.016	-0.013	-0.012	-0.010	-0.010	-0.009
Panel B: Market timing coefficient						
%						
> 0	51.99	54.24	55.12	54.29	55.90	58.11
≤ 0	48.01	45.76	44.88	45.71	44.10	41.89
> 0***	2.48	2.08	2.08	0.96	0.65	0.62
≤ 0***	1.80	0.80	0.61	0.57	0.34	0.28
Mean						
> 0	0.211	0.145	0.138	0.125	0.111	0.101
≤ 0	-0.212	-0.135	-0.125	-0.119	-0.102	-0.089
> 0***	0.563	0.399	0.371	0.442	0.362	0.338
≤ 0***	-0.649	-0.461	-0.429	-0.467	-0.390	-0.414

Table 5-9: Summary statistics of synthetic fund instance coefficients of the Carhart (1997) four-factor Henriksson and Merton (1981) style timing model – continued

	3, 36	5, 36	5, 60	9, 36	9, 60	9, 108
Panel C: Size timing coefficient						
%						
> 0	51.20	48.98	49.51	47.96	47.27	48.06
≤ 0	48.80	51.02	50.49	52.04	52.73	51.94
> 0***	2.74	2.21	2.32	2.93	3.21	3.66
≤ 0***	3.24	2.87	2.56	3.04	3.08	3.27
Mean						
> 0	0.263	0.193	0.181	0.178	0.162	0.154
≤ 0	-0.245	-0.184	-0.168	-0.161	-0.144	-0.128
> 0***	0.736	0.596	0.568	0.548	0.517	0.504
≤ 0***	-0.668	-0.534	-0.486	-0.453	-0.397	-0.351
Panel D: Growth timing coefficient						
%						
> 0	43.62	55.07	57.29	60.02	64.43	62.73
≤ 0	56.38	44.93	42.71	39.98	35.57	37.27
> 0***	3.70	5.27	5.41	7.29	8.10	7.46
≤ 0***	6.33	3.68	3.13	2.63	1.74	1.83
Mean						
> 0	0.279	0.247	0.236	0.234	0.225	0.208
≤ 0	-0.443	-0.266	-0.232	-0.220	-0.154	-0.137
> 0***	0.686	0.583	0.555	0.525	0.502	0.465
≤ 0***	-1.134	-0.779	-0.693	-0.734	-0.494	-0.410
Panel E: Momentum timing coefficient						
%						
> 0	56.23	57.11	57.94	63.54	68.52	75.51
≤ 0	43.77	42.89	42.06	36.46	31.48	24.49
> 0***	3.85	4.45	4.41	4.62	5.23	6.58
≤ 0***	2.51	2.74	2.54	1.51	0.85	0.43
Mean						
> 0	1.372	1.206	1.156	0.983	0.960	0.942
≤ 0	-1.012	-0.856	-0.806	-0.752	-0.637	-0.510
> 0***	3.682	3.130	2.946	2.419	2.306	2.137
≤ 0***	-2.608	-2.214	-2.048	-2.361	-2.073	-1.957

Table 5-10: The correlation between the intercept and timing coefficients of the Carhart (1997) four-factor Treynor and Mazuy (1966) style timing model: synthetic funds

This table reports the correlation between intercept and timing coefficients of the Carhart (1997) four-factor Treynor and Mazuy (1966) style timing model (CTM) for the 3,181 synthetic funds under six test settings. Panels A to D examine the correlations between intercept and market timing, size timing, growth timing, and momentum timing coefficients respectively. Each panel examines six fund instance groups with different test settings: the first number is the sub-period length (years) and the second number is minimum observation number (months). Columns 2 and 3 report Pearson's correlation coefficients and the corresponding p-values. Columns 4 and 5 report Spearman's rank correlation coefficients and the corresponding p-values. The last four columns report the percentage of fund instances with significant intercept (α) and timing coefficient (γ) at the 0.1 significance level.

Test Setting	Pearson	p-val.	Spearman	p-val.	α>0 γ>0	α>0 γ<0	α<0 γ>0	α<0 γ<0
Panel A: Correlation between intercept and market timing coefficient								
3, 36	-0.320***	0.000	-0.352***	0.000	1.20	5.15	4.52	0.95
5, 36	-0.308***	0.000	-0.305***	0.000	0.84	3.24	4.45	1.16
5, 60	-0.318***	0.000	-0.307***	0.000	0.72	2.97	4.78	1.29
9, 36	-0.286***	0.000	-0.287***	0.000	0.70	2.92	4.49	1.42
9, 60	-0.293***	0.000	-0.290***	0.000	0.50	2.48	4.76	1.61
9, 108	-0.279***	0.000	-0.284***	0.000	0.41	2.06	5.84	2.05
Panel B: Correlation between intercept and size timing coefficient								
3, 36	-0.225***	0.000	-0.234***	0.000	2.07	4.79	4.30	1.11
5, 36	-0.255***	0.000	-0.230***	0.000	1.51	4.12	4.27	1.83
5, 60	-0.246***	0.000	-0.215***	0.000	1.56	3.61	4.49	2.03
9, 36	-0.269***	0.000	-0.216***	0.000	1.12	3.78	5.14	3.07
9, 60	-0.274***	0.000	-0.205***	0.000	1.03	3.15	5.68	3.65
9, 108	-0.282***	0.000	-0.204***	0.000	0.89	2.62	6.49	4.18

***, **, and * represent significance levels of 0.01, 0.05, and 0.1 respectively.

Table 5-10: The correlation between the intercept and timing coefficients of the Carhart (1997) four-factor Treynor and Mazuy (1966) style timing model: synthetic funds – continued

Test Setting	Pearson	p val.	Spearman	p val.	α>0 γ>0	α>0 γ<0	α<0 γ>0	α<0 γ<0
Panel C: Correlation between intercept and growth timing coefficient								
3, 36	-0.168***	0.000	-0.154***	0.000	1.92	5.19	3.64	2.29
5, 36	-0.130***	0.000	-0.077***	0.000	3.44	2.90	3.90	2.25
5, 60	-0.102***	0.000	-0.056***	0.000	3.52	2.45	4.05	2.39
9, 36	-0.157***	0.000	-0.104***	0.000	2.77	2.27	5.87	2.26
9, 60	-0.115***	0.000	-0.077***	0.000	2.55	1.65	6.63	2.38
9, 108	-0.166***	0.000	-0.120***	0.000	1.62	1.51	7.65	2.70
Panel D: Correlation between intercept and momentum timing coefficient								
3, 36	-0.300***	0.000	-0.289***	0.000	2.34	3.90	5.65	0.51
5, 36	-0.361***	0.000	-0.355***	0.000	1.17	3.74	6.69	0.37
5, 60	-0.379***	0.000	-0.363***	0.000	0.94	3.58	6.96	0.41
9, 36	-0.334***	0.000	-0.332***	0.000	1.07	2.55	8.91	0.38
9, 60	-0.338***	0.000	-0.327***	0.000	0.83	2.02	9.81	0.46
9, 108	-0.336***	0.000	-0.317***	0.000	0.52	1.50	11.25	0.60

***, **, and * represent significance levels of 0.01, 0.05, and 0.1 respectively.

Table 5-11: The correlation between the intercept and timing coefficients of the Carhart (1997) four-factor Henriksson and Merton (1981) style timing model: Synthetic funds

This table reports the correlation between intercept and timing coefficients of the Carhart (1997) four-factor Henriksson and Merton (1981) style timing model (CHM) for the 3,181 synthetic funds under six test settings. Panels A to D examine the correlations between intercept and market timing, size timing, growth timing, and momentum timing coefficients respectively. Each panel examines six fund instance groups with different test settings: the first number is the sub-period length (years) and the second number is minimum observation number (months). Columns 2 and 3 report Pearson's correlation coefficients and the corresponding p-values. Columns 4 and 5 report Spearman's rank correlation coefficients and the corresponding p-values. The last four columns report the percentage of fund instances with significant intercept (α) and timing coefficient (γ) at the 0.1 significance level.

Test Setting	Pearson	p-val.	Spearman	p-val.	α>0 γ>0	α>0 γ<0	α<0 γ>0	α<0 γ<0
Panel A: Correlation between intercept and market timing coefficient								
3, 36	-0.433***	0.000	-0.413***	0.000	0.96	4.69	4.86	0.60
5, 36	-0.369***	0.000	-0.346***	0.000	0.54	2.22	5.08	0.54
5, 60	-0.355***	0.000	-0.345***	0.000	0.45	1.96	5.53	0.64
9, 36	-0.385***	0.000	-0.367***	0.000	0.31	1.64	7.06	0.61
9, 60	-0.374***	0.000	-0.375***	0.000	0.13	1.23	8.10	0.70
9, 108	-0.358***	0.000	-0.368***	0.000	0.05	1.27	10.24	0.95
Panel B: Correlation between intercept and size timing coefficient								
3, 36	-0.323***	0.000	-0.305***	0.000	1.22	4.31	4.54	0.77
5, 36	-0.354***	0.000	-0.302***	0.000	0.41	2.89	4.65	1.30
5, 60	-0.357***	0.000	-0.297***	0.000	0.37	2.56	4.89	1.42
9, 36	-0.369***	0.000	-0.301***	0.000	0.26	2.25	6.24	2.07
9, 60	-0.390***	0.000	-0.308***	0.000	0.17	1.66	6.92	2.43
9, 108	-0.385***	0.000	-0.302***	0.000	0.18	1.25	8.18	2.62

***, **, and * represent significance levels of 0.01, 0.05, and 0.1 respectively.

Table 5-11: the correlation between CHM intercept and timing coefficients: synthetic funds – continued

Test Setting	Pearson	p val.	Spearman	p val.	α>0 γ>0	α>0 γ<0	α<0 γ>0	α<0 γ<0
Panel C: Correlation between intercept and growth timing coefficient								
3, 36	-0.308***	0.000	-0.299***	0.000	1.00	6.69	4.04	1.24
5, 36	-0.282***	0.000	-0.245***	0.000	0.94	2.74	4.82	1.16
5, 60	-0.269***	0.000	-0.229***	0.000	0.88	2.16	5.15	1.24
9, 36	-0.303***	0.000	-0.267***	0.000	0.64	1.99	7.44	1.69
9, 60	-0.288***	0.000	-0.248***	0.000	0.45	1.25	8.57	1.92
9, 108	-0.319***	0.000	-0.269***	0.000	0.21	1.23	9.05	2.71
Panel D: Correlation between intercept and momentum timing coefficient								
3, 36	-0.312***	0.000	-0.312***	0.000	1.59	3.49	5.39	0.59
5, 36	-0.364***	0.000	-0.378***	0.000	0.59	2.34	7.11	0.40
5, 60	-0.383***	0.000	-0.390***	0.000	0.42	2.13	7.71	0.38
9, 36	-0.335***	0.000	-0.353***	0.000	0.42	1.34	10.51	0.39
9, 60	-0.328***	0.000	-0.339***	0.000	0.24	0.89	12.05	0.39
9, 108	-0.362***	0.000	-0.359***	0.000	0.13	0.71	14.35	0.37

***, **, and * represent significance levels of 0.01, 0.05, and 0.1 respectively.

Table 5-12: Persistence of fund performance

This table reports the results of persistence tests on the monthly return data of 3,181 US growth-oriented equity mutual funds from Jan. 1993 to Dec. 2006. The sample funds are sorted on January 1 each year (from 1996 until 2006) into decile portfolios based on their Carhart (1997) four-factor model alphas estimated over the prior three years. For funds that have missing observations during these prior three years, observations from the 12 months preceding the three-year window are added to obtain 36 observations. The portfolios are equally weighted monthly. Funds with the highest three-year Carhart alpha comprise 1.dec, and funds with the lowest comprise 10.dec. "Top" ("Bottom") is the portfolio of the fund with the best (worst) Carhart alpha. The "1%ile" ("5%ile") portfolio is an equally weighted portfolio of the top-1% (top-5%) funds, while the "99%ile" ("95%ile") is an equally weighted portfolio of the worst-1% (worst-5%) funds. The last four rows represent the portfolios which hold "Top" and sell "Bottom" (T-B), hold 1%ile and sell 99%ile (1-99), hold 5%ile and sell 95%ile (5-95) and hold 1.dec and sell 10.dec (10-90) respectively. Columns 2 and 3 are the mean and standard deviation of the portfolio excess returns. Columns 4-6 show the portfolios' Carhart alphas, the corresponding t-statistics and the bootstrapped p-value respectively. The following four columns present the coefficients of Carhart's four factors. The last column reports the adjusted R-squared of Carhart's (1997) four-factor model. If high-ranked portfolios (i.e., Top and 1%ile) have significantly positive Carhart alphas, this is evidence of persistent performance.

