

Using Stepwise Reality Check to Analyze Open-end Fund Investors' Herding Redemption in Taiwan

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ABSTRACT: This study aims to examine whether funds with illiquid assets exhibit stronger sensitivity of redemption outflows to bad past performance than funds with liquid assets. An important aspect of our study is whether large outflows should damage future fund performance in illiquid funds more than in liquid funds. When redeemed in a large scale, the liquidity risk of open-end funds will increase, which in turn leads to a vicious circle between fund redemption and the net asset value decline. Accordingly, Stepwise Reality Check method is taken into account of the financial stability problem and to control for the data-snooping bias. Based on the sample of underperformed mutual funds in Taiwan, the empirical results show that (1) bad past performance in liquid funds is more sensitive on flow-performance relations; (2) The evidence in (1) exists only for institutional-oriented funds, but not for retail-oriented funds; and (3) Illiquid funds damage from a large number redemptions with significant return persistence. The above findings provide valuable references for fund managers to make the plan of their investments.

Keywords: Herding redemption; Financial stability; Stepwise Reality Check

JEL Classifications: C1; G2; M1

1. Introduction

Because open-end funds are redeemable by the investors at any time, the collective redemption of fund investors (herding redemption) may cause managers to lose optimal fund allocation when operating open-end funds. This forces managers to liquidate assets with low liquidity, which consequently damages the fund and induces liquidity risks. This further causes investors to produce positive feedback that intensifies the loss. Eventually, the entire fund might be liquidated or merged, thereby affecting the financial stability of the fund market. Edelen (1999) and Gallagher and Jarnecic (2004) suggested that open-end funds may force fund managers to sell shares because these funds provision for liquidation demands. In other words, herding redemption can affect how managers employ manipulation strategies, which may consequently cause drastic fluctuations in the asset market, thereby influencing overall financial stability.

Edwards and Zhang (1998) claimed that herding redemption may cause stock price declines. When fund performance changes, investors should determine the potential factors causing this change, such as the market, inappropriate investment decisions, or poor operation of investment companies. For example, because of the poor operations and cash flow shortage of Procomp (debt issuer), the United Securities Investment Trust were unable to fulfill interest payments and principal repayments. This caused panic in the market, resulting in herding redemption. By determining potential factors that cause changes in fund performance, herding redemption that is caused from investor anticipation can be mitigated (Chen, Goldstein, & Jiang, 2010), thereby reducing liquidity risk and enhancing financial stability.

The following are several examples of herding redemptions in Taiwan: The 921 earthquake in 1998 caused investors to sell their shares irrationally. In 2000, the political-economic environment in Taiwan was uncertain, and investments in the stock market declined. In 2001, China Man-Made Fiber Corporation defaulted on corporate bonds, causing the redemption of three bond funds that amounted to NT\$23.6 billion. In 2001, \$80 billion of nine funds owned by Mosel Vitelic Inc. were redeemed within 2 weeks. In 2003, poor fund performance caused investors to redeem large amounts after the fund was closed. Because of the Procomp scandal, the value of the Yuan Liu fund possessed by Tai Yu Securities Co., Ltd. decreased from \$17.3 billion to \$4.15 billion in a short period. Liquidity immediately became a concern, and all bond funds lost approximately \$200 billion in several days. In 2004, the restructure of the International Investment Trust led to high bond-fund redemptions. The presidential election in that year and political instability resulted in \$109.5 billion worth of redemptions in a single month. In 2005, exchange-traded funds earned profits, but balanced mutual funds experienced major losses because of inefficient operation (the NITC balanced fund diminished by 72.91%). The ABN AMRO Global Emerging Markets Bond Fund employed a new manager in 2007, and the short-term interest rate showed an instant and exponential increase (capital loss amounted to \$62.2 billion in a single month). Furthermore, the subprime mortgage crisis caused high redemptions in real-estate investment trust funds in Taiwan. The funds lost more than 7.5% value in a single week. Because of the financial crisis in 2008, investors showed no interest in newly established funds, and existing bonds in funds were largely redeemed. In addition, domestic bond funds, which possess superior liquidity, experienced high redemption, including redemptions totaling \$100 billion in 1 month. When the trustworthiness of the Polaris Group was challenged, the Polaris De-Li Fund and Polaris De-Bao Fund experienced high redemptions. Because the Mega diamond Bond Fund possessed commercial investments related to Lehman Brothers, panic reached a threshold and resulted in high redemptions. In just 1 week the fund lost \$33 billion. Numerous factors in the domestic fund market lead to high redemptions in mutual funds and affect financial stability.

When large-scale and rare herding redemption phenomena occur in mutual funds, such as that presented in the abovementioned examples, the fragility of the financial market is questioned. When substantial capital flows out of funds, fund managers are compelled to adjust their investment portfolios and conduct high-cost (processing assets with low liquidity) or low-profit transactions. Therefore, prospective fund profits are influenced, and any additional transaction costs become the responsibility of the investors who continue to own shares in the funds. Consequently, investors anticipate the redemption of other investors and damages to the fund. Investor are not willing to hold investments in underperforming funds, and consequently attempt to redeem their investments in these funds as quickly as possible, thereby resulting in herding redemption.

