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Following the Leader? Size-Dependent Herding in the US Equity Fund Market*

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Abstract We examine the herding behavior of individual investors on institutional investors in the US equity fund market. In this paper, individual investors are households entrusting money to mutual funds, while institutional investors are non-household entities. Our empirical investigation determines that the significant herding behavior of individual investors is based on the trading size of institutional investors. In particular, we find evidence that herding in the US equity mutual fund market is triggered by the largest selling and buying of institutional investors. This indicates that the presence of asymmetry in individual investors' herding behavior depends on the size of institutional investors' trade. Further, we find that herding in the US equity fund market is related to market-wide risk aversion, which is intensified in institutional investors' big selling.

Keywords Asymmetric herding, individual investor, institutional investor, equity fund.

JEL Classification C12, C13, G14, G2.

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1. INTRODUCTION

The aim of this study is to examine the herding behavior of individual investors based on institutional investors' trades in the US equity fund market. The crucial point of this work is that herding occurs when institutional investors take greater actions than they usually do-a hypothesis that we support with substantial emprical evidence. Thus, a trigger level is evident when individual investors copy the leaders' actions. Accordingly, we conduct a series of empirical investigations to determine whether individual investor herding is triggered either by large sales or buys from institutional investors. We also provide evidence that this herding behavior is positively associated with equity market risk aversion.

Herding behavior in financial markets has been studied since the 1990s. Lakonishok *et al.* (1992) develop a special measure to detect herding among pension fund managers. They analyze the correlation between the trading patterns of groups of investors in terms of buying or selling certain assets within the same period. Others have investigated similarities in flows into and out of equity markets determined by mutual fund managers (Wermers, 1999; Dennis and Strickland, 2002; Griffin *et al.*, 2003).

Recently, research on herding has been extended to asymmetric herding; however, evidences are mixed. For example, Hwang and Salmon (2004) observe herding behavior during market upturns and found no evidence of herding during crises (such as the Asian and Russian crises and the tech bubble in the United States). Park (2011) find that positive shocks generate stronger herding effects than negative shocks in foreign exchange markets, suggesting that asymmetric volatility of exchange rate returns can be attributed to the asymmetric herding effect. Moreover, Balcilar *et al.* (2013) and Economou *et al.* (2016) argue that herding depends on the market state. Cipriani and Guarino (2014) reveal that, on average, the proportion of herd buyers is 2%, while that of herd sellers is 4%. Fang *et al.* (2017) observe that US fund managers exhibit stronger positive herding behavior when the market size decreases and a stronger negative herding effect when the market size increases.

Because uninformed investors are potentially involved in herding, negative return shocks may give rise to a high degree of dependence among uninformed market participants engaging in mimicking investments. This is because uninformed market participants tend to avoid the stress of expected investment risks generated from turbulent movements of market fundamentals. By contrast, positive return shocks give rise to a low degree of de pendence among market participants with less mimicked trades due to a reduction in expected investment risks and weak herding behavior (Bekaert, 1996). Furthermore, Kim *et al.* (2014) find

that individual investors follow institutional investors in terms of direct and indirect equity investment in the Korean equity market. In particular, they suggest that herding behavior in an indirect equity market is stronger than that in a direct equity market because individual equity fund investors are more risk averse than other equity investor groups. In the literature, almost all of the research on herding has focused on direct equity. It intends that this paper will fill the gap in herding research by focusing on in direct equity or mutual fund markets to provide a more balanced picture of herding.

The United States has the world's largest regulated open-end funds (i.e., mutual funds) market, with assets totaling 34.2 trillion dollars in 2021. The US mutual funds market accounts for almost 50% of the world's mutual fund market. A majority of US mutual-fund net assets in 2020 comprised equity funds, accounting for 53% of the net assets. In fact, mutual funds account for 30% of US-issued equities outstanding. In particular, ownership of mutual funds by US households grew substantially during the 1980s and 1990s and has held steady for the past two decades, averaging about 45% since 2000. Approximately 106.3 million people (47% of all US households) own mutual funds as of 2020. In the United States, mutual funds are a major component of most households' investment (Investment Company Institute, 2021). Accordingly, the coverage of mutual funds in the US equity market has intensified the academic and practical importance of this work.

Mutual fund investors are divided into two categories: individual investors (i.e., househ olds) and institutional investors (i.e., non-households) such as financial institutions, non-financial businesses, and nonprofit organizations. Despite the importance of the mutual funds market in the whole US equity market, the herding of individual and institutional investors has not yet been fully explored due to the unavailability of data. In this study, we employ the flows into and out of equity mutual funds of by investors provided by the Investment Company Institute.

This study begins with a micro-foundation of the herding behavior of both individual and institutional investors by extending the studies of Hirshleifer *et al.* (1994) and Kim *et al.* (2014). Naturally assuming that individual equity fund investors are less informed than institutional equity fund investors who are basically professionals, we demonstrate that individual equity fund investors' herding becomes effective after crossing a certain thres hold trade level of institutional investor. This leads to the asymmetric herding of individual investors between excess and normal trading. By employing time series empirical analysis, we find a positive association between the net fund flows of individual and

institutional investors. This tendency is particularly evident when the net fund flow by institutional investors is excess. We refer to this phenomenon as "asymmetric herding," which suggests that individual investors tend to follow the lead of institutional investors depending on the size of their trading. Furthermore, we find that herding among investors is related with market-wide risk aversion, particularly during heavy selling. This implies that individual investors tend to follow institutional investors when selling because investment gain or loss is realized upon selling.

