Mutual Fund Redemption Risk: The Role of Mandatory Public Disclosures

Yun Lee*
Singapore Management University

November 2023

Abstract

This paper examines how mutual funds' mandatory periodic public disclosures, a key device for their transparency, affect their redemption risk, i.e., the likelihood of capital outflows conditional on performance. Using a sample of U.S. equity and bond funds, I find that for a one standard deviation decline in performance, funds suffer about 17% higher outflows during the post-disclosure period. The increase in redemption risk is driven mainly by two disclosure-related factors. First, disclosures make fund investors more sensitive to performance by enabling them to assess fund fundamentals better. Second, disclosures induce fund investors to withdraw capital at a higher level of performance by reinforcing their beliefs that other investors will withdraw capital. Additional tests reveal that disclosures reduce redemption risk to some extent when information asymmetry among fund investors is particularly problematic. Overall, my findings contribute to the ongoing debate on the role of transparency in financial stability.

Keywords: mutual fund, redemption risk, public disclosure, transparency, coordination problem, asymmetric information problem.

JEL codes: G01, G20, G23, D80, D82, D83.

---

* I thank Karthik Balakrishnan, Mark Bradshaw, Qi Chen, Xia Chen, Qiang Cheng, Aytekin Ertan, Pingyang Gao, Emmanuel De George, Evgenii Gorbatikov, Charles Hsu, Amy Hutton, Anshu Jain, Minsoo Kim, Anya Kleymenova, Alastair Lawrence, Yoon-Ho Alex Lee, Stefan Lewellen, Miao Liu (discussant), Yun Lou, Narayan Naik, James Ohlson, David Reeb, James Ryans, Haresh Sapra, Varun Sharma, Lakshmanan Shivakumar, Ahmed Tahoun, Mikhail Tirskikh, İrem Tuna, Florin Vasvari, Liandong Zhang, seminar participants at Boston College, Chinese University of Hong Kong, City University of Hong Kong, Hong Kong Polytechnic University, Hong Kong University of Science and Technology, IESE Business School, London Business School, National University of Singapore, Singapore Management University, and University of Melbourne, and conference participants at the 2018 Trans-Atlantic Doctoral Conference for their helpful comments and suggestions. All remaining errors are my own.

Address: Singapore Management University, 60 Stamford Road, Singapore 178900. Email: ylee@smu.edu.sg.

1. Introduction

Since the global financial crisis, nonbank financial institutions, especially mutual funds, have been a critical item on the financial policy agenda. As mutual funds have expanded rapidly and increased illiquid asset holdings, policymakers have raised concerns that the size and structure of these entities can threaten the stability of the financial system (OFR 2013; IMF 2015; FSB 2017). In particular, if investors redeem fund shares en masse, mutual funds can suffer substantial capital outflows, which can trigger large-scale asset sales that lower market prices and increase market volatility. Meanwhile, regulatory pressure to enhance mutual funds' transparency has intensified with strengthened mandatory public disclosure requirements (SEC 2009a, 2009b, 2014, 2016a). However, the effects of greater transparency on financial stability are debatable (Goldstein and Sapra 2013; Acharya and Ryan 2016), and in the case of the fast-growing mutual fund sector, this issue has remained empirically unexplored. Accordingly, I examine how mutual funds' mandatory periodic public disclosures, a key device for their transparency, affect redemption risk, i.e., the likelihood that funds will suffer capital outflows conditional on past fund performance.[1]

Mutual funds provide a wide range of information that fund investors can use when making a redemption decision. On their websites, mutual funds provide key summary information, including past performance, risk profile, asset size, and portfolio mix, typically on a daily or monthly basis. Mutual funds also send their shareholders quarterly or semiannual mandatory financial reports that contain more detailed, decision-relevant information, such as the components of past performance, a discussion of risk factors, the amounts of shares sold and redeemed, and the schedule of portfolio holdings. Using these two sources of information, investors try to predict future fund performance as precisely as possible to decide whether to redeem their fund shares. If the predicted performance is below a certain level, or their redemption threshold, investors choose to redeem.[2]

The effect of mutual funds' mandatory public disclosures on redemption risk is not obvious.

[1] In this paper, I focus on fund outflows under bad performance, recognizing the recent concerns about redemption risk. To provide a more balanced picture, I also examine fund inflows under good performance in the empirical test section.

[2] In this disclosure landscape, mandatory financial reporting can operationalize the notion of greater transparency. Specifically, while fund websites provide the frequently updated summary information, the relatively infrequent but more derailed, comprehensive information presented in the financial reports renders periodic jumps in the information supply to investors. Several points also suggest that investors pay attention to the financial reports (see Section 2.1).

On the one hand, mandatory public disclosures can increase redemption risk for two reasons. First, using the detailed information contained in mandatory financial reports in addition to the summary information available on fund websites, investors may perform a better assessment of fund fundamentals and thereby make a more precise prediction of fund performance.[3] As a result, investors become more confident about their forecasts and thus be more likely to redeem their shares, given the same level of past fund performance that is below their redemption threshold. In other words, investors may become more sensitive to bad performance after disclosures. I term this the "fundamental role" of mandatory public disclosures in increasing redemption risk.

Second, mandatory public disclosures can induce investors to be even more likely to redeem by aggravating coordination problems among investors. Following redemption requests from some investors, funds may need to conduct costly and unprofitable trades to satisfy the outflows, which can damage future performance (e.g., inefficient rebalancing, fire sales). Because such trades are conducted after the day of the redemption requests, the liquidation costs are assumed not by the redeeming investors but by the remaining investors. Due to such negative externalities, investors who would have chosen to stay in the fund based on a fundamental assessment may revise their performance forecasts downwards and end up withdrawing from the fund—*if* they believe that other investors will withdraw (Chen, Goldstein, and Jiang 2010; Goldstein, Jiang, and Ng 2017).[4] Mandatory public disclosures can reinforce such a belief, i.e., strengthen investors' perception that other investors will redeem. As individual investors predict fund performance more precisely and be more likely to redeem after disclosures, which they know all other investors observe, they may expect other investors to do so as well (Morris and Shin 1998; Hellwig 2002; Metz 2002; Vives 2014). As a result, investors may be incentivized to start redeeming even at a higher level of past fund performance to avoid the negative externalities from other investors' earlier redemptions. I term this the "coordination role" of mandatory public disclosures in increasing redemption risk.

[3] For example, using the portfolio holdings schedule that lists all the securities held by the fund, sophisticated investors may incorporate the earnings forecasts of the fund's investees into the performance prediction to reduce the variance of the predicted performance. Unsophisticated investors may start to make a prediction once receiving the financial reports, as the reports raise their attention to the fund's performance (especially when the performance is bad).

[4] Such bank-run-like redemptions and the subsequent fund collapses have occurred recently in many funds, such as the Third Avenue Focused Credit Fund and the liquid-alternative mutual fund operated by J.P. Morgan (see Section 2.2).

On the other hand, mandatory public disclosures can make investors less likely to redeem by mitigating the adverse effects of information asymmetry among investors. Asymmetric information problems can be severe in mutual funds, as fund investors typically possess different levels of private information about the fund's fundamentals (Barber, Huang, and Odean 2016).[5] In the absence of disclosures, when less-informed investors observe decreases in the fund's asset size on its website, they may decide to exit the fund, concerned that other investors have superior negative private information about the fund. However, when provided with disclosures that convey detailed fund fundamental information, the less-informed may overcome their informational disadvantages by conducting a fundamental assessment and become less inclined to exit the fund, i.e., they start redeeming at a lower level of performance. I term this the "information-asymmetry-reducing role" of mandatory public disclosures in reducing redemption risk.