Few studies have addressed the influence that herding redemptions in mutual funds may have on financial stability. Nanda, Narayanan, and Warther (2000) investigated the relationship between their fund redemption model and liquidity risk. Edelen (1999) and Gallagher and Jarnecic (2004) argued that herding redemption may be stimulated by herd behavior, and may be a vital factor that influences fund performance and the financial market. Plantin (2009) analyzed investor ownership or redemption to explain the subprime mortgage crisis. Chen et al. (2010) explored the liquidity of funds and the fragility of finance. Several domestic academic studies have investigated high redemption rates from the perspective of fund investors. For example, Lee, Shen, and Yen (2010) were the first to investigate the disposition effect of fund investors based on herd behavior. Luo and Li (2009) noted that herd behavior may cause asset values to rise or fall simultaneously, leading to drastic market fluctuations.

Unlike previous studies, we are the first to examine if positive feedback influences high redemption rates because of the effect of herd behavior on financial stability. Based on various characteristics of onshore open-end exchange-traded funds, this study fills the gap in empirical research in academia. If most assets owned by a fund are of low liquidity (non-liquid funds), are investors tempted to redeem shares in the fund because the fund has high holding costs or apparent negative performance results? Does this feedback increase the outflow in non-liquid funds? If a fund is owned by primarily judicious people, will such situations change? In addition, does a high rate of share redemptions affect future performance or create feedback effects?

According to the Regulations Governing Securities Investment Trust Funds in Taiwan, mutual funds may be liquidated if the average scale is too small. By 2009, almost one third of domestic onshore funds was liquidated or merged (Wang & Chen, 2009). In May 1999, Uni-President Magic Fund experienced high redemption rates and was nearly liquidated or merged. Had this occurred, the financial stability of the fund market would have been affected. Our results can assist investors with identifying herd behavior (e.g., capital drawback) and assist securities investment trust companies in devising investment strategies. These companies can reduce permissible transaction numbers or times, or minimize net outflow to reduce the impact on performance. Moreover, these results may serve as a reference for administrative departments in revising the Regulations Governing the Management of Collective Trust Funds and determining the ratio of current assets possessed by funds. Consequently, high redemption rates will no longer cause capital instabilities in open-end funds.

Based on the described research background and motives, the objectives of this study are as follows:

- A. To adopt stepwise multiple testing to screen and identify funds with poor performance. Funds that performed worse than the reference funds (excluding bad luck) are then compared with all onshore open-end exchange traded funds.
- B. To investigate the relationship between bad performance and outflows of illiquid and liquid funds.
- C. To examine whether the relationship between bad performance and outflows of illiquid and liquid funds changes with different client composition.
- D. Determine whether a lot of fund redemption affect the future performance of liquid funds when compared to illiquid funds.
- E. Determine if Objectives 1–4 possess feedback effects that influence the financial stability of the fund market.

2. Literature Review

When encountering factors such as specific fund characteristics, do investors of mutual funds choose to promptly redeem fund shares? This study is the first to determine the influence of positive feedback, which is caused by herding redemption, on the financial stability and liquidity risks of investors in onshore domestic open-end exchange-traded funds. Based on the various characteristics of onshore open-end exchange-traded funds, this study fills the gap of empirical studies in academia. Related literature that comply with this criteria are listed below.

2.1 Literature Regarding the Persistence of Positive or Negative Fund Performance

Previous literature regarding performance persistence in mutual funds for Taiwan includes Wang and Tu (2004); Chih, Lin, and Chou (2007); Lin and Wang (2003); Kao, Chen, Yu, and Lu (2007); Kuo and Li (2006); and Wang and Chen (2009). By contrast, several scholars have argued that fund ratings do not influence the performance persistence of original funds, such as Lin and Wang (2003), and Blake, Elton, and Gruber (1993). Bollen and Busse (2005) identified the existence of short-term persistence for funds with outstanding performance. In addition, Huij and Verbeek (2007) claimed that the leading one tenth of funds regarding performance could earn significantly abnormal returns of up to 0.26% per month. Kuo and Li (2006) adopted the mover-stayer model developed by Blummen et al. (1955) to study the dynamics of performance persistence. They found that, among open-end exchange-traded funds in Taiwan, funds in the best and worst performance groups demonstrated higher persistence than did those in the medium-performance group. In addition, stayer funds were the highest proportion of the worst performance group, indicating that persistence in the worst performance group was highly significant compared to the other groups. Wang and Chen (2009) adopted the winner-lose method, the Spearman rank correlation coefficient, and Fama-Macbeth regression to verify performance persistence. Their results showed that compared to funds with

medium performance, bond funds in the best and worst performance groups had highly intense 2-year performance persistence.

Several previous studies have contended that persistence is directly proportional to fund performance, but several scholars have argued that groups with the worst performance show significantly superior persistence than other groups. In this study, the stepwise multiple testing method developed by Romano and Wolf (2005) was adopted to evaluate the onshore open-end exchange-traded funds with negative performance in Taiwan. This method enables data snooping, and was used to examine whether various fund characteristics (the proportion of illiquid asset possession) influenced fund outflows. In addition, whether high redemption rates caused by herd behavior influenced the financial stability of the fund market was examined.