The remainder of the paper is organized as follows. Section 2 describes the US mutual fund market data along with the other equity market data employed in this study. Section 3 describes the implication of asymmetric herding. Empirical evidence regarding the a symmetric herding of individual equity fund investors is provided in Section 4. Section 5 reports the empirical evidence regarding risk aversion of herding behavior. Section 6 concludes this study.

2. DATA

For our empirical analysis, we employ the monthly US equity fund flow data for the period January 2000 to May 2021, 257 observations, which are provided by the Investment Company Institute. The sample period is chosen based on data availability including the financial crisis period of 2008 and the COVID-19 Pandemic of 2020.[1] We utilize the aggregate net fund flows of both individual and institutional investors $\left(mf^{\mathrm{ID}} \text{ and } mf^{\mathrm{IT}}\right)$, S&P 500 market returns (r), and market volatility (vol). Following previous studies, equity fund flows in this study are referred to as equity funds net flow (buy minus sell), normalized by the total equity fund market net asset values (NAV) of the previous month (Warther, 1995; Kim *et al.*, 2019). Individual fund flows $\left(mf^{\mathrm{ID}}\right)$ indicate the fund flows by individual investors, while institutional fund flows $\left(mf^{\mathrm{IT}}\right)$ indicate those by institutions such as a business, financial, or nonprofit organization (Investment Company Institute, 2021). Each fund flow is defined in (1) as follows:

$$\begin{aligned} mf_t^{ID} &= \frac{\text{Individuals Buy}_t - \text{Individuals Sell}_t}{\text{Total Equity Fund of Net Asset Value}_{t-1}}, \\ mf_t^{IT} &= \frac{\text{Institutions Buy}_t - \text{Institutions Sell}_t}{\text{Total Equity Fund of Net Asset Value Fit}_{t-1}}. \end{aligned} \tag{1}$$

Therefore, the relationships between flows of different equity fund investors

[1] Excluding the periods such as financial crisis and pandemic, the estimation results are similar.

is an appropriate measure of herding in the case of "herding with respect to the aggregate mutual fund market" (Kim *et al.*, 2019).[2]

With regard to the market return data, we employ the representative market return of the S&P 500 index. Following Busse (1999) and Cao *et al.* (2008), the volatility of the equity market is defined as the log difference between the highest S&P 500 index and the lowest S&P 500 index of the month in (2):

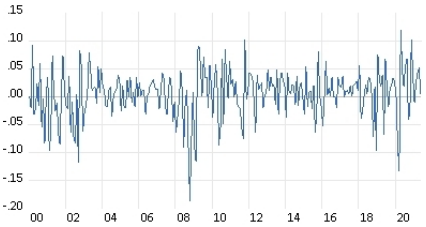
$$\text{Volatility}_t = \log\left[\frac{\text{highest } S\&P500_t}{\text{lowest } S\&P500_t}\right]. \tag{2}$$

Basic summary statistics regarding market returns, market volatility, and two different types of equity flows are reported in Table 1. In the sample period 2000-2021, the average net flows of these two investors ranged between the individual equity fund investors' per month and the institutional equity fund investors' at 0.0007 per month. Their standard deviations range between 0.0038 for mf^{ID} and 0.001 for mf^{IT}. Hence, individual equity fund investors' flows are relatively

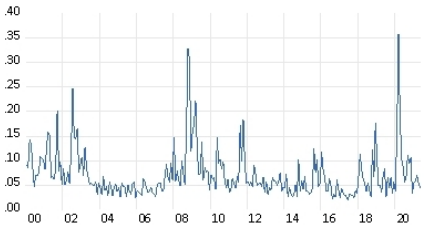
Variable	Mean	Std. Dev.
Individual equity fund flows $\left(mf^{f\text{D}}\right.$, monthly $\left.\right)$	-0.0009	0.0038
Institutional equity fund flows $\left(mf^{\text{IT}}\right.$, monthly)	0.0007	0.0010
S&P 500 Market return (r, monthly)	0.0043	0.0438
Market volatility (vol, monthly)	0.0709	0.0482

Table 1: SUMMARY STATISTICS FOR VARIABLES (2000.1-2021.5). This table reports the summary statistics for four variables employed.

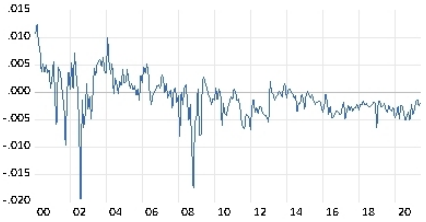
[2]This empirical work assumes that the equity funds' structure is homogeneous like S&P 500 based on thr ee reasons. First of all, the assumption of homogenous equity would be something like the 'representative consumer' assumption in macroeconomics. Macro models assume a representative consumer and firm for e mploying aggregate consumption data and aggregate production data. This is also true for Capital Asset Pricing Model (CAPM) representative investor assumptions. Second, under the Investment Company Act of 1940, there is a regulation that prevents an equity fund from investing more than 5% of its assets in any individual stock. This rule ensures that equity funds are diversified investments that include a range of stocks from the S&P 500. Third, we have more evidence from real US equity market that equity funds are be coming more like SP500 in terms of structure. For example, the correlation between the S&P 500 return and the return of a general equity fund in the US, such as a tracking a broad market index like the Russel 13000 or the Wilshire 5000 , tends to exhibit a high correlation with the S&P 500 because they track a wide range of US stocks, many of which are also included in the S&P 500 index. Historically, the correlation between the S&P 500 and broad market equity fund has often been quite strong, typically ranging from 0.90 to 0.95 or higher over longer time periods. This means that the returns of these equity funds tend t o move closely in line with the returns of the S&P 500 index according to reports of Morningstar.com.