To better understand the opposing effects of mandatory public disclosures on redemption risk, I employ a sample of U.S. equity and corporate bond mutual funds over the period of 2000–2017. For each fund share class and month in the sample, I examine the flow-performance relation, i.e., the function that shows net fund flow for each level of past fund performance.[6] Prior researchers have extensively documented a positive association between flow and performance (see Christoffersen, Musto, and Wermers 2014 for a review). In contrast, I examine the *changes* in the two main characteristics of the function: the *slope* (i.e., how much capital outflow occurs for each unit of performance) and the *intercept* (i.e., at what level of performance the average investor redeems capital).[7] Specifically, my regression models estimate changes in these two aspects from one month before disclosure (the "pre-disclosure period") to the month of disclosure (the "post-disclosure period").[8] I measure flow by the percentage change in the fund's total net assets from the prior

[5] For instance, in the mutual fund scandal of 2003, a number of U.S. funds allowed selected investors to conduct market-timing and late-trading to reap abnormal returns at the expense of uninformed buy-and-hold investors (see Section 2.2).

[6] Mutual funds typically issue multiple share classes with different fee structures and restrictions on investor types. As these differences can affect investors' redemption decisions, I perform the regressions at the share class level.

[7] A typical flow-performance function shows performance on the x-axis and flow on the y-axis. Thus, precisely speaking, the x-intercept captures the average level of performance that triggers redemptions. As the function has a positive slope, a decrease (an increase) in the y-intercept corresponds to an increase (a decrease) in the x-intercept (see Section 4.1).

[8] Because most funds disclose before the middle of the second month after each fiscal quarter-end (the disclosure month), I use the second month as the main post-disclosure period. Using the third month yields consistent results.

month, excluding the effects of fund returns and fund mergers. Performance is measured by the average of monthly style-adjusted returns for the three months preceding the month when the flow is calculated.

I find that mutual funds suffer higher capital outflows during the post-disclosure period, given the same level of past performance. The post-disclosure increase in outflows arises from changes in the two aspects of the flow-performance function. The function becomes steeper (i.e., its slope increases), which indicates that investors become more sensitive to performance. The function also shifts downwards (i.e., its intercept decreases), which indicates that investors start redeeming at a higher level of performance. These changes manifest when performance is negative.[9] Specifically, in an event study that tests changes in the slope and intercept of the function, I find that after disclosures, the slope increases by about 31% and the intercept decreases by about 13%. These estimates indicate a substantial increase in redemption risk—for a one standard deviation decline in performance (0.76%), funds suffer about 17% higher outflows during the post-disclosure period.

I further conduct a quasi-experiment to mitigate potential endogeneity problems and test the sensitivity of the event study results to alternative measurements and samples. The main findings are robust to these analyses. I also exploit the contents of disclosures to supplement the main findings. Specifically, I find that the effects of disclosures are stronger when mandatory financial reports contain more detailed information, which supports the idea that an increase in transparency due to disclosures is the key driver of the main results.[10]

Having documented that mandatory public disclosures can increase redemption risk, I test the extent to which this effect is driven by the fundamental and coordination roles of disclosures. In terms of the fundamental role, I expect that funds whose fundamentals are harder to assess will show a greater increase in the slope of the flow-performance function after disclosures, because

[9] Strictly speaking, redemption risk would manifest when past performance is below an investor's redemption threshold. I use zero performance as a simple proxy for the (unobservable) threshold. I also estimate the threshold for each fund share class and month using rolling regressions of flow on performance. Results are consistent (see Section 4.2).

[10] I measure the level of detail by the type of financial reports. A unique feature of mutual funds' financial reports is that while the first and third quarter reports contain only a holdings schedule, the annual and semiannual reports also contain financial statements along with management's discussion of fund performance, which can support investors' redemption decisions (see Section 3). Thus, the latter type contains more detailed, decision-relevant information.

disclosures should help investors' assessments of fund fundamentals and predictions of fund performance to a larger extent in such funds, thereby making investors more sensitive to performance. Using funds with a larger number of security holdings, higher portfolio turnover, and higher return volatility as proxies for harder-to-assess funds, I find evidence consistent with this expectation.

In terms of the coordination role, I expect that funds whose investors have higher incentives to redeem when they expect other investors to redeem will show a greater decrease in the intercept of the function after disclosures. I identify two types of such funds: illiquid funds and corporate bond funds. Illiquid funds (funds that hold less cash and more illiquid securities) tend to incur higher liquidation costs when rebalancing their portfolios to satisfy capital outflows. Accordingly, the remaining investors would bear higher negative externalities from others' redemptions. Similarly, bond funds, as against equity funds, hold inherently less-liquid debt securities. In addition, bond fund investors are more concerned about poor performance due to the asymmetric payoff function of debt. Consistent with the expectation, I find that illiquid and bond funds' investors, relative to their counterparts, withdraw capital at a higher level of performance after disclosures (i.e., the post-disclosure decrease in the intercept is greater). Overall, these results suggest that both the fundamental and coordination roles are plausible mechanisms at work.

To study investors' information set more comprehensively, I next examine the role of their private information. The effects of mandatory public disclosures on redemption risk can depend on the precision of investors' private information about the fund. If investors possess more precise private information, they will be likely to put less weight on public disclosures. Thus, both the fundamental and coordination roles of disclosures in increasing redemption risk would be alleviated in funds held by investors with more precise private information. As the main proxies for investors with more precise private information, I use investors in broker-sold funds (relative to investors in direct-sold funds) and institutional investors (relative to retail investors). As an additional metric, I estimate the extent to which the component of fund flows driven by private information predicts future fund performance.[11] Using these proxies, I find that the post-disclosure increase

[11] Investors in broker-sold funds can obtain information privately from financial advisors (Huang, Wei, and Yan 2007). Institutional investors can obtain (superior) private information from in-house research departments and fund managers

(decrease) in the slope (intercept) of the flow-performance function are less pronounced for funds held by investors with more precise private information.

My analyses so far suggest that mandatory public disclosures can increase redemption risk. While this inference might appear inconsistent with the information-asymmetry-reducing role of disclosures, it is based on average estimates. Accordingly, I explore the possibility of this role by examining a specific sample of funds in which information asymmetry among investors could be particularly problematic. Specifically, I examine the post-disclosure redemption behavior of less-informed investors in funds owned mainly by more-informed investors. In such funds, the less-informed would worry more about their informational disadvantages in the absence of disclosures. I find that in funds with more than 75% institutional ownership, the flow-performance function of retail investors does not move after disclosures; however, in the case of liquid funds, in which the coordination problems would not be severe, the function shifts upward after disclosures (i.e., retail investors redeem at a lower level of performance). These results indicate that disclosures reduce redemption risk to some extent by mitigating the adverse effects of information asymmetry.

Related Literature:

Researchers have made significant progress in understanding mutual fund redemption risk, especially in identifying the existence and fundamental determinants of fund outflows arising from coordination problems among investors (Chen, Goldstein, and Jiang 2010; Goldstein, Jiang, and Ng 2017; Schmidt, Timmermann, and Wermers 2016; Morris, Shim, and Shin 2017 among others). I contribute to this line of research by providing evidence on the role of transparency. My results suggest that enhanced transparency, as captured by mandatory periodic public disclosures, can increase redemption risk by amplifying the negative effects of bad fund fundamentals when investors have an incentive to redeem in anticipation of others' redemptions. That is, more precise public information exacerbates the coordination problems, as predicted by the global games theory that studies coordination games under incomplete information.[12]

via professional networks. I develop the statistical metric based on the idea that fund flows from those investors with a better ability to assess the fund would predict future performance better (see Section 4.5).

