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THE EFFECT OF CONCENTRATED INSTITUTIONAL PORTFOLIO ON STOCK RETURNS

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SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF SCIENCE IN FINANCE

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Abstract

This paper examines whether stock return is related to the extent of portfolio concentration on the part of institutional fund managers. There is evidence that large firms are preferred for both concentrated and well-diversified funds. Also, a trading strategy based on concentrated ownership generates positive abnormal return. This implies that informational effect (implied in an increase in concentrated capital) has significant impacts and predictability on returns. Meanwhile, we do not find diversified ownership has predictability on future stock returns.

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1. Introduction

For decades, the truth about diversification has exerted a significant influence on the way investors managed their portfolios as well as finance researchers thought about portfolio theories and applications. Even among novices, the idea of not putting all eggs in one basket has caused far-reaching societal and cultural responses toward their finances, which manifest themselves in the form of value investing and index fund products. Conventional wisdom, which needs no complex mathematical discourse, suggests that investors should widely diversify their holdings across stocks and industries to reduce their portfolios' idiosyncratic risk.

But what exactly comes with diversifying behavior? Do we diversify because we don't know, or do we decide *not* to diversify because we *know*? Diversification, despite its desirable characteristics of safeguarding an investor's asset, is at its core no more than a hedge against ignorance. If an investor "knows" Apple stock is going to blow on the upside tomorrow as soon as market opens, would he or she prefer to have a sizable bet (i.e. bet of a lifetime) on the stock, or would he or she remain methodically 'sound', emotionally inert, and invest only up to an amount emitted out of its portfolio optimization algorithm?

The answer is not clear, nor do we attempt to showcase our success in predicting abnormal return by tracking the number of outrageous gamblers toward various stock positions. All we refer to is that diversification does have something to do with a lack of "special" information. In the extreme sense, it is time to throw away your computer

if you know *exactly* what is going to occur to a stock or a basket of stocks.

The above implies that when we see more "concentrated" positions toward a stock that should imply its favorable return in the future periods, because "concentrated" implies "know". Fund managers, however, might want to hold concentrated portfolios if they believe some industries will outperform the overall market or if they have superior information to select profitable stocks in specific industries [Kacperczyk, Sialm, Zheng (2005)].

Levy and Livingston (1995) show in a mean-variance framework that managers with superior information should hold a relatively concentrated portfolio. Van Nieuwerburgh and Veldkamp (2005) argue that optimal under-diversification arises because of increasing returns to scale in learning. Chen, Hong, Huang, and Kubik (2004) find that smaller funds tend to outperform larger funds due to diseconomies of scale. While the size of the fund negatively affects its performance, it is possible that a wide dispersion of holdings across many industries also may erode its performance.

Mutual fund managers may also hold concentrated portfolios due to a potential conflict of interest between fund managers and investors. Several studies indicate that investors reward stellar performance with disproportionately high money inflows but do not penalize poor performance equivalently. (Numerous studies have called attention to the performance-flow relation, for example, Ippolito(1992), Brown, Harlow, and Starks (1996), Gruber (1996), Chevalier and Ellison (1997), Goetzmann and Peles (1997), Sirri and Tufano (1998), Del Guercio and Tkac (2002), and Nanda, Wang, and Zheng (2004).) This behavior results in a convex option-like payoff profile

for mutual funds. Consequently, some managers, especially those with lower investment abilities, may have an incentive to adopt volatile investment strategies to increase their chances of having extreme performance.

Kacperczyk, Sialm, Zheng (2005) argue that mutual fund managers may decide to deviate from a well-diversified portfolio and concentrate their holdings in industries where they have informational advantages. Their results indicate that, on average, more concentrated funds perform better after controlling for risk and style differences using various performance measures. They also find that the superior performance of concentrated mutual funds is primarily due to their stock selection ability.

Furthermore, they find that concentrated funds are able to select better stocks even after controlling for the average industry performance. They also show that the return difference between the buys and the sells by mutual funds increases significantly with industry concentration. This finding indicates that concentrated mutual funds are more successful in selecting securities than diversified funds.

All these findings indicate that the choice between diversify and concentrate may contain some information which would reflect the expectations of investors and thus affect the returns of the stocks. Since the amount of wealth managed by institutional investors has grown considerably and mutual funds can represent the institutional investors, it is reasonable to investigate the preference of mutual funds and thus check the characteristics of stocks hold by institutions with different diversification level.

However, the opposite can be said with comparable analytical strengths. We could envision a case where having larger and “diversified” investors going into a stock

could make stock gain publicity, investor assurance, and thus help boost its future returns. It is because large and "diversified" funds carry themselves as being prudent, and that spells much wanted sentiments especially in an unsettling market with extreme volatility. When reputable and usually well-diversified funds such as Vanguard and Fidelity increase their stakes in a few stocks, does the funds' positive image and publicity get transmitted into bullish sentiments toward the stocks as well? Related studies show the positive impact of index inclusion has on stock returns (e.g. Jain (1987)). We believe the similar reasoning, along the line of positive sentiments, is applied when stocks are considered desirable simply because large and reputable funds increase their stakes in those stocks. Coincidentally, those large and reputable funds are usually well-diversified compared to other funds.

Two opposing effects are therefore at work. Besides having "concentrated implying knows", we also expect stocks largely held by diversified funds have good performance because of the some signal effect. The informational effect of undiversified bets might either be more or less intense than the signal effect of apparently un-informational positioning done by large players. The net effect is at this point unknown, and will be our principle task to address in this paper.

Prior literature suggests that institutional investors may over-diversify since many funds hold more than 100 stocks. Statman (1987) shows a well-diversified portfolio of randomly chosen stocks must include at least 30 stocks for a borrowing investor and 40 stocks for a lending investor. We could suspect that some institutional investors may over-diversify their portfolios. Goyal and Santa-Clara (2003) provides rational

and irrational justifications for limited diversification. Transaction costs and taxes restrict the portfolio holdings of investors. Private information is another motive for holding large and undiversified positions. Van Nieuwerburgh and Veldkamp (2005) argue that optimal under-diversification arises because of increasing returns to scale in learning. Chen, Hong, Huang, and Kubik (2004) find that smaller funds tend to outperform larger funds due to diseconomies of scale. While the size of the fund negatively affects its performance, it is possible that a wide dispersion of holdings across many industries also may erode its performance.

These findings give us the impression that concentrated portfolio is a prelude to superior performance. Some investors might hold over-diversified portfolios compared with the diversified ones. Some investors might hold under-diversified portfolios because of the transaction costs or inside information. The pertinent issue is whether a change in capital commitment toward a stock by undiversified investors says anything about its future returns. Due to the two opposing effects as mentioned above, there is no straightforward answer to this query other than to give the problem its structure which we could test against with data.

Gompers and Metrick (2001) show that large institutions, as compared with other investors, prefer to invest in large, liquid stocks that have low past returns. They also find that the level of institutional ownership in a stock can help to forecast its future return. Their analysis supports the importance of investor clienteles for understanding asset pricing. Their conclusions also support the plausible, but un-informational, impact of increased stock holdings by large institutional funds.

Goetzmann and Kumar (GK 2003) find that systematic under-diversification of individual investors influence asset prices and their diversification factor has incremental explanatory power over the standard risk factors for small stocks, value stocks and growth stocks. In addition, they also predict that the examinations for combined diversification levels of individual and institutional investors will be more accurate to analyze the pricing impact of idiosyncratic risk. In our paper, we adopt GK's diversification measures in extracting the fund's parameters for our tests.