2.2 Studies Investigating Investor Behavior from the Perspective of Fund Flow

Cooper, Gulen, and Rau (2005) contended that data of mutual fund flows are beneficial for research on individual investor behavior. Scholars that have studied mutual fund flows include Brown, Harlow, and Starks (1996); Chevalier and Ellison (1997); Sirri and Tufano (1998); and Zheng (1999). In addition, Green and Hodges (2002) verified that the previous performance of funds affects fund flow. Indro (2004) found that weekly fund flows are higher when individual investors feel more optimistic in that or the previous week. High flows can also make investors feel optimistic. O'Neal (2004) studied equity funds by analyzing the relationship between purchase (redemption) ratios and net flows. He asserted that, compared to actively managed funds, index funds demonstrate a low redemption ratio when investors use funds with high redemption ratios to punish funds with low performance. Berk and Green (2004) developed a simplified rational model of active investment portfolio management and found that fund flows rationally reflected past performances. Frazzini and Lamont (2008) examined the relationship between the flows of exchange-traded funds and the investor emotions.

They referenced fund flows to probe into the behavior of individual investors. Unlike previous research, we investigated rarely discussed investor behavior. In this study, investor decisions to redeem fund shares were analyzed to learn whether their decisions were influenced by herd behavior, and whether investors of mutual funds were restricted to strategic risks because external redemptions. This is a novel perspective on fund flows.

2.3 Studies Investigating Herd Behavior in Mutual Fund Transactions

Most domestic studies have analyzed herd behavior from the perspective of fund management. Few have been based on the perspective of investors. Shu, Chen, and Huang (2005) used relationships between fund flows, herd behavior, and profits to identify the cause of herd behavior in fund transactions. Their results showed that if herd behavior in fund transactions is characterized by private information concerning profits, the herd behavior index is positively correlated to subsequent profits. Thus, herd behavior in fund transactions is characterized by speculation regarding information that is known by others. In addition, herd behavior may be shaped by collecting fund information from pioneers who possess in-depth information (Bikhchandani, Hirshleifer, & Welch, 1992). High herd indices are observed when shares of preliminary winners are pursued or shares of preliminary losers are avoided.

Li and Liu (2006) suggested that although herd behavior in fund transactions raises management fee income, the fund reputation is worthless, and the equilibrium price is reduced. Yu, Chen, and Yang (2006) used mutual fund shareholder data to study institutional investor behavior. They noted that institutional investors alter business strategies when forming transaction decisions. Momentum investing is favorable for purchasing, and contrarian investing is favorable for selling. Kacperczyk, Sialm, and Zheng (2007) argued that hidden behavior of managers has long-term influences on fund performance. Therefore, upon disclosing shareholder information, fund manager behavior may generate implicit costs, and such agency costs are directly linked with the concealed conversion behavior of managers. In brief, benefits derived from manager operations cannot be evaluated by investigating the influence of fund flows on fund performance.

Trinomial distribution has been used to verify the herd behavior of domestic fund managers. Lu and Lee (2008) identified the herd behavior of Taiwanese fund managers. They argued that company scale, current stock profit, and fund performance are cause herd behavior in fund managers. In general, small companies may show explicit herd behavior because information acquisition is difficult for them. High current stock profits result in significant purchasing herd behavior, and low current stock profits

may lead to substantial selling herd behavior. In addition, herd behavior is exhibited when fund managers attempt to respond to negative fund performance and avoid poor reputations. From a long-term perspective, the herd behavior of Taiwanese fund managers stabilizes stock prices. Lee and Wu (2009) investigated the possibilities of mutual fund manager herd behavior, such as that in collective transactions.

Lee, Shen, and Yen (2010) were the first to investigate the disposition effect of fund investors based on herd behavior. They introduced using quantile regressions for the least square dummy variable estimator to examine the disposition effect of fund investors in conditions where redemption was or was not caused by herd behavior. Their results showed that investors are disinclined to redeem funds because of low performance of open-end exchange-traded funds in Taiwan. If investors redeem funds because of herd behavior, disposition effects may heighten Taiwanese manager willingness to sell open-end exchange-traded funds with negative performances for high-risk investments.

Based on the literature, studies discussing herd behavior in Taiwan have focused on fund manager or fund management. This study adopted the perspective of investors to evaluate whether investors demonstrate significant herd behavior regarding fund redemptions when various funds performed negatively. Redemptions caused by herd behavior might affect the future performance of funds and result in liquidity risks. Consequently, the resulting feedback might generate drastic fluctuations in the corresponding asset markets and influence overall financial stability.

2.4 Studies Investigating Mutual Fund Liquidity and Financial Stability

Topkis (1979) proposed the global game concept. According to this theory, if most players select a certain strategy, this strategy must be the optimal response for all and all players will select it to reach equilibrium. By contrast, if most players select another strategy, then this strategy becomes the optimal response for individuals, and all players will select it to reach a different equilibrium. Therefore, games have multiple equilibriums if the strategies involved are complimentary. When responding to high redemption rates of mutual funds, investors expect that other investors will begin to remove their capital and damage the funds. No investor wishes to be last in redeeming fund shares. Consequently, individual investors attempt to redeem as soon as possible, resulting in high redemption rates because of herd behavior, which damages financial stability.

Chen and Chang (2002) discussed whether the Asian financial crisis was caused by deteriorating fundamentals or contagion. Huang (2007) constructed an evaluation model by using public market information. In addition, he adopted the copula function to describe the between-group default correlations of financial products. Luo and Li (2009) stated that herd behavior may cause asset values in the stock market to rise or fall simultaneously, leading to drastic market fluctuations. Thus, herd behavior fosters irrational negative impressions. Their empirical results revealed positive correlations between herd behavior and market return tendencies. Moreover, transactions based on herd behavior may reduce inaccurate evaluations of real asset values.