[12] A main prediction of the global games theory is as follows. In coordination games with strategic complementarities (i.e., when individual players' incentive to act increases in their beliefs about other players take the same action), more

More broadly, this paper contributes to the literature that examines the costs and benefits of transparency in the financial industry. On the cost side, Nagar and Yu (2014) find that precise public signals lead to self-fulfilling banking and currency crises. Banerjee and Maier (2016) show that granular public information yields coordination failures in bank creditors' rollover decisions. Chen, Goldstein, Huang, and Vashishtha (2021) find that transparency impedes banks' liquidity transformation role by making deposit flows more sensitive to bank performance. On the benefit side, Granja (2018) suggests that transparency can enhance financial stability by showing that reporting financial statements in local newspapers reduced bank defaults. Balakrishnan and Ertan (2018) find that banks improved loan quality after switching to a more frequent disclosure regime. I add to this line of work insights into the role of transparency in the asset management industry. My study is new to this literature, as asset managers face different structural issues from banks (e.g., funds raise capital via equity shares, which are more information-sensitive than deposits). In addition, my results allude to the delicacy of the cost-benefit calculation. While heighted redemption risk due to the fundamental role of disclosures is a cost to individual funds, it could be beneficial to the economy if it disciplines fund managers. An increase in redemption risk due to the coordination role would be a cost to both sides, but it is partly mitigated by the information-asymmetry reducing role. This multi-faceted role of transparency deserves attention.[13]

Lastly, this paper expands our understanding on the consequences of mutual fund disclosures. Although mutual funds have been growing substantially and their disclosure practices differ from those of other firms, only a few studies on this topic appear in the literature. Notable recent papers include Agarwal, Mullally, Tang, and Yang (2015), Agarwal, Vashishtha, and Venkatachalam (2018), and Balakrishnan, Mukhopadhyay, and Shivakumar (2018), which examine the effects on fund investees' stock liquidity, investment behavior, and insider trading, respectively. I focus on the effects on fund investors' redemption decisions in anticipation of other investors' redemptions and the corresponding risk mutual funds face.

---

precise public information (i.e., information with lower variance around the true fundamentals) can lead to coordination failures, as it strengthens their beliefs that other players will take that action. See Morris and Shin (2006) for a review.

[13] To make sure, this study does not make a definitive conclusion on the net desirability of transparency for the entire mutual fund sector, as it does not fully examine potential benefits (e.g., a prevention of fund managers' moral hazard).

2. Institutional Background and Hypothesis Development

2.1. Institutional Background

Mutual funds (a.k.a. open-end funds) are a major player in the asset management industry. Mutual funds hold 25% of total assets under management of the industry (OFR 2013) and are the largest type of SEC-registered investment companies, holding 84% of total investment firm assets, followed by exchange-traded funds/notes, closed-end funds, and unit investment trusts (ICI 2021). Mutual funds raise capital by issuing equity shares, called fund shares or units, to invest in stocks, bonds, money market instruments, and other asset classes. Fund shares are redeemable on any given day. That is, a mutual fund stands ready to buy back its shares from investors at the end of every business day at the day-close net asset value (price per share) upon investors' redemption requests. Due to this feature, mutual funds face redemption risk—the likelihood that they will suffer capital outflows arising from investors' redemptions, conditional on performance. Mutual funds typically issue multiple share classes with different combinations of fees and loads, minimum investment requirements, and restrictions on investor types (e.g., retail and institutional classes). The main institutional investors are investment advisers, insurance companies, and pension funds. Mutual funds typically sign investment management agreements with an asset management company, which manages portfolios of multiple funds.

Mutual funds have grown significantly over the last two decades. The total net assets have more than tripled from $7 trillion in 2001 to $12 trillion in 2010 and then to $25 trillion in 2020 (ICI 2021). Two trends have made mutual funds a critical item on the financial policy agenda since the global financial crisis. Mutual funds have grown at a faster pace, partly by absorbing capital outflows from banks, which faced stricter regulations and a loss of consumer trust. Moreover, mutual funds have increased their holdings of illiquid assets, such as corporate bonds, emerging market assets, bank loans, and even real estate (Hanouna, Novak, Riley, and Stahel 2015). As a result, like banks, they have been exposed to liquidity mismatch risk (illiquid assets are funded by liquid, redeemable capital). Recognizing these trends, policymakers have raised concerns that the size and structure of mutual funds can threaten the stability of the financial system (OFR

2013; IMF 2015; FSB 2017). In particular, if mutual funds conduct large-scale asset sales to satisfy substantial capital outflows arising from investors' concerted redemptions, this can lower market prices and increase market volatility.

Mutual funds provide a wide range of information that investors can use when making a redemption decision. Important public information sources are fund websites and mandatory periodic financial reports (ICI 2006). On their websites, mutual funds provide summary information about their fundamentals, including net asset value, past performance and risk profile, and asset size and portfolio mix. Each category of information is updated with a different frequency. The net asset value is typically updated on a daily basis; performance and risk on a monthly basis; and asset size and portfolio mix on a monthly or quarterly basis.

Mutual funds send two types of mandatory financial reports to their shareholders via (e-)mail: a quarterly schedule of portfolio holdings (Form N-Q) and a (semi-)annual certified shareholder report (Form N-CSR). The holdings schedule, which must be sent within 60 days after each first and third fiscal quarter-end, lists all securities held by the fund, along with each security's fair value, number of units, and other security-level information. The shareholder report, which must be sent within 60 days after each second and fourth fiscal quarter-end, contains a larger amount of more detailed information, such as financial statements with notes and management's discussion of fund performance as well as the holdings schedule with its tabular or graphical presentation.[14] The financial statements include the statement of net assets, the statement of operations (which presents investment income, operating expenses, and realized and unrealized gain or loss), and the statement of changes in net assets (which presents net asset changes arising from operations, capital and dividend distributions to shareholders, and capital share transactions including the amounts of shares sold and redeemed). The notes to financial statements and the management's discussion section typically explain components of fund performance and risk factors in detail.

This mutual funds' disclosure landscape offers an empirical advantage to study the effects of greater transparency on redemption risk. Specifically, while fund websites provide the frequently

[14] The SEC regulation effective May 2004 (SEC 2004) replaced Form N-30D with Form N-CSR and first introduced Form N-Q. Hence, before that time, mandatory financial reporting frequency was two times a year.

updated summary information, the relatively infrequent but more detailed information presented in mandatory financial reports constitutes a periodic jump in the information supply to fund investors. Several points also suggest that fund investors pay attention to the financial reports, especially when fund performance is bad. My empirical approach hinges on this feature by comparing investors' redemption behaviors before and after disclosures within a fund and quarter.[15]

2.2. Hypothesis Development

To hypothesize how mutual funds' mandatory public disclosures affect their redemption risk, I first posit that mutual fund investors make a redemption decision in the following way.[16] Using the information on the fund's website and mandatory financial reports, investors assess fund fundamentals and thereby forecast future fund performance. They also consider the implications of other investors' redemptions for fund performance. Investors then decide to redeem fund shares if they predict that fund performance will fall below a certain level, or their redemption threshold (which is determined by their investment objectives, risk aversion, liquidity needs, and other idiosyncratic factors). While investors try to predict fund performance as precisely as possible, such a prediction is inevitably noisy (i.e., the variance of the predicted performance is non-zero) due to the uncertainty about fund fundamentals and other investors' redemptions.

Mandatory public disclosures can play a critical role in this redemption decision process. First, disclosures can enable investors to forecast future fund performance more precisely with a better knowledge of fund fundamentals (the "fundamental role"). Second, disclosures can enable investors

[15] While the feature allows me to capture the effects of greater transparency (the incremental effects of more detailed, decision-relevant information of financial reports), it also poses an identification challenge. As key information is already available on fund websites (especially, past performance, the key information for a performance prediction), fund investors may not pay attention to mandatory financial reports. If this is the case, observed post-disclosure changes in the redemption behaviors cannot be attributed to the effects of the financial reports. I note several points suggesting that this is not the case. First, existing fund investors pay attention to the financial reports because they receive the reports electronically (Geoffroy 2018). Especially, when fund performance is poor, investors would pay more attention to the reports in order to make a redemption decision carefully. Redemption is costly, and investors tend to be loss averse (Benartzi and Thaler 1995). Second, ample evidence on mutual funds' window dressing behavior (e.g., Agarwal, Gay, and Ling 2014) implies that fund investors use the financial reports for their investment and withdrawal decisions. Lastly, I observe that downloads of the financial reports from the EDGAR system peak during the disclosure period, using the EDGAR Log File Data Set (I thank James Ryans for sharing this data). Nevertheless, I mitigate the concern by several empirical designs, including an event study with an extensive fixed effect structure, a quasi-experiment, and cross-sectional analyses (including an examination of financial report contents).