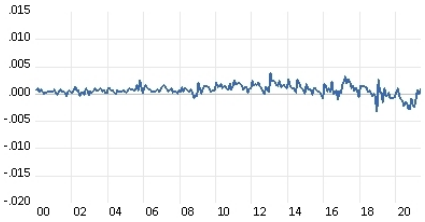
(A) S&P500 return (r, monthly)



(B) Market volatility (vol, monthly)



(C) Individual mutual fund flows (mf^{ID}, monthly)



(D) Institutional mutual fund flows (mf^{IT}, monthly)

Figure 1: GRAPHS OF VARIABLES (2001.1–2021.5).

more volatile than those of institutional equity fund investors. The average market return (r) is 0.0043 per month with a standard deviation of 0.0438. For market volatility (vol_t), the average is 0.0709 per month with a standard deviation of 0.0482. Graphs depicting the four variables are presented in Figure 1.

3. IMPLICATION OF ASYMMETRIC HERDING

According to Hirshleifer *et al.* (1994)'s theoretical setup, herding behavior occurs between late informed investors and early informed investors in the stock market. Here, individual investors' flow $\left(mf_t^{ID}\right)$ is late-informed investors' flow at time t and institutional investors' flow $\left(mf_{t-1}^{IT}\right)$ is early-informed investors' flow at $t-1$. Late-informed investors are likely to follow the early informed investors due to a lack of information, as shown in (3):

$$\operatorname{cov}\left(mf_t^{ID}, mf_{t-1}^{IT}\right) > 0. \tag{3}$$

In general, it is assumed that institutional investors receive relevant information early, while individual investors receive information late due to their inferior information collection ability in the stock market (Barber *et al.*, 2009; Kim *et al.*,

2014). Further, Kim *et al.* (2014) find that herding among individual and institutional investors in the indirect equity or mutual fund markets is stronger than that in the direct equity market. This situation can be attributed to "averaging" the herding of the entire range, offsetting it in the opposite direction. Therefore, we need to analyze the herding effect depending on its level from heavy selling or heavy buying, which is over quintile windows from the institutional investor's net purchase and sale. Furthermore, Karanasos *et al.* (2014) found that buying trades is more informative and valuemotivated than selling trades; this situation may be related to the herding asymmetry present in the equity fund market.

By extending Hirshleifer *et al.* (1994) and Kim*et al*'s (2014) theoretical results regarding herding, we assume that herding thresholds exist at certain levels of institutional net flows at τs. Here, terms τ_{lower} and τ_{upper} are two points in support of triggering individual investors' herding behavior based on the net flows of institutional investors.[3] Then,

$$\operatorname{cov}\left(mf_t^{ID}, mf_{t-1}^{IT}\right) \begin{cases} > 0, & \text{when } \tau_{\text{lower}} < mf_{t-1}^{IT} < \tau_{\text{upper}}\,; \\ = 0, & \text{when } mf_{t-1}^{IT} \geq \tau_{\text{lower}} \text{ or } mf_{t-1}^{IT} \leq \tau_{\text{upper}}\,, \end{cases} \tag{4}$$

where mf_{t-1}^{IT} represents institutional investors' net flows and mf_t^{ID} represents individual investors' net flow. Terms τ_{upper} and τ_{lower} refer to the upper and lower thresholds, respectively.

(4) highlight the fundamental features of individual investors' asymmetric herding with respect to the institutional investors' big buys and big sales. This herding effect does not appear for all sizes of institutional flows but rather when institutional investors' net flows exceed or fall short of two opposite levels of τ_{upper} and τ_{lower}.

4. EMPIRICAL RESULTS

4.1. INDIVIDUAL INVESTORS' HERDING WITH RESPECT TO INSTITUTIONAL INVESTORS

In this section, we provide empirical evidence of an asymmetric herding of individual investors. The individual investors' two seprate herding ranges are far away from each other in terms of institutional investors' trading size between big buys and big sales.

[3]We do not estimate the parameters τ_{lower} and τ_{upper} and, instead, estimate the herding behaviors in the q uantiles of the net flow of institutional investors.

Supported by our theoretical motivation, we first estimate a simple parsimonious benchmark equation, relating individual equity fund investors' $\left(mf^{\mathrm{ID}}\right)$ net purchases to those of institutional investor's $\left(mf^{\mathrm{IT}}\right)$ while equity market return (*return*) and volatility (*vol*) are controlled. To control for the momentum effect of equity fund flows, we also add lagged individual investors' net equity fund purchase mf_{t-1}^{ID}.

According to Hirshleifer *et al.* (1994) and Kim *et al.* (2014), the late-informed (or individual) investor herds to the early-informed (or institutional) investor. The empirical results also indicate that institutional equity fund investors exhibit weaker herding behavior with respect to individual investors at the 10% significance level. Therefore, we assume that individual investors exhibit herding behavior with respect to institutional investors and not vice-versa.[4].

The above two results provide the evidences of herding from individual investors to institutional investors. We appreciate referee's comment on this.