Fractile	E.Ret (%)	Stdev (%)	Alpha (%)	t	BS p-val	RMRF	SMB	HML	MOM	Adj. R^2
Top	0.58	7.43	0.33	0.987	0.001	1.090	0.030	-0.583	0.114	0.786
1%ile	0.61	6.10	0.25	1.542	0.000	0.984	0.209	-0.416	-0.371	0.922
5%ile	0.40	5.79	-0.04	-0.281	0.350	1.025	0.166	-0.290	-0.134	0.949
1.dec	0.41	5.46	-0.03	-0.296	0.322	1.008	0.129	-0.232	-0.055	0.963
2.dec	0.35	4.79	-0.11	-1.645	0.000	0.984	0.012	-0.100	-0.087	0.979
3.dec	0.35	4.51	-0.12	-2.638	0.000	0.956	-0.008	-0.045	-0.039	0.989
4.dec	0.34	4.40	-0.19	-4.088	0.000	0.983	-0.047	0.056	0.014	0.989
5.dec	0.37	4.32	-0.14	-2.908	0.000	0.971	-0.086	0.058	0.010	0.987
6.dec	0.41	4.16	-0.14	-2.783	0.000	0.961	-0.078	0.115	-0.065	0.985
7.dec	0.43	4.03	-0.15	-2.434	0.000	0.954	-0.082	0.192	-0.058	0.974
8.dec	0.38	4.14	-0.25	-2.812	0.000	0.990	-0.103	0.255	-0.087	0.952
9.dec	0.41	4.17	-0.25	-2.218	0.000	0.998	-0.111	0.303	-0.130	0.923
10.dec	0.38	4.33	-0.28	-2.738	0.000	1.025	-0.052	0.261	-0.076	0.939

Table 5-12: Persistence of fund performance – continued

Fractile	E.Ret (%)	Stdev (%)	Alpha (%)	t	BS p-val	RMRF	SMB	HML	MOM	Adj. R^2
95%ile	0.37	4.66	-0.28	-2.521	0.000	1.068	-0.029	0.175	-0.176	0.938
99%ile	0.33	5.52	-0.32	-1.789	0.000	1.175	-0.064	0.129	0.347	0.884
Bottom	-0.52	8.29	-0.96	-1.844	0.000	1.182	-0.047	-0.236	1.342	0.574
T-B	1.03	6.22	1.14	1.937	0.000	-0.036	0.126	-0.294	-1.263	0.061
1-99	0.28	3.72	0.58	2.235	0.000	-0.191	0.273	-0.545	-0.718	0.482
5-95	0.03	3.00	0.25	1.278	0.000	-0.044	0.195	-0.466	0.042	0.552
10-90	0.03	2.97	0.25	1.451	0.000	-0.017	0.181	-0.494	0.021	0.627

Table 5-13: Persistence of synthetic fund performance

This table reports the results of tests on the persistence of fund performance based on the monthly return data of the 3,181 synthetic funds from Jan. 1993 to Dec. 2006. The sample funds are sorted on January 1 each year (from 1996 until 2006) into decile portfolios based on their Carhart (1997) four-factor model alphas estimated over the prior three years. For funds that have missing observations during these prior three years, observations from the 12 months preceding the three-year window are added to obtain 36 observations. The portfolios are equally weighted monthly. Funds with the highest three-year Carhart alpha comprise 1.dec, and funds with the lowest comprise 10.dec. "Top" ("Bottom") is the portfolio of the fund with the best (worst) Carhart alpha. The "1%ile" ("5%ile") portfolio is an equally weighted portfolio of the top-1% (top-5%) funds, while the "99%ile" ("95%ile") is an equally weighted portfolio of the worst-1% (worst-5%) funds. The last four rows represent the portfolios which hold "Top" and sell "Bottom" (T-B), hold 1%ile and sell 99%ile (1-99), hold 5%ile and sell 95%ile (5-95) and hold 1.dec and sell 10.dec (10-90) respectively. Columns 2 and 3 are the mean and standard deviation of the portfolio excess returns. Columns 4-6 show the portfolios' Carhart alphas, the corresponding t-statistics, and the bootstrapped p-value respectively. The following four columns present the coefficients of Carhart's four factors. The last column reports the adjusted R-squared of Carhart's (1997) four-factor model.

Fractile	E.Ret (%)	Stdev (%)	Alpha (%)	t	BS p-val	RMRF	SMB	HML	MOM	Adj. R^2
Top	0.61	5.67	-0.02	-0.101	0.734	0.895	0.515	0.046	0.484	0.808
1%ile	0.73	5.51	0.06	0.405	0.185	0.955	0.528	0.025	0.006	0.935
5%ile	0.70	5.12	0.05	0.470	0.128	0.922	0.463	0.054	0.213	0.955
1.dec	0.68	4.93	0.02	0.255	0.419	0.918	0.428	0.088	0.267	0.958
2.dec	0.66	4.73	-0.02	-0.183	0.563	0.935	0.370	0.156	0.308	0.955
3.dec	0.64	4.62	-0.05	-0.576	0.059	0.934	0.358	0.186	0.254	0.961
4.dec	0.67	4.45	-0.06	-0.660	0.034	0.950	0.319	0.261	0.200	0.956
5.dec	0.66	4.41	-0.09	-0.905	0.004	0.958	0.296	0.288	0.211	0.950
6.dec	0.70	4.41	-0.06	-0.659	0.033	0.965	0.308	0.307	0.110	0.951
7.dec	0.73	4.40	-0.04	-0.374	0.235	0.973	0.291	0.314	0.077	0.950
8.dec	0.76	4.34	-0.02	-0.157	0.611	0.972	0.267	0.339	0.073	0.937
9.dec	0.73	4.42	-0.05	-0.482	0.115	0.987	0.288	0.332	-0.074	0.934
10.dec	0.78	4.63	0.00	0.034	0.914	0.987	0.327	0.285	-0.030	0.915

Table 5-13: Persistence of synthetic fund performance – continued

Fractile	E.Ret (%)	Stdev (%)	Alpha (%)	t	BS p-val	RMRF	SMB	HML	MOM	Adj. R^2
95%ile	0.77	4.80	0.02	0.149	0.622	0.980	0.371	0.230	-0.045	0.915
99%ile	0.75	5.18	0.04	0.198	0.522	0.970	0.422	0.143	-0.044	0.875
Bottom	0.63	6.53	0.01	0.044	0.888	0.838	0.775	-0.102	0.111	0.825
T-B	0.17	3.38	0.00	-0.008	0.979	0.162	-0.154	0.252	0.218	0.117
1-99	-0.02	2.01	0.02	0.110	0.719	-0.016	0.106	-0.118	0.050	0.116
5-95	-0.07	1.69	0.03	0.207	0.522	-0.058	0.092	-0.175	0.258	0.245
10-90	-0.10	1.65	0.02	0.158	0.608	-0.069	0.101	-0.197	0.297	0.327

Table 6-1: Summary statistics of fund instance coefficients of Carhart's (1997) four-factor model: Equity Aggressive Growth funds

This table reports the fractions and means of the coefficients of Carhart's (1997) four-factor model of 150 Equity Aggressive Growth funds under six test settings. Columns 2-7 show the statistics for six test settings, in which the first number is sub-period length (years) and the second number is minimum observation number (months). The number in parentheses below each test setting is the number of fund instances. Panels A to E show the statistics for the intercept and four coefficients of Carhart's (1997) four-factor model respectively. In each panel are the fractions (%) and means of the corresponding coefficients that are positive (>0), negative (≤0), significantly positive (>0***) and significantly negative (≤0***). *** means significance level of 0.01 based on the bootstrap method of Kosowski et al. (2006).

	3, 36 (971)	5, 36 (976)	5, 60 (683)	9, 36 (748)	9, 60 (589)	9, 108 (255)
Panel A: the intercept (alpha)						
%						
> 0	45.52	44.67	44.80	53.48	58.74	59.22
≤ 0	54.48	55.33	55.20	46.52	41.26	40.78
> 0***	19.36	23.87	22.55	31.55	35.14	32.94
≤ 0***	30.07	30.53	29.14	24.20	18.34	18.82
Mean						
> 0	0.005	0.005	0.004	0.004	0.004	0.003
≤ 0	-0.005	-0.004	-0.003	-0.003	-0.002	-0.002
> 0***	0.009	0.008	0.006	0.006	0.005	0.004
≤ 0***	-0.007	-0.005	-0.005	-0.005	-0.004	-0.004
Panel B: the coefficient of RMRF						
%						
> 0	99.28	99.59	100.00	100.00	100.00	100.00
≤ 0	0.72	0.41	0.00	0.00	0.00	0.00
> 0***	96.40	97.75	99.12	98.93	99.32	100.00
≤ 0***	0.00	0.00	0.00	0.00	0.00	0.00
Mean						
> 0	1.017	1.017	1.028	1.011	1.017	1.067
≤ 0	-0.019	-0.017	---	---	---	---
> 0***	1.038	1.031	1.034	1.019	1.021	1.067
≤ 0***	---	---	---	---	---	---

Table 6-1: Summary statistics of fund instance coefficients of Carhart's (1997) four-factor model: Equity Aggressive Growth funds – continued

	3, 36	5, 36	5, 60	9, 36	9, 60	9, 108
Panel C: the coefficient of SMB						
%						
> 0	81.87	80.84	81.26	81.28	80.81	86.67
≤ 0	18.13	19.16	18.74	18.72	19.19	13.33
> 0***	45.01	46.52	51.83	47.19	51.10	60.39
≤ 0***	1.85	1.95	2.34	3.07	3.57	1.57
Mean						
> 0	0.342	0.292	0.299	0.264	0.270	0.283
≤ 0	-0.097	-0.085	-0.088	-0.074	-0.074	-0.064
> 0***	0.495	0.417	0.400	0.378	0.368	0.362
≤ 0***	-0.205	-0.193	-0.204	-0.158	-0.161	-0.120
Panel D: the coefficient of HML						
%						
> 0	15.35	13.63	13.91	14.44	11.88	11.76
≤ 0	84.65	86.37	86.09	85.56	88.12	88.24
> 0***	3.91	4.71	5.12	5.21	5.09	3.53
≤ 0***	48.71	60.25	62.37	66.18	71.65	78.82
Mean						
> 0	0.219	0.213	0.198	0.229	0.228	0.184
≤ 0	-0.414	-0.412	-0.408	-0.405	-0.419	-0.425
> 0***	0.449	0.407	0.388	0.409	0.422	0.346
≤ 0***	-0.562	-0.510	-0.498	-0.478	-0.479	-0.461
Panel E: the coefficient of MOM						
%						
> 0	29.35	26.74	29.58	24.20	25.13	20.78
≤ 0	70.65	73.26	70.42	75.80	74.87	79.22
> 0***	1.24	1.02	1.46	0.67	0.85	1.57
≤ 0***	9.37	16.80	18.45	28.07	30.39	30.98
Mean						
> 0	0.517	0.471	0.457	0.466	0.448	0.462
≤ 0	-0.718	-0.701	-0.699	-0.748	-0.765	-0.731
> 0***	1.592	1.761	1.761	2.620	2.620	2.596
≤ 0***	-1.512	-1.395	-1.367	-1.350	-1.331	-1.307

Table 6-2: Summary statistics of fund instance coefficients of Carhart's (1997) four-factor model: Equity Growth funds

This table reports the fractions and means of the coefficients of Carhart's (1997) four-factor model of 1,956 Equity Growth funds under six test settings. Columns 2-7 show the statistics for six test settings, in which the first number is sub-period length (years) and the second number is minimum observation number (months). The number in parentheses below each test setting is the number of fund instances. Panels A to E show the statistics for the intercept and four coefficients of Carhart's (1997) four-factor model respectively. In each panel are the fractions (%) and means of the corresponding coefficients that are positive (>0), negative (≤0), significantly positive (>0***) and significantly negative (≤0***). *** means significance level of 0.01 based on the bootstrap method of Kosowski et al. (2006).

	3, 36 (10,883)	5, 36 (10,844)	5, 60 (7,203)	9, 36 (8,705)	9, 60 (6,200)	9, 108 (2,578)
Panel A: the intercept (alpha)						
%						
> 0	34.14	31.91	30.71	32.85	32.45	31.85
≤ 0	65.86	68.09	69.29	67.15	67.55	68.15
> 0***	11.58	14.54	14.22	15.37	16.39	16.29
≤ 0***	35.55	42.14	43.23	42.58	43.95	45.58
Mean						
> 0	0.003	0.003	0.002	0.002	0.002	0.002
≤ 0	-0.003	-0.003	-0.003	-0.002	-0.002	-0.002
> 0***	0.006	0.005	0.004	0.004	0.003	0.003
≤ 0***	-0.005	-0.004	-0.004	-0.003	-0.003	-0.003
Panel B: the coefficient of RMRF						
%						
> 0	99.95	99.95	99.96	99.94	99.95	100.00
≤ 0	0.05	0.05	0.04	0.06	0.05	0.00
> 0***	99.78	99.86	99.93	99.86	99.95	100.00
≤ 0***	0.02	0.02	0.00	0.02	0.00	0.00
Mean						
> 0	0.986	0.993	0.995	1.000	1.001	0.998
≤ 0	-0.094	-0.089	-0.104	-0.090	-0.107	---
> 0***	0.987	0.994	0.996	1.001	1.001	0.998
≤ 0***	-0.069	-0.066	---	-0.066	---	---

Table 6-2: Summary statistics of fund instance coefficients of Carhart's (1997) four-factor model: Equity Growth funds – continued

	3, 36	5, 36	5, 60	9, 36	9, 60	9, 108
Panel C: the coefficient of SMB						
%						
> 0	46.28	40.94	40.58	37.04	35.06	34.13
≤ 0	53.72	59.06	59.42	62.96	64.94	65.87
> 0***	14.64	14.99	15.54	14.19	14.71	15.32
≤ 0***	23.45	29.58	30.13	35.53	38.85	40.46
Mean						
> 0	0.196	0.175	0.172	0.168	0.163	0.156
≤ 0	-0.143	-0.132	-0.128	-0.129	-0.128	-0.125
> 0***	0.390	0.330	0.320	0.309	0.293	0.273
≤ 0***	-0.217	-0.192	-0.187	-0.180	-0.175	-0.169
Panel D: the coefficient of HML						
%						
> 0	39.53	41.77	42.22	43.03	42.66	43.44
≤ 0	60.47	58.23	57.78	56.97	57.34	56.56
> 0***	18.74	24.82	25.81	28.85	30.23	31.65
≤ 0***	34.14	38.56	38.50	40.78	42.23	42.59
Mean						
> 0	0.240	0.255	0.258	0.273	0.281	0.283
≤ 0	-0.294	-0.287	-0.279	-0.282	-0.279	-0.268
> 0***	0.381	0.369	0.371	0.368	0.371	0.368
≤ 0***	-0.416	-0.378	-0.371	-0.354	-0.348	-0.333
Panel E: the coefficient of MOM						
%						
> 0	43.18	41.99	42.30	41.34	41.03	42.59
≤ 0	56.82	58.01	57.70	58.66	58.97	57.41
> 0***	2.26	2.48	2.62	3.77	4.45	4.81
≤ 0***	5.27	6.78	7.14	9.67	10.97	11.68
Mean						
> 0	0.352	0.326	0.319	0.325	0.321	0.293
≤ 0	-0.418	-0.405	-0.388	-0.421	-0.404	-0.376
> 0***	1.009	0.970	0.904	0.919	0.875	0.813
≤ 0***	-1.027	-0.944	-0.925	-0.904	-0.879	-0.808

Table 6-3: Summary statistics of fund instance coefficients of Carhart's (1997) four-factor model: Equity Growth-and-Income funds

This table reports the fractions and means of the coefficients of Carhart's (1997) four-factor model of 856 Equity Growth-and-Income funds under six test settings. Columns 2-7 show the statistics for six test settings, in which the first number is sub-period length (years) and the second number is minimum observation number (months). The number in parentheses below each test setting is the number of fund instances. Panels A to E show the statistics for the intercept and four coefficients of Carhart's (1997) four-factor model respectively. In each panel are the fractions (%) and means of the corresponding coefficients that are positive (>0), negative (≤0), significantly positive (>0***) and significantly negative (≤0***). *** means significance level of 0.01 based on the bootstrap method of Kosowski et al. (2006).

