Feature Article: Managing the Investment Firm

Investigation of Manager Trading and Herding
– Using Composition Data of Equity Portfolios –

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Table of Contents

In this paper we analyze and clarify whether asset managers are momentum oriented or contrarian oriented in their investment behavior, using the weighting of companies comprising equity pension funds in Japan. Furthermore, we also verify the relationships between investment behavior and performance. Asset managers exhibit trading behavior similar to that of other asset managers for several reasons. This is called "herding." Pension funds are divided into several categories to examine how significant their herding behavior is in each category. The existence of herding behavior has significant implications for efficient "manager structures" at pension fund sponsors.

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Introduction

The bear market in recent years has been a difficult environment for pension fund operations. While pension fund managers operate huge amounts of assets under management, their fund performance has been very poor, failing to add any value to their portfolios. With the emergence of non-Japanese asset management companies and Japanese investment advisory companies, the competition landscape has been changing for pension fund management in Japan. A large amount of trust assets are still managed by traditional Japanese domestic asset managers, namely Japanese trust banks and life insurance companies. Their presence is still very big in pension fund management in Japan. Then, what is the trading behavior of the managers of trust banks and life insurance companies with respect to stocks comprising their portfolios? Is there any constant relationship between managers' behavior and their performance? The financial instruments covered by this paper are jointly managed funds. As such, their fund-operation orientation affects many trustors. First, we clarify the above-mentioned issues.

Many studies have analyzed the investment behavior of US funds, such as that by Grinblatt, Titman and Wermers (1995) (hereafter called GTW <1995>), and many concluded that the researched funds took investment action based on momentum strategies by raising the weighting of issues with historically higher returns and decreasing the weighting of issues with historically lower returns. In this paper, we examine the investment behavior of Japanese pension funds using measures that consider the weighting of companies included in the funds in order to determine whether their investment behavior is based on momentum or contrarian strategies. In addition to analyzing respective managers' investment behavior individually, we categorize investments by a company's business nature (trust banks or life insurance companies) and investment style (value or growth) to determine whether there is any difference in average investment behavior between these categories. Furthermore, we also verify the influence of investment behavior on fund performance by examining the relationships between the investment behavior of pension funds and their performance.

Next, we research the herding behavior of fund managers. It is easily assumed that investment behavior varies depending on the manager. Employing several managers who exhibit different investment behavior is one method of stabilizing investment results. On the other hand, if you employ managers whose trading behavior is similar to that of other funds around the same time, for example if all of them trade the same particular issue, the manager structure can be inefficient in terms of cost. Then, is the trading behavior of one pension fund actually independent from that of other pension funds? To answer this question, we clarify whether or not herding (following the crowd) is observed for individual issues in funds of the same/different business nature, asset management company, and investment style. In other words, we elucidate whether or not they tend to take similar action for the same issues simultaneously. Explaining the trading behavior of pension funds for individual issues will help in constructing more efficient "manager structures."

1. Data

In this analysis, we use the semi-annual weighting data of all the issues comprising Japanese domestic equity funds that Rating and Investment Information Inc., (R&I) is assigned for evaluation. These funds are active funds in the pension investment fund trust of Japanese domestic trust banks and on the general accounts based on No.1 rider for separate account of life insurance companies. The covered period is from the end of March 1995 to the end of September 2002. Using this data, we identified how many transactions each manager executed for each issue over the relevant period.

The covered funds are 53 in total, comprising pension investment fund trust (19 value, 12 growth, and 16 others) and six funds of life insurance companies (six general accounts). The categories of investment styles are in accordance with those claimed by respective asset management companies in their reports. Regarding the "16 others", there is no investment concentration on particular equity attributes in the above 16 pension investment fund trust and other funds. Funds covered are those for which samples can be obtained for 10 periods for analysis. We also limited the coverage of our analysis for the following reasons: When there are only a few samples, the investment behavior measure may show extreme values, depending on the sample period. In addition, it is difficult to derive statistically significant results from few samples in terms of measures. Thus, the number of statistically significant funds may be estimated to be less than the actual number, resulting in biased evaluations.

2. Investment Behavior of Managers

In this section, we analyze the relationships between investment behavior and the performance of pension fund managers. We clarify whether pension fund managers tend to invest based on momentum or return reversals of the stock market. There has been a lot of discussion concerning momentum strategies and contrarian strategies based on return reversals. GTW (1995) analyzed the relationships between momentum strategies and return anomalies by highlighting the relationships between changes in the weighting of issues included in funds and their returns. Mutual funds exhibit momentum orientation by buying stock issues with historically higher returns. This momentum orientation is the strongest for aggressive growth equity funds, while normal growth equity funds exhibit the second strongest tendency. When funds are biased not to buy issues with historically higher returns, we found that they do not show statistically significant performance anomalies. On the other hand, momentum-oriented funds are found to outperform contrarian-oriented funds.

Similarly, Badrinath and Wahal (2002) analyzed investment behavior by a company's business nature, using the weighting of companies comprising the funds, which GTW (1995) also used. It was found that investment behavior is different depending on a company's business nature. Investment advisory management companies and mutual funds are more sensitive to the historical returns of stocks, while

pension funds and banks are less sensitive to them. Institutional investors as a whole are slightly momentum oriented on average in their investment behavior. In terms of investment style, growth funds and growth and value funds are momentum oriented, while value funds are contrarians. Burch and Swaminathan (2001) also analyzed the difference in investment behavior by a company's business nature. In their reports, investment advisory companies are the most active momentum-oriented investors, while banks (trust divisions) and life insurance companies are the weakest momentum-oriented investors. There is also an analysis of investment behavior by the business nature of asset management companies, conducted by Jones, Lee and Weis (1999). They indicated that companies most business natures bought and sold stocks based on momentum from 1984 to 1993.

Thus, there have been many studies that support institutional investors' momentum orientation. However, Gompers and Metrick (2001) reported that institutional investors with huge assets under management are not momentum-oriented investors. They conducted cross-sectional OLS regression analysis by setting the shareholding ratio of institutional investors as explained variables and the attributes of issues as explanatory variables. For most of the period, the regression coefficients for the momentum factors posted negative values with statistical significance. This indicates that the higher historical returns issues have, the lower the shareholding ratio of such issues becomes.

In Japan, Iihara, Kato and Tokunaga (2001) observed investment behavior by comparing institutional investors' shareholding ratios for respective issues with their excessive returns in the previous one year[1]. If such investors hold an issue that showed excessive return in the previous year at a higher shareholding ratio in the following year, this indicates momentum orientation for the issue. If the shareholding ratio of such an issue is lowered, the indication is that investors are contrarian oriented. In our study, we highlighted the relationships between changes in the weighting of the all the issues comprising the funds and their historical returns. This is a different approach from theirs that focuses on individual stock issues. According to them, the higher-return issue group has much stronger momentum orientation than the other groups. As a whole, they are likely to be momentum oriented. Analyzing investors' investment behavior by market capitalization, we could identify that Japanese institutional investors tend to invest only in large market-cap stocks if they invest on a momentum basis. Based on these results, we can surmise that investment behavior is momentum oriented, especially at funds focusing on large-cap issues.