For a diversified owner, a stock's short term price fluctuation is less likely to induce him to liquidate his position on the stock (since his overall portfolio is well diversified). In other words, he would have higher tolerance for short-term performance of each individual stock, compared with an undiversified owner of the same stock.

Our present goal is to first go into the mutual fund's holding data and determine their levels of diversification. We then aggregate this fund-level characteristic information for each stock that the funds own. This aggregation allows us to form stock-level measure that indicates the extent of concentrated vs. diversified ownerships. Using standard tests, we then explore whether this measure has a directional linkage with expected stock returns. The relationship, when observed, would help us whether the informational effect of undiversified holding, or the opposing, signal effect of diversified holding, dominates at the margin.

The rest of this paper is organized as follows. We first introduce the data and methodology this paper uses. This section includes some summary statistics about the

sample data. Then we test if the portfolios formed on our concentrated investment measures yield abnormal return. We will then analyze the results, perform various robustness tests, and specify the further researches to be done. Finally, we will conclude the results obtained thus far with an emphasis on promising insights we could stimulate on this subject.

2. Data and Methodology

The data we used in this paper is obtained from Thomson Reuters (s12) database as well as the Center for Research in Security Prices (CRSP). Our dataset covers 4470 funds whose stock holdings were recorded in the Thomson database from March 1980 to December 2005. To study if portfolio concentration has an independent impact on stock returns, we include only funds are not considered index funds. In the Thomson Reuters data, we have singled out funds that describe themselves as aggressive growth, growth, growth & income, or balanced (i.e. they have an investment objective code (ioc) of 2, 3, 4, and 7, respectively).

For the ease of exposition, let us first define a few variables that are useful for our analysis.

Let $I_{q,t}$ be the collection of stocks owned by institution q by the end of month t, $X_{i,q,t}$ be the dollar amount of stock I, owned by institution q, by the end of month t. Having these variables defined, let's define $w_{i,q,t}$ as institution q's portfolio weight on stock i by the end of month t. By definition,

$$w_{i,q,t} = \frac{X_{i,q,t}}{\sum_{j \in Q_t} X_{j,q,t}}$$

After we obtained the basic data, we computed the fund-wise diversification measures which would then be aggregated at the stock levels.

(1).Fund level diversification measures

Goetzmann and Kumar (GK, 2003) discuss three diversification measures, each of

which has different emphases and characteristics. For intuitive and illustrative purposes, I have chosen to adopt one of the measures, as follows:

$$Div_{q,t} = \sum_{j \in I_{q,t}} (w_{j,t} - w_m)^2 = \sum_{j \in I_{q,t}} (w_{j,t} - \frac{1}{N_m})^2 \approx \sum_{j \in I_{q,t}} {w_{j,t}}^2$$

Where N_m is the number of stocks in the market at a given time (i.e. end of month t) and w_m is the average market weight of a stock, based on N_m. Alternatively, we have adopted a value-based approach in computing w_m, and it made no significant deviation to our main results. There are, however, various ways we could compute fund J's $w_{j,t.}$ We could compute this weight based on the fund's reported NAV at the end of month t, or we could compute it based on the total value of its stock holdings derived from the database directly. The following measures describe these alternative measures.

w: the weight of a stock in fund's portfolio, based on the total value of a fund's stock holdings;

We, then, define the following diversification measures for each interval in the sample period.

Div = sum of w's squared.

Stkcount = the number of stocks being held by the fund.

Intuitively, the higher a Div variable is, the more concentrated, or undiversified, a fund's portfolio is. Div also falls between 0 and 1 by definition, making comparisons and further aggregations convenient. We expect the deviation from average diversification level of the group could be a more effective measure to form stock-level characteristics, especially when we examine the sub samples. Therefore,

we define the deviation from the average Div as follows:

$$Abdiv_{q,t} = Div_{q,t} - Avg(Div_{q,t})$$

Here, $Div_{q,t}$ is the Div measure of fund q at time t while Avg ($Div_{q,t}$) is the average of $Div_{q,t}$ of the sample. The larger $Abdiv_{q,t}$ is, the more diversified the fund is.

(2). Aggregation of Div to form Stock-Level Characteristics

After computing $Abdiv_{q,t}$ is for each fund q, and we know the $\{X_{i,q,t}\}$ and $\{w_{i,q,t}\}$ series for each stock I, being held by fund q at the end of time t, we need to devise a way to gauge the level of *concentrated investment* toward a certain stock i.

The following is a list of stock-level variables we formed based on an aggregation of fund-level diversification measures.

(i) $NDivWgt_{i,t}$ = sum of $X_{i,q,t}$ over all fund q's whose $Abdiv_{q,t}$ is among the highest 10% for all funds at the end of time t.

(ii) $DivWgt_{i,t}$ = sum of $X_{i,q,t}$ over all fund q's whose $Abdiv_{q,t}$ is among the lowest 10% for all funds at the end of time t.

$NDivWgt_{i,t}$ and $DivWgt_{i,t}$ are stock i's attributes that reflect the capital invested by its under-diversified, and well-diversified, institutions, respectively. The top and bottom 10% are arbitrarily specified for illustrating our hypothesized relationship between concentrated positions and stock returns.

Portfolios could be generated to test if a concentration-return relationship exists. For instance, let's form a portfolio, called Ndiv, which include all stocks that registered a non-zero Ndivwgt value (i.e. because by definition, not all stocks would have a positive value of Ndivwgt). Ndiv is therefore a portfolio of stocks that have

implied the presence of concentrated capital committed to its value appreciation. The Ndiv portfolio is equally weighted portfolio including all stocks with a non-zero Ndivwgt value.

The same could be done to generate Div portfolio using the stocks' Divwgt weights. Our thesis is now reduced to a testable hypothesis of whether Ndiv, Div, or a mixture of them, performed differently relative to a random portfolio of stocks.

Should we expect the Ndiv portfolio to command a higher return than a random portfolio? If it did, concentrated investment carried informational value that was generally not priced in during our sample period. Alternatively, Div portfolio might do better than Ndiv if positive sentiments arisen from an injection of large and well-diversified capital dominates unusual information toward stocks. Our paper presents an opportunity to test if one of the effects is more important than the other.

3. Statistical summary

(1). Fund level statistical summary

Table 1 shows us the summary statistics of the diversification measures for fund level. As we can see that the average number of stocks increases with the portfolio size. This means that when an institution is larger, it tends to hold more stocks. We also find that sum_w_sq decreases with the portfolio size. For Div (sum_w_sq), the mean decreases from 0.0217 to 0.0133 as portfolio size increases from small to large. This implies that the larger the institutions, the more diversified the institution is. Because the lower the diversification measures, the more diversified the fund is. In addition, we find the variance of number of stocks increases with fund size.

Goetzmann and Kumar (2003) find that during the 1991-96 sample periods, the average number of stocks in individual investor portfolios increases from 4 to 7. We also examine the time-variation in the average diversification level of portfolios of institutional investors. We divide the entire sample period into five sub periods and see how the diversification level varies as time changes.

(2). Sub periods statistical summary

Table 2 shows the summary statistics of diversification measures for different sub periods. It is very obvious that institutions tend to hold more stocks and there is a monotonic increase in number of stocks over time. The mean of sum_w_sq decreases over the time which implies that there is an improvement of diversification level from 1980 to 2005. Since sum_w_sq is a more effective proxy of the diversification level

and the decrease of this proxy is the largest in the small fund sample, small funds have the largest improvement of diversification level over time.