The estimation is represented by (5) as follows: [5]

$$mf_t^{ID} = \beta_0 + \beta_1 mf_{t-1}^{ID} + \beta_2 mf_{t-1}^{IT} + \beta_3 return_t + \beta_4 vol_t + \varepsilon_t, \tag{5}$$

[4]The unilateral herding from institutional investor to individual investor is explained by two parts of the paper. The first is theoretical approach in Section 3. According to Hirshleifer *et al.* (1994) and Kim *et al.* (2014), the herding behavior occurs between late informed investors and early informed investors in the stock market. Here, individual investors' flow $\left(mf_t^{ID}\right)$ is late-informed investors' flow at time t and institutional investors' flow $\left(mf_{t-1}^{IT}\right)$ is early-informed investors' flow at $t-1$. Late-informed investors are likely to follow the early-informed investors due to a lack of information. Secondly, the below estimation indicates individual investor's net flow $\left(mf_{t-1}^{ID}\right)$ does not give significant impact on institutional investor's net flow $\left(mf_t^{IT}\right)$ at 10% significance level, as below (The values under the regression coefficients in parenthesis are standard errors).

$$mf_t^{IT} = \underset{(0.0022)}{-0.0057} + \underset{(0.2115)}{0.3173} mf_{t-1}^{ID} - \underset{(0.002)}{0.0004} return_t - \underset{(0.0082)}{0.0041} vol_t + \varepsilon_t.$$

Adjusted $R^2 = 0.1866$.

Furthermore, we estimate the below with new volatility variable of S&P500 return's 12-month window standard deviation centered at t (sd_t). The estimation results below still do not find significant impact of individual investor flow's $\left(mf_{t-1}^{ID}\right)$ impact on institutional investor flow $\left(mf_t^{IT}\right)$ at 10% significance level (The values under the regression coefficients in parenthesis are standard errors).

$$mf_t^{IT} = \underset{(0.0019)}{-0.01147} + \underset{(0.0458)}{0.0385} mf_{t-1}^{ID} - \underset{(0.1497)}{0.1048} return_t - \underset{(0.3172)}{0.184}\, sd_t + \varepsilon_t.$$

Adjusted $R^2 = 0.1079$

[5]According to the unit root test using the augmented Dickey-Fuller test and the Phillips-Perron test with a nd without an intercept term, all variables are stationary, rejecting the null hypothesis of the unit root at t he 1% significance level.

$$mf_t^{ID} = \underset{(0.0006)}{-0.0006^{*}} + \underset{(0.0444)}{0.6078^{***}} mf_{t-1}^{ID} + \underset{(0.1658)}{0.4999^{***}} mf_{t-1}^{IT} + \underset{(0.0038)}{0.0252^{***}} return_t - \underset{(0.0038)}{0.0351} vol_t + \varepsilon_t$$

Adjusted $R^2 = 0.5350$

Table 2: INDIVIDUAL EQUITY FUND INVESTORS' HERDING ON INSTITUTIONAL EQUITY FUND INVESTORS (2000.1-2021.5). $^{***},^{**},^{*}$ indicates statistical significance at the $1\%, 5\%$ and 10% levels, respectively. The values under the regression coefficients in parenthesis are standard errors.

where mf_t^{ID} represents individual investors' equity fund flows, mf_{t-1}^{IT} represents institutional equity fund flows, $return_t$ represents S&P 500 market return, and vol_t represents market volatility.

This benchmark estimation result, as shown in Table 2[6] , indicates that significant herding exists between the two mutual fund investor groups. Term β_2 is estimated to be 0.4999 at the 1% significance level, which indicates that institutional investor net purchase has a significant impact on individual investors' net purchase or herding. In accordance with the theoretical background, our empirical results also reveal a significant relationship between individual investors' fund flows and the contemporaneous market return with a β_3 estimate of 0.0252 , which is significant at the 1% significance level. However, we do not observe a significant relationship between individual investors' fund flows and contemporaneous volatility. This lack of explanatory power of market volatility toward equity demand is also reported by Boyer and Zheng (2009). These empirical results become the benchmark in understanding further empirical results on asymmetric herding in next section.

[6]We employ S&P500 return's 12-month window standard deviation centered at t(sd_t) as another volatility variable in estimating. The estimation results with new volatility variable (sd_t) is reported in the following.

$$mf_t^{ID} = \underset{(0.0115)}{0.02302^{**}} + \underset{(0.2122)}{0.5518^{***}} mf_{t-1}^{ID} + \underset{(0.1372)}{0.2881^{**}} mf_{t-1}^{IT} + \underset{(0.0510)}{0.1429^{***}} return_t + \underset{(0.3300)}{0.1980} sd_t + \varepsilon_t.$$

Adjusted $R^2 = 0.6013$.

$^{***},^{**},^{*}$ indicates statistical significance at the $1\%, 5\%$ and 10% levels, respectively. The values under the regression coefficients in parenthesis are standard errors.

According the above result, we find that institutional investor net purchase in previous period $\left(mf_{t-1}^{IT}\right)$ has a significant impact on current period's individual investor net purchase $\left(mf_t^{ID}\right)$ or herding with new volatility variable of sd_{t}. Therefore, this result could be another evidence of herding of individual investors from institutional investors.

4.2. ASYMMETRIC HERDING

Next, we investigate the existence of asymmetry in individual equity fund investors' herding to institutional equity fund investor. To conduct our empirical investigation to identify asymmetric herding, we construct a dataset, by ranking the monthly institutional equity fund net flow from the lowest to the highest. The order of the corresponding individual mutual fund net flow, S&P 500 market returns (*return*), and market volatility (*vol*) are rearranged as shown in Figure 3. To provide a visual understanding and comparison of the data reconstruction, we present the original dataset graphs from Figure 2 and ordered dataset graphs in Figure 3.