[16] This assumption is based on the literature on individual investor behavior (see Barber and Odean 2012 for a review) and a series of surveys on mutual fund shareholder characteristics conducted by the Investment Company Institute.

to estimate the likelihood of other investors' redemptions more easily (the "coordination role"). Third, disclosures can reduce the asymmetry of information about fund fundamentals among investors (the "information-asymmetry-reducing role"). I expect that these three roles will affect the likelihood of investors' redemptions given the same level of bad fund performance (i.e., performance that is below individual investors' redemption threshold), in different ways.

In terms of the fundamental role of mandatory public disclosures, I expect that investors will be more likely to redeem fund shares after disclosures. Before disclosures, an investor may make a relatively noisy prediction of future fund performance by relying only on the summary information available on the fund's website. As a result, even if the mean of the predicted performance is lower than her redemption threshold, the investor may decide to stay in the fund considering the high possibility that realized future performance will be higher than the threshold.

After disclosures, the investor could make a relatively precise prediction of fund performance by using the detailed information contained in the financial reports. For example, using the portfolio holdings schedule, she can incorporate the earnings forecasts of the fund's investees into the fund performance prediction to reduce the variance of the predicted performance (if she is sophisticated enough); or, she may start to make a prediction once receiving the financial reports as the reports raise her attention to bad fund performance.[17] As a result, the investor may become more likely to redeem their shares with stronger confidence in her prediction (i.e., she predicts that realized future performance will be unlikely to be above her redemption threshold). As fund performance declines, the investor will become increasingly more likely to redeem. In other words, the investor will become more sensitive to bad fund performance after disclosures. This process is further explained in Figure 1, Panel A.

In terms of the coordination role of mandatory public disclosures, I expect that investors will

[17] The main role of mandatory public disclosures would be enabling investors to reduce the *variance* of predicted performance rather than shifting its *mean*. The past performance is known to be the best predictor of the near-future performance due to the momentum feature of fund performance (Lou 2012). Thus, the predicted performance would be centered on the past performance. This information is already available on its website before disclosures. As the mandatory financial reports contain historical information, investors are unlikely to significantly change the mean of predicted performance in one particular direction (i.e., investors *on average* would not make a biased prediction due to the financial reports). Rather, investors would be able to reduce the variance of the prediction using the more detailed information contained in the reports. This assumption is validated in Section 4.3.

be even more likely to withdraw from the fund after disclosures. This is because public disclosures can exacerbate coordination problems among investors. Following redemption requests from some investors, funds may need to conduct costly and unprofitable trades to satisfy the outflows, which can damage future fund performance.[18] Because such trades are conducted after the day of the redemption requests, the liquidation costs are assumed not by the redeeming investors but by the remaining investors. Due to such negative externalities, investors who would have chosen to stay in the fund based on a fundamental assessment may revise their performance forecasts downwards and end up withdrawing from the fund—*if* they believe that other investors will withdraw. These bank-run-like redemptions that arise from coordination failures with self-fulfilling beliefs are detected by several researchers, including Chen, Goldstein, and Jiang (2010) and Goldstein, Jiang, and Ng (2017).[19] This phenomenon has also occurred in a number of mutual funds, including the the Third Avenue Focus Credit Fund in 2015.[20]

Mandatory public disclosures can reinforce such a belief. As individual investors predict fund performance more precisely and thus become more likely to redeem after disclosures (due to the fundamental role), they may expect that other investors will do the same. Investors are likely to make such an expectation as they know that all other investors observe public disclosures (i.e., this is common knowledge). In addition, as (Bayesian) investors put more weight on the more precise public disclosures (than on their private information) in forecasting fund performance, investors' information sets become more similar, and thus individual investors may form beliefs about other investors' redemptions more easily (Morris and Shin 1998, 2006; Hellwig 2002; Metz

[18] Funds with illiquid assets would need to (fire) sell the assets. Even funds with sufficient liquid assets would need to rebalance their portfolios inefficiently or sell the assets to maintain the minimum cash buffer set by the fund policy. These actions can cause substantial losses (Coval and Stafford 2007; Manconi, Massa, and Yasuda 2012).

[19] The authors study equity and corporate bond mutual funds and find that funds that hold illiquid assets suffer a greater sensitivity of outflows to poor performance. As illiquid funds should suffer higher portfolio rebalancing costs subsequent to outflows, investors in such funds have higher incentives to redeem in the expectation of others' redemptions. The results point to the possibility of bank-run-like redemptions in the mutual fund sector.

[20] The Focused Credit Fund was the single largest holder of high-yield corporate bonds, and its fundamentals were good. After runs, however, the fund suffered about a 30% loss and lost almost 75% of its assets due to junk-bond selloff. The fund halted redemptions in December of 2015 and stated that it could not meet the investors' withdrawal requests by selling assets at rational prices. Many so-called liquid-alternative mutual funds, operated by hedge fund managers such as Whitebox Advisors, J.P. Morgan, and Guggenheim Partners, also experienced investor runs and were forced to close in 2015. Many real estate funds in the UK also suffered severe runs after the vote for the Brexit in 2016.

2002; Vives 2014). In this way, public disclosures can strengthen individual investors' perception that other investors will redeem. As a result, investors may start to redeem even at a higher level of fund performance to avoid the negative externalities from others' earlier redemptions. This process is further explained in Figure 1, Panel B.

Lastly, mandatory public disclosures can play an information-asymmetry-reducing role. Asymmetric information problems can be severe in the mutual fund industry, as fund investors typically possess different levels of private information about the fund's fundamentals (Barber, Huang, and Odean 2016). For example, both institutional and retail investors can own a fund. While institutional investors can obtain private information from in-house research departments and perhaps from the fund managers via professional networks, retail investors generally have limited access to such information sources. In that case, less-informed investors may exit the fund worrying about the presence of more-informed investors. Such withdrawals occurred during the mutual fund scandal of 2003 and are documented by Choi and Kahan (2006) and McCabe (2009).[21]

Mandatory public disclosures can make investors less likely to withdraw from the fund by mitigating the adverse effects of information asymmetry. In the absence of disclosures, when less-informed investors observe decreases in the fund's asset size on its website, they may decide to exit the fund, concerned that other investors may have superior negative private information about the fund. However, when provided with disclosures that convey detailed information about the fund's fundamentals, less-informed investors may overcome their informational disadvantages by conducing fundamental analyses and be less inclined to exit the fund. i.e., they start redeeming at a lower level of fund performance. This process is further explained in Figure 1, Panel C.

Overall, theory provides different predictions on whether mutual funds' mandatory public disclosures will increase or reduce their redemption risk. I empirically explore these opposing effects using a large sample of U.S. mutual funds.

[21] In the mutual fund scandal of 2003, large U.S. funds allowed selected investors, particularly hedge funds, to engage in market-timing and late-trading to reap abnormal returns at the expense of buy-and-hold investors. Mutual fund trades received after 4 pm (Eastern time) must be executed at the following day's closing price. However, brokers colluded with investors and submitted post-4 pm trades as if the trades had been placed before 4 pm. These trades were thus executed at the price that was set at 4 pm. This allowed selected investors to trade with information about after-hours market developments at the stale end-of-day fund shares price. The funds collapsed due to heavy redemptions.