	3, 36 (5,285)	5, 36 (5,217)	5, 60 (3,649)	9, 36 (4,022)	9, 60 (3,078)	9, 108 (1,403)
Panel A: the intercept (alpha)						
%						
> 0	27.47	25.74	25.60	22.20	20.57	18.46
≤ 0	72.53	74.26	74.40	77.80	79.43	81.54
> 0***	8.78	9.20	9.35	8.35	7.99	6.49
≤ 0***	41.59	49.15	50.07	55.97	60.20	64.01
Mean						
> 0	0.002	0.002	0.002	0.001	0.001	0.001
≤ 0	-0.003	-0.002	-0.002	-0.002	-0.002	-0.002
> 0***	0.004	0.003	0.003	0.002	0.002	0.002
≤ 0***	-0.004	-0.003	-0.003	-0.003	-0.003	-0.003
Panel B: the coefficient of RMRF						
%						
> 0	100.00	100.00	100.00	100.00	100.00	100.00
≤ 0	0.00	0.00	0.00	0.00	0.00	0.00
> 0***	99.94	99.98	99.97	100.00	100.00	100.00
≤ 0***	0.00	0.00	0.00	0.00	0.00	0.00
Mean						
> 0	0.971	0.968	0.966	0.966	0.968	0.965
≤ 0	---	---	---	---	---	---
> 0***	0.971	0.968	0.966	0.966	0.968	0.965
≤ 0***	---	---	---	---	---	---

Table 6-3: Summary statistics of fund instance coefficients of Carhart's (1997) four-factor model: Equity Growth-and-Income funds – continued

	3, 36	5, 36	5, 60	9, 36	9, 60	9, 108
Panel C: the coefficient of SMB						
%						
> 0	22.33	20.26	19.24	15.56	14.72	13.33
≤ 0	77.67	79.74	80.76	84.44	85.28	86.67
> 0***	3.82	4.39	4.74	3.61	3.77	4.28
≤ 0***	39.98	46.10	46.67	57.11	58.80	59.59
Mean						
> 0	0.105	0.096	0.095	0.088	0.086	0.093
≤ 0	-0.152	-0.134	-0.129	-0.134	-0.128	-0.122
> 0***	0.267	0.222	0.215	0.206	0.191	0.184
≤ 0***	-0.216	-0.181	-0.173	-0.167	-0.159	-0.150
Panel D: the coefficient of HML						
%						
> 0	76.44	80.95	82.16	82.12	83.07	84.53
≤ 0	23.56	19.05	17.84	17.88	16.93	15.47
> 0***	48.36	63.10	66.79	68.95	72.68	76.91
≤ 0***	6.19	7.34	6.96	7.96	8.22	7.27
Mean						
> 0	0.289	0.321	0.329	0.351	0.366	0.372
≤ 0	-0.152	-0.150	-0.146	-0.144	-0.145	-0.131
> 0***	0.394	0.388	0.388	0.403	0.408	0.405
≤ 0***	-0.321	-0.269	-0.266	-0.246	-0.246	-0.227
Panel E: the coefficient of MOM						
%						
> 0	59.89	61.41	60.54	64.17	63.74	63.65
≤ 0	40.11	38.59	39.46	35.83	36.26	36.35
> 0***	3.41	3.81	3.45	4.25	4.26	4.78
≤ 0***	1.91	2.88	3.21	4.13	4.45	5.13
Mean						
> 0	0.304	0.276	0.268	0.270	0.259	0.248
≤ 0	-0.287	-0.251	-0.243	-0.243	-0.242	-0.236
> 0***	0.741	0.651	0.589	0.612	0.553	0.489
≤ 0***	-0.819	-0.745	-0.739	-0.690	-0.691	-0.663

Table 6-4: Summary statistics of fund instance coefficients of Carhart's (1997) four-factor model: Equity Income-and-Growth funds

This table reports the fractions and means of the coefficients of Carhart's (1997) four-factor model of 219 Equity Income-and-Growth funds under six test settings. Columns 2-7 show the statistics for six test settings, in which the first number is sub-period length (years) and the second number is minimum observation number (months). The number in parentheses below each test setting is the number of fund instances. Panels A to E show the statistics for the intercept and four coefficients of Carhart's (1997) four-factor model respectively. In each panel are the fractions (%) and means of the corresponding coefficients that are positive (>0), negative (≤0), significantly positive (>0***) and significantly negative (≤0***). *** means significance level of 0.01 based on the bootstrap method of Kosowski et al. (2006).

	3, 36 (1,335)	5, 36 (1,294)	5, 60 (941)	9, 36 (954)	9, 60 (732)	9, 108 (414)
Panel A: the intercept (alpha)						
%						
> 0	24.94	22.80	21.25	17.82	13.52	7.97
≤ 0	75.06	77.20	78.75	82.18	86.48	92.03
> 0***	6.37	7.03	6.27	6.39	5.46	1.69
≤ 0***	37.15	49.23	48.88	61.22	66.53	72.46
Mean						
> 0	0.002	0.002	0.001	0.002	0.001	0.001
≤ 0	-0.002	-0.002	-0.002	-0.002	-0.002	-0.002
> 0***	0.004	0.003	0.003	0.003	0.002	0.001
≤ 0***	-0.004	-0.003	-0.003	-0.003	-0.003	-0.002
Panel B: the coefficient of RMRF						
%						
> 0	100.00	100.00	100.00	100.00	100.00	100.00
≤ 0	0.00	0.00	0.00	0.00	0.00	0.00
> 0***	100.00	100.00	100.00	100.00	100.00	100.00
≤ 0***	0.00	0.00	0.00	0.00	0.00	0.00
Mean						
> 0	0.890	0.877	0.871	0.876	0.865	0.862
≤ 0	---	---	---	---	---	---
> 0***	0.890	0.877	0.871	0.876	0.865	0.862
≤ 0***	---	---	---	---	---	---

Table 6-4: Summary statistics of fund instance coefficients of Carhart's (1997) four-factor model: Equity Income-and-Growth funds – continued

	3, 36	5, 36	5, 60	9, 36	9, 60	9, 108
Panel C: the coefficient of SMB						
%						
> 0	20.75	18.32	19.23	13.31	13.93	15.70
≤ 0	79.25	81.68	80.77	86.69	86.07	84.30
> 0***	3.52	4.10	3.93	3.56	3.96	3.86
≤ 0***	37.90	41.58	41.98	53.56	53.01	53.14
Mean						
> 0	0.103	0.098	0.089	0.071	0.059	0.049
≤ 0	-0.150	-0.117	-0.113	-0.118	-0.107	-0.107
> 0***	0.254	0.229	0.212	0.140	0.123	0.110
≤ 0***	-0.223	-0.169	-0.161	-0.153	-0.140	-0.140
Panel D: the coefficient of HML						
%						
> 0	97.00	98.53	99.04	99.16	99.59	100.00
≤ 0	3.00	1.47	0.96	0.84	0.41	0.00
> 0***	75.36	91.04	92.88	92.87	93.85	93.24
≤ 0***	0.07	0.00	0.00	0.00	0.00	0.00
Mean						
> 0	0.354	0.399	0.415	0.428	0.450	0.452
≤ 0	-0.055	-0.043	-0.037	-0.022	-0.023	---
> 0***	0.415	0.422	0.437	0.451	0.474	0.482
≤ 0***	-0.252	---	---	---	---	---
Panel E: the coefficient of MOM						
%						
> 0	63.37	62.67	62.81	71.80	72.95	69.08
≤ 0	36.63	37.33	37.19	28.20	27.05	30.92
> 0***	2.85	2.47	1.81	3.98	3.55	3.38
≤ 0***	0.75	0.54	0.74	0.00	0.00	0.00
Mean						
> 0	0.289	0.241	0.236	0.225	0.210	0.203
≤ 0	-0.292	-0.207	-0.197	-0.185	-0.171	-0.157
> 0***	0.744	0.747	0.611	0.698	0.579	0.521
≤ 0***	-1.121	-0.941	-0.941	---	---	---

Table 6-5: Summary statistics of fund instance coefficients of the Carhart (1997) four-factor Treynor and Mazuy (1966) style timing model: Equity Aggressive Growth funds

This table reports the fractions and means of the coefficients of the Carhart (1997) four-factor Treynor and Mazuy (1966) style timing model (CTM) of 150 Equity Aggressive Growth funds. Columns 2-7 show the statistics for six test settings, in which the first number is sub-period length (years) and the second number is minimum observation number (months). The number in parentheses below each test setting is the number of fund instances. Panels A to E show the statistics for the intercept and four style timing coefficients of CTM respectively. In each panel are the fractions (%) and means of the corresponding intercepts or timing coefficients that are positive (>0), negative (≤0), significantly positive (>0***) and significantly negative (≤0***). *** means significance level of 0.01 based on the bootstrap method of Kosowski et al. (2006).

	3, 36 (971)	5, 36 (976)	5, 60 (683)	9, 36 (748)	9, 60 (589)	9, 108 (255)
Panel A: the intercept (alpha)						
%						
> 0	47.48	49.90	48.46	49.60	51.44	43.14
≤ 0	52.52	50.10	51.54	50.40	48.56	56.86
> 0***	5.05	4.10	2.49	4.28	3.74	1.18
≤ 0***	5.97	4.92	4.98	5.75	5.60	9.41
Mean						
> 0	0.007	0.005	0.004	0.004	0.003	0.003
≤ 0	-0.005	-0.004	-0.004	-0.004	-0.003	-0.003
> 0***	0.016	0.016	0.011	0.014	0.011	0.006
≤ 0***	-0.015	-0.009	-0.009	-0.008	-0.008	-0.008
Panel B: market timing coefficient						
%						
> 0	62.00	64.45	66.47	73.53	75.04	78.82
≤ 0	38.00	35.55	33.53	26.47	24.96	21.18
> 0***	5.15	6.66	4.98	4.28	3.23	0.39
≤ 0***	0.72	0.51	0.59	0.53	0.51	0.00
Mean						
> 0	2.299	1.422	1.210	1.256	1.084	0.776
≤ 0	-1.999	-1.359	-1.309	-1.272	-1.117	-0.711
> 0***	4.764	3.658	3.065	3.257	3.058	2.774
≤ 0***	-5.461	-4.463	-3.861	-6.482	-6.353	---

Table 6-5: Summary statistics of fund instance coefficients of the Carhart (1997) four-factor Treynor and Mazuy (1966) style timing model: Equity Aggressive Growth funds – continued

	3, 36	5, 36	5, 60	9, 36	9, 60	9, 108
Panel C: size timing coefficient						
%						
> 0	42.64	45.90	48.76	56.55	59.76	58.43
≤ 0	57.36	54.10	51.24	43.45	40.24	41.57
> 0***	3.50	4.51	5.56	6.15	6.96	10.20
≤ 0***	3.30	3.38	3.81	2.81	3.06	3.92
Mean						
> 0	2.694	1.309	1.242	0.881	0.829	0.967
≤ 0	-3.336	-2.282	-2.087	-1.421	-1.010	-0.666
> 0***	3.337	2.237	2.288	2.065	2.085	2.198
≤ 0***	-7.219	-4.619	-4.263	-3.403	-2.931	-1.496
Panel D: growth timing coefficient						
%						
> 0	50.15	64.75	67.35	77.94	82.51	85.49
≤ 0	49.85	35.25	32.65	22.06	17.49	14.51
> 0***	5.77	9.12	11.57	12.17	14.60	25.49
≤ 0***	3.40	2.05	2.05	1.47	0.85	0.00
Mean						
> 0	3.786	2.420	2.409	1.778	1.776	1.897
≤ 0	-6.369	-2.878	-2.293	-2.041	-1.323	-0.758
> 0***	6.151	4.151	4.112	3.138	3.159	3.152
≤ 0***	-21.982	-6.232	-3.640	-3.647	-3.691	---
Panel E: momentum timing coefficient						
%						
> 0	33.88	21.11	18.74	14.30	13.92	12.16
≤ 0	66.12	78.89	81.26	85.70	86.08	87.84
> 0***	1.34	1.23	1.02	1.60	1.53	0.39
≤ 0***	10.20	15.16	15.81	25.94	28.01	30.59
Mean						
> 0	64.606	52.983	42.959	49.321	44.676	36.842
≤ 0	-77.520	-65.613	-64.096	-63.888	-65.257	-62.532
> 0***	271.097	122.203	94.830	111.742	102.382	91.568
≤ 0***	-146.476	-109.546	-109.263	-98.514	-96.667	-101.847

Table 6-6: Summary statistics of fund instance coefficients of the Carhart (1997) four-factor Treynor and Mazuy (1966) style timing model: Equity Growth funds

This table reports the fractions and means of the coefficients of the Carhart (1997) four-factor Treynor and Mazuy (1966) style timing model (CTM) of 1,956 Equity Growth funds. Columns 2-7 show the statistics for six test settings, in which the first number is sub-period length (years) and the second number is minimum observation number (months). The number in parentheses below each test setting is the number of fund instances. Panels A to E show the statistics for the intercept and four style timing coefficients of CTM respectively. In each panel are the fractions (%) and means of the corresponding intercepts or timing coefficients that are positive (>0), negative (≤0), significantly positive (>0***) and significantly negative (≤0***). *** means significance level of 0.01 based on the bootstrap method of Kosowski et al. (2006).