Next, we utilize the same sample size $(n = 64)$, which is a quarter of a total of 256 observations, to monitor the "herding" of individual mutual-fund investors with respect to institutional investors while controlling market return and volatility. Thus, with $n = 64$, in the first quantile (or QI in Figure 3) of institutional investors' net flow, there are 64 institutional mutual- fund net flows ranging from the lowest to the 64th lowest (or 25% of 256 observations). The other three variables are matched depending on the ranks of institutional variable at each month.[7] The data for the second, third, and fourth quantiles are similarly constructed. Thus, to empirically investigate asymmetry in the herding behavior of individual investors $\left(mf^{\mathrm{ID}}\right)$ triggered by institutional investors $\left(mf^{\mathrm{IT}}\right)$ in equity fund markets, we constructe four quantiles of ordered institutional equity

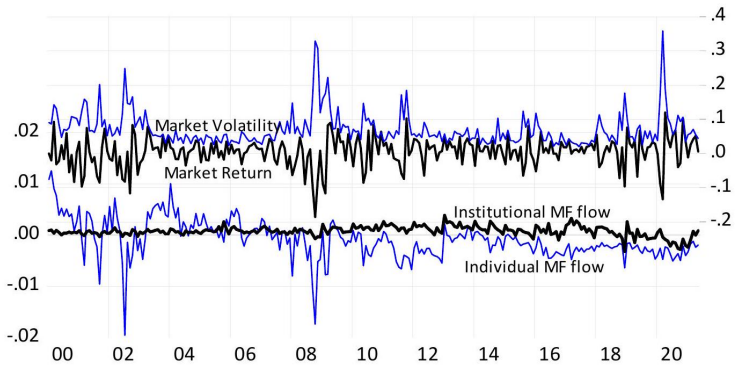


Figure 2: ORIGINAL INSTITUTIONAL EQUITY FUND FLOW, INDIVIDUAL EQUITY FUND FLOW, RETURN, AND VOLATILITY (2001.1-2021.5).

[7]The number of observations in each quantile (n) is determined in terms of robustness of estimation in each quantile.

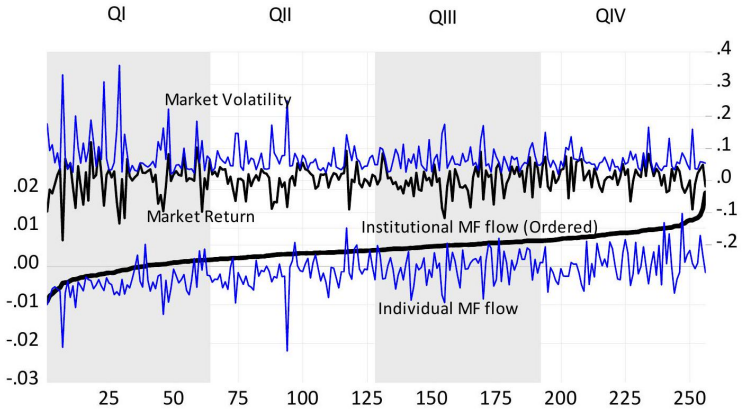


Figure 3: RANKED INSTITUTIONAL EQUITY FUND FLOW FROM THE SMALLEST TO THE LARGEST ALONG WITH CORRESPONDING INDIVIDUAL EQUITY FUND FLOW, RETURN, AND VOLATILITY. Each Q indicates 25% of institutional investors' equity fund flows ranked from the lowest to the highest. QI indicates the lowest 25% of institutional investor equity fund flows and QIV indicates the highest 25% of institutional investor equity fund flows.

fund flows categorized by region in QI, QII, QIII, and QIV, respectively (Figure 3).

Subsequently, we estimate (6) for the four quantiles. The empirical results are reported in Table 3.

Estimations of (5) in four different quantiles provides the key results of this study. We report significant herding in the first quantile of Big Sale region (QI) and the fourth quantile of Big Buy region (QIV). As the size of institutional investors' net flows $\left(mf^{\mathrm{IT}}\right)$ increases, there is a significant change in individual investors' net flows $\left(mf^{\mathrm{ID}}\right)$, with the estimate, β_2, of 0.3134 at the 10% significance level in Quantile I or the institutional investors' Big Sale region. Further, the estimate of β_2 in (5) is 0.3648 and significant at the 10% level for Quantile IV or the institutional investors' Big Buy region. However, we do not obtain significant β_2 estimates across the "lukewarm" trading regions, i.e., Quantiles II and III, but we find significant evidence of herding in the fourth quantile (Quantile VI).

What do all these empirical results mean for the herding between the two investor groups? Interestingly, individual investors' herding with respect to institutional investors is only triggered by the Big Sales and Big Buys of institutional investors. This indicates that individual equity fund investor's herding behav-