3. Data, Sample, and Variables

My empirical analyses employ 8,523 actively-managed U.S. equity and corporate bond mutual funds from the CRSP Mutual Fund Database over the period of 2000–2017. The database contains the fundamental information of each fund, including its name, investment style/objective, and share classes; total net assets, net asset values, and returns per share (monthly); asset allocation and holdings (quarterly); and fee structure (by the fund's fiscal year). The sample period starts from 2000, because some of the key variables in the database are available from that time, and fund websites became more prevalent in the 2000s. I first select all equity and corporate bond funds within the sample period, using the style/objective codes provided by the database.[22] From a total of 10,653 such funds, I exclude index funds and exchange-traded funds to focus on actively-managed funds that directly face redemption risk. These exclusions yield 9,323 funds. I then exclude funds with total net assets less than $0.1 million, as all amounts lower than that threshold are recorded as 0.1 in the database. I further require that funds have at least one year of history. The final sample contains 1,781,135 share class-months (the unit of observation), with 24,093 unique share classes in 8,523 funds managed by 2,059 asset management companies.

I obtain other key data from several sources. I identify the fund's financial report filing dates using the Electronic Data Gathering, Analysis, and Retrieval (EDGAR) index files of the Securities and Exchange Commission (SEC). I obtain the frequency with which mandatory financial reports are downloaded from the EDGAR system from the EDGAR Log File Data Set. Finally, the financial market and macroeconomic data come from Kenneth French's website, the Chicago Board Options Exchange, and the Federal Reserve Statistical Release.

The key variables are fund flow and fund performance. Following the standard practice in the mutual fund literature (e.g., Sirri and Tufano 1998), I measure fund flow by the percentage change in total net assets from the prior month, excluding the effects of fund returns and fund mergers.

[22] Specifically, I classify a fund as an equity fund if it has a CRSP style code starting with 'ED (Equity Domestic)' or 'EF (Equity Foreign)'. A fund is classified as a corporate bond fund if it has (i) a CRSP style code starting with 'IC (Fixed Income Corporate)', (ii) a Lipper objective code in the set ('A', 'BBB', 'HY', 'IID', 'SID', 'SII'), (iii) a Strategic Insight objective code in the set ('CGN', 'CHQ', 'CHY', 'CIM', 'CMQ', 'CPR', 'CSM'), or (iv) a Wiesenberger objective code in the set ('CBD', 'CHY'), following Goldstein, Jiang, and Ng (2017).

Specifically, I compute flow for each fund share class and month as $FLOW_{i,\,t} = [TNA_{i,\,t} - TNA_{i,\,t-1} - (TNA_{i,\,t-1} \times RET_{i,\,t}) - MGN_{i,\,t}] \div TNA_{i,\,t-1}$, where $TNA_{i,\,t}$ is total net assets of share class i at the end of month t, and $RET_{i,\,t}$ is its return during month t (the rate of change in its net asset value (price per share)). $MGN_{i,\,t}$ is the increase in total net assets arising from fund mergers in month t (estimated following Lou 2012).[23] Thus, $FLOW_{i,\,t}$ is net fund flow (inflow minus outflow) imputed from the changes in total net assets and the return during month t.[24] To mitigate the influence of outliers, flows are winsorized at the 1% and 99% levels.

Fund performance can be measured in many ways. My main measure $PERF_{i,\,t-1}$ is the average of monthly style-adjusted returns for the three months before the month when flow is calculated. The monthly style-adjusted return of each share class i is calculated as its return minus the cross-sectional average of returns of all other share classes that follow the same investment style. I then average the monthly style-adjusted returns over the three months from $t-3$ to $t-1$, considering that funds release mandatory financial reports quarterly. Thus, $PERF_{i,\,t-1}$ estimates fund performance relative to its peer funds' performance. This measure is widely used in the prior studies, along with other measures such as alpha (e.g., Chen, Goldstein, and Jiang 2010). Using alternative performance measures and averaging periods does not change my inferences (see Section 4.2).

Two sets of control variables are employed. The first set pertains to the fund's fundamental characteristics that prior research has found to be associated with flow and performance (e.g., Sirri and Tufano 1998; Chen and Quin 2017). *Size* (the natural log of total net assets in million dollars) and *Age* (the natural log of the number of years since the fund's inception) are related

[23] Following Lou (2012), I estimate *MGN* as follows. I first use the last net asset value report date of the target fund as a simple estimate of the merger date. I then perform a smoothing procedure: a target fund is matched to its acquirer from one month before its last net asset value report date to five months after, and the month when the acquirer has the smallest absolute flow after accounting for the merger is designated as the event month. I assume that funds that are initiated have inflows equal to their initial total net assets while funds that are liquidated have outflows equal to their terminal total net assets, and that inflows and outflows occur at the end of each month.

[24] Redemption risk refers to the risk of outflow (redemption) under bad performance. The prior studies on redemption risk use negative net flow as a proxy for outflow (e.g., Chen, Goldstein, and Jiang 2010; Goldstein, Jiang, and Ng 2017), because CRSP Mutual Fund Database does not provide outflow and inflow data separately. Using the same approach, I attribute a decrease in net flow to an increase in outflow in empirical tests. This inference would not be biased because funds with bad performance are unlikely to have much inflow, and even if there is inflow, it should decrease toward zero as performance gets worse. Moreover, what really hurts a fund is net outflow rather than gross outflow (for example, if outflow is exceeded by inflow, it will not hurt the fund much). Nevertheless, I perform a sensitivity analysis using a subsample of funds that are closed to new investors and thus do not have any inflow (see Section 4.2).

with flow and performance broadly. Net return to investors depends on the fund's fee structure, which is measured by *Expense* (management fee and operating expenses as a percentage of total net assets), *Front Load* (average sales charge as a percentage of total net assets), and *Rear Load* (average redemption fee and contingent deferred sales charge as a percentage of total net assets). *Distribution* (capital and dividend distribution amounts as a percentage of total net assets) also affects investor return. The riskiness of return is measured by *Return Volatility* (the standard deviation of monthly returns over 12 months). Performance is also affected by the funds' asset management behavior, which is captured by *Portfolio Holdings* (the natural log of the number of securities held), *Portfolio Turnover* (total security sales/purchase amounts divided by average total net assets), and *Cash Govi Portion* and *Illiquid Securities* (the percentage of assets held in cash and government securities and an indicator for funds that invest mainly in illiquid securities such as micro-cap equities and high-yield bonds, respectively, both capturing portfolio liquidity). The second set pertains to informational features that can affect the flow-performance relation in the month of disclosure. *Public Disc Precision* (an indicator for (semi-)annual shareholder reports) captures the precision of mandatory financial reports. *Private Info Precision* (measured in three ways) captures the precision of investors' private information. See Sections 4.2.3 and 4.5, respectively, for the rationale and measurement. Appendix A contains the definitions of all variables.

Table 1 presents the summary statistics. As Panel A shows, the funds in my sample recorded a net flow of 1% per month on average, ranging from −37.7% to 39.3%. Fund performance (style-adjusted return) ranges from −2.3% to 2.3% with a median of 0% (for context, raw return ranges from −7.7% to 7.2% with a median of 0.7%). The median fund size is \$30 million ($=e^{3.398}$), and the median fund age is 6 years ($=e^{1.767}$). On average, the funds incurs an annual expense of 1.3% and charges a front- (rear-) load of 0.5% (0.3%). The funds invest in 116 securities ($=e^{4.756}$) on average, with an average turnover of 0.56. The funds hold 5.4% of their assets in cash and government securities, and 23.8% of them invest in illiquid securities. Panel B presents the pairwise correlations matrix, which shows that flows are positively correlated with performance. It also shows that flows are negatively related with expenses and return volatility and that larger and younger funds tend to have higher flows.