2.1 Measurement of Investment Behavior

We elucidate whether fund managers are momentum oriented or contrarian oriented in their investments, using changes in the weighting of issues comprising portfolios and their returns:

$$\text{Investment behavior measure} = \sum_{t=1}^{T}\sum_{j=1}^{N} R_{j,t-k,t}(w_{j,t+1}-w_{j,t})/T \qquad (1)$$

[1] *They analyzed investors by categorizing them into institutional investors, individual investors, and non-Japanese investors.*

"$w_{j,t}$" is the portfolio weighting of stock issue "j" at the end of the "t" period. "$w_{j,t+1}$ " is the portfolio weighting of issue "j" at the end of the "t+1" period. "$R_{j,t-k,t}$ " is the return of issue "j" from the end of the "t-k" period through the end of the "t" period. "N" is the number of issues comprising the fund, and "T" is the number of periods for which we measure changes in the weighting (the number of available samples)[2].

As seen from the calculation formula, the investment behavior measure multiplies historical returns by the following changes in weighting. If a fund as a whole buys (sells) a historically high-return issue and increases (decreases) the issue's weighting in the portfolio, the investment behavior measure shows a positive (negative) value. On the other hand, if a fund on the whole buys (sells) a historically negative-return issue and increases (decreases) the issue's weighting in the portfolio, the investment behavior measure shows a negative (positive) value. By checking whether the investment behavior measure is positive or negative, we can determine whether the investment is based on a momentum strategy or contrarian strategy. Similarly, the magnitude of the measure's absolute value represents how strong the momentum orientation or contrarian orientation is.

We also analyzed investment behavior using the following "holding period-based investment behavior measure."

Holding period-based investment behavior measure

$$=\sum_{j=1}^{N} R_{j,t-k,t}(w_{j,t+1}-w_{j,t}) \qquad (2)$$

Using this measure, we can examine each manager's investment behavior semi-annually, obtaining many samples.

The weighting is expressed as follows:

$$w_{j,t}=\frac{P_{j,t}H_{j,t}}{\sum_{j=1}^{N} P_{j,t}H_{j,t}} \qquad (3)$$

$P_{j,t}$ is the stock price of issue "j" at the end of the "t" period, while $H_{j,t}$ is the number of shares held at the end of the "t" period.

In this study, we also conducted analysis using drift-adjusted weighting changes concurrently, in addition to the above investment behavior measures.
Drift is adjusted by replacing $w_{j,t}$ with the following w_{jt}*.

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[2] *The measure is based on GTW (1995). There are some differences regarding how to take the lag between returns and resultant changes in weighting and variations in the weighting-measured periods.*

$$w_{j,t}^{*}=\frac{\frac{P_{j,t+1}}{P_{j,t}}w_{j,t}}{\sum_{j}^{N}\frac{P_{j,t+1}}{P_{j,t}}w_{j,t}} \qquad (4)$$

We interpret results derived from drift-adjusted weighting in a slightly different way from those derived from non-drift adjusted weighting. The figures of the above drift-adjusted measure focus on fund managers' intended weighting bias. On the other hand, the measure using non-drift adjusted weighting shows higher (lower) weighting if the appreciation rate of the market value of a particular stock outperforms (underperforms) the appreciation rate of the total value of the entire portfolio. Thus, the non-drift adjusted weighting measure includes the effects of changes in this unintended weighting. In our analysis, we verify investment behavior to determine what investment behavior pension fund managers show based on historical returns, focusing on investment measures based on drift-adjusted weighting (drift-adjusted behavior measure)[3].

2. 2 Analysis Results (on Investment Behavior)

2.2.1 Entire funds

Here, we examined investment behavior using the following four measures that consider drift adjustment/non-drift adjustment and different holding periods for calculating returns. As for drift-adjusted weighting, the measure using one-year holding periods for calculating returns (k=2) is called the 1 year drift-adjusted behavior measure (DABM 1yr), while the measure using 6-month holding periods for calculating returns (k=1) is called the 6-month drift-adjusted behavior measure (DABM 6m). In addition, the measures using weighting changes without drift adjustment are divided into the following two measures. One is the 1-year behavior measure (BM 1yr) and the other the 6-month behavior measure (BM 6m). The investment behavior measures take the 6-month holding periods to measure weighting changes. We examined all the funds covered in our analysis to find how many funds have statistically significant positive/zero/negative values according to investment behavior measures. The results are shown in Table 1. (Due to space limitations, the table illustrates only the results of drift-adjusted behavior measures <DABM>.)

[3] *In the course of researching the investment behavior of fund managers, the existence of price-drift adjustment is deemed to affect the conclusion. Preceding studies using measures without drift adjustment may have misread fund managers' investment behavior. The results of analysis, where measures are not adjusted for drift, are used here only for the purpose of comparison with drift-adjusted measures to verify the possibility of drift-adjusted measures.*

Table 1 Investment Behavior and Statistical Significance (Covering all funds)

	Number of samples	Positive/negative	Significance level	
			1%	5%
DABM 1yr	53	Positive 46	1	7
		Negative 7	0	0
DABM 6m	53	Positive 37	3	3
		Negative 16	0	0

Note: The 1% and 5% significance levels here show significance levels in two-tailed tests.

According to Table 1, an overwhelming number of funds have positive DABM values. It seems that pension funds in Japan are more oriented to momentum strategies than contrarian strategies in their fund operations. In terms of the statistical significance of investment behavior, there are several funds with positive DAMB values that are statistically significant, while none of the funds with negative values had statistical significance. Now, let us briefly summarize the holding period-based measures. Periods of positive values also account for the majority of the covered periods as well. Their percentages, however, are lower than the chronologically averaged results of the investment behavior measures. This indicates that the absolute values of the negative-value holding periods are smaller than those of the positive-value holding periods.

2.2.2 Analysis by a Company's Business Nature (i.e. Trust Banks and Life Insurance Companies)

Here, we categorize funds by the business nature of fund-operating companies to observe their investment behavior. The basic statistics and tested results are shown in Table 2 for the investment behavior of all the funds covered in our analysis. We also checked the positive/negative values and their statistical significance in terms of investment behavior, categorizing the funds by trust bank and life-insurance company (see Table 3 and Table 4). According to Table 2, all the measures show positive values on average, which is different from the statistically significant "zero" (significance level = 5%). No big difference is found in the verified results between drift-adjusted behavior measures and behavior measures without drift adjustment. We can thus infer that the price-drift factor has a limited impact on investment behavior measures. Regardless of a company's business nature, we can also surmise that all of them tend to buy issues with historically high returns and sell issues with historically low returns. As shown in Table 3 and Table 4, an overwhelming number of funds exhibit investment behavior with "positive value," namely momentum-oriented investment. Especially for life insurance companies, all the six funds indicated momentum-based investment. As for trust banks, approximately two-thirds of their funds are momentum oriented.