	3, 36 (10,883)	5, 36 (10,844)	5, 60 (7,203)	9, 36 (8,705)	9, 60 (6,200)	9, 108 (2,578)
Panel A: the intercept (alpha)						
%						
> 0	37.10	34.89	34.28	29.79	27.98	25.33
≤ 0	62.90	65.11	65.72	70.21	72.02	74.67
> 0***	2.96	2.14	1.72	1.28	1.06	0.50
≤ 0***	12.16	12.28	12.98	15.04	17.13	17.57
Mean						
> 0	0.004	0.003	0.003	0.003	0.002	0.002
≤ 0	-0.004	-0.003	-0.003	-0.003	-0.003	-0.003
> 0***	0.011	0.010	0.008	0.010	0.008	0.006
≤ 0***	-0.008	-0.006	-0.006	-0.006	-0.005	-0.005
Panel B: market timing coefficient						
%						
> 0	54.49	48.03	47.31	46.95	45.37	42.40
≤ 0	45.51	51.97	52.69	53.05	54.63	57.60
> 0***	5.07	3.29	2.82	2.15	1.39	0.54
≤ 0***	2.00	1.89	1.40	2.34	2.13	1.59
Mean						
> 0	1.929	0.991	0.871	0.881	0.698	0.490
≤ 0	-1.272	-0.745	-0.656	-0.662	-0.533	-0.419
> 0***	5.420	3.105	2.761	3.542	3.184	2.311
≤ 0***	-3.480	-2.169	-1.512	-2.008	-1.528	-1.084

Table 6-6: Summary statistics of fund instance coefficients of the Carhart (1997) four-factor Treynor and Mazuy (1966) style timing model: Equity Growth funds – continued

	3, 36	5, 36	5, 60	9, 36	9, 60	9, 108
Panel C: size timing coefficient						
%						
> 0	44.76	46.20	46.58	51.72	52.84	54.31
≤ 0	55.24	53.80	53.42	48.28	47.16	45.69
> 0***	4.59	5.31	5.50	6.71	6.77	7.06
≤ 0***	4.90	4.19	4.39	4.38	4.77	5.59
Mean						
> 0	2.045	1.204	0.984	0.953	0.646	0.533
≤ 0	-2.384	-1.505	-1.405	-0.950	-0.631	-0.447
> 0***	3.715	2.466	2.109	2.051	1.582	1.390
≤ 0***	-6.777	-3.705	-3.414	-2.141	-1.472	-1.137
Panel D: growth timing coefficient						
%						
> 0	54.29	61.27	63.61	68.08	73.98	76.61
≤ 0	45.71	38.73	36.39	31.92	26.02	23.39
> 0***	6.19	10.26	11.40	13.56	15.77	16.95
≤ 0***	3.40	3.53	3.60	2.53	2.40	1.75
Mean						
> 0	2.871	1.760	1.637	1.329	1.175	1.095
≤ 0	-4.387	-2.302	-1.927	-1.934	-1.083	-0.808
> 0***	5.295	3.013	2.808	2.296	2.156	2.071
≤ 0***	-11.004	-5.458	-4.505	-4.761	-2.735	-2.362
Panel E: momentum timing coefficient						
%						
> 0	44.47	43.16	42.02	42.16	41.55	41.82
≤ 0	55.53	56.84	57.98	57.84	58.45	58.18
> 0***	2.11	3.08	2.54	4.96	5.03	5.55
≤ 0***	5.95	7.96	8.30	10.33	11.77	12.57
Mean						
> 0	43.015	33.470	30.001	30.361	27.844	26.027
≤ 0	-46.897	-38.549	-35.655	-38.348	-36.455	-32.797
> 0***	98.116	84.413	72.585	71.746	63.483	57.546
≤ 0***	-104.561	-84.495	-78.642	-81.549	-75.752	-66.162

Table 6-7: Summary statistics of fund instance coefficients of the Carhart (1997) four-factor Treynor and Mazuy (1966) style timing model: Equity Growth-and-Income funds

This table reports the fractions and means of the coefficients of the Carhart (1997) four-factor Treynor and Mazuy (1966) style timing model (CTM) of 856 Equity Growth-and-Income funds. Columns 2-7 show the statistics for six test settings, in which the first number is sub-period length (years) and the second number is minimum observation number (months). The number in parentheses below each test setting is the number of fund instances. Panels A to E show the statistics for the intercept and four style timing coefficients of CTM respectively. In each panel are the fractions (%) and means of the corresponding intercepts or timing coefficients that are positive (>0), negative (≤0), significantly positive (>0***) and significantly negative (≤0***). *** means significance level of 0.01 based on the bootstrap method of Kosowski et al. (2006).

	3, 36 (5,285)	5, 36 (5,217)	5, 60 (3,649)	9, 36 (4,022)	9, 60 (3,078)	9, 108 (1,403)
Panel A: the intercept (alpha)						
%						
> 0	30.63	25.82	25.84	19.34	17.97	15.89
≤ 0	69.37	74.18	74.16	80.66	82.03	84.11
> 0***	2.29	1.21	1.26	0.82	0.91	0.71
≤ 0***	19.28	20.74	20.72	26.55	28.59	28.37
Mean						
> 0	0.003	0.002	0.002	0.002	0.001	0.001
≤ 0	-0.004	-0.003	-0.003	-0.003	-0.003	-0.003
> 0***	0.009	0.007	0.006	0.006	0.005	0.005
≤ 0***	-0.006	-0.005	-0.005	-0.005	-0.005	-0.004
Panel B: market timing coefficient						
%						
> 0	42.71	36.42	35.16	29.61	27.49	25.30
≤ 0	57.29	63.58	64.84	70.39	72.51	74.70
> 0***	2.57	1.55	1.53	0.30	0.16	0.21
≤ 0***	4.56	3.87	3.95	4.33	4.45	5.84
Mean						
> 0	1.216	0.644	0.590	0.498	0.409	0.307
≤ 0	-1.277	-0.727	-0.680	-0.631	-0.538	-0.478
> 0***	3.793	1.994	1.776	2.253	1.205	1.198
≤ 0***	-3.897	-1.964	-1.756	-1.680	-1.370	-1.279

Table 6-7: Summary statistics of fund instance coefficients of the Carhart (1997) four-factor Treynor and Mazuy (1966) style timing model: Equity Growth-and-Income funds – continued

	3, 36	5, 36	5, 60	9, 36	9, 60	9, 108
Panel C: size timing coefficient						
%						
> 0	54.17	47.00	45.27	39.11	34.41	30.29
≤ 0	45.83	53.00	54.73	60.89	65.59	69.71
> 0***	4.98	3.87	4.00	3.36	3.02	2.71
≤ 0***	3.25	2.78	3.45	5.97	7.67	10.83
Mean						
> 0	2.001	1.259	1.104	0.857	0.475	0.351
≤ 0	-1.514	-0.777	-0.703	-0.540	-0.471	-0.447
> 0***	4.914	2.946	2.614	2.165	1.253	0.990
≤ 0***	-4.512	-1.457	-1.355	-0.946	-0.908	-0.829
Panel D: growth timing coefficient						
%						
> 0	56.31	59.29	59.47	66.51	67.84	70.06
≤ 0	43.69	40.71	40.53	33.49	32.16	29.94
> 0***	7.57	11.56	12.47	11.59	12.15	9.91
≤ 0***	3.86	4.33	4.74	1.24	1.36	1.85
Mean						
> 0	2.352	1.385	1.273	1.042	0.872	0.768
≤ 0	-2.926	-1.666	-1.552	-0.962	-0.660	-0.632
> 0***	3.775	2.462	2.281	2.006	1.765	1.828
≤ 0***	-7.601	-4.709	-4.506	-3.004	-1.676	-1.585
Panel E: momentum timing coefficient						
%						
> 0	59.24	65.29	66.87	72.30	75.44	77.41
≤ 0	40.76	34.71	33.13	27.70	24.56	22.59
> 0***	3.77	6.10	6.60	11.44	13.19	14.61
≤ 0***	2.44	2.47	2.30	2.71	2.63	2.28
Mean						
> 0	37.940	31.911	30.647	29.702	28.827	28.543
≤ 0	-30.354	-22.630	-21.330	-20.493	-18.958	-18.316
> 0***	85.064	63.471	59.795	58.611	56.347	53.390
≤ 0***	-80.089	-55.688	-55.285	-47.930	-45.711	-44.858

Table 6-8: Summary statistics of fund instance coefficients of the Carhart (1997) four-factor Treynor and Mazuy (1966) style timing model: Equity Income-and-Growth funds

This table reports the fractions and means of the coefficients of the Carhart (1997) four-factor Treynor and Mazuy (1966) style timing model (CTM) of 219 Equity Income-and-Growth funds. Columns 2-7 show the statistics for six test settings, in which the first number is sub-period length (years) and the second number is minimum observation number (months). The number in parentheses below each test setting is the number of fund instances. Panels A to E show the statistics for the intercept and four style timing coefficients of CTM respectively. In each panel are the fractions (%) and means of the corresponding intercepts or timing coefficients that are positive (>0), negative (≤0), significantly positive (>0***) and significantly negative (≤0***). *** means significance level of 0.01 based on the bootstrap method of Kosowski et al. (2006).

	3, 36 (1,335)	5, 36 (1,294)	5, 60 (941)	9, 36 (954)	9, 60 (732)	9, 108 (414)
Panel A: the intercept (alpha)						
%						
> 0	32.51	22.87	22.64	13.52	9.43	6.52
≤ 0	67.49	77.13	77.36	86.48	90.57	93.48
> 0***	2.62	0.85	0.43	1.05	0.41	0.00
≤ 0***	18.35	18.70	17.00	21.80	21.45	25.12
Mean						
> 0	0.003	0.002	0.001	0.003	0.002	0.001
≤ 0	-0.004	-0.003	-0.003	-0.003	-0.003	-0.003
> 0***	0.008	0.012	0.007	0.013	0.011	---
≤ 0***	-0.006	-0.005	-0.005	-0.005	-0.004	-0.004
Panel B: market timing coefficient						
%						
> 0	41.65	45.52	45.16	48.43	51.64	53.62
≤ 0	58.35	54.48	54.84	51.57	48.36	46.38
> 0***	2.92	4.02	3.61	1.26	0.55	0.97
≤ 0***	5.02	2.78	2.55	0.84	0.14	0.24
Mean						
> 0	0.927	0.720	0.691	0.585	0.534	0.597
≤ 0	-1.603	-0.695	-0.605	-0.592	-0.432	-0.399
> 0***	2.441	1.974	1.880	2.499	2.339	2.339
≤ 0***	-4.150	-1.989	-1.649	-2.333	-1.029	-1.029

Table 6-8: Summary statistics of fund instance coefficients of the Carhart (1997) four-factor Treynor and Mazuy (1966) style timing model: Equity Income-and-Growth funds – continued

	3, 36	5, 36	5, 60	9, 36	9, 60	9, 108
Panel C: size timing coefficient						
%						
> 0	63.90	54.10	49.31	43.29	34.84	32.13
≤ 0	36.10	45.90	50.69	56.71	65.16	67.87
> 0***	6.97	4.02	2.98	6.60	5.74	7.25
≤ 0***	3.22	4.48	5.31	12.79	15.71	16.43
Mean						
> 0	2.214	1.357	1.169	1.042	0.453	0.401
≤ 0	-1.522	-0.775	-0.696	-0.647	-0.552	-0.445
> 0***	5.498	3.800	3.294	2.159	0.743	0.725
≤ 0***	-5.245	-1.963	-1.498	-1.443	-1.200	-0.781
Panel D: growth timing coefficient						
%						
> 0	47.34	44.13	46.55	42.98	43.03	39.37
≤ 0	52.66	55.87	53.45	57.02	56.97	60.63
> 0***	2.85	4.02	5.31	0.94	0.96	0.00
≤ 0***	5.77	9.12	10.20	5.77	6.42	8.21
Mean						
> 0	2.396	1.027	0.995	0.616	0.514	0.448
≤ 0	-2.674	-1.731	-1.543	-1.094	-0.764	-0.796
> 0***	3.548	2.103	2.114	1.553	1.478	---
≤ 0***	-4.595	-3.499	-3.511	-2.105	-1.899	-1.899
Panel E: momentum timing coefficient						
%						
> 0	66.22	74.03	77.15	72.22	75.55	78.02
≤ 0	33.78	25.97	22.85	27.78	24.45	21.98
> 0***	3.82	3.55	4.25	11.22	14.07	17.63
≤ 0***	0.37	0.46	0.43	0.84	0.82	0.48
Mean						
> 0	36.089	31.681	30.739	31.613	31.025	31.424
≤ 0	-26.387	-21.575	-22.119	-17.199	-15.876	-14.998
> 0***	90.267	61.721	60.104	45.766	44.245	43.635
≤ 0***	-137.897	-138.555	-124.040	-125.495	-111.465	-80.520

Table 6-9: Summary statistics of fund instance coefficients of the Carhart (1997) four-factor Henriksson and Merton (1981) style timing model: Equity Aggressive Growth funds

This table reports the fractions and means of the coefficients of the Carhart (1997) four-factor Henriksson and Merton (1981) style timing model (CHM) of 150 Equity Aggressive Growth funds. Columns 2-7 show the statistics for six test settings, in which the first number is sub-period length (years) and the second number is minimum observation number (months). The number in parentheses below each test setting is the number of fund instances. Panels A to E show the statistics for the intercept and four style timing coefficients of CHM respectively. In each panel are the fractions (%) and means of the corresponding intercepts or timing coefficients that are positive (>0), negative (≤0), significantly positive (>0***) and significantly negative (≤0***). *** means significance level of 0.01 based on the bootstrap method of Kosowski et al. (2006).