4. Research Design and Empirical Results

To test how mutual funds' mandatory public disclosures affect their redemption risk via the three roles of disclosures (fundamental, coordination, and information-asymmetry-reducing roles), for each fund share class and month in the sample, I examine the flow-performance relation, i.e., the function that shows fund flow for each level of past fund performance (with performance on the x-axis and flow on the y-axis). Prior researchers have extensively documented a positive association between flow and performance (see Christoffersen, Musto, and Wermers 2014 for a review). In contrast, I examine the *changes* in the two main characteristics of the function: the *slope* (which captures how much capital outflow occurs for each unit of performance) and the *intercept* (which captures at what level of performance the average investor redeems capital). Specifically, my regression models estimate changes in these two characteristics from one month before disclosure (the "pre-disclosure period") to the month of disclosure (the "post-disclosure period").[25] I attribute the change in the slope to the change in redemption risk that arises from the fundamental role, while the change in the intercept is attributed to the change in redemption risk that arises from the coordination role or the information-asymmetry-reducing role (see Figure 1 for the rationale). This identification approach is complemented by a series of cross-sectional analyses. I focus on outflows under bad performance, i.e., performance that is below investors' redemption thresholds.

4.1. Main Analyses

I conduct two main analyses: a semiparametric analysis and an event study. The semiparametric analysis, in which flow-performance relation is not restricted to be linear, offers a diagnostic view of how the relation changes from the pre- to the post-disclosure period. I conduct the following fund share class-month level semiparametric regressions (Robinson 1988) separately for the pre- and post-disclosure periods and observe changes in the fitted flow-performance functions:

[25] The pre- and post-disclosure periods are defined as follows. The Investment Company Act of 1940 requires each fund to transmit a financial report to its shareholders via (e-)mail within 60 days after each fiscal quarter-end and file the report with the SEC no later than 10 days after the transmission. As the actual transmission date, i.e., the disclosure date, is unobservable, I estimate it as the filing date minus 10 days. The estimation indicates that most funds disclose before the middle of the second month after each fiscal quarter-end. Accordingly, I use the second month as the main post-disclosure period. (Using the third month yields consistent results.) The pre-disclosure period is the first month after each fiscal quarter-end.

$$FLOW_{i,\,t} = \alpha + f\left(PERF_{i,\,t-1}\right) + \Theta\, \boldsymbol{Fundamentals}_{i,\,t-1} + \varepsilon_{i,\,t}, \tag{1}$$

where $FLOW_{i,\,t}$ is the net flow of share class i in month t, and $PERF_{i,\,t-1}$ is its one-month lagged performance. $\boldsymbol{Fundamentals}_{i,\,t-1}$ includes size, age, expense, front- and rear-loads, capital and dividend distributions, return volatility, portfolio holdings, portfolio turnover, and asset liquidity, as well as lagged flow. See Section 3 and Appendix A for variable definitions. Note that the flow-performance relation is nonlinearly estimated by the nonparametric function $f(\cdot)$. This analysis is important as flow-performance relation is typically nonlinear.[26]

Figure 2 plots the fitted flow-performance functions for the pre- and post-disclosure periods. The vertical y-axis is the net flow, and the horizontal x-axis is the one-month lagged performance. The figure shows that after disclosures, funds suffer higher outflows given the same level of bad performance (i.e., performance that is lower than the x-intercept, which approximates the average redemption threshold of fund investors). It also reveals that the post-disclosure increase in redemption risk arises from changes in the two aspects of the function. The function becomes steeper (its slope increases), which indicates that investors redeem increasingly more capital as performance declines (they become more sensitive to bad performance). The function also moves downwards (its y-intercept decreases, or equivalently, its x-intercept increases), which indicates that investors start redeeming at a higher level of performance (note that the average redemption threshold was lower than -1% before disclosures, but it approaches 0% after disclosures).

Although this paper focuses on outflow under bad performance, I also note that under good performance, the function does not substantially change after disclosures (the downward shift is statistically insignificant, as tested by the event study below), which suggests that disclosures do not significantly affect inflows. Perhaps, this is because fund investors may pay attention to disclosures only when performance is bad, as they are loss averse (Benartzi and Thaler 1995) and it is costly to analyze the fund's financial reports.[27] Moreover, potential investors may not necessarily

[26] Robinson's (1988) semiparametric regression technique allows a nonparametric estimation of the nonlinear relation between the dependent variable and the independent variable of interest while linearly controlling for other variables by parametric ordinary least squares. This technique is used by prior research to study the nonlinear flow-performance relation (e.g., Chevalier and Ellison 1997; Chen and Quin 2017).

[27] To support this view, I find that institutional investors, who may be less loss averse and be able to analyze the financial reports with lower costs, exhibit higher inflows after disclosures. I relegate further analyses to future research.

make investment decisions in the month of disclosure, but rather be guided by their own financial situations and other idiosyncratic factors. Lastly, to select a fund to invest in, potential investors typically compare several funds at the same time using mutual fund portal sites and with the help of financial advisers. Such comparisons are unlikely to coincide with disclosure dates as the dates are different across funds (funds have different fiscal year-ends).

The event study statistically tests changes in the flow-performance function from the pre- to the post-disclosure period. Specifically, I run the following fund share class-month level regressions:

$$\begin{aligned} FLOW_{i,\,t} = (\beta_1 + \beta_2\, PERF_{i,\,t-1}) + (\beta_3 + \beta_4\, PERF_{i,\,t-1}) \times DISC_{m,\,t} \\ + \Theta\, \boldsymbol{Fundamentals}_{i,\,t-1} + \Gamma\, \boldsymbol{Information}_{i,\,t} + u_{cm} + w_m + s_q + \varepsilon_{i,\,t}, \end{aligned} \tag{2}$$

where $DISC_{m,\,t}$ is an indicator that switches on in the post-disclosure periods of fund m held by share class i. $FLOW_{i,\,t}$, $PERF_{i,\,t-1}$, and $\boldsymbol{Fundamentals}_{i,\,t-1}$ are as in equation (1). I additionally control for informational features by $\boldsymbol{Information}_{i,\,t}$, which includes the precision of mandatory financial reports and the precision of investors' private information (as explained in Section 3).

I employ three sets of fixed effects. First, asset management company-mutual fund fixed effects (u_{cm}) control for the fund's investment style, manager skills, and other company-fund level factors. Second, Nov/Dec-post fixed effects (w_m) mitigate an endogeneity problem arising from flow seasonality. Mutual funds release their mandatory financial reports in different calendar months, as they have different fiscal year-ends. (I exploit this feature in a quasi-experiment performed in Section 4.2.1.) This feature reduces the likelihood that the post-disclosure changes in the flow-performance function correlate with calendar-month-based events. However, due to investors' tax-loss harvesting, funds tend to suffer higher outflows in November and December.[28] Thus, if funds disclose in those months, they could suffer higher outflows that are not driven by performance and disclosures. I mitigate this problem by including an indicator that turns on if funds disclose in those months. Lastly, year-quarter fixed effects (s_q) control for time-varying macro conditions.

The coefficients of interest are β_3 and β_4. $\widehat{\beta}_3$ captures the post-disclosure change in the y-

[28] Fund investors have an incentive to redeem their fund shares at a loss before the end of the year because they can use the capital loss to offset capital gain tax liability under U.S. tax laws (Ivković and Weisbenner 2009).

intercept of the flow-performance function, and $\widehat{\beta}_4$ captures the post-disclosure change in its slope. Note that a decrease (an increase) in the y-intercept corresponds to an increase (a decrease) in the x-intercept, given that the flow-performance function has a positive slope.