Cherkes, Jacob, and Stanton (2009) focused on the liquidity of closed-end funds. Lee, Shen, and Yen (2010) proved that investors are disinclined to redeem their funds because of low performance in open-end exchange-traded funds in Taiwan. Chen et al. (2010) indicated that if funds possess high proportions of illiquid assets, negative performance leads to high outflows. In addition, they investigated how strategic compensation for investors damages the stability of the financial market. Their results showed that compared to funds with low proportions of illiquid assets, funds with high proportions of illiquid assets demonstrate increased outflow sensitivity when unsatisfactory performance occurs. Moreover, if most investors are large investors, funds with high proportions of illiquid assets demonstrate low outflow sensitivity when performance is poor.

3. Research Methods

Our objectives were to identify hidden fund characteristics (current asset traits and client composition) to examine the relationship between fund flows and funds with a negative performance history. If investors start a wave of redemptions, investment portfolios devised by managers during open-end fund operations may become less optimal. Consequently, assets with low liquidity may experience losses, thereby leading to liquidity risk and positive feedback. Finally, the corresponding asset market may experience considerable fluctuations that affect the financial stability of the fund market.

3.1 Sample Description

The duration of this study was from March 1, 2011 to December 20, 2011. The research data were retrieved from the *Taiwan Economic Journal* (TEJ) database, and the investment targets were classified by referencing the categories of the Securities Investment Trust & Consulting Association of the R.O.C. In addition, characteristics of domestic onshore funds were retrieved from the fund characteristic criteria in the TEJ database. The characteristics are as follows: total net asset value, raw returns, Sharpe index, Treynor index, Jensen index, years of fund establishment, and expense ratios. In addition, prior flow-fund scales, years of fund establishment, expense ratios, non-liquid funds data, and client compositions were obtained from the fund investment portfolio database, fund turnover ratio database, and fund-rating database. Data of non-liquid funds were divided into five qualifications, Q1–Q5, based on the global game model and the proportions of current assets possessed by funds. Client composition was also divided into five qualifications, Q1–Q5, based on the proportion of judicious investors.

Our design of the global game model adapted that by Chen et al. (2010), the investment target classification and investment scope of which were adopted to identify the asset type of each fund. Virtual variables (set to 1 for non-liquid funds, including small-caps, international or domestic mid-caps, and the investment region of a single country; otherwise set to 0) were created for open-end exchange-traded funds (these were general stocks, small-caps, and tech stocks; stock prices could be lower than 70% of the net asset values). Furthermore, unobserved fund characteristics (e.g., current assets and client composition) were defined to examine the relationship between flows and funds with a negative performance history.

Up to December 20, 2010, domestic onshore open-end exchange traded funds totaled 489. Based on Chen et al. (2010), the asset type of each fund was identified according to the investment target classification and investment scope. Non-liquid funds totaled 52 (including 20 funds that were liquidated or merged). The TEJ fund investment portfolio database contains 29,142 observation units dated from March 1, 2001 to December 20, 2010. Depending on the proportions of cash and current assets, open-end exchange-traded funds were divided into five qualifications (Q1–Q5). Current assets consisted of investment commercial papers (including asset-backed commercial paper), banker acceptance, negotiable certificates of deposit, other domestic temporary investments, general deposits, and short-term financial instruments. The mean of these observation units was 8.65% and the standard deviation was 1.438. Regarding the client composition in the TEJ fund turnover ratio database, the ratio of judicious people to total investors was calculated by dividing the number of judicious people by the number of total investors. The ratio of retail investors to total investors was calculated by dividing the number of actual people. The mean of the ratio of judicious people to total investors was 2.89%, and the standard deviation was 0.085.

3.2 Statistical Methods

This study examined which fund characteristics demonstrated high outflows when performance was disappointing. The stepwise multiple testing method developed by Romano and Wolf (2005) was employed to control data snooping in the samples. Excluding the influence of luck, funds with performance worse than the market price were identified. In addition, the complete sample and subsamples (funds with performance worse than the market price) were analyzed. Finally, samples with a Jensen's alpha less than 0 were categorized as negative performance samples, which were then compared to other samples.

3.2.1 Stepwise Reality Check

When studying finance and economics, the dataset is always historical data and does not repeat. The same dataset used repeatedly for different research purposes or model selection might have a statistical error or produce positive results by chance or opportunity. For example, when examining the performance persistence of mutual funds, will strong performance over a past period continue to do so in future periods? Good luck or good operation skills of fund managers might indicate data snooping problems.

Earlier studies support some statistical inference, but they might have some bias, such as the finding by Jensen and Bennington (1970) that selection bias could affect technical analysis for the stock market. Lo and MacKinley (1990) examined the capital asset pricing model in the finance field and found that data snooping leads to inference bias. Levich and Thomas (1993) found that currency market profitability has data snooping problems. Sullivan, Timmewemann, and White (1999) proved

the profitability of technical analysis in the stock market because it affected data snooping.