(2). Stock level statistical summary

Table 3 shows us the summary statistics of the diversified/undiversified ownership measure at the stock level. There are at least three observations worth mentioning. First, return increases with Mkt-Cap for data of the both panels except for the largest quintile. This implies that large firms tend to gain higher return than small firms. This phenomenon is consistent with the disappearance of the small-stock premium in recent years. Small-stock premium was first pointed out by Banz (1981) and then analyzed in subsequent studies. However, this premium has reversed since 1980.The summary statistics of our sample data seems to support this.

Second, in panel A, Ndivwgt increases with Mkt-Cap, which implies that the larger the firm is, the more likely that it will be largely held by under-diversified institutions. We know that under-diversified institutions face a higher idiosyncratic risk and tend to require a higher return. Recall that large stocks earn a significant premium over small stocks since 1980(Gompers and Metrick (2001)).It is reasonable that under-diversified institutions are infatuated with large stocks.

In panel B, Divwgt also increases with Mkt-Cap, which implies that well-diversified institutions tend to hold large stocks. This phenomenon is consistent with the finding of Gompers and Metrick (2001) and a related study by Falkenstein (1996). They find that the one hundred largest institutions increased their share of the market from 19.0 percent in 1980 to 37.1 percent in 1996. Also, they argue that large

institutions prefer large, liquid stocks. Recall that we find that larger institutions tend to be more diversified in the fund level analysis.

Together with the two facts, it is understandable that there is a positive relation between Divwgt and Mkt-Cap. Finally, we also find from table 4 that the mean of excess return for firms with NDivwgt is slightly larger than that for firms with Divwgt. This suggests that the informational effect might be sufficiently large to offset the signal effect from diversified capital, and thus dominates in terms of return predictability for stocks over our testing period.

4. Multi-factor model estimation

(1). Empirical results of Ndiv/ Div portfolios

After we generated the Ndiv and Div portfolios based on the Ndivwgt and Divwgt variable, we check whether one or both of these two portfolios generated abnormal return from an asset pricing perspective. We used the Fama-French (1992) specification to provide our primary benchmark.

$$R_p - r_f = \alpha + \beta_1 mktrf + \beta_2 smb + \beta_3 hml + \varepsilon$$

Table 5 reports the main results of the regression. It seems that both Ndiv and Div portfolio generate statistically significant return at the 1% level. It is intuitive, as NDiv is correlated with favorable but unpriced information, while Div being related to sentiments (or herding-related feedback trading) induced from large institutional participants. It is therefore natural to expect both NDiv and Div are predictive of future returns as a result. Now what remains to be explored is which effect is marginally stronger. Table 5 shows the abnormal return of Ndiv portfolio is larger than that of Div portfolio. This indicates the informational effect is larger than signal effect. The coefficient of market premium is larger for Ndiv portfolio. This implies the Ndiv portfolio has higher system risk.

Gompers and Metrick (2001), in a related work, find that the level of institutional ownership in a stock has predictive power to forecast its future return, and this power comes from the demand shocks resulting from the compositional shift in ownership toward institutions. From this point of view, stocks which are largely hold by well-diversified institutions may convey a positive signal since investors might believe the judgments of powerful institutions. Therefore, a stock with high Divwgt might generate high demand for this stock and thus boost future return.

However, Gompers and Metrick (2001) also find that large institutions, as compared with other investors, prefer to invest in large, liquid stocks that have low past returns. From this perspective, we might say that a stock with high Divwgt tends to be large, liquid one and thus with low return. If we define the points from the two different angles as two different effects of Divwgt variable, does the total result imply that the demand effect is stronger than the preference effect? Thus far, these issues remain a puzzle to us and we will come back to this point in the next draft.

Table 6 reports the regression results of different fund size samples. We find Div portfolio get larger abnormal return for the large fund sample. While for medium and small fund sample, Ndiv portfolio generates larger abnormal return.

(2). Robustness test

As a cross check, table 7 reports the mean of the prices of stocks included in the two portfolios for several arbitrage chosen time point. We observe from table 7 that almost for all periods, the mean of stock price is larger, three months after the respective portfolio formation dates. Assume the portfolio is generated at time t and then we can compare the stock prices of three months later with the stock prices of time t. In figure 2 and figure 3 we find that actually prices of most stocks will increase. Three monthly time-periods are arbitrarily chosen in the sample period for Ndiv and Div portfolio respectively (December 1992, March 1999, March 2005). To make the price difference more visible, we use the logarithmic scale of the real figure. Therefore, data points above 1 means the price difference are positive while the data points below 1 means the price difference are negative. We find that prices of most stocks in the portfolio increased after three months. This also verifies that the diversification measure can be used as a portfolio formation tool.

(3). Overlapping between Ndiv and Div portfolios

Although both the Ndiv and Div portfolios can generate positive abnormal return, we found that some stocks held by under-diversified funds are also held by well-diversified funds. And the number of such stocks is not small. Table 8 shows us the number of stocks for each portfolios and the total number of tradable stocks as of the end of each year in our sample. We observed that Ndiv portfolio and Div portfolio have a fair number of stocks in common. This could point to the fact that well-diversified funds and under-diversified funds hold the same stocks for different reasons. A ready explanation that justifies the overlap would be that well-diversified funds sometimes also adjust their stock holdings based on informational reasons (i.e. not just the undiversified funds possess special information). If that is true, both undiversified and diversified funds increase their holdings toward a stock because of special information. Diversified funds might need to observe guidelines in terms of their exposure on a single stock, while undiversified funds are not constrained by this stringent requirement. This will be a plausible argument for the observed overlap, and await further research for confirmations. We find the correlation of returns of Ndiv portfolio and Div portfolio is very large and the large fund sample has the largest correlation. The Seemly unrelated regression of the two portfolios indicates there is no significant difference between abnormal returns of two portfolios.

Although the empirical result shows that both the Ndivwgt and Divwgt portfolios can earn abnormal return, the mechanism of the profit generation probably is different for the two portfolios. Since the overlapped stocks are held by both well-diversified investors and under-diversified investors, we expect that stocks with more dollar value held by under-diversified investors tend to command a higher return. To test this hypothesis, we generate a special parameter and call it z variable for the moment. We

define the z variable as follows

$$Z= Ndivwgt / (Ndivwgt+Divwgt)$$

For all the overlapped stocks in the two portfolios, we calculate the z variable. The higher the z variable, the larger percentage the stock is held by the under-diversified investors. Therefore, we expect that a trading scheme that longs the stocks within the top 5% of all z variables while shorts the stocks within the bottom 5% of all z variables can be a profitable strategy. We use the z variable as the portfolio weight to verify the presence of abnormal return. We find that this trading strategy earned 0.7% return for the three months holding period. Although the magnitude is not very large, it demonstrates that this z variable might provide a promising angle to exploit our main results in this paper.

5. Test of Concentrated/Diversified Ownership

To better understand whether concentrated/diversified ownership has some predictability of future stock returns, we analyzed a long-short strategy based on ranking of concentrated/diversified ownership. We define concentrated/ diversified ownership as follows:

$$CO_{i,t} = \frac{Ndivwgt_{i,t}}{MktCap_{i,t}}$$

$$DO_{i,t} = \frac{Divwgt_{i,t}}{MktCap_{i,t}}$$

Here, Concentrated Ownership of stock *i* at time t is the percentage of capital committed by concentrated funds. Diversified Ownership of stock *i* at time t is the percentage of capital committed by diversified funds. We construct two portfolios based on ranking of $CO_{i,t}$ and $DO_{i,t}$ respectively. We long stocks with top 10% $CO_{i,t}$ while short stocks with bottom 10% $CO_{i,t}$ within the concentrated funds holding universe. For diversified funds holding universe, we long stocks with top 10% $DO_{i,t}$ while short stocks with bottom 10% $DO_{i,t}$.