	3, 36 (971)	5, 36 (976)	5, 60 (683)	9, 36 (748)	9, 60 (589)	9, 108 (255)
Panel A: the intercept (alpha)						
%						
> 0	53.96	51.13	46.85	40.24	36.84	25.10
≤ 0	46.04	48.87	53.15	59.76	63.16	74.90
> 0***	3.40	2.66	2.49	1.47	1.02	0.00
≤ 0***	2.88	2.05	2.78	4.14	5.09	8.63
Mean						
> 0	0.008	0.007	0.006	0.006	0.005	0.004
≤ 0	-0.008	-0.007	-0.007	-0.006	-0.005	-0.005
> 0***	0.026	0.013	0.014	0.015	0.012	---
≤ 0***	-0.022	-0.016	-0.016	-0.013	-0.013	-0.013
Panel B: market timing coefficient						
%						
> 0	67.35	66.91	69.25	74.87	76.57	86.27
≤ 0	32.65	33.09	30.75	25.13	23.43	13.73
> 0***	5.87	4.92	2.93	4.68	3.74	0.78
≤ 0***	0.41	0.31	0.00	0.13	0.17	0.00
Mean						
> 0	0.371	0.297	0.250	0.268	0.239	0.194
≤ 0	-0.342	-0.261	-0.241	-0.216	-0.198	-0.143
> 0***	0.980	0.859	0.604	0.614	0.586	0.637
≤ 0***	-0.872	-0.733	---	-0.377	-0.377	---

Table 6-9: Summary statistics of fund instance coefficients of the Carhart (1997) four-factor Henriksson and Merton (1981) style timing model: Equity Aggressive Growth funds – continued

	3, 36	5, 36	5, 60	9, 36	9, 60	9, 108
Panel C: size timing coefficient						
%						
> 0	39.44	42.11	45.68	47.99	49.92	55.69
≤ 0	60.56	57.89	54.32	52.01	50.08	44.31
> 0***	1.44	1.74	2.20	2.81	3.40	5.49
≤ 0***	4.33	3.18	3.22	1.47	1.02	0.00
Mean						
> 0	0.364	0.246	0.226	0.200	0.184	0.187
≤ 0	-0.448	-0.318	-0.297	-0.249	-0.210	-0.209
> 0***	0.713	0.642	0.636	0.580	0.566	0.567
≤ 0***	-1.018	-0.709	-0.683	-0.779	-0.754	---
Panel D: growth timing coefficient						
%						
> 0	50.77	65.06	69.55	80.08	88.29	94.51
≤ 0	49.23	34.94	30.45	19.92	11.71	5.49
> 0***	4.43	5.53	6.59	11.10	12.90	20.78
≤ 0***	4.63	3.79	3.66	2.94	1.87	0.00
Mean						
> 0	0.476	0.397	0.399	0.374	0.372	0.375
≤ 0	-0.564	-0.377	-0.345	-0.359	-0.327	-0.167
> 0***	1.067	0.766	0.787	0.621	0.613	0.622
≤ 0***	-1.878	-0.947	-0.838	-0.810	-0.762	---
Panel E: momentum timing coefficient						
%						
> 0	30.38	22.03	20.79	13.64	12.56	8.63
≤ 0	69.62	77.97	79.21	86.36	87.44	91.37
> 0***	1.03	0.51	0.15	0.80	0.51	0.00
≤ 0***	7.21	11.78	10.98	18.45	19.69	21.18
Mean						
> 0	1.660	1.286	1.080	1.534	1.384	1.191
≤ 0	-2.165	-2.100	-2.087	-2.069	-2.077	-1.868
> 0***	7.699	6.492	5.583	6.585	5.730	---
≤ 0***	-4.896	-3.956	-3.969	-3.375	-3.270	-3.484

Table 6-10: Summary statistics of fund instance coefficients of the Carhart (1997) four-factor Henriksson and Merton (1981) style timing model: Equity Growth funds

This table reports the fractions and means of the coefficients of the Carhart (1997) four-factor Henriksson and Merton (1981) style timing model (CHM) of 1,956 Equity Growth funds. Columns 2-7 show the statistics for six test settings, in which the first number is sub-period length (years) and the second number is minimum observation number (months). The number in parentheses below each test setting is the number of fund instances. Panels A to E show the statistics for the intercept and four style timing coefficients of CHM respectively. In each panel are the fractions (%) and means of the corresponding intercepts or timing coefficients that are positive (>0), negative (≤0), significantly positive (>0***) and significantly negative (≤0***). *** means significance level of 0.01 based on the bootstrap method of Kosowski et al. (2006).

	3, 36 (10,883)	5, 36 (10,844)	5, 60 (7,203)	9, 36 (8,705)	9, 60 (6,200)	9, 108 (2,578)
Panel A: the intercept (alpha)						
%						
> 0	40.70	35.56	33.86	26.12	21.65	18.31
≤ 0	59.30	64.44	66.14	73.88	78.35	81.69
> 0***	2.10	1.72	1.76	0.52	0.31	0.19
≤ 0***	8.87	8.17	8.33	9.20	9.74	9.97
Mean						
> 0	0.006	0.004	0.004	0.004	0.003	0.002
≤ 0	-0.007	-0.005	-0.005	-0.005	-0.004	-0.004
> 0***	0.017	0.013	0.012	0.013	0.011	0.010
≤ 0***	-0.013	-0.010	-0.010	-0.009	-0.008	-0.008
Panel B: market timing coefficient						
%						
> 0	56.38	53.48	54.28	54.24	55.13	56.01
≤ 0	43.62	46.52	45.72	45.76	44.87	43.99
> 0***	4.64	2.53	2.10	2.16	1.66	0.78
≤ 0***	1.67	0.95	0.79	0.84	0.60	0.19
Mean						
> 0	0.270	0.176	0.158	0.163	0.141	0.110
≤ 0	-0.196	-0.138	-0.125	-0.124	-0.105	-0.089
> 0***	0.735	0.551	0.506	0.588	0.572	0.496
≤ 0***	-0.576	-0.375	-0.339	-0.362	-0.340	-0.296

Table 6-10: Summary statistics of fund instance coefficients of the Carhart (1997) four-factor Henriksson and Merton (1981) style timing model: Equity Growth funds – continued

	3, 36	5, 36	5, 60	9, 36	9, 60	9, 108
Panel C: size timing coefficient						
%						
> 0	44.46	48.33	48.74	53.34	54.11	55.82
≤ 0	55.54	51.67	51.26	46.66	45.89	44.18
> 0***	4.00	3.91	3.75	4.37	3.98	3.61
≤ 0***	5.32	3.09	3.00	2.42	2.23	1.94
Mean						
> 0	0.263	0.199	0.174	0.181	0.150	0.132
≤ 0	-0.301	-0.221	-0.206	-0.174	-0.142	-0.114
> 0***	0.561	0.490	0.450	0.486	0.454	0.392
≤ 0***	-0.779	-0.592	-0.565	-0.532	-0.472	-0.414
Panel D: growth timing coefficient						
%						
> 0	56.21	62.36	65.13	69.08	74.82	76.45
≤ 0	43.79	37.64	34.87	30.92	25.18	23.55
> 0***	6.27	7.26	7.96	9.14	10.39	11.17
≤ 0***	3.19	3.05	3.26	1.86	1.50	1.32
Mean						
> 0	0.335	0.269	0.257	0.244	0.232	0.216
≤ 0	-0.371	-0.270	-0.253	-0.231	-0.180	-0.153
> 0***	0.708	0.560	0.536	0.493	0.461	0.433
≤ 0***	-1.123	-0.786	-0.752	-0.654	-0.529	-0.440
Panel E: momentum timing coefficient						
%						
> 0	42.40	39.88	39.08	39.06	38.76	38.75
≤ 0	57.60	60.12	60.92	60.94	61.24	61.25
> 0***	1.61	1.72	1.31	2.10	1.73	1.44
≤ 0***	4.89	5.79	5.94	6.28	6.69	6.87
Mean						
> 0	1.077	0.957	0.876	0.907	0.856	0.806
≤ 0	-1.265	-1.159	-1.105	-1.152	-1.113	-0.970
> 0***	3.057	3.019	2.751	2.700	2.404	2.136
≤ 0***	-3.026	-2.655	-2.448	-2.632	-2.460	-2.125

Table 6-11: Summary statistics of fund instance coefficients of the Carhart (1997) four-factor Henriksson and Merton (1981) style timing model: Equity Growth-and-Income funds

This table reports the fractions and means of the coefficients of the Carhart (1997) four-factor Henriksson and Merton (1981) style timing model (CHM) of 856 Equity Growth-and-Income funds. Columns 2-7 show the statistics for six test settings, in which the first number is sub-period length (years) and the second number is minimum observation number (months). The number in parentheses below each test setting is the number of fund instances. Panels A to E show the statistics for the intercept and four style timing coefficients of CHM respectively. In each panel are the fractions (%) and means of the corresponding intercepts or timing coefficients that are positive (>0), negative (≤0), significantly positive (>0***) and significantly negative (≤0***). *** means significance level of 0.01 based on the bootstrap method of Kosowski et al. (2006).

	3, 36 (5,285)	5, 36 (5,217)	5, 60 (3,649)	9, 36 (4,022)	9, 60 (3,078)	9, 108 (1,403)
Panel A: the intercept (alpha)						
%						
> 0	31.39	25.46	25.40	16.83	15.24	11.40
≤ 0	68.61	74.54	74.60	83.17	84.76	88.60
> 0***	1.38	0.52	0.52	0.20	0.23	0.29
≤ 0***	13.43	14.36	14.14	16.66	16.83	14.33
Mean						
> 0	0.005	0.003	0.003	0.003	0.002	0.002
≤ 0	-0.006	-0.005	-0.005	-0.005	-0.004	-0.004
> 0***	0.013	0.011	0.009	0.010	0.007	0.007
≤ 0***	-0.011	-0.009	-0.008	-0.008	-0.008	-0.007
Panel B: market timing coefficient						
%						
> 0	46.60	46.52	45.88	44.46	43.44	45.76
≤ 0	53.40	53.48	54.12	55.54	56.56	54.24
> 0***	2.35	1.23	1.12	0.37	0.26	0.07
≤ 0***	3.16	1.63	1.37	1.52	1.14	0.78
Mean						
> 0	0.174	0.118	0.112	0.102	0.096	0.082
≤ 0	-0.192	-0.124	-0.112	-0.107	-0.089	-0.077
> 0***	0.462	0.327	0.299	0.415	0.331	0.350
≤ 0***	-0.592	-0.445	-0.398	-0.417	-0.348	-0.289

Table 6-11: Summary statistics of fund instance coefficients of the Carhart (1997) four-factor Henriksson and Merton (1981) style timing model: Equity Growth-and-Income funds – continued

	3, 36	5, 36	5, 60	9, 36	9, 60	9, 108
Panel C: size timing coefficient						
%						
> 0	56.65	52.96	51.71	50.32	46.78	43.05
≤ 0	43.35	47.04	48.29	49.68	53.22	56.95
> 0***	5.53	3.76	3.64	3.21	2.92	2.35
≤ 0***	2.71	2.07	2.33	1.82	2.18	2.64
Mean						
> 0	0.243	0.172	0.153	0.147	0.120	0.103
≤ 0	-0.202	-0.142	-0.135	-0.119	-0.113	-0.111
> 0***	0.584	0.447	0.396	0.401	0.324	0.329
≤ 0***	-0.563	-0.392	-0.367	-0.327	-0.317	-0.289
Panel D: growth timing coefficient						
%						
> 0	57.20	58.00	57.96	61.88	62.41	60.94
≤ 0	42.80	42.00	42.04	38.12	37.59	39.06
> 0***	6.53	7.53	8.28	6.91	6.79	5.13
≤ 0***	2.61	2.36	2.85	0.90	1.04	1.57
Mean						
> 0	0.266	0.209	0.204	0.176	0.159	0.141
≤ 0	-0.275	-0.186	-0.181	-0.140	-0.130	-0.117
> 0***	0.550	0.454	0.452	0.414	0.393	0.419
≤ 0***	-0.816	-0.541	-0.521	-0.407	-0.383	-0.365
Panel E: momentum timing coefficient						
%						
> 0	56.52	62.70	63.55	70.11	73.81	74.91
≤ 0	43.48	37.30	36.45	29.89	26.19	25.09
> 0***	2.35	3.11	3.32	5.69	6.27	7.63
≤ 0***	2.04	2.43	2.52	2.11	2.21	2.28
Mean						
> 0	0.980	0.888	0.856	0.861	0.843	0.827
≤ 0	-0.785	-0.688	-0.663	-0.635	-0.615	-0.523
> 0***	2.393	2.351	2.279	2.010	1.939	1.785
≤ 0***	-2.129	-1.781	-1.789	-1.613	-1.616	-1.507

Table 6-12: Summary statistics of fund instance coefficients of the Carhart (1997) four-factor Henriksson and Merton (1981) style timing model: Equity Income-and-Growth funds

This table reports the fractions and means of the coefficients of the Carhart (1997) four-factor Henriksson and Merton (1981) style timing model (CHM) of 150 Equity Income-and-Growth funds. Columns 2-7 show the statistics for six test settings, in which the first number is sub-period length (years) and the second number is minimum observation number (months). The number in parentheses below each test setting is the number of fund instances. Panels A to E show the statistics for the intercept and four style timing coefficients of CHM respectively. In each panel are the fractions (%) and means of the corresponding intercepts or timing coefficients that are positive (>0), negative (≤0), significantly positive (>0***) and significantly negative (≤0***). *** means significance level of 0.01 based on the bootstrap method of Kosowski et al. (2006).