Quantile	Result
Quantile I	$mf_t^{ID} = \underset{(0.0007)}{-0.0021} + \underset{(0.1259)}{0.03475^{**}} mf_{t-1}^{ID} + \underset{(0.1685)}{0.3134^{*}} mf_{t-1}^{IT} + \underset{(0.0086)}{0.2140^{**}} return_t - \underset{(0.0072)}{0.0096} vol_t + \varepsilon_t$ Adjusted $R^2 = 0.5193$
Quantile II	$mf_t^{ID} = \underset{(0.0022)}{-0.0028} + \underset{(0.0659)}{0.6612^{***}} mf_{t-1}^{ID} + \underset{(0.5368)}{0.3095} mf_{t-1}^{IT} + \underset{(0.0089)}{0.0200^{**}} return_t - \underset{(0.0094)}{0.0191^{**}} vol_t + \varepsilon_t$ Adjusted $R^2 = 0.7187$
Quantile III	$mf_t^{ID} = \underset{(0.0039)}{0.0001} + \underset{(0.6382)}{0.0810^{***}} mf_{t-1}^{ID} - \underset{(0.6123)}{0.0517} mf_{t-1}^{IT} + \underset{(0.0082)}{0.0532^{***}} return_t - \underset{(0.0100)}{0.0049} vol_t + \varepsilon_t$ Adjusted $R^2 = 0.6746$
Quantile IV	$mf_t^{ID} = \underset{(0.0021)}{-0.0039} + \underset{(0.0910)}{0.6684^{***}} mf_{t-1}^{ID} + \underset{(0.1982)}{0.3648^{*}} mf_{t-1}^{IT} + \underset{(0.0116)}{0.0121} return_t - \underset{(0.0139)}{0.0196} vol_t + \varepsilon_t$ Adjusted $R^2 = 0.5260$

Table 3: HERDING OF INDIVIDUAL EQUITY FUND INVESTORS ON INSTITUTIONAL EQUITY FUND INVESTORS ACROSS FOUR QUANTILES OF INSTITUTIONAL EQUITY FUND FLOWS.

ior with respect to institutional equity fund investors' trade activities is triggered when institutional investors sell and buy equity funds at the maximum level.

In the institutional investors' lukewarm trading region (Quantiles II and III), no significant herding among individual investors is observed. Therefore, in the US mutual fund market, significant asymmetric herding exists across big trading (i.e., Quantiles I and IV) and normal trading (i.e., Quantiles II and III) regions.

This asymmetry in herding implies that in normal times, followers (or individual investors) do not significantly alter their trading even though they observe the leaders' trading patterns. During big action times of the leader or institutional investors, however, individual investors become sensitive to changes in leaders' actions. Therefore, an asymmetric herding effect exists where individual investors copy the leaders' action.

4.3. ROBUSTNESS CHECK

Since the full sample (256 observations) is divided into four subsamples (with 64 observations each), the degrees of freedom are too small. Also, the variation in mf^{IT} is too little, shown in Figure 3: the range of mf^{IT} in Quantile I and IV is quite wide while that in Quantile II and III is almost constant. These two facts of too small degrees of freedom and too little variation in mf^{IT} can lead to a highly imprecise estimation result with large standard errors. One possible approach to get around this problem is to run a regression with full sample but use dummy variables (that indicate Quantile I and IV). Specifically, we include the interaction terms (dummies $\cdot mf^{\mathrm{IT}}$) and check whether the coefficients of the interaction terms are significantly positive.[8]

We investigate the following estimation results with Quantile I dummy variable (dum_1) and Quantile IV's dummy variable (dum_4) reported in Table 4. Estimation equations are defined as follows.

$$\begin{aligned} mf_t^{ID} = {} & \beta_0 + \beta_1 dum_1 + \beta_2 mf_{t-1}^{ID} + \beta_3 mf_{t-1}^{IT} \\ & + \beta_4 dum_1 \cdot mf_{t-1}^{IT} + \beta_5 return_t + \beta_6 vol_t + \varepsilon_t, \end{aligned} \tag{6.1}$$

$$\begin{aligned} mf_t^{ID} = {} & \beta_0 + \beta_1 dum_4 + \beta_2 mf_{t-1}^{ID} + \beta_3 mf_{t-1}^{IT} \\ & + \beta_4 dum_4 \cdot mf_{t-1}^{IT} + \beta_5 return_t + \beta_6 vol_t + \varepsilon_t, \end{aligned} \tag{6.2}$$

where mf_t^{ID} is individual equity fund flow, mf_t^{IT} is institutional equity fund flow, $return_t$ is S&P500 market return, vol_t is market volatility, dum_1 is Quantile I dummy variable, and dum_4 is Quantile IV's dummy variable.

According to estimation results, we find almost similar results with previous sub-sample 4 quantile estimations in Table 4. In estimation results of (6.1) for quantile I, the estimate for the interaction variable of $dum_1 \cdot mf_{t-1}^{IT}$ is 0.0016 and significant at 5% level. This results supports intensified herding in quantile I or 'big sale' by institutional investors.

We also find the intensified herding in quantile IV or 'big buy' by institutional investors. The estimate of interaction variable, $dum_4 \cdot mf_{t-1}^{IT}$, coefficient is 0.1321 and significant at 1% level.

This robustness check indicates that there is stronger herding in big sales and big buy regions of institutional investors.

[8] We appreciate referee's suggestion for providing this robustness check.