Table 9 reports the regression results based on the trading strategy mentioned above. We find the concentrated ownership has some predictability about future stock returns and the trading strategy based on $CO_{i,t}$ generate significant positive (0.46% per month) abnormal return. While the strategy based on $DO_{i,t}$ is unable to get significant abnormal return. The higher percentage of capital committed from concentrated funds, the better performance the stock will get in the future. While

diversified capital percentage does not have significant relationship with the future stock return. This is also consistent with the result that informational effect is larger. Because we find percentage of capital committed from concentrated funds has better predictability of future stock returns.

6. Test of An Alternative Strategy

(1). Test of Delta-Y strategy

In most of our earlier tests, we look at only the most diversified funds and most concentrated funds. This might leave out important observations. It is thus instructive to devise a way to examine other diversified-undiversified deciles.

A potentially fruitful measure is one that registers an increase / decrease of capital going into a certain decile. For example, let us define variable Y as

Y=m / # of funds in the decile

Change in $Y_{i,t}$= $\Delta Y_{i,t} = Y_{i,t} - Y_{i,t-3}$ [1]

Here m refers to the sum dollar value held by different diversified level funds respectively for each stock. Because the change of Y (Delta-Y) reflects the average cash inflow or outflow from the respective diversification level funds, it might contain more information. Therefore, the testing hypothesis is a trading strategy that long the top Delta-Y stocks while short the bottom Delta-Y stocks will get abnormal return. We construct two portfolios based on the ranking of Delta-Y of stocks and use the Market capitalization as the portfolio weight. The long portfolio concludes stocks with the top 10% large Delta-Y whiles the short portfolio concludes stocks with the bottom 10% Delta-Y. Table 10 shows us the abnormal returns of this Delta-Y trading strategy for various holding periods.

The comparison among different holding periods indicates that in the short run (e.g. 3months/6 months), the cash inflows (positive Delta-Y) from several most diversified deciles can get better positive market reaction and the specified Delta-Y trading

[1] Here, i refers to stock i while $Y_{i,t}$ refers to the Y of stock i at the time of t.

strategy can obtain more abnormal returns in these deciles. However, for the longer holding period (e.g. 9 months/1 year), the cash inflows (positive Delta-Y) from the relative concentrated deciles tend to reflect more positive information and the specified Delta-Y trading strategy can obtain more abnormal returns in these deciles. That means investors can implement this Delta-Y strategy in different diversification level funds according to the expected holding period. If investors need a short term investment, they can use the Delta-Y trading strategy within more diversified deciles. Firstly, they should rank funds based on diversification level. Then, they should implement the Delta-Y strategy in the more diversified deciles. In contrast, if investors need a relatively long term investment, they should implement the Delta-Y strategy in the concentrated deciles. As long as investors implement this Delta-Y strategy flexibly, they can always earn abnormal returns.

(2). Sub periods results of Delta-Y strategy

To analyze whether this result holds for the sub periods, we also divide the entire sample into sub period samples. Recall we use the quarterly data to run the regression, it is inherently impossible to have too many sub periods due to few observation problem. Therefore, we just divide the whole sample period into two sub periods. Table 11 shows us the abnormal returns gained by the Delta-Y trading strategy for the 3 months holding period for the two sub periods. Since the longer holding period results for sub periods analyses are exhibit the same conclusion, we do not show the longer holding period results here.

For the three month holding period, we can still find the sub period results are consistent with the previous results. For both most diversified decile and most concentrated decile, the abnormal return from Delta-Y trading strategy is larger at the

more recent period (1993-2005). It indicates that the Delta-Y trading strategy is more useful for the more recent period. Therefore, it could be useful to implement the Delta-Y trading strategy in the recent portfolio management.

(3). Results based on different fund size or stock size samples

Some people may argue that the results may be largely driven by the fund sizes or stock sizes. It is necessary to check whether the fund sizes or stock sizes lead to the results. Firstly, we divide the entire sample into three sub samples based on the size of funds. We use the rank of assets as the proxy for the size of funds. Then we implement the Delta-Y trading strategy in the large fund, medium fund and small fund sub samples respectively. Secondly, we divide the entire sample into three sub samples based on the size of stocks. We use the rank of market capitalization as the proxy for the size of stocks. Also we use the Delta-Y trading strategy in the large stock, medium stock and small stock sub samples respectively.

From table 12, we may conclude that the overall result for the more diversified deciles may be driven by the large funds while the overall result for the more concentrated deciles may be driven by the small funds. This is reasonable because large funds tend to hold more diversified portfolios while small funds tend to hold more concentrated portfolios. This fact can be verified by the correlation between the size rank and the div rank. Recall the larger the size rank, the larger the fund is while the higher the div rank, the more concentrated the fund is. The general negative correlation coefficient between these two ranks (-0.22425) indicates that large funds tend to be more diversified while small funds tend to be more concentrated. Figure 1

shows the correlation coefficient between size rank and diversification rank of funds. The correlation coefficient is negative for the entire sample period. Figure 1 also shows the trend that the phenomenon described above is not so significant in the recent period as before. The absolute value of the negative correlation coefficient decreases in the more recent period.

Table 13 shows the abnormal return gained by Delta-Y trading strategy for 3 months holding period for the different stock size samples. We can clearly find from table 11 that in the small stocks universe, investors view the cash inflow from the more diversified funds contains more positive information. The magnitude of the abnormal return for more diversified deciles is much larger than that for more concentrated deciles. When we compare horizontal numbers in the most diversified decile, the result of the whole sample is more similar with that of large stocks universe. Thus for most diversified deciles, the overall result is more likely driven by large stocks. However, for most concentrated deciles, the overall result is more likely driven by small stocks. When we compare the most diversified deciles and the most undiversified deciles, it is obvious that the Delta-Y strategy performs better for the most diversified funds in the three months holding period analysis.

7. Conclusion

In this paper, we take a look at how funds' diversification profiles affect stock returns. We expect that how much return a risk-taker requires depends on his diversification profile. The study uses quarterly data from 1980 to 2005 drawn from SDC and monthly return data from CRSP. We find that there is a positive relation between the level of diversification and the size of the fund. Also, we find there is an obvious improvement of general diversification level over time. The summary statistics of stock level data seem to be consistent with the disappearance of small-stock premium in recent years. In addition, both under-diversified institutions and well-diversified institutions tend to hold large stocks.

For the multi-factor model test, the abnormal return of both Ndiv and Div portfolio are significantly positive and expected. This shows that both increases in concentrated capital and diversified capital predict positive abnormal returns. The reasons were extensively hypothesized in the introduction section. Briefly put, an increase in undiversified position points to an informational reason, while that in diversified position points toward a positive-sentiment argument. Both effects are important. However, the tests, especially those toward the end of our analysis, showed that the former effect tends to dominate the former,

We also find that there are many overlapped stocks in Ndiv and Div portfolios. That means these stocks are held both by well-diversified funds and under-diversified funds. We also suspect that well-diversified funds and under-diversified funds hold

these two stocks based on different motivations. In addition, the robustness test shows us that the mean of the prices will increase in the next three months for stocks that are included in either the Ndiv portfolio or Div portfolio. Therefore, the two portfolios can obtain positive abnormal return is obviously possible. We also find the concentrated ownership has some predictability of the future stock returns while the diversified ownership has no significant predictability of future stock performance. Concentrated ownership matters while diversified ownership does not matter within the concentrated or diversified fund holding universe.