Both trust banks and life insurance companies tend to pursue momentum-based trading. Is there any difference in average investment behavior between them? We answered this by applying a t-test and

Mann-Whitney U-test (non-parametric test)[4]. The results are shown in Table 5. In the t-test, all the measures showed statistically significant differences in investment behavior. In the U-test, three of the measures showed statistically significant differences in investment behavior. Life insurance companies are more momentum oriented in investment behavior with strong statistical significance. In addition, all the holding period-based measures indicate positive values on average regardless of a company's business nature, with the average investment behavior of life insurance companies exceeding that of trust banks. A subject of future study will be to clarify the difference in fund attributes of business nature and unveil what factors cause differences in investment behavior.

Table 2 Basic Statistics and Test Results on Investment Behavior (by Business Nature)

	Number of samples	Average	Standard deviation
Trust Banks			
DABM 1yr	47	3,376	8,779
		t-value 2.636	(0.011)
DABM 6m	47	1.703	4.437
		t-value 2.631	(0.012)
BM 1yr	47	2.377	4.494
		t-value 3.626	(0.001)
BM 6m	47	1.203	2.432
		t-value 3.390	(0.001)
Life Insurance Companies			
DABM 1yr	6	14.140	11.274
		t-value 3.072	(0.028)
DABM 6m	6	5.776	4.743
		t-value 2.983	(0.031)
BM 1yr	6	5.498	1.203
		t-value 11.190	(0.000)
BM 6m	6	2.706	1.025
		t-value 6.468	(0.001)

Notes: Averages and standard deviations are shown as annualized percentages. The lower rows of the two lines of the respective measures are the results of the tests conducted to determine whether or not the average of each measure for each business nature is a statistically significant "zero." Figures in parentheses are p-values.

[4] *The t-test assumes that both populations have normal distribution. To verify the average difference in the two populations with less normal distribution, we used the U-test as a non-parametric test that does not depend on distribution.*

Table 3 Investment Behavior and Statistical Significance (Trust Banks)

	Number of samples	Positive/negative	Significance level	
			1%	5%
DABM 1yr	47	Positive 40	1	5
		Negative 7	0	0
DABM 6m	47	Positive 31	1	3
		Negative 16	0	0

Table 4 Investment Behavior and Statistical Significance (Life Insurance Companies)

	Number of samples	Positive/negative	Significance level	
			1%	5%
DABM 1yr	6	Positive 6	0	2
		Negative 0	0	0
DABM 6m	6	Positive 6	2	0
		Negative 0	0	0

Table 5 Test Results of the Average Difference (Life Insurance Companies – Trust Banks)

Measures	t-value	p-value	p-value (U-test)
DABM 1yr	2.742	0.008**	0.003**
DABM 6m	2.103	0.040*	0.009**
BM 1yr	3.810	0.001**	0.023**
BM 6m	2.740	0.016*	0.152

Notes: ** and * respectively indicate that we can abandon the null hypothesis that assumes the average value of each population is the same value at 1% and 5% significance levels. The p-values (of the U-test) show the probability that the z-values of the U-test will exceed the absolute value of the actually observed z-values in the case where the null hypothesis is true.

2.2.3 Analysis by Investment Style

Due to the limited number of samples, we only covered value funds and growth funds for analysis by investment style. Value funds usually invest in issues that are relatively undervalued in the market. When stock prices reach their undervalued levels, the returns are likely to be negative. As a result, value funds tend to invest in issues with historically lower returns. US studies confirm that value investments are in line with return reversals. On the other hand, growth funds mainly buy stocks of industries expecting higher growth. These issues are often bought at the appreciation stage of asset values in the course of

corporate growth. As a result, investment behavior is consistent with momentum-based investment.

From the above analysis, we can expect the value investment style to show negative values in investment behavior measures, while the growth investment style presents positive values. On the growth side, 11 of the 12 growth funds show positive values by the measures. Not only growth funds, but also many value funds indicate positive values. Some of the measures are positive values with statistical significance (see Table 6 and Table 7). As shown in Table 8, investment behavior shows positive average figures for both value and growth funds. In the test results, we confirmed statistically significant momentum orientation with growth funds, especially noting the high statistical significance of the measures excluding price-drift factors. We did not observe any statistical significance of orientation in value funds (significance level = 5%). Depending on whether they are drift adjusted or not, there is a big difference in the average values of the measures for both value and growth funds. This means that price-drift factors have a strong impact on them. Drift-adjusted measures indicate smaller values for value funds, and bigger values for growth funds. Based on fund managers' intended investment behavior, value investment is more momentum oriented than growth investment. The difference seems to be big. Despite the difference in investment behavior between investment styles, the findings of this analysis are not consistent with those of Badrinath, Wahal (2002) which show that value investment styles are contrarian in their investment behavior.

Table 6 Investment Behavior and Statistical Significance (Value Funds)

	Number of samples	Positive/negative	Significance level	
			1%	5%
DABM 1yr	19	Positive 14	1	1
		Negative 5	0	0
DABM 6m	19	Positive 9	0	1
		Negative 10	0	0

Table 7 Investment Behavior and Statistical Significance (Growth Funds)

	Number of samples	Positive/negative	Significance level	
			1%	5%
DABM 1yr	12	Positive 11	0	3
		Negative 1	0	0
DABM 6m	12	Positive 11	1	1
		Negative 1	0	0

Table 8 Basic Statistics and Test Results on Investment Behavior (by Investment Style)

	Number of samples	Average	Standard deviation
Value Funds			
DABM 1yr	19	0.147	7.265
		t-value 0.088	(0.931)
DABM 6m	19	0.283	3,050
		t-value 0.404	(0.691)
BM 1yr	19	1.600	4.478
		t-value 1.557	(0.137)
BM 6m	19	0.955	2.349
		t-value 1.772	(0.093)
Growth Funds			
DABM 1yr	12	10.206	11.105
		t-value 3.184	(0.009)
DABM 6m	12	5.714	5.919
		t-value 3.344	(0.007)
BM 1yr	12	3.871	4.980
		t-value 2.693	(0.021)
BM 6m	12	2.230	2.469
		t-value 3.128	(0.010)

Notes: The lower rows of the two lines of the respective measures are the results of the tests conducted to determine whether or not the average of each measure for each investment style is a statistically significant "zero." Figures in parentheses are p-values.