	3, 36 (1,335)	5, 36 (1,294)	5, 60 (941)	9, 36 (954)	9, 60 (732)	9, 108 (414)
Panel A: the intercept (alpha)						
%						
> 0	32.66	20.48	19.66	13.42	10.79	8.94
≤ 0	67.34	79.52	80.34	86.58	89.21	91.06
> 0***	0.97	0.46	0.64	0.10	0.00	0.00
≤ 0***	13.78	14.53	14.03	12.58	11.34	8.94
Mean						
> 0	0.005	0.003	0.002	0.003	0.002	0.001
≤ 0	-0.006	-0.005	-0.005	-0.004	-0.004	-0.004
> 0***	0.010	0.010	0.010	0.018	---	---
≤ 0***	-0.011	-0.008	-0.008	-0.007	-0.007	-0.007
Panel B: market timing coefficient						
%						
> 0	43.30	57.19	57.92	60.59	64.62	68.84
≤ 0	56.70	42.81	42.08	39.41	35.38	31.16
> 0***	2.32	2.32	2.02	0.94	0.55	0.72
≤ 0***	4.49	1.62	0.43	1.26	0.00	0.00
Mean						
> 0	0.179	0.140	0.141	0.121	0.120	0.120
≤ 0	-0.220	-0.119	-0.103	-0.103	-0.075	-0.070
> 0***	0.500	0.390	0.408	0.396	0.400	0.438
≤ 0***	-0.559	-0.438	-0.306	-0.456	---	---

Table 6-12: Summary statistics of fund instance coefficients of the Carhart (1997) four-factor Henriksson and Merton (1981) style timing model: Equity Income-and-Growth funds – continued

	3, 36	5, 36	5, 60	9, 36	9, 60	9, 108
Panel C: size timing coefficient						
%						
> 0	67.42	58.19	54.20	52.31	44.67	41.06
≤ 0	32.58	41.81	45.80	47.69	55.33	58.94
> 0***	7.34	3.09	2.44	3.56	2.60	1.93
≤ 0***	2.55	2.09	2.34	4.09	4.64	3.86
Mean						
> 0	0.266	0.172	0.150	0.154	0.116	0.094
≤ 0	-0.194	-0.132	-0.133	-0.120	-0.116	-0.109
> 0***	0.629	0.548	0.467	0.468	0.311	0.287
≤ 0***	-0.527	-0.373	-0.298	-0.362	-0.314	-0.260
Panel D: growth timing coefficient						
%						
> 0	51.46	45.13	47.18	39.94	38.66	34.06
≤ 0	48.54	54.87	52.82	60.06	61.34	65.94
> 0***	2.47	2.24	2.98	0.84	0.96	0.00
≤ 0***	3.45	5.26	5.84	3.77	4.51	6.28
Mean						
> 0	0.221	0.152	0.161	0.096	0.094	0.085
≤ 0	-0.293	-0.206	-0.197	-0.158	-0.143	-0.147
> 0***	0.482	0.434	0.437	0.305	0.296	---
≤ 0***	-0.671	-0.491	-0.443	-0.327	-0.320	-0.322
Panel E: momentum timing coefficient						
%						
> 0	66.59	71.95	73.22	72.64	75.68	78.26
≤ 0	33.41	28.05	26.78	27.36	24.32	21.74
> 0***	1.05	2.24	2.76	5.14	6.28	8.45
≤ 0***	0.52	0.31	0.32	0.42	0.27	0.00
Mean						
> 0	0.879	0.856	0.870	0.869	0.897	0.888
≤ 0	-0.778	-0.667	-0.685	-0.568	-0.541	-0.465
> 0***	2.122	2.038	2.019	1.471	1.452	1.362
≤ 0***	-3.151	-3.876	-3.454	-4.738	-4.173	---

Table 6-17: Summary statistics of fund instance coefficients of Carhart's (1997) four-factor model: Growth funds

This table reports the fractions and means of the coefficients of Carhart's (1997) four-factor model of 1,470 Growth funds under six test settings. Columns 2-7 show the statistics for six test settings, in which the first number is sub-period length (years) and the second number is minimum observation number (months). The number in parentheses below each test setting is the number of fund instances. Panels A to E show the statistics for the intercept and four coefficients of Carhart's (1997) four-factor model respectively. In each panel are the fractions (%) and means of the corresponding coefficients that are positive (>0), negative (≤0), significantly positive (>0***) and significantly negative (≤0***). *** means significance level of 0.01 based on the bootstrap method of Kosowski et al. (2006).

	3, 36 (8,752)	5, 36 (8,694)	5, 60 (5,961)	9, 36 (6,843)	9, 60 (5,092)	9, 108 (2,179)
Panel A: the intercept (alpha)						
%						
> 0	35.59	33.02	32.28	35.67	38.02	39.51
≤ 0	64.41	66.98	67.72	64.33	61.98	60.49
> 0***	12.67	16.57	16.27	18.30	20.35	20.15
≤ 0***	35.83	41.89	42.66	39.94	38.33	37.17
Mean						
> 0	0.003	0.003	0.003	0.002	0.002	0.002
≤ 0	-0.003	-0.003	-0.003	-0.003	-0.002	-0.002
> 0***	0.006	0.005	0.004	0.004	0.004	0.003
≤ 0***	-0.005	-0.004	-0.004	-0.004	-0.003	-0.003
Panel B: the coefficient of RMRF						
%						
> 0	99.97	100.00	100.00	100.00	100.00	100.00
≤ 0	0.03	0.00	0.00	0.00	0.00	0.00
> 0***	99.59	99.78	99.88	99.88	99.92	100.00
≤ 0***	0.00	0.00	0.00	0.00	0.00	0.00
Mean						
> 0	0.986	0.996	0.999	1.007	1.006	1.004
≤ 0	-0.022	---	---	---	---	---
> 0***	0.988	0.997	0.999	1.007	1.007	1.004
≤ 0***	---	---	---	---	---	---

Table 6-17: Summary statistics of fund instance coefficients of Carhart's (1997) four-factor model: Growth funds – continued

	3, 36	5, 36	5, 60	9, 36	9, 60	9, 108
Panel C: the coefficient of SMB						
%						
> 0	52.73	46.50	46.38	43.21	41.12	40.66
≤ 0	47.27	53.50	53.62	56.79	58.88	59.34
> 0***	19.62	19.82	21.25	19.60	20.40	23.31
≤ 0***	21.10	28.94	29.59	35.06	38.47	38.27
Mean						
> 0	0.230	0.204	0.205	0.196	0.197	0.202
≤ 0	-0.145	-0.140	-0.138	-0.138	-0.139	-0.134
> 0***	0.418	0.352	0.346	0.326	0.318	0.303
≤ 0***	-0.221	-0.198	-0.193	-0.186	-0.183	-0.177
Panel D: the coefficient of HML						
%						
> 0	17.49	17.36	18.94	17.04	17.69	19.83
≤ 0	82.51	82.64	81.06	82.96	82.31	80.17
> 0***	3.12	4.41	4.86	5.25	5.99	7.11
≤ 0***	48.23	56.06	55.07	61.16	62.45	61.73
Mean						
> 0	0.126	0.111	0.109	0.105	0.103	0.100
≤ 0	-0.313	-0.303	-0.294	-0.295	-0.294	-0.287
> 0***	0.272	0.244	0.240	0.213	0.201	0.187
≤ 0***	-0.430	-0.390	-0.384	-0.362	-0.358	-0.351
Panel E: the coefficient of MOM						
%						
> 0	34.32	30.49	30.83	28.29	28.06	29.14
≤ 0	65.68	69.51	69.17	71.71	71.94	70.86
> 0***	1.03	1.21	1.16	1.49	1.77	1.70
≤ 0***	7.29	10.50	11.02	15.71	17.38	18.36
Mean						
> 0	0.325	0.300	0.294	0.292	0.292	0.252
≤ 0	-0.482	-0.468	-0.447	-0.491	-0.475	-0.442
> 0***	1.026	1.113	1.039	1.085	1.054	1.027
≤ 0***	-1.106	-1.021	-1.009	-0.987	-0.968	-0.910

Table 6-18: Summary statistics of fund instance coefficients of Carhart's (1997) four-factor model: Blend funds

This table reports the fractions and means of the coefficients of Carhart's (1997) four-factor model of 428 Blend funds under six test settings. Columns 2-7 show the statistics for six test settings, in which the first number is sub-period length (years) and the second number is minimum observation number (months). The number in parentheses below each test setting is the number of fund instances. Panels A to E show the statistics for the intercept and four coefficients of Carhart's (1997) four-factor model respectively. In each panel are the fractions (%) and means of the corresponding coefficients that are positive (>0), negative (≤0), significantly positive (>0***) and significantly negative (≤0***). *** means significance level of 0.01 based on the bootstrap method of Kosowski et al. (2006).

	3, 36 (2,385)	5, 36 (2,437)	5, 60 (1,582)	9, 36 (1,953)	9, 60 (1,436)	9, 108 (554)
Panel A: the intercept (alpha)						
%						
> 0	30.90	28.93	27.37	29.65	28.34	26.35
≤ 0	69.10	71.07	72.63	70.35	71.66	73.65
> 0***	10.94	12.23	11.57	13.42	14.07	12.82
≤ 0***	39.71	47.03	48.42	51.20	55.29	60.65
Mean						
> 0	0.002	0.002	0.002	0.002	0.002	0.002
≤ 0	-0.003	-0.002	-0.002	-0.002	-0.002	-0.002
> 0***	0.005	0.004	0.003	0.003	0.003	0.003
≤ 0***	-0.004	-0.003	-0.003	-0.003	-0.003	-0.002
Panel B: the coefficient of RMRF						
%						
> 0	99.83	99.84	100.00	100.00	100.00	100.00
≤ 0	0.17	0.16	0.00	0.00	0.00	0.00
> 0***	99.25	99.55	100.00	99.74	100.00	100.00
≤ 0***	0.00	0.00	0.00	0.00	0.00	0.00
Mean						
> 0	0.951	0.951	0.950	0.950	0.952	0.952
≤ 0	-0.017	-0.017	---	---	---	---
> 0***	0.955	0.954	0.950	0.952	0.952	0.952
≤ 0***	---	---	---	---	---	---

Table 6-18: Summary statistics of fund instance coefficients of Carhart's (1997) four-factor model: Blend funds – continued

	3, 36	5, 36	5, 60	9, 36	9, 60	9, 108
Panel C: the coefficient of SMB						
%						
> 0	27.92	24.70	23.01	22.12	19.57	16.79
≤ 0	72.08	75.30	76.99	77.88	80.43	83.21
> 0***	6.58	6.69	6.51	6.40	6.55	3.43
≤ 0***	43.52	50.10	50.25	58.53	61.98	66.06
Mean						
> 0	0.151	0.141	0.125	0.138	0.135	0.091
≤ 0	-0.151	-0.139	-0.135	-0.140	-0.136	-0.135
> 0***	0.367	0.330	0.268	0.325	0.292	0.241
≤ 0***	-0.195	-0.177	-0.173	-0.167	-0.161	-0.157
Panel D: the coefficient of HML						
%						
> 0	58.70	68.73	71.05	72.45	74.03	74.73
≤ 0	41.30	31.27	28.95	27.55	25.97	25.27
> 0***	21.01	34.43	37.61	42.50	44.57	48.92
≤ 0***	10.99	10.09	9.10	8.81	8.08	8.48
Mean						
> 0	0.159	0.157	0.156	0.165	0.159	0.157
≤ 0	-0.155	-0.149	-0.137	-0.145	-0.132	-0.086
> 0***	0.278	0.239	0.232	0.229	0.221	0.208
≤ 0***	-0.341	-0.314	-0.293	-0.341	-0.328	-0.168
Panel E: the coefficient of MOM						
%						
> 0	54.93	53.39	54.24	54.79	56.69	55.05
≤ 0	45.07	46.61	45.76	45.21	43.31	44.95
> 0***	3.40	4.68	4.42	5.79	6.69	7.58
≤ 0***	2.14	2.26	2.53	2.51	2.30	3.79
Mean						
> 0	0.295	0.271	0.259	0.251	0.246	0.238
≤ 0	-0.292	-0.253	-0.258	-0.241	-0.232	-0.219
> 0***	0.781	0.652	0.679	0.616	0.621	0.642
≤ 0***	-0.850	-0.750	-0.750	-0.736	-0.754	-0.678

Table 6-19: Summary statistics of fund instance coefficients of Carhart's (1997) four-factor model: Value funds

This table reports the fractions and means of the coefficients of Carhart's (1997) four-factor model of 1,283 Value funds under six test settings. Columns 2-7 show the statistics for six test settings, in which the first number is sub-period length (years) and the second number is minimum observation number (months). The number in parentheses below each test setting is the number of fund instances. Panels A to E show the statistics for the intercept and four coefficients of Carhart's (1997) four-factor model respectively. In each panel are the fractions (%) and means of the corresponding coefficients that are positive (>0), negative (≤0), significantly positive (>0***) and significantly negative (≤0***). *** means significance level of 0.01 based on the bootstrap method of Kosowski et al. (2006).

	3, 36 (7,337)	5, 36 (7,200)	5, 60 (4,933)	9, 36 (5,633)	9, 60 (4,071)	9, 108 (1,917)
Panel A: the intercept (alpha)						
%						
> 0	28.49	27.19	26.25	23.13	18.35	13.41
≤ 0	71.51	72.81	73.75	76.87	81.65	86.59
> 0***	8.48	9.11	8.88	8.20	6.80	4.80
≤ 0***	37.59	45.60	46.62	53.19	59.74	66.98
Mean						
> 0	0.002	0.002	0.002	0.002	0.002	0.001
≤ 0	-0.003	-0.002	-0.002	-0.002	-0.002	-0.002
> 0***	0.005	0.004	0.003	0.004	0.003	0.002
≤ 0***	-0.004	-0.003	-0.003	-0.003	-0.003	-0.003
Panel B: the coefficient of RMRF						
%						
> 0	99.93	99.93	99.94	99.91	99.93	100.00
≤ 0	0.07	0.07	0.06	0.09	0.07	0.00
> 0***	99.90	99.89	99.92	99.88	99.93	100.00
≤ 0***	0.03	0.03	0.00	0.04	0.00	0.00
Mean						
> 0	0.972	0.968	0.965	0.966	0.965	0.961
≤ 0	-0.094	-0.089	-0.104	-0.090	-0.107	---
> 0***	0.972	0.968	0.965	0.966	0.965	0.961
≤ 0***	-0.069	-0.066	---	-0.066	---	---

Table 6-19: Summary statistics of fund instance coefficients of Carhart's (1997) four-factor model: Value funds – continued

	3, 36	5, 36	5, 60	9, 36	9, 60	9, 108
Panel C: the coefficient of SMB						
%						
> 0	27.37	26.07	24.97	21.23	20.39	19.51
≤ 0	72.63	73.93	75.03	78.77	79.61	80.49
> 0***	5.21	6.63	6.59	5.34	5.43	5.27
≤ 0***	31.10	33.88	34.97	42.54	44.19	46.95
Mean						
> 0	0.127	0.119	0.112	0.106	0.093	0.088
≤ 0	-0.145	-0.119	-0.114	-0.118	-0.109	-0.107
> 0***	0.316	0.270	0.251	0.240	0.205	0.184
≤ 0***	-0.224	-0.177	-0.168	-0.162	-0.149	-0.142
Panel D: the coefficient of HML						
%						
> 0	93.43	96.90	97.57	98.03	99.16	99.32
≤ 0	6.57	3.10	2.43	1.97	0.84	0.68
> 0***	66.59	83.04	87.33	89.15	95.43	97.08
≤ 0***	0.85	0.22	0.18	0.09	0.02	0.05
Mean						
> 0	0.332	0.376	0.390	0.408	0.436	0.443
≤ 0	-0.112	-0.081	-0.083	-0.076	-0.084	-0.099
> 0***	0.411	0.417	0.423	0.436	0.449	0.452
≤ 0***	-0.330	-0.270	-0.337	-0.185	-0.145	-0.145
Panel E: the coefficient of MOM						
%						
> 0	63.80	67.74	67.97	71.72	72.34	72.51
≤ 0	36.20	32.26	32.03	28.28	27.66	27.49
> 0***	4.01	4.04	3.93	5.93	6.29	6.73
≤ 0***	0.90	1.26	1.30	1.62	1.79	1.77
Mean						
> 0	0.351	0.316	0.308	0.315	0.300	0.283
≤ 0	-0.281	-0.233	-0.214	-0.221	-0.208	-0.204
> 0***	0.881	0.811	0.730	0.820	0.760	0.676
≤ 0***	-0.900	-0.743	-0.710	-0.700	-0.661	-0.585

Table 6-20: Summary statistics of fund instance coefficients of the Carhart (1997) four-factor Treynor and Mazuy (1966) style timing model: Growth funds

This table reports the fractions and means of the coefficients of the Carhart (1997) four-factor Treynor and Mazuy (1966) style timing model (CTM) of 1,470 Growth funds. Columns 2-7 show the statistics for six test settings, in which the first number is sub-period length (years) and the second number is minimum observation number (months). The number in parentheses below each test setting is the number of fund instances. Panels A to E show the statistics for the intercept and four style timing coefficients of CTM respectively. In each panel are the fractions (%) and means of the corresponding intercepts or timing coefficients that are positive (>0), negative (≤0), significantly positive (>0***) and significantly negative (≤0***). *** means significance level of 0.01 based on the bootstrap method of Kosowski et al. (2006).