Equation	Result
(6.1)	$mf_t^{ID} = \underset{(0.0007)}{0.0002} + \underset{(0.0007)}{0.0000^{**}} dum_1 + \underset{(0.1259)}{0.0375^{**}} mf_{t-1}^{ID} + \underset{(0.2185)}{0.0291} mf_{t-1}^{IT} + \underset{(0.0058)}{0.0116^{**}} dum_1 \cdot mf_{t-1}^{IT} + \underset{(0.0055)}{0.1987^{***}} return_t - \underset{(0.0071)}{0.1375^{***}} vol_t + \varepsilon_t$ Adjusted $R^2 = 0.7583$
(6.2)	$mf_t^{ID} = \underset{(0.0017)}{0.0021} + \underset{(0.0000)}{0.0195^{*}} dum_4 + \underset{(0.0900)}{0.6783^{***}} mf_{t-1}^{ID} + \underset{(0.2185)}{0.2048} mf_{t-1}^{IT} + \underset{(0.0880)}{0.1321^{***}} dum_4 \cdot mf_{t-1}^{IT} + \underset{(0.0255)}{0.0036} return_t + \underset{(0.0200)}{0.0759^{***}} vol_t + \varepsilon_t$ Adjusted $R^2 = 0.6520$

Table 4: HERDING OF INDIVIDUAL EQUITY FUND INVESTORS ON INSTITUTIONAL EQUITY FUND INVESTORS ACROSS FOUR QUANTILES OF INSTITUTIONAL EQUITY FUND FLOWS WITH A DUMMY VARIABLE OF QUANTILE I (dum_1) AND A DUMMY VARIABLE OF QUANTILE IV (dum_4).

5. THE IMPACT OF RISK AVERSION ON HERDING

This asymmetric herding in the US equity fund market raises a further question as to what is driving this phenomenon. One additional contribution of this work is to use these new predictions to understad why and how models could predict asymmetric herding with risk aversion.

Supported by earlier theoretical study on the relationship between herding $\left(\text{cov}\left(mf_t^{ID}, mf_{t-1}^{IT}\right)\right)$ and risk aversion (RA), we estimate how risk aversion is associated with equity fund market herding.[9]

To examine risk aversion, we employ Bekaert *et al*'s (2013) aggregate equitymarket risk-aversion measure. We replicate the risk aversion measure of Bekaert *et al.* (2013) from the US market volatility index (VIX) over sample period.[10] US equity market risk aversion is reported in Figure 4 together with

[9]Detailed explanation about the positive effect of risk aversion on herding is presented in our earlier study (Kim *et al.*, 2014).

[10]Bekaert *et al.* (2013) decompose the VIX index into its two components: uncertainty and risk aversion. For this, the conditional variance of stock returns is projected onto monthly realized variances. The logarit hm of the difference between the conditional variance and squared VIX is

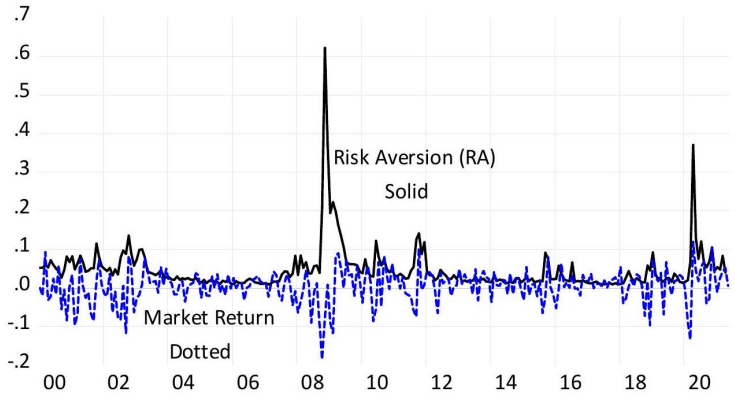


Figure 4: MARKET RETURN AND RISK AVERSION (RA) (2001.1-2021.5).

market return of S&P500.

As a corresponding empirical investigation of the theoretical section, we specify the dependent variable for the degree of herding as the sum of institutional and individual investors' fund flows absolute value or $\left|mf_{t-1}^{IT}\right| + \left|mf_t^{ID}\right|$. [11] In (7), β_3, the coefficient of risk aversion, indicates the extent to which herding, i.e., $\left|mf_{t-1}^{IT}\right| + \left|mf_t^{ID}\right|$, is associated with risk aversion, while market return and volatility are controlled. The estimation results are reported in Table 5.

$$\left|mf_{t-1}^{IT}\right| + \left|mf_t^{ID}\right| = \beta_0 + \beta_1 return_t + \beta_2 vol_t + \beta_3 RA_t + \varepsilon_t, \tag{7}$$

where mf_t^{ID} is individual equity fund flow at t, mf_{t-1}^{IT} is institutional equity fund flow at $t-1$, $return_t$ is S&P 500 market return, vol_t is the market volatility, and RA_t is Bekaert *et al*'s (2013) market risk aversion measure.

called as risk aversion while the logarithm of the variance estimate is called as uncertainty.

[11] As a measure of herding, we have considered other different candidates like $\left|mf_t^{ID}\right|$ and $\left|mf_{t-1}^{IT}\right| * \left|mf_t^{ID}\right|$ before estimating (6). We conclude that the most appropriate variable would be the absolu te sum of mf_{t-1}^{IT} and mf_t^{ID} because herding drives out to equity market from the action of institutional flow at $(t-1)\left(mf_{t-1}^{IT}\right)$ and reaction of individual flow at t $\left(mf_t^{ID}\right)$. It means that the herding is not only produced by individual flow but also by institutional flow. We appreciate the referee's comment on this issue. However, there is still limitation of this work identifying the empirical regularities of herding behavior.

$$\left|mf_{t-1}^{IT}\right| + \left|mf_{t}^{ID}\right| = \underset{(0.0008)}{0.0053^{***}} - \underset{(0.1112)}{0.0073 return_t} - \underset{(0.1321)}{0.0002 vol_t} + \underset{(0.3387)}{0.8211 RA_t} + \varepsilon_t$$

Adjusted R^2=0.2958

Table 5: RISK AVERSION (RA)'S IMPACT ON HERDING. $^{***},^{**},^{*}$ indicates statistical significance at the 1%, 5% and 10% levels, respectively. The values under the regression coefficients in parenthesis are standard errors.