The main reason for this inconsistency is the impact of the IT bubble. In the next section we discuss changes in investment behavior for each holding period. As shown in Diagram 2 (DABM Change by Investment Style), the magnitude of momentum orientation was not outstanding for value funds during the IT bubble period. Not only growth funds, but also value funds indicate momentum orientation for the majority of the holding periods. We can infer that the IT bubble had a limited impact on the momentum orientation of value funds.

Table 9 shows the average difference in investment behavior from the test results. Using drift-adjusted weighting, we observed that different investment styles displayed different investment behavior, which have high statistical significance. Without adjusting the drift, values have lower statistical significance. Thus, it is possible that the prices of some issues in value funds continue to increase (decrease) and, consequently, drift-adjusted weighting changes affect investment behavior measures.

Briefly, drift-adjusted p-values are smaller than non-adjusted p-values for holding period measures. The test results are the same. For the period covered in this analysis, momentum strategies tend to be taken across all investment styles. Given the measures' magnitude for value and growth funds, we can infer that value managers are not affected by market moves and that they are less biased toward momentum-based investment.

Table 9 Test Results of Average Difference (Growth – Value)

Measures	t-value	p-value	p-value (U-test)
DABM 1yr	3.059	0.005**	0.002**
DABM 6m	2.942	0.010*	0.002**
BM 1yr	1.318	0.198	0.035*
BM 6m	1.444	0.160	0.114

2.2.4 Investment Behavior by Holding Period

As shown in the calculation formula, investment behavior measures are chronological averages of semi-annual investment behavior. How does investment behavior change across holding periods? To answer this, we observed investment behavior by holding period to highlight changes over time. Investment behavior measures are viewed cross-sectionally to discuss average investment behavior for each holding period, regardless of fund type. We used the Kruskal-Wallis test[5], namely variance analysis and non-parametric analysis, to determine whether or not investment behavior shows any difference among holding periods, while Scheffe's test, which is a multiple comparison[6], is used to elucidate which holding periods show a difference in investment behavior on average. In all the measures, we confirmed statistical significant difference in investment behavior among the holding periods. Fund managers seem to adjust their investment behavior to the economic environment.

As a result of this multiple comparison, the difference in investment behavior is confirmed between several holding periods with all the measures. With 1-year holding periods for measuring returns, drift-adjusted weighted measures show a difference in investment behavior in three out of the 105 combinations of holding periods, while behavior measures without weighting adjustment show a difference in investment behavior in 30 combinations of the holding periods. With six-year holding periods for measuring returns, drift-adjusted weighted measures show a difference in investment behavior in one out of the 105 combinations of the holding periods, while behavior measures without weighting adjustment show

[5] *We also used the non-parametric test here when three or more populations were involved, in order to verify the difference independently from the normal distribution of the populations. The Kruskal-Wallis test is generally used for three or more populations.*

[6] *When statistical significance is noted for the variance analysis of multiple clusters, this is one of the multiple comparisons used to locate the difference in the clusters. This can be applied to a number of data, variance, and distributions of each cluster without limitation.*

a difference in investment behavior in 36 combinations of holding periods. The changes in investment behavior over holding period are affected less by the positions intended by the fund managers, and more by weighting changes due to unintended stock price drift.

Diagram 1 illustrates changes in investment behavior. Diagram 1 cross-sectionally averages holding period-based measures (annualized %) for each holding period of all the funds, showing the averages in chronological change. The diagram's year/month corresponds to the "t" values of the calculation formula for investment behavior measures. Diagram 2 shows the changes in investment behavior by investment style (for drift-adjusted measures only). Although these analyses of all the funds and investment style highlight many momentum-oriented funds, investment behavior significantly varies depending on the holding period across all the analyzed periods.

Diagram 1 Chronological Changes by Investment Behavior

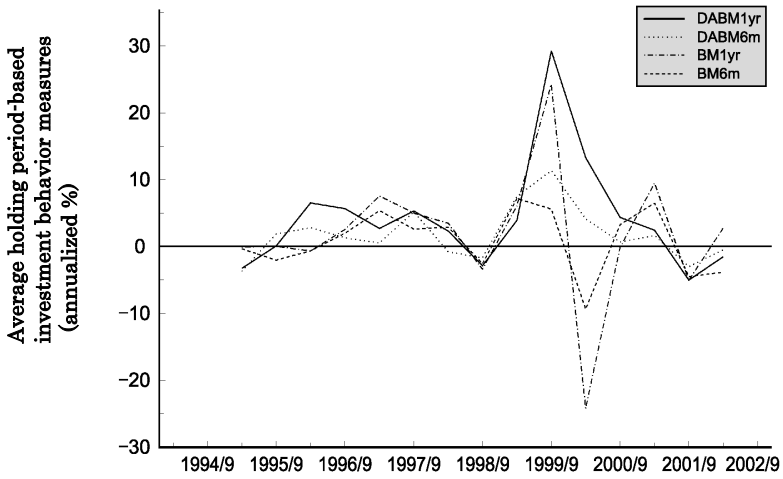
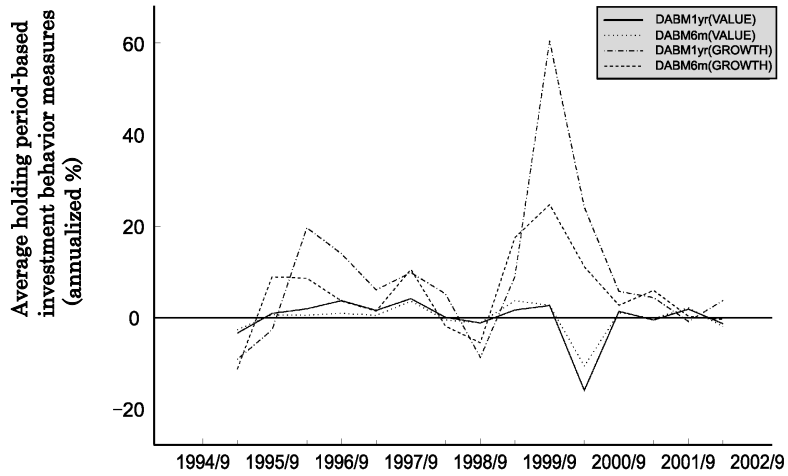


Diagram 2 Chronological Changes (by Investment Style)



3. Relationships Between Investment Behavior and Performance

We will also analyze whether or not there is a constant relationship between investment behavior and performance. The relationship between the investment behavior measure (BM) and performance measures has already been identified for each fund. If the relationship shows a positive (negative) value, momentum-oriented funds record higher (lower) performance, and funds invested based on return-reversals record lower (higher) performance. GTW (1995) used regression analysis to find the relationship between investment behavior measures and performance measures, covering US mutual funds. There was a positive correlation between them, substantiating the momentum effects confirmed in many markets.