The analysis of our change-in-Y (Delta-Y) strategy indicates that the average net cash flow of more diversified funds contains more positive information than that of more undiversified funds. However, for a longer holding period, the average net cash flow of more undiversified funds tend to deliver more positive information.

Based on our analysis in this paper, we confirm the importance of the extent of concentration in institutional portfolios in stock returns, and will resolve any outstanding issues in our future research on this topic.

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Appendices:

Table 1

Summary Statistics for Different Fund Sizes (Fund Level)

This table reports the statistics of the diversification measures of portfolios for different fund sizes. We use the holding assets at the end of each quarter as the proxy for fund size. The sample period is from March 1980 to December 2005.All the data are obtained from 13F and SDC quarterly data for mutual fund. Variable Stkcount refers to number of stocks held by funds while sum_w_sq (Div) is sum of w squared.

Fund level summary statistics					
	mean	median	minimum	maximum	std dev
Full Sample					
Stkcount	455.2	151	1	3735	708.89
Sum_w_sq	0.0163	0.0122	0.0007	1	0.0237
Large Fund Sample					
Stkcount	615	233	0	3735	867.52
sum_w_sq	0.0133	0.0107	0.0007	1	0.0162
Medium Fund Sample					
Stkcount	394	137	0	3621	600.22
sum_w_sq	0.0178	0.0127	0.0006	1	0.0288
Small Fund Sample					
Stkcount	257	88	0	2864	452.34
sum_w_sq	0.0217	0.0170	0.0008	1	0.0312

Table 2

Summary Statistics for Different Sub Periods (Fund Level)

This table reports the summary statistics for fund level for different sub periods. The sample period is from March 1980 to December 2005.All the data are obtained from 13F and SDC quarterly data for mutual fund. Variable sum_w1_sq (Div1) is sum of w1 squared while w1 is defined as value of a stock's position/ total value the fund's stock holdings. We divide the whole sample period into five sub periods, which are 1980-1985, 1986-1990, 1991-1995, 1996-2000, and 2001-2005.

	Sub periods				
	1980-1985	1986-1990	1991-1995	1996-2000	2001-2005
Panel A: Mean					
Full Sample					
Stkcount	111.7	218.2	370.7	484.6	546.3
Sum_w1_sq	0.0257	0.021	0.0158	0.0154	0.0154
Large					
Stkcount	169.7	375.7	437.9	637.8	796.1
Sum_w1_sq	0.0199	0.0153	0.0133	0.0134	0.0119
Medium					
Stkcount	107.5	154.1	421.9	451.2	415
Sum_w1_sq	0.0239	0.0215	0.0158	0.0159	0.0189
Small					
Stkcount	54.5	113.5	186.8	265.5	343.8
sum_w1_sq	0.0345	0.0273	0.0235	0.0211	0.0185
Panel B: Median					
Full Sample					
Stkcount	68	82	135	171	211
Sum_w1_sq	0.022	0.018	0.0126	0.0119	0.0105
Large					
Stkcount	89	142	190	269	400
Sum_w1_sq	0.0189	0.0137	0.011	0.011	0.0094
Medium					
Stkcount	75	81	138	150	172
Sum_w1_sq	0.02	0.0184	0.0119	0.0121	0.0116
Small					
Stkcount	44	53	78	95	111
Sum_w1_sq	0.0297	0.0249	0.0183	0.0162	0.0142

Table 3

Summary Statistics for Different Mkt-Cap Firms (Stock Level)

This table reports the statistics of the Ndivwgt and Divwgt for different Mkt-Cap firms. The sample period is from March 1980 to December 2005.All the data are obtained from SDC quarterly data for mutual fund. The Return is the monthly return data from CRSP. The Ndivwgt will be assigned to the next two months for each quarter end month data. This is to make sure that the Ndivwgt/ Divwgt reflect the most recently reported situation. Panel A shows the summary statistics for the Ndivwgt variable while panel B shows the summary statistics for the Divwgt variable.

	Mkt-Cap Quintiles					
Panel A:NDivWgt Statistics						
	All	Small	Q2	Q3	Q4	Large
Mean						
Return	0.0135	0.0088	0.0134	0.0152	0.0156	0.0146
NDivWgt	74,476,008	1,375,703	4,012,906	10,446,936	31,360,924	325,383,064
Median						
Return	0.0075	0	0.0054	0.0096	0.0109	0.0121
NDivWgt	4,138,625	521,076	1,639,700	4,152,932	12,362,625	80,041,734
Panel B:DivWgt Statistics						
Mean						
Return	0.0132	0.0092	0.0123	0.0148	0.0155	0.0148
DivWgt	6,987,228	476,239	1,540,415	4,298,801	10,047,470	18,577,828
Median						
Return	0.0044	0	0	0.0071	0.0101	0.0119
DivWgt	1,599,213	215,888	816,000	2,078,384	4,873,660	7,315,342

Table 4

Summary Statistics for Excess Returns of Different Portfolios

Table4 reports the summary statistics of the excess return for the Ndiv portfolio and Div portfolio respectively. Summary statistics include N (number of observations), the mean, median, variance, skewness and kurtosis of the excess return over risk free rate for the two portfolios.

	Summary statistics for excess return					
	N	Mean	Median	Variance	Skewness	Kurtosis
Ndiv portfolio	310	0.0094	0.014	0.0031	-0.81	2.997
Div portfolio	310	0.0092	0.014	0.003	-0.66	3.42

Table 5

Abnormal Return of Div/Ndiv portfolios

This table shows us the main results of the regression for the Ndiv and Div portfolio respectively. The sample period is from March 1980 to December 2005. The standard risk factors are obtained from the CRSP. Here, we use monthly portfolio return minus the risk free return as dependent variable. The mktrf refers to the market premium. Each of the numbers reported is the coefficient of the regression. Figures in parentheses are t-statistics. I indicate two-side statistical significance at 1%, 5%, 10% as ***, ** and * respectively.

Regression result for the Div portfolio and Ndiv portfolio		
Variable	Div portfolio	Ndiv portfolio
Intercept	0.00323	0.00397
	(2.63)***	(3.32)***
Mktrf	1.02823	1.09981
	(34.72)***	(37.09)***
SMB	0.59222	0.54597
	(15.51)***	(14.28)***
HML	0.16392	0.14806
	(3.57)***	(3.22)***
Adjusted R-sq	0.9506	0.9455

Table 6

Monthly Abnormal Return of Ndiv/Div Portfolio for Different Fund Size Sample

This table shows us results of the regression for the Ndiv and Div portfolio for different fund size respectively. The sample period is from March 1980 to December 2005. The standard risk factors are obtained from the CRSP. Here, we use monthly portfolio return minus the risk free return as dependent variable. The mktrf refers to the market premium. Each of the numbers reported is the coefficient of the regression. Figures in parentheses are t-statistics. I indicate two-side statistical significance at 1%, 5%, 10% as ***, ** and * respectively.