	3, 36 (8,752)	5, 36 (8,694)	5, 60 (5,961)	9, 36 (6,843)	9, 60 (5,092)	9, 108 (2,179)
Panel A: the intercept (alpha)						
%						
> 0	39.45	39.02	38.25	35.29	34.94	32.58
≤ 0	60.55	60.98	61.75	64.71	65.06	67.42
> 0***	3.55	2.67	1.86	1.93	1.75	1.28
≤ 0***	9.64	9.88	10.60	12.07	13.51	14.78
Mean						
> 0	0.004	0.003	0.003	0.003	0.002	0.002
≤ 0	-0.004	-0.003	-0.003	-0.003	-0.003	-0.002
> 0***	0.011	0.010	0.008	0.010	0.008	0.005
≤ 0***	-0.009	-0.007	-0.006	-0.006	-0.006	-0.005
Panel B: market timing coefficient						
%						
> 0	60.39	55.66	55.54	58.15	56.87	54.02
≤ 0	39.61	44.34	44.46	41.85	43.13	45.98
> 0***	5.79	4.29	3.67	2.59	1.79	0.83
≤ 0***	1.49	1.30	1.07	1.21	1.08	1.33
Mean						
> 0	2.026	1.068	0.940	0.933	0.773	0.561
≤ 0	-1.172	-0.678	-0.610	-0.565	-0.467	-0.367
> 0***	5.271	3.258	2.847	3.545	3.099	2.036
≤ 0***	-2.883	-2.000	-1.722	-1.962	-1.591	-0.955

Table 6-20: Summary statistics of fund instance coefficients of the Carhart (1997) four-factor Treynor and Mazuy (1966) style timing model: Growth funds – continued

	3, 36	5, 36	5, 60	9, 36	9, 60	9, 108
Panel C: size timing coefficient						
%						
> 0	40.28	44.34	46.15	57.42	62.12	64.48
≤ 0	59.72	55.66	53.85	42.58	37.88	35.52
> 0***	4.41	5.31	6.11	7.44	8.37	9.36
≤ 0***	4.82	4.13	4.23	2.27	2.10	2.16
Mean						
> 0	1.898	0.906	0.822	0.705	0.618	0.596
≤ 0	-2.580	-1.770	-1.672	-1.108	-0.667	-0.378
> 0***	3.186	1.824	1.808	1.616	1.564	1.526
≤ 0***	-6.989	-4.443	-4.107	-3.007	-1.768	-0.786
Panel D: growth timing coefficient						
%						
> 0	54.74	62.95	64.47	70.55	75.55	78.94
≤ 0	45.26	37.05	35.53	29.45	24.45	21.06
> 0***	6.04	9.96	11.29	14.44	17.07	21.11
≤ 0***	3.34	3.30	3.44	2.19	2.06	1.33
Mean						
> 0	2.888	1.853	1.730	1.382	1.258	1.251
≤ 0	-4.597	-2.190	-1.916	-1.699	-1.083	-0.869
> 0***	5.213	3.168	2.912	2.305	2.205	2.188
≤ 0***	-12.190	-4.928	-4.393	-4.115	-2.932	-2.525
Panel E: momentum timing coefficient						
%						
> 0	35.27	29.96	28.84	24.57	24.10	25.01
≤ 0	64.73	70.04	71.16	75.43	75.90	74.99
> 0***	1.23	1.12	1.04	1.18	1.12	1.19
≤ 0***	8.42	11.49	12.10	16.47	18.32	19.60
Mean						
> 0	42.949	28.242	24.854	19.911	17.103	15.614
≤ 0	-52.790	-43.804	-41.219	-43.179	-41.907	-38.947
> 0***	122.667	73.133	62.658	58.944	45.443	29.350
≤ 0***	-109.760	-89.005	-83.254	-83.306	-78.737	-72.493

Table 6-21: Summary statistics of fund instance coefficients of the Carhart (1997) four-factor Treynor and Mazuy (1966) style timing model: Blend funds

This table reports the fractions and means of the coefficients of the Carhart (1997) four-factor Treynor and Mazuy (1966) style timing model (CTM) of 428 Blend funds. Columns 2-7 show the statistics for six test settings, in which the first number is sub-period length (years) and the second number is minimum observation number (months). The number in parentheses below each test setting is the number of fund instances. Panels A to E show the statistics for the intercept and four style timing coefficients of CTM respectively. In each panel are the fractions (%) and means of the corresponding intercepts or timing coefficients that are positive (>0), negative (≤0), significantly positive (>0***) and significantly negative (≤0***). *** means significance level of 0.01 based on the bootstrap method of Kosowski et al. (2006).

	3, 36 (2,385)	5, 36 (2,437)	5, 60 (1,582)	9, 36 (1,953)	9, 60 (1,436)	9, 108 (554)
Panel A: the intercept (alpha)						
%						
> 0	31.32	28.89	27.05	22.89	19.99	15.52
≤ 0	68.68	71.11	72.95	77.11	80.01	84.48
> 0***	1.84	1.48	1.58	0.77	0.91	0.18
≤ 0***	19.79	22.28	22.95	26.68	29.94	28.70
Mean						
> 0	0.003	0.002	0.002	0.002	0.002	0.001
≤ 0	-0.004	-0.003	-0.003	-0.003	-0.003	-0.002
> 0***	0.010	0.010	0.007	0.011	0.009	0.005
≤ 0***	-0.006	-0.005	-0.005	-0.005	-0.004	-0.004
Panel B: market timing coefficient						
%						
> 0	47.71	42.72	40.71	36.35	33.22	27.98
≤ 0	52.29	57.28	59.29	63.65	66.78	72.02
> 0***	4.78	2.71	2.59	1.84	1.46	0.72
≤ 0***	2.94	2.59	2.28	2.87	2.65	1.62
Mean						
> 0	1.509	0.780	0.666	0.758	0.608	0.331
≤ 0	-1.152	-0.687	-0.620	-0.543	-0.441	-0.380
> 0***	4.688	2.213	1.935	2.791	2.510	1.360
≤ 0***	-3.044	-1.927	-1.522	-1.435	-0.893	-1.293

Table 6-21: Summary statistics of fund instance coefficients of the Carhart (1997) four-factor Treynor and Mazuy (1966) style timing model: Blend funds – continued

	3, 36	5, 36	5, 60	9, 36	9, 60	9, 108
Panel C: size timing coefficient						
%						
> 0	49.31	45.92	46.52	44.75	43.73	45.85
≤ 0	50.69	54.08	53.48	55.25	56.27	54.15
> 0***	3.90	4.97	5.44	4.76	4.94	3.79
≤ 0***	4.53	2.67	2.72	5.33	5.99	7.76
Mean						
> 0	1.784	1.021	0.819	0.796	0.507	0.347
≤ 0	-1.610	-0.910	-0.815	-0.638	-0.493	-0.403
> 0***	3.979	1.567	1.169	1.761	1.370	0.702
≤ 0***	-5.067	-1.916	-1.687	-1.457	-1.282	-1.068
Panel D: growth timing coefficient						
%						
> 0	56.44	63.19	64.41	70.92	74.23	75.81
≤ 0	43.56	36.81	35.59	29.08	25.77	24.19
> 0***	9.52	15.10	16.37	18.54	20.06	15.70
≤ 0***	2.39	3.69	4.17	2.66	2.92	3.43
Mean						
> 0	2.373	1.498	1.439	1.195	1.074	0.953
≤ 0	-3.155	-1.918	-1.548	-1.712	-1.052	-0.753
> 0***	3.822	2.305	2.209	1.952	1.799	2.151
≤ 0***	-8.653	-3.835	-3.078	-3.405	-2.072	-1.459
Panel E: momentum timing coefficient						
%						
> 0	54.68	57.12	58.34	61.39	63.23	61.91
≤ 0	45.32	42.88	41.66	38.61	36.77	38.09
> 0***	3.73	3.94	3.60	3.64	2.58	1.81
≤ 0***	3.73	3.78	3.03	3.64	3.62	3.43
Mean						
> 0	36.909	28.688	25.731	23.348	20.567	19.395
≤ 0	-34.050	-26.317	-23.586	-24.186	-20.983	-13.650
> 0***	75.442	60.381	56.607	77.854	67.861	80.667
≤ 0***	-80.025	-58.251	-53.744	-59.573	-50.414	-31.243

Table 6-22: Summary statistics of fund instance coefficients of the Carhart (1997) four-factor Treynor and Mazuy (1966) style timing model: Value funds

This table reports the fractions and means of the coefficients of the Carhart (1997) four-factor Treynor and Mazuy (1966) style timing model (CTM) of 1,283 Value funds. Columns 2-7 show the statistics for six test settings, in which the first number is sub-period length (years) and the second number is minimum observation number (months). The number in parentheses below each test setting is the number of fund instances. Panels A to E show the statistics for the intercept and four style timing coefficients of CTM respectively. In each panel are the fractions (%) and means of the corresponding intercepts or timing coefficients that are positive (>0), negative (≤0), significantly positive (>0***) and significantly negative (≤0***). *** means significance level of 0.01 based on the bootstrap method of Kosowski et al. (2006).

	3, 36 (7,337)	5, 36 (7,200)	5, 60 (4,933)	9, 36 (5,633)	9, 60 (4,071)	9, 108 (1,917)
Panel A: the intercept (alpha)						
%						
> 0	32.06	25.24	25.30	17.91	14.59	11.32
≤ 0	67.94	74.76	74.70	82.09	85.41	88.68
> 0***	2.40	1.08	0.99	0.80	0.54	0.21
≤ 0***	18.22	18.08	18.00	22.40	24.69	26.03
Mean						
> 0	0.004	0.002	0.002	0.002	0.002	0.001
≤ 0	-0.004	-0.003	-0.003	-0.003	-0.003	-0.003
> 0***	0.010	0.010	0.008	0.010	0.007	0.006
≤ 0***	-0.007	-0.005	-0.005	-0.005	-0.005	-0.005
Panel B: market timing coefficient						
%						
> 0	39.83	33.97	32.74	28.42	27.17	28.12
≤ 0	60.17	66.03	67.26	71.58	72.83	71.88
> 0***	2.29	1.82	1.70	0.55	0.12	0.26
≤ 0***	4.50	3.65	3.63	4.33	4.15	4.02
Mean						
> 0	1.252	0.705	0.636	0.565	0.417	0.410
≤ 0	-1.507	-0.842	-0.756	-0.768	-0.632	-0.521
> 0***	4.064	2.091	1.937	2.849	2.016	2.016
≤ 0***	-4.304	-2.092	-1.753	-2.037	-1.532	-1.295

Table 6-22: Summary statistics of fund instance coefficients of the Carhart (1997) four-factor Treynor and Mazuy (1966) style timing model: Value funds – continued

	3, 36	5, 36	5, 60	9, 36	9, 60	9, 108
Panel C: size timing coefficient						
%						
> 0	58.61	50.50	46.97	37.42	28.27	23.37
≤ 0	41.39	49.50	53.03	62.58	71.73	76.63
> 0***	5.72	4.47	3.57	3.78	2.19	1.83
≤ 0***	3.33	3.40	4.12	8.72	11.32	14.29
Mean						
> 0	2.304	1.656	1.388	1.411	0.657	0.373
≤ 0	-1.700	-0.794	-0.695	-0.628	-0.552	-0.508
> 0***	5.483	4.132	3.695	3.348	1.354	0.800
≤ 0***	-5.209	-1.742	-1.498	-1.301	-1.173	-0.964
Panel D: growth timing coefficient						
%						
> 0	52.69	54.54	56.52	60.02	62.96	62.55
≤ 0	47.31	45.46	43.48	39.98	37.04	37.45
> 0***	6.05	8.43	9.43	7.17	7.32	4.90
≤ 0***	4.59	5.07	5.37	2.38	2.33	3.03
Mean						
> 0	2.660	1.437	1.325	1.072	0.879	0.711
≤ 0	-3.474	-2.039	-1.727	-1.424	-0.741	-0.669
> 0***	4.781	2.743	2.612	2.348	2.085	1.767
≤ 0***	-7.413	-5.225	-4.570	-4.124	-1.883	-1.891
Panel E: momentum timing coefficient						
%						
> 0	65.33	72.96	74.58	79.78	83.47	85.03
≤ 0	34.67	27.04	25.42	20.22	16.53	14.97
> 0***	4.12	7.22	7.14	15.21	17.83	19.61
≤ 0***	1.01	0.72	0.59	0.51	0.27	0.31
Mean						
> 0	41.608	36.758	34.502	36.358	35.263	33.856
≤ 0	-29.318	-21.645	-19.633	-17.820	-13.850	-13.428
> 0***	94.008	75.979	66.069	63.158	58.087	53.732
≤ 0***	-94.458	-64.547	-60.978	-68.188	-58.012	-76.200

Table 6-23: Summary statistics of fund instance coefficients of the Carhart (1997) four-factor Henriksson and Merton (1981) style timing model: Growth funds

This table reports the fractions and means of the coefficients of the Carhart (1997) four-factor Henriksson and Merton (1981) style timing model (CHM) of 1,470 Growth funds. Columns 2-7 show the statistics for six test settings, in which the first number is sub-period length (years) and the second number is minimum observation number (months). The number in parentheses below each test setting is the number of fund instances. Panels A to E show the statistics for the intercept and four style timing coefficients of CHM respectively. In each panel are the fractions (%) and means of the corresponding intercepts or timing coefficients that are positive (>0), negative (≤0), significantly positive (>0***) and significantly negative (≤0***). *** means significance level of 0.01 based on the bootstrap method of Kosowski et al. (2006).