Here, we used the numerical figures of the performance measure (PCM)[7] suggested by Grinblatt, and Titman (1993) and the investment behavior measures in this paper. The PCM multiplies changes in historical returns by the returns in the following periods for all the issues included in the funds. All the products are added up to calculate their chronological average in order to reach the PCM. As one whole fund, the weighting changes in the previous period correctly projected the return of the following period, and high values are shown, evidencing the excellent performance of the fund managers. We used DAPCM 6m and PCM 6m as the performance measures. PCM 6m takes 6-month holding periods to measure both weighting changes and returns. DAPCM also takes 6-month holding periods for measuring weighting changes and returns. The difference between PCM and DAPCM is that DAPCM uses drift-adjusted weighting as its weighting. Drift adjustment enables us to measure particular performance realized by the weighting change intended by fund managers. We conducted two regression analyses. For one analysis, we used DAPCM 6m as the explained variable and DABM 6m as the explanatory variable. For the other, we used PCM 6m as the explained variable and BM 6m as the explanatory variable[8].

The estimated results are as follows. (Values in parentheses on the left are t-values, while values on the right are p-values.)

$$DAPCM6m = 0.199 - 0.107\,DABM6m$$
$$(-1.213, 0.231)$$
$$PCM6m = 0.185 - 0.143\,BM6m$$
$$(-1.583, 0.120)$$

For both of the formulas, the regression coefficients estimate negative values. It is inferred that there is a negative relationship between strong momentum orientation and performance. In short, contrarian-oriented funds achieve higher performance. The negative relationship between performance and investment

[7] *See Appendix A for performance measures.*
[8] *We selected combinations of measures with the same conditions, such as periods to measure returns, periods to measure weighting, and the existence of drift adjustment, from performance measures and investment behavior measures.*

behavior shows no statistical significance. No strong evidence was obtained to support the idea that existing funds covered in this analysis exert return-reversal effects. This may be related to the fact that Japanese funds are return-reversal oriented and US funds are momentum oriented in the short term.

4. Herding (following the crowd)

Pension funds with a multiple manager structure expect diversification effects in their manager selections at the issue level and at the investment style level. Although one invests capital into funds with different mandates of investment styles for the purpose of diversification, the funds may take similar trading action toward the same issue. If different fund managers show similar behavior, pension fund sponsors may not be able to obtain the expected diversification effects sufficiently. As a result, the cost may be relatively high for the actual performance. If two managers take similar action, for example, one fund manager increases the inclusion ratio of his/her portfolio for one issue, and another manager also does the same, there is almost no point in employing these two managers at the same time. In this case, it is necessary to increase their fund sizes and to lower performance incentive fees for improving net performance by reducing the number of such fund managers.

If asset managers exhibit similar investment behavior at the same time or across several periods, such investment behavior is called "herding," which is following the crowd. Similar investment behavior here represents trading concentration on the same issue. We verify whether or not fund manager herding exists for several groups, such as asset management company and investment style, in order to further probe the potential efficiency of fund operations.

It seems that fund managers display similar investment behavior toward respective stock issues due to rational or irrational investment behavior, such as crowd psychology. The investment behavior is as follows. 1) Fund managers infer information from each other's actual trading and make investment decisions based on the estimated information regardless of their own proprietary information. 2) They follow the same signals, obtaining similar information. 3) They mimic prestige fund managers, not emphasizing their own information. 4) They invest based on temporary trends.[9] 5) Fund managers feel attracted to issues featuring particular attributes (e.g. historically high returns) and invest in them.

Lakonishok, Shleifer, and Vishny (1992) proved that herding is small for all pension funds. Looking at this by company size, only a little herding can be identified with large market cap stocks, while small-cap companies show much bigger herding in trading. Herding for small market caps is not conspicuously huge. According to Wermers (1999), the herding level of mutual funds is fairly low, but a bit stronger than that for pension funds. On the whole, mutual funds show little herding. Herding level depends

[9] *Froot, Scharfstein, and Stein (1992) pointed out that traders for short-term dealing gather about the same information and consequently may follow information irrelevant to fundamentals.*

on the groups analyzed. Growth funds see higher herding levels than income funds. According to Wermers, small-cap companies show stronger herding especially when they are sold. In addition, Sias (2002) says, herding varies by business nature. At banks and insurance companies, fund managers follow the other fund managers of their peer sectors rather than those of different sectors. Generally, however, the herding measure shows small values, and there is only weak evidence to support institutional investors following herding behavior. Despite the theoretical rationale for herding behavior, many studies present almost no evidence to substantiate the existence of herding behavior.

4. 1 Measurement of Herding

This study confirms the herding tendency using correlations of weighting changes in issues included in the funds measured for herding. Thus, we verify the herding of each manager. As a historical herding study, we took the evaluation measures of Lakonishok, Shleifer, and Vishny (1992). Their model observes individual issues for herding behavior, which is appropriate for clarifying which issue attributes show a strong/weak tendency for herding. On the other hand, the measurement of herding this time is not applied to individual issues, but to survey whether or not there is strong/weak demand for all the issues comprising the entire funds to find the herding tendency at fund level. These attributes enable a herding comparison among fund managers, funds with different investment styles, business nature, and asset management companies.

We research correlations of weighting changes in issues included in funds according to business nature, within the same asset management company, among different asset management companies, and among funds with different investment styles. Furthermore, the covered funds are divided into several groups to verify whether there is a difference in terms of magnitude of herding. As our purpose here is to analyze and clarify the behavior of fund managers, we observe a similarity in the trading behavior intended by fund managers using drift-adjusted weighting. The herding measure ($\rho_{i,j,t}$) is defined as follows:

$$\rho_{i,j,t} = \frac{cov(w_{i,t+1} - w^*_{i,t}, w_{j,t+1} - w^*_{j,t})}{\sigma_{i,t+1}\sigma_{j,t+1}} \qquad (5)$$

Here, "$\rho_{i,j,t}$" is the correlation of weighting changes between fund "i" and fund "j" from the end of the "t" period through the end of the "t+1" period. "$w^*_{i,t}$" is the drifted-adjusted weighting[10] of fund "i" at the end of the "t" period. "$w_{i,t+1}$ " is the weighting of fund "i" at the end of the "t+1" period. "$w^*_{j,t}$ " is the drift-adjusted weighting of fund "j" at the end of the "t" period. "$w_{j,t+1}$ " is the weighting of fund "j" at the end of the "t+1" period. "$\sigma_{i,t+1}$ " is the standard deviation of weighting changes in issues included in fund "i" for the "t+1" period. "$\sigma_{j,t+1}$ " is the standard deviation of weighting changes in issues held by fund "j" for the "t+1" period. In short, this measure is shown as the correlation of weighting changes on a

[10] *Formula (4) in Section 2 is also used here. It is a drift-adjusted weighting.*

drift-adjusted basis[11].