	Large	Large	Medium	Medium	Small	Small
	Ndiv	Div	Ndiv	Div	Ndiv	Div
intercept	0.00272	0.00397	0.00494	0.00396	0.00399	0.00329
	(2.34)**	(3.05)***	(3.99)***	(3.12)***	(3.01)***	(3.02)***
mktrf	1.11632	0.99867	1.10814	1.04069	1.09356	1.04007
	(38.35)***	(30.71)***	(35.77)***	(32.71)***	(32.92)***	(38.12)***
SMB	0.44778	0.56233	0.44321	0.53036	0.45575	0.53858
	(12.36)***	(13.89)***	(11.5)***	(13.39)***	(11.02)***	(15.86)***
HML	0.16087	0.13891	0.15147	0.1716	0.15554	0.1439
	(3.52)***	(2.72)***	(3.12)***	(3.44)***	(2.99)***	(3.36)***
UMD	-0.0997	-0.19931	-0.09779	-0.16594	-0.1097	-0.13403
	(-3.51)***	(-6.29)***	(-3.24)***	(-5.35)***	(-3.39)***	(-5.04)***

Table 7

Robustness Test-Price Changes for Ndiv/Div Portfolios

Table6 reports the mean of the prices of stocks included in the two portfolios. Price (t) refers to the current stock price while the Price (t+3) refers to the stock price three months later.

Robustness test					
Panel A. NDiv portfolio					
	1988-09	1992-12	1999-03	2005-03	2005-06
Price(t)	21.38	28.46	27.12	27.87	29.66
Price(t+3)	21.82	29.02	28.8	28.08	31.12
Panel B. Div portfolio					
Price (t)	18.05	20.13	20.83	21.38	23.62
Price(t+3)	17.82	20.47	23.05	21.82	24.31

Table 8

Number of Stocks of Each Portfolio and exchangeable stocks

This table shows the number of stocks for each portfolios and the total number of exchangeable stocks for each year during the entire sample (1980-2005).

Year	#Stocks that have Ndivwgt	#Stocks that have Divwgt	#Stocks that can be traded
1980	1513	1486	5507
1981	1566	1695	5846
1982	1478	1801	6070
1983	1712	2422	6732
1984	1836	2835	6972
1985	1928	3107	7093
1986	2347	3370	7531
1987	2669	3888	7810
1988	2536	4052	7849
1989	2588	3926	7567
1990	2667	3744	7377
1991	2863	3847	7447
1992	3090	4073	7743
1993	4419	4936	8301
1994	5302	5488	8830
1995	5887	5742	9226
1996	6472	6456	9816
1997	7053	6605	10048
1998	6867	6792	9900
1999	6450	6537	9582
2000	6254	6711	9293
2001	5146	6191	8569
2002	4866	6020	7886
2003	4801	5255	7456
2004	4991	5376	7309
2005	5052	5275	7325

Table 9

Results of Long-Short Strategy within Ndiv/Div Portfolio

This table shows us results of the regression for the Long-Short Strategy based on the concentrated ownership and diversified ownership for different fund size sample respectively. The sample period is from March 1980 to December 2005. The standard risk factors are obtained from the CRSP. Here, we use monthly Long-Short portfolio return minus the risk free return as dependent variable. The mktrf refers to the market premium. Each of the numbers reported is the coefficient of the regression. Figures in parentheses are t-statistics. I indicate two-side statistical significance at 1%, 5%, 10% as ***, ** and * respectively.

	Entire Sample		Large Fund Sample		Medium Fund Sample		Small Fund Sample	
	Ndiv	Div	Ndiv	Div	Ndiv	Div	Ndiv	Div
Intercept	0.00461	-0.002	0.00478	-0.00299	0.0032	-0.00309	0.00548	-0.00444
	(2.65)***	(-0.68)	(2.45)**	(-1.55)	(1.12)	(-1.87)	(2.87)***	(-1.35)
Mktrf	0.20107	0.06455	0.18431	-0.04116	0.08019	0.04088	0.07281	0.05506
	(3.19)***	(0.9)	(3.1)***	(-0.47)	(1.25)	(0.64)	(1.08)	(0.7)
SMB	0.06612	0.23264	0.14904	0.04014	-0.15634	0.27568	-0.00885	0.22391
	(0.81)	(2.52)***	(1.51)	(0.35)	(-1.89)	(3.36)***	(-0.1)	(2.19)**
HML	0.24969	0.15246	0.18443	0.20088	0.02177	0.16248	0.09407	0.16457
	(2.55)***	(1.37)	(1.55)	(1.47)	(0.22)	(1.65)*	(0.9)	(1.34)
UMD	-0.08193	-0.11096	-0.10184	-0.13294	-0.10403	-0.02119	-0.17195	-0.10967
	(-1.31)	(-1.57)	(-1.35)	(-1.52)	(-1.64)*	(-0.34)	(-2.58)***	(-1.4)

Table 10

Abnormal Return of Delta-Y trading strategy

This table shows us the abnormal returns gained by the Delta-Y trading strategy for different holding periods. The diversification level indicates the rank of sum_w1_sq of funds. The most diversified deciles refer to the bottom rank funds while the most undiversified deciles refer to the top rank funds. 3 months, 6 months, 9 months and 1 year in the table refer to the holding period for the strategy. Figures in parentheses are t-statistics. I indicate two-side statistical significance at 1%, 5%, 10% as ***, ** and * respectively.

Results of Delta-Y trading strategy				
	Abnormal return (intercept)			
Diversification level	3 months	6 months	9 months	1 year
Most diversified	0.0239 (3.13)***	0.0087 (0.76)	0.0133 (2.77)***	0.01275 (1.58)
2nd deciles	0.02 (1.76)*	0.0129 (0.99)	0.0149 (2.06)**	0.01143 (1.05)
3rd deciles	0.0304 (2.38)**	0.0071 (1.28)	0.0186 (2.25)***	0.0004 (0.08)
4th deciles	0.0280 (1.75)*	0.0167 (1.61)	0.0189 (1.99)**	0.0052 (0.76)
5th deciles	0.0023 (0.39)	0.0121 (1.12)	0.0132 (2.64)***	0.0064 (0.83)
6th deciles	0.0039 (0.44)	0.0222 (1.71)	0.0203 (2.23)**	0.0078 (0.86)
7th deciles	0.0094 (0.85)	0.0037 (0.62)	0.0202 (2.44)**	0.0123 (2.81)***
8th deciles	0.0135 (1.01)	0.0056 (0.85)	0.0225 (2.2)**	0.0160 (2.33)**
9th deciles	0.0047 (0.57)	0.0127 (1.48)	0.0067 (1.41)	0.0296 (3.77)***
Most concentrated	0.0242 (0.42)	0.0149 (1.51)	0.0151 (1.59)	0.0308 (2.79)***

Table 11

Abnormal Return of Delta-Y Trading Strategy for Sub Periods

This table shows the abnormal returns gained by the Delta-Y trading strategy for the 3 months holding period. The diversification level indicates the rank of sum_w1_sq of funds. The most diversified deciles refer to the bottom rank funds while the most undiversified deciles refer to the top rank funds. The two sub periods of the sample are from 1980-1992 and 1993-2005. The division of the sub periods is a subjective decision. Since it is impossible to divide into more sub periods, I just divide the whole sample period into two sub periods. Figures in parentheses are t-statistics. I indicate two-side statistical significance at 1%, 5%, 10% as ***, ** and * respectively.