When attaching data snooping problems, White (2000) improved the bootstrap method and developed a new algorithm, the reality check, to solve bias problems from chance. Reality check effectiveness seemingly avoids data snooping bias. However, adding more non-explanatory variables into the forecast model using the reality check might enhance critical value. The probability of rejecting the null hypothesis approaches zero, which might decrease test power. Screening out the outperformance model still cannot reject the null hypothesis. Increasing the non-explanatory or forecast ability into the model raises the critical value of the test statistics and we cannot reject the null hypothesis under the p-value unchanged.

Romano and Wolf (2005) referred to the stepwise reality check to settle if the bootstrap reality-check of White (2000) addresses whether the strategy that appears best in the sample actually beats the benchmark. Since strategy selection is not based on each time it beats the benchmark, the stepwise reality check considers the dependent of all test statistics for all models at the same time. When testing more hypothesizes at the same period, the procedure asymptotically controls the familywise error rate. Compared to related single-step methods, the procedure is more powerful and often rejects false hypotheses. The method implicitly captures the joint dependence structure of the test statistics, resulting in increased ability to detect false hypotheses. The methodology is presented in the context of comparing several strategies to a common benchmark, regarding the modified BRC as the first step. The crucial difference is that if some hypotheses are rejected in this first step, the SRC does not stop there and will potentially reject further hypotheses in subsequent steps.

The process of the stepwise reality check mainly produces the critical value of the joint confidence interval, $c_j, j = 1, 2, 3, \dots$, from the multiple test, $H_0^s = \alpha_s \leq 0, s = 1, \dots, S$, where S is the number of funds, and the familywise error rate under 5%, c_j is the critical value under the j^{th} round. Each critical value is produced by bootstrap sampling, alpha value $\hat{\alpha}_{r_s}^{*,b}, b = 1, \dots, B$, where B is the number of bootstrap sampling, suffix r_s is the rank value of minima 1 through S , suffix r_1 is the rank value of maximum 1 through S , on the other hand, when $s = S$, suffix r_s is the rank value of maximum 1 through S . Then, we calculate the difference of the sample alpha from its bootstrapped counterpart for each fund under each bootstrap. The difference of fund r_1 under the first bootstrap will be $\hat{\alpha}_{r_s}^{*,b} - \alpha_{r_s}^*$. Then, we find the maximum amongst the differences of all funds under each bootstrap and rank the values of $\max_j^{*,b=1}$ through $\max_j^{*,b=B}$ in an ascending order for the j^{th} round of SRC. In mathematical form, $\hat{c}_j \equiv c_j = \inf\{x : Prob_{\hat{p}} \{ \max_{R_{j-1}+1 \leq s \leq S} (\hat{\alpha}_{r_s}^{*,b} - \alpha_{r_s}^*) \leq x\} \geq 1 - \alpha\}$, where α is a significance level, where R_{j-1} refers to the number of funds that have been selected as outperformance in the previous round of SRC. Note that, for the first round of SRC, that is to say, when j is equal to one, it lacks funds to be chosen, so $R_0 = 0$.

According to Romano and Wolf (2005), it satisfies the three assumptions when: (a) $\hat{\alpha}_{r_s}$ is linear, (b) $\alpha_{r_s} = E(\hat{\alpha}_{r_s})$, (c) probability distribution \hat{p} is from the Efron (1979) bootstrap method, or the Politis and Romano circulation block bootstrap method in 1992, or the Politis and Romano stationary bootstrap in 1994. More, $\hat{\alpha}_{r_s}^*$ is equal to the estimate of real alpha ($\hat{\alpha}_{r_s}$). Based on Politis and Romano (1994), when the data type is a stationary series, we suggest using stationary bootstrap sampling. Lahiri (1992) pointed out that if the three hypotheses are not established, it also can use $\hat{\alpha}_{r_s}$ instead of $\hat{\alpha}_{r_s}^*$, the consistence of bootstrap process cannot be affected, and $\hat{\alpha}_{r_s}^{*,b} - \hat{\alpha}_{r_s}$ is the test statistic.

3.2.2 Multiple regression models

Funds possessing a high proportion of illiquid assets may have high transaction costs (Coval & Stafford, 2006). When investors in these funds choose to redeem shares, the funds must perform high-cost transactions for low-liquidity assets. These transactions have a negative impact on future fund profits, and the additional transaction costs are paid for by investors still in possession of shares in the funds. Consequently, investors expect that other investors may begin to withdraw their capital and damage the funds. No investor wishes to be last when redeeming shares, and consequently, individual investors attempt to redeem shares as soon as possible, thereby resulting in a high redemption rate that is attributable to herd behavior. Does this situation occur more frequently when the funds have a long-term negative performance history?