Thus, if one fund manager exhibits trading behavior similar to that of other managers, there will be a stronger correlation of weighting changes, and the values of the measure become bigger. If one fund manager displays trading behavior different from that of other managers, the negative range of the values will widen. As mentioned above, the bigger the herding is, the less efficient the manager structure is. On the other hand, if two employed fund managers show opposite trading behavior, this also lowers the efficiency of the manager structure. In this case, they offset trading behavior within one whole fund, possibly increasing transaction costs.

4. 2 Analysis Results (on Herding)

4.2.1 Difference in Herding Behavior by Category

We looked for correlations for six months on weighting changes in issues included in each fund[12]. The basic statistics and their t-test results are shown for the correlation of each category in Table 10. Value and growth, respectively, show the correlations between value funds and growth funds, while value/growth presents the correlations of weighting changes between value and growth funds. Similarly, the categories of trust bank, life insurance company, and trust bank/life insurance company, within the same asset management company and between different asset management companies show correlations of weighting changes between funds that belong to the respective categories. Table 10 tells us that the average correlation of all the categories has a statistically significant positive value (significance level=1%).

[11] *We added "issues included only in one of the two funds measured for herding" to the sample for calculating the correlations. Issues not held historically and in the future are taken as passive trading behavior.*

[12] *Similarly, we examined the correlations of weighting changes for one year. The result is not given here as there was no big difference noted. Using weighting changes for one year, the average correlations of all the categories were larger than the average correlations calculated from weighting changes for six months.*

Table 10 Basic Statistics and Test Results Regarding Correlations of Weighting Changes

	Number of samples	Average	Standard deviation
A. Investment Style			
Value fund	1816	0.085	0.173
		t-velue 22.180	(0.000)
Growth fund	583	0.126	0.223
		t-value 13.577	(0.000)
Value-growth funds	2232	0.085	0.184
		t-value 21.918	(0.000)
B. Business Nature			
Trust bank	10654	0.098	0.191
		t-value 52.960	(0.000)
Life insurance company	159	0.193	0.285
		t-value 8.547	(0.000)
Trust bank/life insurance company	2568	0.128	0.220
		t-value 29.473	(0.000)
C. Asset Management Company			
Same asset management company	1271	0.157	0.239
		t-value 23.475	(0.000)
Different asset management company	12110	0.100	0.194
		t-value 56.576	(0.000)
The entire samples	13381	0.105	0.199
		t-value 61.028	(0.000)

Notes: The lower rows of the two lines of the respective measures are the results of tests conducted to determine whether or not the average of each measure for each category is a statistically significant "zero." Figures in parentheses are p-values.

We explored how big the correlations are, i.e., we examined whether or not there is a difference in terms of strength of the herding tendency using the t-test. The test results are shown in Table 11. The results shown in Table 10 and Table 11 are based on weighting changes for the entire period covered in this analysis (from the end of March 1995 through the end of September 2002). It is assumed that the herding tendency is stronger between growth funds than between value funds. Accurate information on the future profits of growth stocks is more limited than that of value stocks. We can infer that herding behavior is promoted among growth funds due to there being less information. As shown in Table 11, growth funds

more strongly tend to exhibit trading behavior similar to that of other growth funds compared to value funds. Thus, these values of growth funds have stronger statistical significance. As a result, this can support Wermers' (1999) results that conclude that the herding of growth funds is stronger than that of income funds. Correlations of weighting changes between value funds are a little smaller on average than those between funds with different investment styles. No statistical significance is noted for the difference in averages. On the other hand, when we compare correlations between the same growth funds to those between funds with different investment styles (value and growth), the correlation between the same growth funds is stronger, which is statistically significant. Correlations between the same value funds show positive values on weighting changes. Fund managers of growth funds tend to exhibit trading behavior similar to that of other growth fund managers. Despite the herding tendency being confirmed, it is weaker than the tendency of growth funds and as strong as that of diversified investments between value and growth funds. Therefore, if diversified investments are made across several value funds or funds with different investment styles (value and growth), their diversification effects are stronger than those from investing in several growth funds. It is generally assumed that we can enjoy greater diversification effects if we diversify our investments across funds with different investment styles, such as value funds and growth funds, than across several funds with the same investment style. This, however, is probably not the case with investing across several value funds.

Table 11 t-Test Results Regarding Correlations of Weighting Changes

	t-value	p-value
A. Investment Style		
G-V	4.048	0.000**
G-VG	4.005	0.000**
V-VG	-0.061	0.951
B. Business Nature		
I-T	4.187	0.000**
T-TI	-6.318	0.000**
I-TI	2.828	0.005**
C. Asset Management Company		
S-D	8.345	0.000**

Notes: ** and * p-values respectively indicate that we can abandon the null hypothesis that assumes the average value of each population has the same value at 1% and 5% significance levels.

G = growth, V = value, VG = value/growth, I = life insurance company, T = trust bank, TI = trust bank and life insurance company, S = the same asset management company, and D = different asset management companies.

The herding tendency is obviously different by business nature. Average correlations between life insurance funds are approximately twice as big as those of trust bank funds, even with their bigger standard deviation. It is clear that trading behavior is more similar between life insurance funds than between trust bank funds. It must be noted, however, that life insurance funds include only the general accounts based on No.1 rider for separate account of life insurance companies due to the limitation of available data. The general accounts do not take any particular investment styles as their investment mandates. Thus, when we compare the pension investment fund trust of Japanese domestic trust banks with various investment styles to the general accounts based on No.1 rider for separate account of life insurance companies, the latter are likely to be similar in trading behavior. The magnitude of difference in herding tendency would become smaller if we excluded the impact of the particularities of analyzed fund products. The herding tendency between the funds of a different business nature is stronger than the tendency between peer trust funds, while the herding tendency between life insurance funds is stronger than the tendency between funds of a different business nature. This is attributed to the different particularities included in the pension investment fund trust of Japanese domestic trust banks and the general accounts based on No.1 rider for separate account of life insurance companies.

We also compared trading behavior between funds operated by the same asset management company and trading behavior between funds operated by different asset management companies. The former are more likely to display similar trading behavior because almost the same interpretation is applied to the same investment information or because trading behavior is affected by the internal investment criteria of the company. According to Table 10, the correlation among funds operated by the same company is higher than the correlation among those operated by different asset management companies. As one can see from this difference in the averages, t-values are so large that they obviously indicate the existence of considerable difference in the herding tendency.

4.2.2 Herding Behavior by Holding Period

In the above section, we examined what difference there is in similar trading behavior, depending on the category. The unveiled difference in trading behavior may derive from period-specific factors. For example, the difference may have occurred because the trading behavior of one category was more conspicuous or less conspicuous than that of other categories for a given period. Is the difference in trading behavior consistent over the entire analyzed period? How does “the correlation of weighting changes” change over time during the covered period? To answer these questions, we also observed herding behavior on a period basis.