The redemption risk manifests mainly when fund performance is below investors' redemption thresholds. Thus, it is important to estimate equation (2) across ranges of performance, especially, for subsamples of funds that have past performances below and above the redemption thresholds. As a simple proxy for the unobservable thresholds, I use zero performance. Since the performance measure is based on style-adjusted returns, this proxy assumes that investors start to redeem if their funds underperform other funds following the same investment style. The zero-performance threshold is also used in prior research on redemption risk (e.g., Goldstein, Jiang, and Ng 2017). I additionally estimate the redemption threshold for each fund share class in each month by taking the x-intercept from rolling regressions of flow on performance (see Section 4.2.2).

Table 2 presents the results, which are consistent with the semiparametric analysis results. In columns (1) and (2), I show the results under all ranges of performance to provide a benchmark. The result under negative performance, the focus of this paper, is shown in column (3). In column (4), I show the result under positive performance for comparison purposes. Column (1), which does not include fixed effects, shows that after disclosures, the y-intercept of the flow-performance function decreases by 0.056 from 1.898, and its slope increases by 0.087 from 0.351. Including fixed effects in column (2) yields similar results. Column (3) shows that when performance is negative, the y-intercept of the function decreases by 0.128 (about a 13% decrease from the mean flow in the pre-disclosure periods), and its slope increases by 0.061 (about a 31% increase from the pre-disclosure slope level). These estimates indicate a substantial increase in redemption risk after disclosures—for a one standard deviation decline in performance (0.764%), funds suffer about 17% higher outflows during the disclosure period.[29] Under positive performance (column (4)), post-

[29] The 13% decrease in the y-intercept is calculated as -0.128 (the estimated coefficient of *DISC*) divided by 0.998 (the pre-disclosure mean flow). The 31% increase in the slope is computed as 0.061 (the estimated coefficient of $PERF \times DISC$) divided by 0.196 (the estimated coefficient of *PERF*, i.e., the pre-disclosure slope estimate). The 17% increase in outflows for a one standard deviation-decline in performance (0.764) is calculated as the total post-disclosure change in flows ($-0.175 = -0.128 - 0.061 \times 0.764$) divided by the pre-disclose mean flow (0.998).

disclosure changes in the flow-performance function are statistically insignificant. The estimates of control variables are generally consistent with the findings in the prior literature. For example, while larger and younger funds have higher flows, funds with higher expenses and more volatile returns have lower flows.

Overall, the semiparametric analysis and the event study provide evidence that mandatory public disclosures are associated with an increase in redemption risk. They also suggest that the increase in redemption risk is related with the fundamental and coordination roles of disclosures—the increase in the slope of the flow-performance function captures the fundamental role (investors become more sensitive to bad performance), while the movement of the function to the right captures the coordination role (investors start redeeming at a higher level of past performance).

4.2. Additional Analyses

I perform several additional analyses to further mitigate potential endogeneity concerns, to test the sensitivity of the event study results to alternative measurements and samples, and to supplement the main findings by examining the contents of disclosures.

4.2.1. Quasi-Experiment

Endogeneity problems are unlikely to be severe in the event study (which compares pre- and post-disclosure flow-performance functions within a fund and quarter), as funds release their mandatory reports in different calendar months and investors' tax-loss selling incentive is controlled for by Nov/Dec-post fixed effects. However, omitted correlated variable problems may still exist if funds with the same fiscal year-ends experience common shocks. To mitigate such concerns, I conduct a quasi-experiment by estimating the following difference-in-difference model:

$$\begin{aligned} FLOW_{i,\,t} = {} & (\beta_{11} + \beta_{21}\, PERF_{i,\,t-1}) + (\beta_{12} + \beta_{22}\, PERF_{i,\,t-1}) \times TREAT_{m,\,t} \\ & + (\beta_{31} + \beta_{41}\, PERF_{i,\,t-1}) \times POST_t + (\beta_{32} + \beta_{42}\, PERF_{i,\,t-1}) \times TREAT_{m,\,t} \times POST_t \\ & + \Theta\, \boldsymbol{Fundamentals}_{i,\,t-1} + \Gamma\, \boldsymbol{Information}_{i,\,t} + u_{cm} + w_m + s_q + \varepsilon_{i,\,t}\,, \end{aligned} \tag{3}$$

where $POST_t$ is an indicator that switches on in either even or odd calendar months (not in the month of disclosure). This specification automatically yields treated and control groups as funds' fiscal year-ends differ. For example, for the two-month period from January to February (during

which $POST_t$ turns on in February, an even calendar month), funds with a December fiscal year-end are classified into the treated group as they are required to disclose in February. In contrast, funds with an October fiscal year-end fall into the control group as they do not have disclosure requirements over the period (they disclosed in December, and the next disclosure is in March). Importantly, the treated and control groups trade places in the next periods. From March to April (during which $POST_t$ turns on in April), the December year-end funds become the control group as they do not disclose (they disclosed in February, and the next disclosure month is May). The October year-end funds are excluded from the sample as their disclosure occurs in the pre-period (i.e., March). From May to June (during which $POST_t$ turns on in June), the October year-end funds become the treated group, and the December year-end funds are excluded from the sample. The same procedure applies to the two-month periods ending in odd calendar months. I construct an indicator $TREAT_{m,\,t}$ for all funds such that it turns on if a fund is required to disclose in the second month of each two-month period. Appendix B illustrates this research design. All other variables are as in equation (2).

The coefficients of interest are β_{32} and β_{42}. $\widehat{\beta}_{32}$ ($\widehat{\beta}_{42}$) captures an incremental post-disclosure change in the intercept (slope) of the flow-performance function of the treated funds relative to the control funds over the same two-month period.

Table 3 presents the results, which are consistent with the event study results. In both even and old calendar month specifications (columns (1) to (3) and columns (4) to (6), respectively), the post-disclosure decrease (increase) in the y-intercept (slope) of the treated group is significantly greater than that of the control group. These changes manifest only when performance is negative. These results suggest that endogeneity is not a significant problem in the event study.

4.2.2. Sensitivity Analyses

I conduct three sets of sensitivity analyses. First, I examine the sensitivity of the event study results to alternative measures of flow and performance. In the main analyses, I interpret a decrease in net flow as an increase in outflow. Although this inference is unlikely to be biased (see Section 3), I conduct the event study for a subsample of funds that are closed to new investors

and thus do not have inflows.[30] Table 4, column (1) shows the consistent results, but the statistical significances are lower, perhaps due to the small sample size (6% of the original sample). For alternative performance measures, I use the one-month style-adjusted return instead of the three-month average of style-adjusted returns. I also use alpha from the one-factor market model.[31] As columns (2) and (3) show, the results are consistent with the main results.

Second, instead of zero performance as a proxy for investors' redemption thresholds, I estimate the threshold by rolling regressions. Specifically, I regress flow on performance for each share class in each month with a 12-month rolling window and obtain the estimated x-intercept. This statistical proxy assumes that investors' redemption thresholds are similar in the same share class and in the same month. Columns (4) and (5) show the results. Consistent with the main results, the post-disclosure decrease (increase) in the intercept (slope) of the function manifests only when the past performance is below the estimated threshold.

Lastly, I conduct the event study using two alternative samples. First, I exclude October fiscal year-end funds, which comprise about 25% of the sample (see Appendix B). As those funds disclose in December, they can suffer higher outflows due to the investor's tax-loss harvesting. Although the Nov/Dec-post fixed effects are employed to address the concern, I further test the robustness of the main results to the exclusion of those funds. Second, I exclude the financial crisis period (2007–2009) to rule out any unusual confounding factors during this special time. The main inferences hold for these two subsamples as columns (6) and (7) show.

4.2.3. Examination of Disclosure Contents

The main findings suggest that mandatory public disclosures increase redemption risk as they provide more detailed information than fund websites. If the level of detail of information is the main driver of the results, financial reports that contain more detailed information should increase redemption risk to a greater extent. A unique feature of mutual funds' financial reports is that

[30] Open-end funds sometimes do not accept new investors for a certain period of time, although it is very unusual.