In this study, we examined the relationship between performance and net flows of sample funds with 1-year persistence (consisting of all open-end exchange-traded funds and open-end exchange traded funds with negative performance). The definition of flow is as follows:

$$flow_t = \frac{TNA_t - TNA_{t-1}(1 + R_{row})}{TNA_{t-1}}$$

where $flow_t$ represents the net flow, TNA represents total net asset, and R_{row} represents raw returns. Robinson (1988) proposed the following equation:

$$flow_t = f(\alpha_{i,t-1}) + \beta X_{i,t} + \varepsilon_{i,t}$$

where α represents the monthly data of Jensen's α that is acquired by using a single-factor model. Variable X represents the vector of the control variables (consisting of fund scales, fee percentages, and overall selling expenses). All variables affect the total fund flow. Chevalier and Ellison (1997) were referenced to examine the sensitivity of flow and performance. The following multiple regression analysis was used to define hidden fund characteristics (i.e., current asset traits and client composition) to examine the relationship between fund flow and funds with a negative performance history.

$$flow_{i,t} = \beta_0 R_{i,t-1} + \beta_1 Illiq_i * R_{i,t-1} + \beta_2 Illiq_i + \beta_3 Control_{i,t} + \beta_4 Control_{i,t} * R_{i,t-1} + \varepsilon_{i,t}$$

where $R_{i,t-1}$ represents prior performance. This study involved various performance indices (i.e., raw return, Sharpe index, Treynor index, and Jensen index) to examine the relationship between the flow in the t th period and the average monthly excess return during the $t-1$ th to $t-6$ th period. In addition, the control variables comprised the prior flow $Flow(-1)$, fund scale $Ln(Size)$, years of fund establishment $Ln(Age)$, expense ratio Exp , determinant of current or illiquid fund $Illiq$, client composition (ratio of judicious people to total investors $Inst$), and multiples of control variables and performance ($Size * R$, $Age * R$, $Exp * R$, and $Inst * R$).

Is the relationship between negative performance and outflows of illiquid and liquid funds changed by client composition? Is the sensitivity to flows and performance low if non-liquid funds are primarily possessed by large investors (higher $Inst$)? To answer these questions, this study identified the characteristics of fund client composition based on the percentage of mutual funds possessed by large investors. The percentage was classified into five qualifications (Q1–Q5). Q1 is the institution-oriented fund and Q5 is the retail investor oriented fund. In addition, we investigated the relationship between negative fund performance and net flows based on various client composition qualifications (e.g., institution-oriented and retail investor oriented funds).

3.2.3 Fund outflow, liquidity, and performance

Another key perspective discussed in this study was whether the redemption based on herd behavior of illiquid fund investors was more likely to damage future fund performance compared to that of current fund investors. Thus, a model of fund flows and future performance was constructed:

$$R_{i,t} = \beta_0 Outflow_{i,t-1} + \beta_1 Size_{i,t-1} + \beta_2 Exp_{i,t} + \sum_{j=1}^{j=6} \gamma_j R_{i,t-j} + \varepsilon_{i,t}$$

where $R_{i,t}$ represents Jensen index, $Outflow_{i,t-1}$ represents the index variables of prior net

flow (1 indicates that the flow is 5% less than the total net asset value), $Size_{i,t-1}$ represents the natural logarithm of total net asset value. Because present performance is influenced by the prior performance, the significance of β_0 implies that large redemption rates by investors attributable to herd behavior results in massive fund outflows that affects future returns. Moreover, the outflows may surpass the predictions based on prior returns. These models were used in this study to analyze current and non-liquid funds (in the form of virtual variables).

The management of mutual funds may consider plans that reduce investor intentions to redeem shares in funds based on herd behavior. These plans could mitigate the influence of large redemptions on future performance. Moreover, this study identified the characteristics (e.g., possession percentages of current assets) that might spur investors to actively redeem shares. Our results may be referenced by fund managers and administrative departments to improve the financial stability of the fund market.

4. Empirical Results

We hypothesized that the outflows of illiquid funds are more easily affected by prior low performance because some investors' behavior of redemption will lead others investors to follow. The empirical results of this study support this view. The reason behind is that complementarities effect begins to work on investors' redemption decision when facing difference fund performance.

In this section, we show the evidence that the outflows in illiquid funds are more sensitive to bad performance than in liquid funds. Table 1 presented the summary statistics of 29,142 fund-share month observations from 489 equity funds over March 2001 to December 2010. The definition of %Cash was the percentage of fund assets held in cash, and the bin of 95% was around 16.49. Age is the number of years since the fund's inception, and the holding of 95% was around 19.70. Expense Ratio was the expenses of a fund share as percentage of total assets, and the bin of 95% was around 0.17. Flow was the net flow of a fund share as percentage of last month's TNA, and the bin of 95% was around 0.09.

Illiq is a dummy equals 0 if a fund primarily invests in illiquid assets, and 1 otherwise; funds specializing in small-cap, mid-cap, and single-country international stocks (except in UK, Canada, and Japan) are classified as illiquid funds, and the bin of 95% is around 1.00. *Size* is the total asset of a fund share, and the bin of 95% is around 5818.

Table 1. Summary statistics

Variable	Mean	Standard deviation	5%	25%	50%	75%	95%
%Cash	5.87	6.45	0.40	1.78	4.33	8.27	16.49
Jensen Index	0.06	1.12	-1.74	-0.60	0.03	0.70	1.96
Sharpe Index	0.07	0.33	-0.50	-0.15	0.08	0.29	0.60
Treynor Index	0.48	28.04	-5.51	-1.23	0.56	2.03	5.16
Age	11.65	5.54	2.88	6.63	12.34	15.10	19.70
Direct Costs Ratio	0.13	0.56	0.01	0.04	0.09	0.18	0.37
Expense Ratio	0.16	0.04	0.12	0.14	0.15	0.17	0.21
Cost & Exp. Ratios	0.29	0.56	0.16	0.20	0.25	0.34	0.52
Flow	-0.01	0.17	-0.12	-0.03	-0.01	0.01	0.09
<i>Illiq</i>	0.62	0.48	0.00	0.00	1.00	1.00	1.00
<i>Size</i>	1762	2402	222	485	976	2061	5818

The sample contains 29,142 fund-share month observations from 489 equity funds over March 2001-December 2010. Funds are classified as equity funds when more than 70% of their holdings are in equity investments for all years during J March 2001-December 2010. Data items are collected from the Taiwan Economic Journal (TEJ) mutual fund database.