Diagrams 3 and 4 illustrate changes in average correlations of the respective periods chronologically. Year/month in the diagram corresponds to the “t” values of the calculation formula for the herding measure, as with investment behavior. Diagram 3 divides the comparison coverage for correlations by investment style. Diagram 4 categorizes it by business nature or the same asset management company or

not. As seen from these two diagrams, all the average correlations of all the categories show consistently positive values for the covered periods, excluding that of the growth fund in March 1995. All the categories follow similar patterns of movement for average correlations. The average correlations of weighting changes were very strong, especially from the end of March 1999 through the end of September 1999 and from the end of March 2001 through the end of March 2002. The diagram period (September 1998-March 1999) overlaps the period when high-tech stocks were bought, pushing up stock prices sharply. It can easily be assumed that growth funds took much more similar trading action during this phase of the stock market. However, the herding tendency among the other funds also became stronger in the same period. This means the diversification effects would not have been very big even though one had invested in various funds with different investment styles. The period since the end of September 2001 is volatile reflecting the simultaneous terrorist attacks on the US. In the midst of such volatility, stock issues such as airlines and tourism were intensively sold off because of declining demand. This is probably the factor that affected trading behavior.

Thus, herding behavior varies depending on the period. Furthermore, the bigger the event is, the more it probably affects trading behavior. For almost all periods, average correlations indicate a difference among the categories that have been confirmed to have statistically significant difference in terms of magnitude of the herding tendency, such as correlations among growth funds and correlations among value funds. From the above analysis, we can determine that the difference in the magnitude of the herding tendency is consistent for all periods.

Diagram 3 Chronological Changes (by Investment Style)

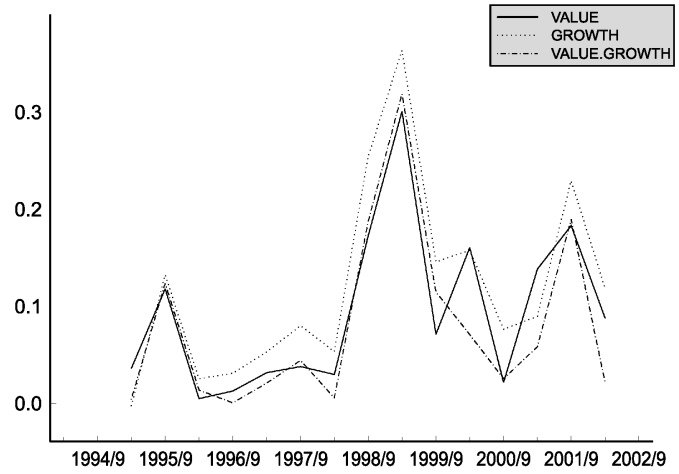
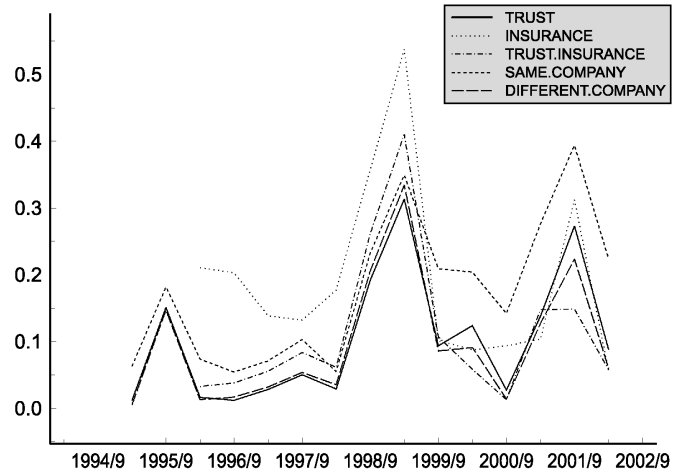


Diagram 4 Chronological Changes (by Business Nature/Asset Management Company)



In order to verify further details of the herding difference by holding period, we checked whether there is any statistically significant difference in average correlations among the respective categories for the respective periods, using the t-test[13]. By testing the correlations of weighting changes for the entire period covered in the analysis, we confirmed the correlation difference among the following funds: correlation between growth funds/ correlation between value funds (V-G), correlation between growth funds/ correlation between funds with different investment styles (G-VG), correlation between life insurance funds/ correlation between trust funds (I-T), correlation between trust funds/correlation between funds of a different business nature (T-TI), correlation between life insurance funds/ correlation between funds of a business nature (I-TI), and correlation between funds operated by the same company/correlation between funds operated by different companies (S-D). A statistically significant difference is noted among these six categories for at least one of the periods, supporting the results for the whole period covered in the

[13] *For detailed results of the analysis, see Appendix B.*

analysis. When we compare the correlation between value funds and that between funds with different investment styles, average correlations have higher values with statistical significance for five out of the 15 holding periods. On the other hand, there was no period when the correlation between value funds was lower than the correlation between funds with different investment styles in terms of statistical significance. Therefore, investment in several value funds is not inefficient in long-term fund operations because there is no herding difference in trading behavior between investment in several value funds and investment in funds with different investment styles. However, when value funds take a more similar position for one-third of the entire period, it is potentially inefficient to invest across several value funds for a short-term holding period.

Conclusion

We came to the conclusion that investment behavior shows momentum-biased operations on the whole. Based on the fund group categories of trust banks and life insurance companies, the latter are more momentum oriented in investment behavior with strong statistical significance. Looking at value funds and growth funds separately, we obtained evidence to substantiate that growth funds exhibit stronger momentum orientation in their investment behavior. Statistical significance is strongly noted for the difference in investment behavior between funds with different investment styles. Unlike the US study, however, the value funds we covered were slightly more momentum oriented in their investment behavior. Fund managers in Japan are highly likely to be more momentum oriented in their value funds than fund managers in the US. As for investment behavior, we analyzed many samples using holding period-based measures. The results are also very similar to those of the above analysis. Thus, we can determine that this verification is highly reliable. There is a negative relationship between performance and investment behavior measures. As such, the more momentum oriented the investment is, the lower the performance. However, this negative relationship is not statistically significant.

The herding tendency is stronger between growth funds than between value funds, stronger between funds operated by the same asset management company than funds operated by different asset management companies, and stronger between life insurance funds (the general accounts based on No.1 rider for separate account of life insurance companies) than between trust funds. Given the impact of the performance incentive fee on performance, we need to review the manager structure and reduction in asset management fees by reducing the number of asset management companies. The results of the herding analysis based on categories will be useful in efficiently entrusting capital to trustees.

This study took six months to measure weighting changes. The values of the measures based on changes every six months implicitly assume that fund managers replace individual issues only once every six months. Fund managers may have raised the weighting of one issue and lowered the weighting of the same issues back to the previous level over the same six months. This does not appear in the weighting

statistics. Assuming that positions are changed at the end of every half-year, we cannot avoid biased changes during the period. More detailed analysis is needed with quarterly data, etc., in order to exclude the possibility and reflect the positions changed by fund managers in the investment behavior evaluation.