Sub-period analysis /3 months holding(exclude outliners)				
Diversified level	1980-1992		1993-2005	
	Abnormal return	R-sq	Abnormal return	R-sq
Most diversified	0.0189	0.1922	0.02835	0.1322
	(1.97)**		(3.82)***	
2nd deciles	0.0064	0.0282	0.0221	0.1955
	0.94		1.52	
3rd deciles	0.0215	0.1631	0.0371	0.0686
	1.71		(3.56)***	
4th deciles	0.00813	0.062	0.02945	0.1154
	1.42		(3.45)***	
5th deciles	0.0036	0.0732	-0.0037	0.0766
	0.83		(-0.5)	
6th deciles	0.0023	0.0854	0.0045	0.0385
	(0.27)		(1.15)	
7th deciles	0.00814	0.0319	0.0103	0.1315
	(0.72)		(0.97)	
8th deciles	0.0062	0.0255	0.0139	0.1265
	(0.94)		(2.11)**	
9th deciles	-0.0006	0.0675	0.0075	0.1172
	(-0.11)		(1.49)	
Most undiversified	0.0129	0.0045	0.0257	0.1532
	(0.37)		(0.68)	

Table 12

Abnormal Return of Delta-Y Trading Strategy for Different Fund Size Universe

This table shows the abnormal returns gained by the Delta-Y trading strategy for the 3 months holding period. The entire sample was divided into three sub samples- large funds, medium funds and small funds. The diversification level indicates the rank of sum_w1_sq of funds. The most diversified deciles refer to the bottom rank funds while the most undiversified deciles refer to the top rank funds. Figures in parentheses are t-statistics. I indicate two-side statistical significance at 1%, 5%, 10% as ***, ** and * respectively.

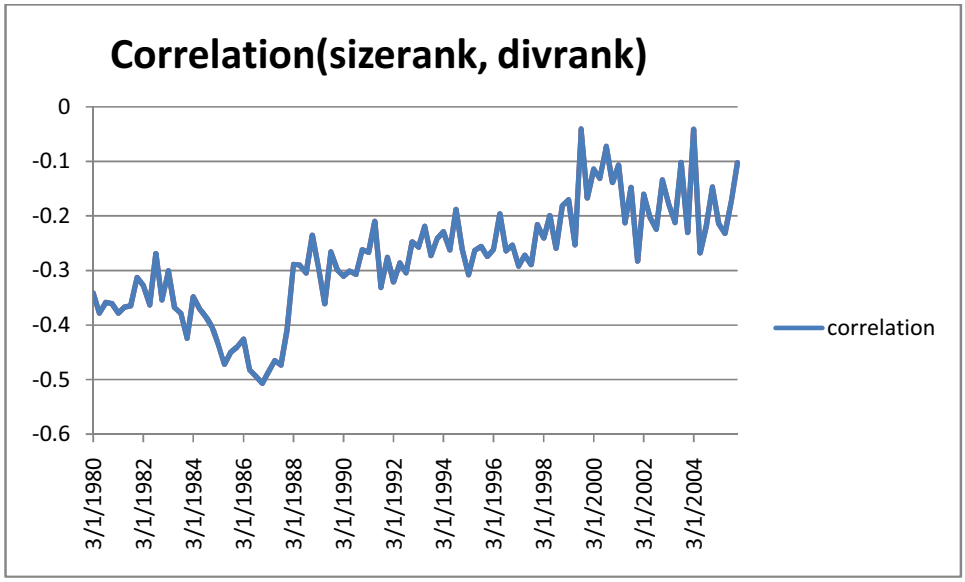
	3 months holding period			
Diversified level	Large funds	Medium funds	Small funds	All funds
Most diversified	0.0247	0.0206	0.0152	0.0239
	(4.18)***	(3.04)***	(2.72)***	(3.13)***
2nd deciles	0.0206	0.0095	0.0191	0.02
	(1.79)*	(1.13)	(1.11)	(1.76)*
3rd deciles	0.0321	0.0071	0.0063	0.0304
	(3.09)***	(1.09)	(0.9)	(2.38)**
4th deciles	0.0276	0.0137	0.0158	0.0280
	(1.73)*	(1.43)	(2.06)*	(1.75)*
5th deciles	-0.0025	0.0078	0.0031	0.0023
	(-0.46)	(0.45)	(1.12)	(0.39)
6th deciles	0.0042	0.0016	0.0028	0.0039
	(0.66)	(0.29)	(0.42)	(0.44)
7th deciles	0.0031	0.0096	0.0094	0.0094
	(0.56)	(1.68)	(1.66)	(0.85)
8th deciles	0.0106	0.0119	0.0158	0.0135
	(0.89)	(1.02)	(1.25)	(1.01)
9th deciles	0.0034	0.0045	0.0049	0.0047
	(0.31)	(0.56)	(0.61)	(0.57)
Most concentrated	0.0189	0.0177	0.0259	0.0242
	(0.31)	(0.29)	(0.52)	(0.42)

Table 13

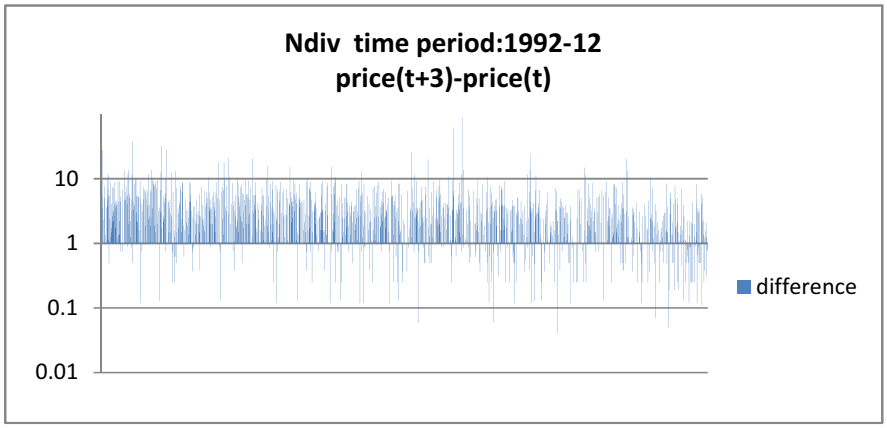
Abnormal Return of Delta-Y Trading Strategy for Different Stock Size Universe

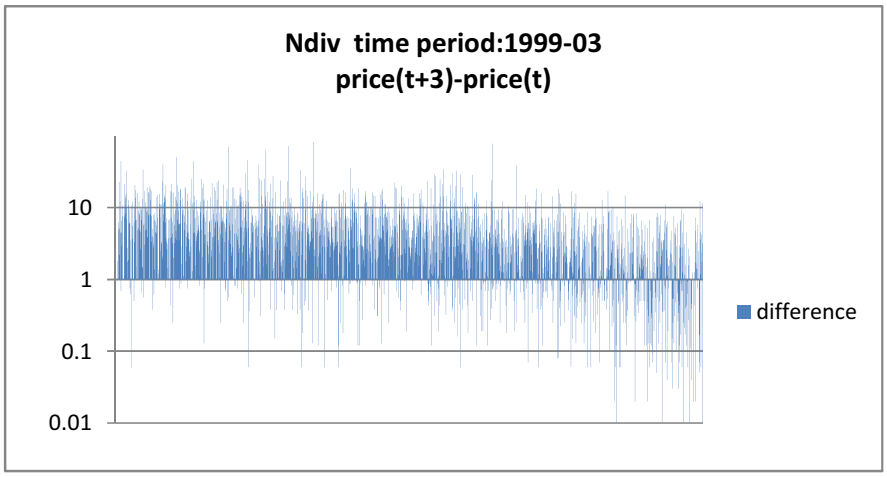
This table shows the abnormal returns gained by the Delta-Y trading strategy for the 3 months holding period. The entire sample was divided into three sub samples- large stocks, medium stocks and small stocks. The diversification level indicates the rank of sum_w1_sq of funds. The most diversified deciles refer to the bottom rank funds while the most undiversified deciles refer to the top rank funds. Figures in parentheses are t-statistics. I indicate two-side statistical significance at 1%, 5%, 10% as ***, ** and * respectively.