Table 2 showed the effect of liquidity on flow-performance sensitivities. Both in full sample and the subsample, the coefficients of *Illiq*Perf* are significantly negative. The sensitivity on flow-performance in illiquidity fund subsample that selected from bad performance with SRC method is 7.51% lower than that in liquidity fund (0.19% versus 0.21%). For the full sample, the sensitivity is 14.61% lower for the liquid funds (0.63% versus 74%). This result supports our first hypothesis that

outflow are more sensitive to bad performance in liquid funds than in illiquid funds (investing the specific country) in Taiwan.

Table 2. Effect of liquidity on flow-performance sensitivities

	Jen		sharp		treynor		IR	
	full	sub	full	sub	full	sub	full	sub
Jen	0.746***	0.213***	0.217***	0.731***	0.002***	0.002***	0.597***	0.583***
Illiq*Jen	-0.112***	-0.013*	-0.023***	-0.099***	-0.001***	-0.001***	-0.053**	-0.020
control variable								
flow(-1)	-0.002	-0.014	-0.009	-0.006	0.003	-0.002	0.002	-0.003
log(size)	1.032***	1.027***	1.038***	1.024***	1.04***	1.03***	1.033***	1.023***
Age	-0.005***	-0.003***	-0.004***	-0.003***	-0.005***	-0.003***	-0.005***	-0.003***
Exp	-0.026	-0.373**	0.047	-0.469***	-0.092	-0.471***	-0.057	-0.394***
Inst	-0.024***	-0.026***	-0.023***	-0.027***	-0.024***	-0.026***	-0.027***	-0.029***
Illiq	-0.019***	-0.029***	-0.022***	-0.028***	-0.025***	-0.033***	-0.028***	-0.036***
size*R	0.003***	0.041***	0.039***	0.003***	0.003***	0.002***	0.002***	0.002**
age*r	0.002***	0	0	0.002***	0.002***	0.003***	0.002***	0.003***
exp*r	0.28***	-0.374***	-0.313***	0.256***	0.635***	0.6***	0.585***	0.55***
inst*r	0.001	0.005	0.002	0.005	0.012**	0.016***	0.009*	0.014**

The dependent variable is the net flow to a fund-share in month t . $Perf$ is the fund's prior performance, measured with three variables, *Jensen Index*, *Sharpe Index* and *Treynor index*. This table lists the detailed definitions and calculations of all variables in the regression. Observations are at the fund share-month level. Columns 1, 3, 5, and 7 use the full sample. Observations are at the fund share-month level. Columns 2, 4, 6, and 8 use the subsample (with SRC method) of observations with negative performance measures. All estimations include year fixed effects. *, ** and *** indicated statistical significant at less than the 10%, 5% and 1% level, respectively.

For bad performance subsample of $Jensen Index < 0$, the coefficient of flow-performance is not statistically significant. For bad performance subsample classified by SRC, the results showed that the coefficients of flow-performance are statistically significant regardless liquid or illiquid funds. When considering survival bias, the full-sample results are different. Another interesting issue is to whom invest liquid funds or illiquid funds affecting the sensitivities on flow-performance. We expect that the complementarities effect on investors' response to poor performance is less pronounced in funds with block shareholders (such as institutional investors). Table 3 showed the effect of investor composition to sensitivity on flow-performance with SRC. As in Chen, Goldstein, and Jiang (2010), we computed the ratio as the number of institutional entity divided by the number of all investors. Institutional-oriented funds are funds with the ratio larger than 2.5%, retail-oriented fund otherwise.

Table 3. The calculations of all variables in the regression to identify the clientele effects

	Jen		sharp		treynor		IR	
	Inst	retail	inst	retail	inst	retail	inst	retail
Jen	0.238***	0.209***	0.723***	0.753***	0.004***	0.001***	0.814***	0.507***
Illiq*Jen	-0.048***	-0.013	-0.12***	-0.109***	-0.004***	0.000	-0.222***	0.026
control variable								
flow(-1)	-0.041	-0.001	-0.035	0.005	-0.037	0.012	-0.040	0.012
log(size)	1.038***	1.036***	1.026***	1.03***	1.034***	1.039***	1.018***	1.034***
age	-0.007***	-0.002***	-0.007***	-0.003***	-0.007***	-0.003***	-0.007***	-0.002***
exp	-0.161	0.183*	-0.176	0.167*	-0.190	0.132	-0.174	0.167
inst	0.320	-0.136***	0.397*	-0.145***	0.342	-0.14***	0.348	-0.147***
Illiq	-0.054***	-0.011	-0.047***	-0.007	-0.049***	-0.012	-0.05***	-0.016**
size*R	0.078***	0.026***	0.000	0.003***	0.000	0.002***	-0.001	0.001
age*r	-0.004***	0.001**	-0.005***	0.003***	-0.005***	0.004***	-0.005***	0.004***
exp*r	-0.100	-0.339***	-0.039	0.173***	-0.041	0.549***	-0.031	0.523***
inst*r	***	0.013	0.137***	0.048*	0.197***	-0.010	0.174***	-0.011

Observations are at the fund share-month level. Columns 1, 3, 5, and 7 use the full sample. Observations are at the fund share-month level. Columns 2, 4, 6, and 8 use the subsample (with SRC method) of observations with negative performance measures. All estimations include year fixed effects. *, ** and *** indicated statistical significant at less than the 10%, 5% and 1% level, respectively.