Quantile	Result
Quantile I	$\left\|mf_{t-1}^{IT}\right\| + \left\|mf_{t}^{ID}\right\| = \underset{(0.0008)}{0.0056^{***}} + \underset{(0.0111)}{0.0087 return_t} + \underset{(0.0132)}{0.0222^{*} vol_t} + \underset{(0.3387)}{0.5819^{*} RA_t} + \varepsilon_t$ Adjusted R^2 = 0.1438
Quantile II	$\left\|mf_{t-1}^{IT}\right\| + \left\|mf_{t}^{ID}\right\| = \underset{(0.0007)}{0.0065^{***}} + \underset{(0.0241)}{0.0134 return_t} + \underset{(0.0133)}{0.0254^{*} vol_t} + \underset{(0.3566)}{0.4735 RA_t} + \varepsilon_t$ Adjusted R^2 = 0.1077
Quantile III	$\left\|mf_{t-1}^{IT}\right\| + \left\|mf_{t}^{ID}\right\| = \underset{(0.0006)}{0.0082^{***}} - \underset{(0.0099)}{0.0208^{*} return_t} + \underset{(0.0101)}{0.0106 vol_t} - \underset{(0.3724)}{0.0091 RA_t} + \varepsilon_t$ Adjusted R^2 = 0.0959
Quantile IV	$\left\|mf_{t-1}^{IT}\right\| + \left\|mf_{t}^{ID}\right\| = \underset{(0.0006)}{0.0086^{***}} - \underset{(0.0009)}{0.0169^{*} return_t} + \underset{(0.0101)}{0.0069 vol_t} + \underset{(0.3724)}{0.0830 RA_t} + \varepsilon_t$ Adjusted R^2 = 0.0582

Table 6: RISK AVERSION'S (RA'S) IMPACT ON THE HERDING ACROSS THE FOUR QUANTILES OF INSTITUTIONAL EQUITY FUND FLOWS. $^{***},^{**},^{*}$ indicates statistical significance at the 1%, 5% and 10% levels, respectively. The values under the regression coefficients in parenthesis are standard errors.

However, we do not find a significant role of risk aversion (RA) on the herding or $\left|mf_{t-1}^{IT}\right| + \left|mf_{t}^{ID}\right|$ in the empirical results. By following previous specification in data ranking in terms of institutional equity fund net flow $\left(mf^{\mathrm{IT}}\right)$ from

the lowest to the highest, we test the impact of risk aversion on herding over the four quantiles from QI to QIV. Empirical results of (6) over the four quantiles are summarized in Table 6.

In the empirical results for the four quantiles, we find that equity market risk aversion (RA) only has a positively estimated coefficient in Quantile I of Big Sales of institutional investors. In Quantile I, the estimate of β_3 is 0.5819 , which is statistically significant at the 10% level. This result corresponds to the theoretical motivation for the relation between two mutual fund investors' herding and risk aversion (RA) or $\frac{\partial \operatorname{cov}\left(mf_{t-1}^{IT}, mf_t^{ID}\right)}{\partial RA} > 0$ in Quantile I. Meanwhile, both market volatility (vol) and return $(return)$ remain insignificant. These results indicate an impact of risk aversion on herding is only triggered when institutional investors sell mutual funds at the maximum in the region (QI). However, significant β_3 estimates of risk aversion (RA) are not found across the lukewarm trading and big buy regions, i.e., Quantiles II, III, IV. Investors are generally more concerned when selling rather than buying. This explains why the effect of risk aversion is significant only in Q1 (extreme selling region) but not in Q4 (extreme buying region).

6. CONCLUSION

The main scope of this paper is to explain the herding of individual investors on institutional investors in US equity mutual fund markets. In particular its empirical focus is on the range of asymmetric herding that is markedly distinct from other financial market phenomena. Based on the empirical analysis, we find that individual equity fund investors' herding with respect to institutional equity fund investors' trades are triggered by large redemptions and purchases of equity. This indicates that an asymmetric herding mechanism exists between the two groups of investors over institutional investors' big buys and sales. Furthermore, we present evidence that the herding of institutional and individual equity fund investors is asymmetrically associated with market-wide risk aversion.

Our two main findings are summarized as follows. First, we observe significant herding only in the first (QI) and fourth (QIV) quantiles of the institutional investors' net flows. This indicates that individual equity fund investors' herding behavior with respect to institutional equity fund investors' trades are triggered when institutional investors either sell or purchase equity funds at the maximum scale. This could be attributed to individual investors' asymmetric herding with respect to the leading (or institutional) investor's equity trading activities, i.e., larger trades (big buy and sales) and smaller trades (lukewarm buy and sales).

Second, we find that herding of individual equity fund investors on institutional equity fund investors intensifies over higher risk aversion, particularly at the largest selling region (Q1). Because institutional investors tend to be more informed (Choi and Sias, 2009; Schuppli and Bohl, 2010) than their individual counterparts, this new evidence that individual investors' herding behavior is based on the size of institutional investors' redemptions or purchases might induce more market-wide trade in extreme trade periods than lukewarm trade periods.

A natural extension of this work would be the impact of herding on market volatility. The fact that individual investors' asymmetric herding is depending on the trading size of institutional investors would play a critical role in many situations of market turbulence. This topic will be investigated in a further study in the future.

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