	3 months holding period			
Diversified level	Large stocks	Medium stocks	Small stocks	All
Most diversified	0.0247	0.0176	0.0169	0.0239
	(3.59)***	(1.99)**	(1.78)*	(3.13)***
2nd deciles	0.0216	0.0188	0.0126	0.02
	(1.79)*	(1.57)*	(1.41)	(1.76)*
3rd deciles	0.0306	0.0256	0.0211	0.0304
	(2.41)**	(1.99)**	(1.59)	(2.38)**
4th deciles	0.0284	0.0201	0.0194	0.0280
	(1.81)**	(1.61)	(1.52)	(1.75)*
5th deciles	0.0025	0.0021	0.0019	0.0023
	(0.41)	(0.37)	(0.35)	(0.39)
6th deciles	0.0027	0.0041	0.0038	0.0039
	(0.33)	(0.47)	(0.43)	(0.44)
7th deciles	0.0085	0.0086	0.0097	0.0094
	(0.77)	(0.78)	(0.89)	(0.85)
8th deciles	0.0116	0.0128	0.0142	0.0135
	(0.91)	(0.96)	(1.12)	(1.01)
9th deciles	0.0031	0.0044	0.0051	0.0047
	(0.48)	(0.52)	(0.66)	(0.57)
Most concentrated	0.0183	0.0207	0.0251	0.0242
	(0.33)	(0.38)	(0.46)	(0.42)



Firgure 1. Correlation between Sizerank and Divrank. This figure shows the correlation coefficient between the size rank and diversification rank of funds during the entire sample period(March 1980 to Dec 2005). The size rank is based on the ranking of total net assets held by the funds, the diversification rank is based on the ranking of Div mentioned in section2.





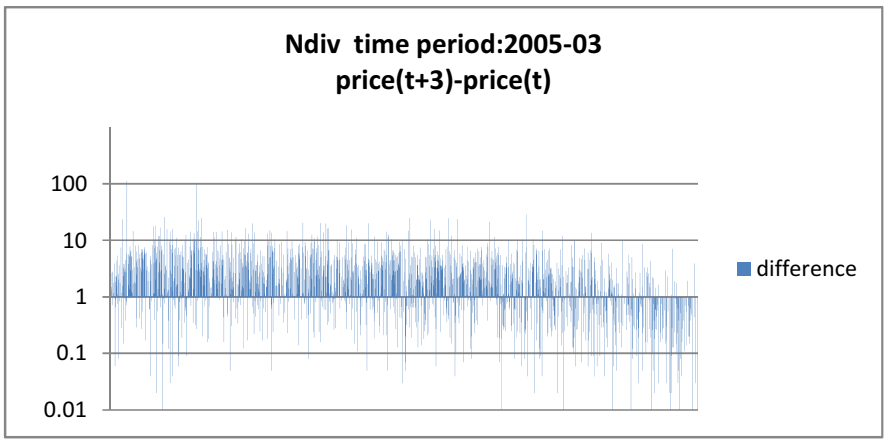
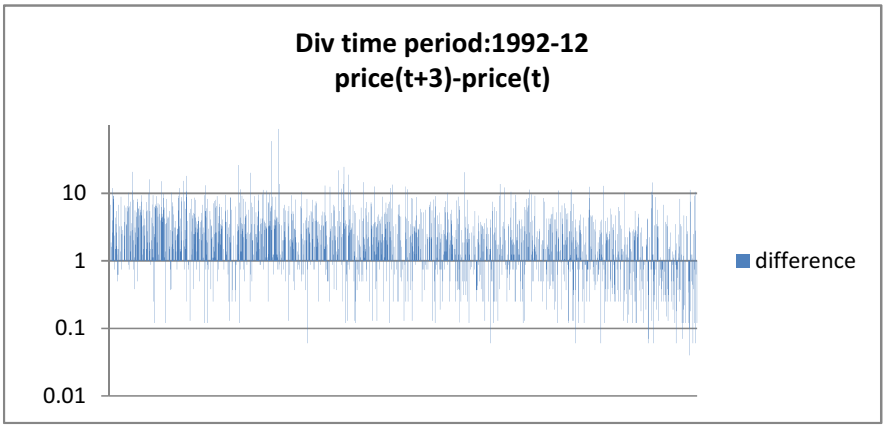
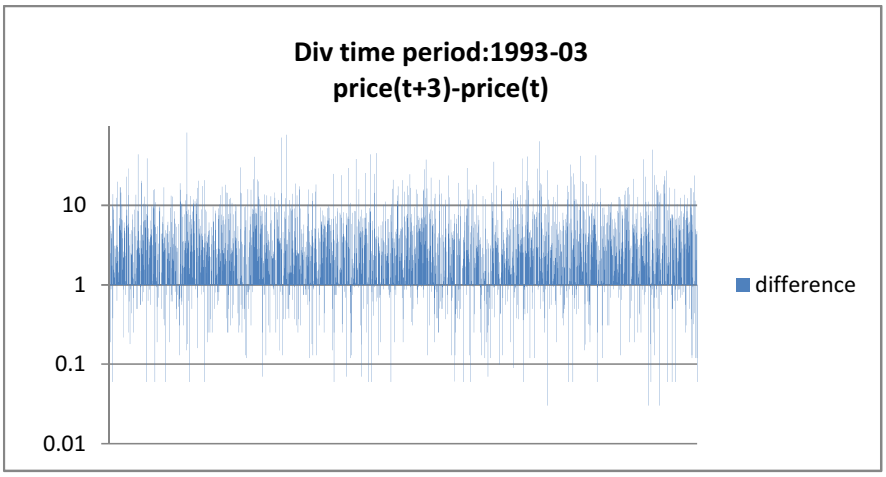


Figure 2 Price difference for the stocks in the Ndiv portfolio. This figure shows the price changes in three months for the stocks in the Ndiv portfolio. Three monthly time-periods are arbitrarily chosen in the sample period(December 1992, March 1999, March 2005). To make the price difference more visible, I use the logarithmic scale of the real figure. Therefore, data points above 1 means the price difference are positive while the data points below 1 means the price difference are negative.





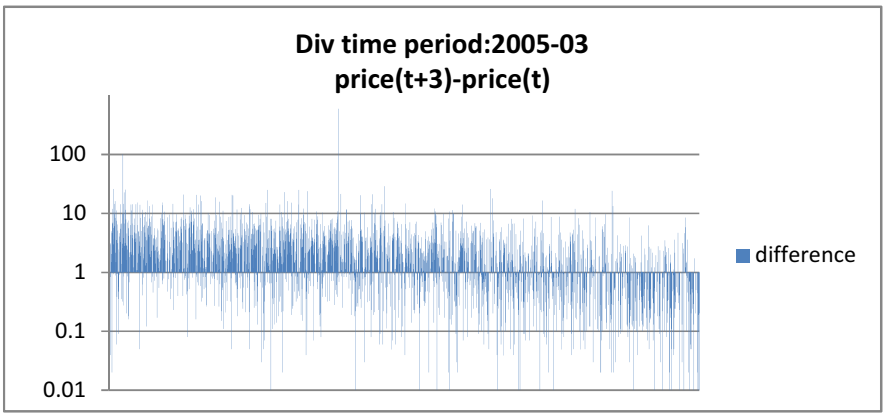


Figure 3 Price difference for the stocks in the Div portfolio. This figure shows the price changes in three months for the stocks in the Div portfolio. Three monthly time-periods are arbitrarily chosen in the sample period(December 1992, March 1999, March 2005). To make the price difference more visible, I use the logarithmic scale of the real figure. Therefore, data points above 1 means the price difference are positive while the data points below 1 means the price difference are negative.