	3, 36 (8,752)	5, 36 (8,694)	5, 60 (5,961)	9, 36 (6,843)	9, 60 (5,092)	9, 108 (2,179)
Panel A: the intercept (alpha)						
%						
> 0	44.68	41.97	39.74	32.22	28.30	23.54
≤ 0	55.32	58.03	60.26	67.78	71.70	76.46
> 0***	2.58	2.29	2.35	0.76	0.51	0.37
≤ 0***	6.01	5.57	6.21	7.28	8.64	9.73
Mean						
> 0	0.006	0.005	0.004	0.004	0.003	0.002
≤ 0	-0.007	-0.005	-0.005	-0.005	-0.004	-0.004
> 0***	0.017	0.013	0.012	0.012	0.010	0.009
≤ 0***	-0.015	-0.011	-0.011	-0.009	-0.009	-0.008
Panel B: market timing coefficient						
%						
> 0	62.73	59.32	59.67	62.34	62.06	61.22
≤ 0	37.27	40.68	40.33	37.66	37.94	38.78
> 0***	5.63	3.24	2.67	2.54	2.02	0.83
≤ 0***	1.01	0.77	0.77	0.38	0.33	0.32
Mean						
> 0	0.296	0.199	0.178	0.185	0.165	0.132
≤ 0	-0.194	-0.138	-0.124	-0.118	-0.102	-0.081
> 0***	0.756	0.614	0.518	0.606	0.562	0.501
≤ 0***	-0.571	-0.397	-0.358	-0.403	-0.358	-0.328

Table 6-23: Summary statistics of fund instance coefficients of the Carhart (1997) four-factor Henriksson and Merton (1981) style timing model: Growth funds – continued

	3, 36	5, 36	5, 60	9, 36	9, 60	9, 108
Panel C: size timing coefficient						
%						
> 0	38.38	43.75	45.85	53.46	57.48	61.45
≤ 0	61.62	56.25	54.15	46.54	42.52	38.55
> 0***	3.34	3.55	3.94	4.41	4.75	4.77
≤ 0***	6.30	3.84	4.11	2.40	2.08	2.25
Mean						
> 0	0.253	0.185	0.175	0.161	0.150	0.141
≤ 0	-0.331	-0.246	-0.232	-0.194	-0.153	-0.124
> 0***	0.555	0.480	0.461	0.456	0.444	0.405
≤ 0***	-0.793	-0.588	-0.558	-0.514	-0.437	-0.384
Panel D: growth timing coefficient						
%						
> 0	56.47	64.42	66.45	74.08	79.40	82.93
≤ 0	43.53	35.58	33.55	25.92	20.60	17.07
> 0***	5.85	7.04	8.15	9.86	11.61	15.19
≤ 0***	3.31	3.08	3.56	1.37	1.18	0.83
Mean						
> 0	0.352	0.283	0.273	0.259	0.253	0.247
≤ 0	-0.396	-0.284	-0.272	-0.240	-0.194	-0.160
> 0***	0.746	0.566	0.541	0.493	0.476	0.471
≤ 0***	-1.276	-0.851	-0.812	-0.733	-0.633	-0.457
Panel E: momentum timing coefficient						
%						
> 0	33.54	28.28	27.76	23.16	22.47	23.41
≤ 0	66.46	71.72	72.24	76.84	77.53	76.59
> 0***	1.03	0.49	0.37	0.31	0.20	0.09
≤ 0***	6.42	8.52	8.67	10.35	11.02	11.34
Mean						
> 0	1.069	0.807	0.740	0.632	0.575	0.521
≤ 0	-1.432	-1.342	-1.290	-1.332	-1.296	-1.170
> 0***	3.397	3.109	2.792	3.184	2.746	0.809
≤ 0***	-3.348	-2.892	-2.704	-2.730	-2.573	-2.363

Table 6-24: Summary statistics of fund instance coefficients of the Carhart (1997) four-factor Henriksson and Merton (1981) style timing model: Blend funds

This table reports the fractions and means of the coefficients of the Carhart (1997) four-factor Henriksson and Merton (1981) style timing model (CHM) of 428 Blend funds. Columns 2-7 show the statistics for six test settings, in which the first number is sub-period length (years) and the second number is minimum observation number (months). The number in parentheses below each test setting is the number of fund instances. Panels A to E show the statistics for the intercept and four style timing coefficients of CHM respectively. In each panel are the fractions (%) and means of the corresponding intercepts or timing coefficients that are positive (>0), negative (≤0), significantly positive (>0***) and significantly negative (≤0***). *** means significance level of 0.01 based on the bootstrap method of Kosowski et al. (2006).

	3, 36 (2,385)	5, 36 (2,437)	5, 60 (1,582)	9, 36 (1,953)	9, 60 (1,436)	9, 108 (554)
Panel A: the intercept (alpha)						
%						
> 0	31.24	26.06	24.40	15.36	11.28	8.30
≤ 0	68.76	73.94	75.60	84.64	88.72	91.70
> 0***	0.80	0.57	0.44	0.05	0.00	0.00
≤ 0***	15.30	15.72	15.42	17.00	17.83	16.43
Mean						
> 0	0.005	0.003	0.003	0.003	0.003	0.001
≤ 0	-0.006	-0.005	-0.005	-0.004	-0.004	-0.003
> 0***	0.021	0.018	0.011	0.033	---	---
≤ 0***	-0.010	-0.008	-0.008	-0.007	-0.007	-0.006
Panel B: market timing coefficient						
%						
> 0	53.67	50.64	50.06	49.21	49.37	53.25
≤ 0	46.33	49.36	49.94	50.79	50.63	46.75
> 0***	4.15	2.09	1.64	1.48	1.25	0.36
≤ 0***	2.26	1.40	1.39	1.79	1.95	0.36
Mean						
> 0	0.201	0.144	0.126	0.133	0.112	0.074
≤ 0	-0.176	-0.122	-0.110	-0.098	-0.084	-0.075
> 0***	0.596	0.384	0.325	0.556	0.567	0.614
≤ 0***	-0.500	-0.364	-0.345	-0.272	-0.259	-0.339

Table 6-24: Summary statistics of fund instance coefficients of the Carhart (1997) four-factor Henriksson and Merton (1981) style timing model: Blend funds – continued

	3, 36	5, 36	5, 60	9, 36	9, 60	9, 108
Panel C: size timing coefficient						
%						
> 0	51.95	53.26	53.54	56.99	56.69	59.21
≤ 0	48.05	46.74	46.46	43.01	43.31	40.79
> 0***	4.03	3.78	4.36	3.38	3.27	1.99
≤ 0***	3.27	1.48	1.14	1.64	1.67	0.54
Mean						
> 0	0.221	0.158	0.139	0.144	0.119	0.095
≤ 0	-0.211	-0.150	-0.137	-0.133	-0.120	-0.105
> 0***	0.508	0.391	0.351	0.469	0.417	0.303
≤ 0***	-0.595	-0.402	-0.335	-0.545	-0.570	-0.412
Panel D: growth timing coefficient						
%						
> 0	60.29	63.15	64.22	70.35	73.75	73.65
≤ 0	39.71	36.85	35.78	29.65	26.25	26.35
> 0***	8.34	10.01	10.49	10.60	11.07	9.57
≤ 0***	2.85	2.59	2.84	1.84	1.74	2.53
Mean						
> 0	0.271	0.224	0.220	0.203	0.190	0.164
≤ 0	-0.322	-0.219	-0.194	-0.210	-0.178	-0.145
> 0***	0.543	0.415	0.424	0.401	0.400	0.424
≤ 0***	-0.983	-0.525	-0.448	-0.538	-0.432	-0.358
Panel E: momentum timing coefficient						
%						
> 0	52.41	53.84	54.30	57.45	60.93	57.22
≤ 0	47.59	46.16	45.70	42.55	39.07	42.78
> 0***	2.43	1.52	1.01	1.48	0.63	0.54
≤ 0***	2.94	3.12	2.72	2.30	2.09	2.53
Mean						
> 0	0.956	0.809	0.727	0.695	0.596	0.560
≤ 0	-0.899	-0.807	-0.747	-0.760	-0.708	-0.421
> 0***	2.688	4.038	3.294	4.540	4.046	2.709
≤ 0***	-1.826	-1.642	-1.613	-1.483	-1.379	-1.017

Table 6-25: Summary statistics of fund instance coefficients of the Carhart (1997) four-factor Henriksson and Merton (1981) style timing model: Value funds

This table reports the fractions and means of the coefficients of the Carhart (1997) four-factor Henriksson and Merton (1981) style timing model (CHM) of 1,283 Value funds. Columns 2-7 show the statistics for six test settings, in which the first number is sub-period length (years) and the second number is minimum observation number (months). The number in parentheses below each test setting is the number of fund instances. Panels A to E show the statistics for the intercept and four style timing coefficients of CHM respectively. In each panel are the fractions (%) and means of the corresponding intercepts or timing coefficients that are positive (>0), negative (≤0), significantly positive (>0***) and significantly negative (≤0***). *** means significance level of 0.01 based on the bootstrap method of Kosowski et al. (2006).

	3, 36	5, 36	5, 60	9, 36	9, 60	9, 108
	(7,337)	(7,200)	(4,933)	(5,633)	(4,071)	(1,917)
Panel A: the intercept (alpha)						
%						
> 0	32.62	23.11	22.62	15.53	12.38	9.08
≤ 0	67.38	76.89	77.38	84.47	87.62	90.92
> 0***	1.25	0.44	0.47	0.14	0.07	0.05
≤ 0***	13.03	13.47	13.16	14.06	13.58	11.27
Mean						
> 0	0.005	0.003	0.003	0.003	0.002	0.002
≤ 0	-0.006	-0.005	-0.005	-0.005	-0.005	-0.004
> 0***	0.015	0.014	0.013	0.015	0.010	0.017
≤ 0***	-0.012	-0.009	-0.009	-0.009	-0.008	-0.007
Panel B: market timing coefficient						
%						
> 0	41.72	44.83	45.67	42.98	44.46	50.18
≤ 0	58.28	55.17	54.33	57.02	55.54	49.82
> 0***	1.61	1.26	1.18	0.53	0.20	0.37
≤ 0***	3.84	1.44	0.91	1.78	0.93	0.47
Mean						
> 0	0.180	0.123	0.117	0.104	0.096	0.094
≤ 0	-0.215	-0.140	-0.127	-0.127	-0.104	-0.089
> 0***	0.538	0.389	0.376	0.440	0.379	0.391
≤ 0***	-0.601	-0.432	-0.398	-0.429	-0.388	-0.296

Table 6-25: Summary statistics of fund instance coefficients of the Carhart (1997) four-factor Henriksson and Merton (1981) style timing model: Value funds – continued

	3, 36	5, 36	5, 60	9, 36	9, 60	9, 108
Panel C: size timing coefficient						
%						
> 0	61.58	56.47	53.52	48.89	41.14	35.89
≤ 0	38.42	43.53	46.48	51.11	58.86	64.11
> 0***	6.15	3.74	2.76	3.66	2.24	1.77
≤ 0***	2.47	1.69	1.68	2.41	2.75	2.56
Mean						
> 0	0.278	0.207	0.171	0.196	0.140	0.109
≤ 0	-0.214	-0.148	-0.138	-0.128	-0.121	-0.114
> 0***	0.606	0.532	0.464	0.476	0.353	0.335
≤ 0***	-0.645	-0.456	-0.385	-0.403	-0.348	-0.283
Panel D: growth timing coefficient						
%						
> 0	53.70	53.71	55.71	53.95	55.54	51.80
≤ 0	46.30	46.29	44.29	46.05	44.46	48.20
> 0***	4.99	5.82	6.18	4.72	4.27	2.03
≤ 0***	2.97	2.97	3.10	2.02	1.97	2.56
Mean						
> 0	0.282	0.224	0.215	0.190	0.167	0.137
≤ 0	-0.305	-0.213	-0.196	-0.166	-0.137	-0.128
> 0***	0.632	0.557	0.533	0.527	0.453	0.352
≤ 0***	-0.820	-0.599	-0.522	-0.487	-0.365	-0.366
Panel E: momentum timing coefficient						
%						
> 0	62.70	69.04	69.96	76.48	80.67	81.85
≤ 0	37.30	30.96	30.04	23.52	19.33	18.15
> 0***	2.52	4.24	4.20	7.28	8.11	8.56
≤ 0***	1.12	0.89	0.99	0.16	0.00	0.00
Mean						
> 0	1.052	1.020	0.972	1.042	1.033	0.985
≤ 0	-0.801	-0.654	-0.631	-0.543	-0.474	-0.402
> 0***	2.674	2.442	2.282	2.076	1.959	1.750
≤ 0***	-2.281	-1.877	-1.769	-2.621	---	---