Table 3 showed that conditional on low past performance, the phenomenon of fund that hold liquid assets experience more outflows than funds that hold illiquid assets only exit institutional-oriented funds. Under the investors classification, the coefficient for *Illiq*Jen* were negative (-0.048) and significant in institutional-oriented funds and negative (-0.013) and not significant in retail-oriented fund. For the bad performance subsample, institutional-oriented investors that faced the effect of liquidity on flow-performance sensitivities may more sensitivity than retail-oriented investors. In other words, fund managers may exhibit stronger sensitivity of outflows to indeed bad past performance than funds with illiquid assets.

If indeed bad past performance in liquid funds is more informative about the assets or managers, then investors are more sensitive to bad performance in liquid funds than in illiquid funds. The similar results also appear for withdrawals from banks largely driven by bad fundamentals (Corton, 1988; Calomiris and Mason, 1997; Schumacher, 2000; Martinez-Peria and Schmukler, 2001; Calomiris and Mason, 2003). In Table 3, we found that general retail investors do not react strongly to bad fund performance in the liquidity aspect. The results in Table 4 are about the fund performance persistence. We predicted that the fund investment incentives will be reduced because of expecting other investors taking the redemption action. Table 4 showed that when investors face a large number of redemption (top 20% of redemption amount), the fund performance (*Jensen index*, *Sharp index*, *Treynor Index* and *IR*) of liquidity funds seems to be more persistent than illiquidity fund. When the illiquid fund investing to single specific country and was redeemed in a large amount, the investors will be afraid of the restricted redemption action. Once some investors began to take the redeem action, other investors tend to follow and thus result in redemption herding. Investors staying in the funds are assumedly to bear relatively high investment cost.

Table 4. The calculations of all variables in the regression to identify the fund performance persistence

	Jensen		Sharpe		Treynor		IR	
	<u>Illiq</u>	<u>lliq</u>	<u>Illiq</u>	<u>lliq</u>	<u>Illiq</u>	<u>lliq</u>	<u>Illiq</u>	<u>lliq</u>
(Constant)	0.056	-0.002	0.057	0.066	0.438	0.274	0.013	-0.011
retrun(-1)	0.062	-0.15	-0.232*	-0.058	-0.073	-0.066	-0.144	-0.024*
retrun(-2)	-0.103	-0.084	-0.162	0.136	0.03	0.065	-0.101	-0.005
retrun(-3)	0.111	0.092	0.061	-0.058	0	0.076	0	0.002
retrun(-4)	0.411***	-0.163	0.397***	-0.004	0.065	-0.079	0.201*	0.012
retrun(-5)	-0.135	-0.016	0.111	-0.055	-0.096	0.001	0.019	0.028**
retrun(-6)	0.094	-0.142	0.124	-0.013	0.151	0.021	0.073	0.017

Columns 1, 3, 5, and 7 is for illiquid fund. Columns 2, 4, 6, and 8 is for liquid fund. *, ** and *** indicated statistical significant at less than the 10%, 5% and 1% level, respectively.

5. Concluding Remarks

Because of investors' tendency to withdraw when they fear the damaging effect of other investors' redemptions, we expect a stronger payoff complementarities in illiquid funds; that is, outflows are more sensitive to bad performance than in liquid funds. We adopted stepwise multiple testing to screen and identify funds with poor performance. Funds that performed worse than the reference funds (excluding bad luck) are then compared with all onshore open-end exchange traded funds. To examine the relationship between bad performance and outflows under the different fund liquidity. We also consider the effect of different client composition. Determine whether a lot of fund redemption affect the future performance of liquid funds when compared to illiquid funds. And we also test the feedback effects that influence the financial stability of the fund market. Further, the Stepwise Reality Check method is taken into account of the financial stability problem and to control for the data-snooping bias. Based on the sample of underperformed mutual funds in Taiwan, the evidence provided in this study shows that strategic complementarities among investors generate fragility in financial markets. Specifically, the empirical results indicate that (1) bad past performance in liquid funds is more sensitive on flow-performance relations; (2) The evidence in (1) exists only for institutional-oriented funds, but not for retail-oriented funds; and (3) Illiquid funds damage from a large number redemptions with significant return persistence. The above findings provide valuable references for fund managers to make the plan of their investments.

To sum up, this research contributes to the literature in at least the following ways: (1) it shows the new ideas on the decisive factor of investors' behavior, and more importantly the "expected" behavior of other investors as well which generated from the self-fulfilling beliefs of fund outflows; (2) it is the first to attempt to catch the empirical strategic compensation among mutual fund investors, and to illustrate the story of the financial stability in the financial markets; (3) it cites global game framework to distinguish fund liquidity and discusses the goodness of compensation strategy.

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