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(This paper was submitted, selected and published as it was.)

References

[1] Nobuhito Asakura and Yoko Uno, “Analysis on Pension Fund Performance and Investment Behavior, Using Weighting of Issues Consisting of the Portfolio”, October 2003, R&I Research Report. (http://www.r-i.co.jp)

[2] Badrinath, S.G., and S. Wahal, 2002, “Momentum Trading by Institutions,” Journal of Finance 57, pp 2449-2478.

[3] Burch, T. R., and B. Swaminathan, 2001, “Are Institutions Momentum Traders?,” working paper, University of Miami and Cornell University.

[4] Froot, K. A., D. S. Scharfstein, and J. C. Stein, 1992, “Herd on the Street: Informational Ineffciencies in a Market with Short-Term Speculation,” Journal of Finance 47, pp1461-1484.

[5] Gompers, P., and A. Metrick, 2001, “Institutional investors and equity prices,” Quarterly Journal of Economics 116, pp229-260.

[6] Grinblatt, M., S. Titman, 1993, “Performance Measurement without Benchmarks: An Examination of Mutual Fund Returns,” Journal of Business 66, pp47-68.

[7] Grinblatt, M., S. Titman, and R. Wermers, 1995, “Momentum investment strategies, portfolio performance and herding: A study of mutual fund behavior,” American Economic Review 85, pp1088-1105.

[8] Iihara, Y., H. K. Kato, and T. Tokunaga, 2001, “Investors’ Herding on the Tokyo Stock Exchange,” International Review of Finance 2, pp51-78.

[9] Jones, S., D. Lee, and E. Weis, 1999, “Herding and Feedback Trading by Different Types of Institutions and the Effect on Stock Prices,” working paper, Indiana University-Indianapolis Campus, Kennesaw State University, and Merrill Lynch.

[10] Lakonishok, J., A. Shleifer, and R. W. Vishny, 1992, “The Impact of Institutional Trading on Stock Prices,” Journal of Financial Economics 32, pp23-43.

[11] Sias, R., 2002, “Institutional Herding,” working paper, Washington State University.

[12] Wermers, R., 1999, “Mutual Fund Herding and the Impact on Stock Prices,” Journal of Finance 54, pp581-622.

Appendix A: Performance Measures

For performance measures, we defined PCM (without adjusting drift) and DAPCM (drift adjusted) as follows.

$$PCM = \sum_{t=1}^{T} \sum_{j=1}^{N} R_{j,t+1} (w_{j,t} - w_{j,t-k}) / T$$

$$DAPCM = \sum_{t=1}^{T} \sum_{j=1}^{N} R_{j,t+1} (w_{j,t} - w^{*}_{j,t-k}) / T$$

$$w^{*}_{j,t-k} = \frac{\frac{P_{j,t}}{P_{j,t-k}} w_{j,t-k}}{\sum_{j}^{N} \frac{P_{j,t}}{P_{j,t-k}} w_{j,t-k}}$$

"$R_{j,t+1}$" is the investment return of issue "j" for the "t+1" period. "$w_{j,t-k}$" is the weighting of issue "j" at the end of the "t-k" period. "$P_{j,t-k}$" is the stock price of issue "j" at the end of the "t-k" period. The other variables are the same as the investment behavior measures. Drift is adjusted by replacing PCM $w_{j,t-k}$ with $w^{*}_{j,t-k}$.

Appendix B: t-Test Regarding Correlations on Weighting Changes

Table 1 t-Test Results Regarding Correlations on Weighting Changes (By holding period/investment style)

	G-V		G-VG		V-VG	
	t-value	p-value	t-value	p-value	t-value	p-value
March 1995	-1.918	0.060	-0.348	0.729	3.085	0.002**
September 1995	0.482	0.632	0.310	0.757	-0.349	0.727
March 1996	1.032	0.307	0.578	0.566	-0.906	0.365
September 1996	0.783	0.437	0.732	0.467	1.164	0.245
March 1997	0.948	0.347	1.405	0.165	1.169	0.243
September 1997	2.027	0.046*	1.707	0.092	-0.593	0.553
March 1998	1.106	0.272	2.265	0.026*	2.434	0.015*
September 1998	2.349	0.021*	2.074	0.039*	-0.664	0.507
March 1999	1.861	0.064	1.288	0.199	-0.745	0.457
September 1999	1.723	0.090	0.808	0.420	-1.810	0.071
March 2000	-0.050	0.960	1.870	0.067	3.117	0.002**
September 2000	0.897	0.391	0.835	0.423	-0.205	0.838
March 2001	-0.725	0.472	0.377	0.714	2.672	0.009**
September 2001	0.504	0.618	0.583	0.563	-0.112	0.912
March 2002	0.501	0.627	1.633	0.135	3.471	0.001**

** and * for p-values respectively indicate that we can abandon the null hypothesis that assumes the average value of each population is the same value at the 1% and 5% significance levels.

Table 2 t-Test Results Regarding Correlations on Weighting Changes

(By business nature/asset management company)

	I-T		T-TI		I-TI		S-D	
	t-value	p-value	t-value	p-value	t-value	p-value	t-value	p-value
March 1995							3.385	0.001**
September 1995							7.742	0.000**
March 1996	0.599	0.610	-1.192	0.235	0.548	0.639	3.680	0.000**
September 1996	3.670	0.002**	-2.623	0.009**	4.082	0.000**	2.293	0.024*
March 1997	1.886	0.080	-2.817	0.005**	1.405	0.181	2.619	0.009**
September 1997	1.352	0.198	-3.357	0.001**	0.795	0.439	3.094	0.002**
March 1998	2.695	0.017*	-3.696	0.000**	2.083	0.055	0.690	0.492
September 1998	2.779	0.006**	-4.518	0.000**	1.555	0.121	1.221	0.222
March 1999	5.165	0.000**	-5.579	0.000**	1.940	0.053	0.615	0.539
September 1999	0.144	0.885	-0.854	0.393	-0.088	0.930	4.133	0.000**
March 2000	-0.432	0.672	3.023	0.003**	0.440	0.661	3.487	0.001**
September 2000	1.228	0.239	1.254	0.211	1.489	0.158	3.756	0.001**
March 2001	-0.407	0.690	-0.522	0.602	-0.514	0.615	3.258	0.002**
September 2001	0.277	0.782	3.691	0.000**	1.237	0.221	2.955	0.004**
March 2002	-0.089	0.937	1.849	0.067	-0.005	0.996	6.841	0.000**

** and * for p-values respectively indicate that we can abandon the null hypothesis that assumes the average value of each population is the same value at the 1% and 5% significance levels.