[31] The alpha is estimated by the intercept from rolling-window time-series regressions of excess fund returns on excess aggregate market returns for each share class-month with a 12-month rolling window. The aggregate market returns are estimated by CRSP value-weighted market returns for equity funds or by the Vanguard Total Bond Market Index Fund returns for corporate bond funds. I use U.S. one-year Treasury bill rates to proxy for riskless rates.

while the first and third quarter reports contain only a portfolio holdings schedule, the annual and semiannual shareholder reports also contain financial statements along with management's discussion of fund performance, which provide more detailed information that can support investors' redemption decisions. For example, financial statements show the actual redemption amount. Observing this information, investors can be more likely to redeem as they believe more strongly that others will be more likely to redeem after seeing the same information.

Table 4, columns (8) and (9) present the results consistent with the expectation. The post-disclosure decrease (increase) in the intercept (slope) of the flow-performance function is higher when the shareholder reports are released. In particular, the intercept decrease, which reflects the increase in outflows due to the coordination role, is higher by about 25%. These results further support the idea that more detailed public information can lead to higher redemption risk.

4.3. The Fundamental Role of Mandatory Public Disclosures

Having found that mandatory public disclosures can increase redemption risk, I test the extent to which this effect is driven by the fundamental role of disclosures. Mandatory financial reports contain more detailed information about fund fundamentals than fund websites (e.g., the portfolio holdings schedule). Such information would enable investors to assess fund fundamentals better and forecast future performance more precisely, which would make investors more sensitive to performance. Thus, I expect that funds whose fundamentals are harder to assess, for which detailed information in disclosures should be more useful, will show a higher post-disclosure increase in the slope of the flow-performance function (recall that I attribute the change in the slope, not the change in the intercept, to the change in redemption risk arising from the fundamental role).

To test this expectation, I estimate equation (2) for subsamples split by the assessment difficulty/disclosure usefulness, captured by three proxies: the number of portfolio holdings, portfolio turnover, and return volatility. Funds with a larger number of holdings would be harder to assess without the portfolio holdings schedule. Fund websites typically present the overall portfolio mix (e.g., geographical/sector allocation) and sometimes list just a few top securities in the portfolio. In contrast, the holdings schedule lists all securities held by the fund, along with the securities'

fair value, number of units, and other security-level information. Thus, investors would find the holdings schedule more helpful when predicting the performance of such funds. The holdings schedule would also be more useful for funds that frequently rebalance their portfolios. If funds rarely rebalance their portfolios, the incremental information of the recent holdings schedule would be limited. Lastly, the holdings schedule would be more valuable for funds with highly volatile past returns. It would be more difficult to predict the performance of such funds, given that past returns are a key predictor of future performance (Lou 2012).

Table 5 presents the results consistent with the expectation. The post-disclosure increase in the slope of the flow-performance function is substantially greater for all three types of harder-to-assess funds (columns (1), (3), and (5)). Indeed, easier-to-assess funds do not show a statistically significant increase in the slope after disclosures (columns (2), (4), and (6)). I also note that the post-disclosure decrease in the intercept between harder- and easier-to-assess funds do not show consistent patterns. Funds with a high and low number of holdings show similar magnitudes (columns (1) and (2)), while high-turnover funds show a smaller magnitude (columns (3) and (4)), but high-volatility funds show a larger magnitude (columns (5) and (6)), which indicates that the fundamental role does not manifest as a change in the intercept. Overall, these results suggest that the fundamental role is a plausible mechanism at work that drives the main results.

4.4. The Coordination Role of Mandatory Public Disclosures

Next, I test the extent to which the post-disclosure increase in redemption risk is driven by the coordination role of disclosures. Fearing negative externalities from other investors' earlier redemptions, those investors who otherwise would have remained in the fund may end up withdrawing from the fund. Mandatory public disclosures can exacerbate this coordination problem by increasing investors' beliefs that other investors will redeem. Thus, I expect that funds whose investors bear higher negative externalities from others' redemptions will show a higher post-disclosure decrease in the intercept of the flow-performance function (recall that I attribute the change in the intercept, rather than the change in the slope, to the change in redemption risk arising from the coordination role).

To test this expectation, I estimate equation (2) for subsamples split by the degree of such externalities. I identify two types of higher-negative-externality funds: illiquid funds and corporate bond funds. Illiquid funds (funds whose assets are illiquid) tend to incur higher liquidation costs when rebalancing their portfolios following redemptions. Accordingly, the remaining investors bear higher negative externalities from others' redemptions. I measure the illiquidity of fund assets in two ways. First, I use the portion of cash and government security balances to total assets. This quantity is measured at the most recent month before the month when flow is calculated to ensure that the level of cash is not simply the outcome of flow. Second, funds managed under the following investment styles are designated as those holding illiquid securities: small- and micro-cap equities, equities and bonds in emerging markets, and high-yield bonds (Chen, Goldstein, and Jiang 2010). Similarly, corporate bond funds, as against equity funds, hold debt securities, which are inherently less liquid. In addition, bond fund investors are more concerned about poor performance due to the asymmetric payoff function of debt (Goldstein, Jiang, and Ng 2017).

Table 6 presents the results consistent with the expectation. In comparing illiquid and liquid funds, I find that the post-disclosure decrease in the intercept of the flow-performance function is significantly larger for funds that hold cash and government securities below the sample median (columns (1) and (2)) and for funds that invest in illiquid securities (columns (3) and (4)). I also observe that the post-disclosure increase in the slope is higher for illiquid funds, but not substantial. These results indicate that the effects of the coordination role manifest mainly in the intercept change. Bond funds also show a significantly larger decrease in the intercept after disclosures (columns (5) and (6)). A substantially larger increase in the slope reflects bond fund investors' higher concerns about poor performance. Overall, these results suggest that the coordination role is also a plausible mechanism at work that drives the main results.

4.5. The Role of Investors' Private Information

To study fund investors' information set more comprehensively, I examine the role of their private information, which represents (soft) information each investor may independently possess about the fund. The effects of mandatory public disclosures on redemption risk can depend on the

precision of investors' private information, i.e., the extent to which investors' private information helps their assessments of fund fundamentals. Theory suggests that investors with more precise private information are likely to put less weight on public information (Morris and Shin 2006). Thus, such investors would react less strongly to disclosures when making a fundamental assessment. In addition, such investors would care less about the possibility of others' redemptions, as they rely more on a fundamental assessment when making a redemption decision. I thus expect that both fundamental and coordination roles of disclosures in increasing redemption risk will be alleviated in funds owned by investors with more precise private information.

To test this expectation, I estimate equation (2) for subsamples split by private information precision. I use two sets of proxies for the precision: one based on institutional features and the other based on statistical estimation. The institutional proxies for investors with more precise private information are investors in broker-sold funds (relative to investors in direct-sold funds) and institutional investors (relative to retail investors). Investors can purchase mutual funds through brokers with consultation of financial advisors, who are also an important information source for investors' redemption decisions (ICI 2006). As investors can obtain fund information privately from their advisors even after the purchase, investors in broker-sold funds would have more precise private information about the fund than those in direct-sold funds (Huang, Wei, and Yan 2007). Institutional investors can obtain (superior) private information from in-house research departments and perhaps directly from the fund managers thorough professional networks. Retail investors generally have limited access to such private information sources.

To complement the institutional proxies, I develop a statistical metric based on an idea from the flow-based return predictability (or smart money effect) literature starting with Gruber (1996). The idea is that if an investor has a superior ability to assess fund fundamentals, fund flow from that investor would predict future fund performance better. To gauge such an ability related only with private information, I estimate the extent to which the component of flow driven by private information predicts future performance. I first estimate idiosyncratic flow by taking the residual from the following regression for each share class in each month with a 12-month rolling window:

$$FLOW_t = \Omega\, \boldsymbol{Public\ Info}_{t-1} + \Psi\, \boldsymbol{Macro\ Info}_{t-1} + \eta_t, \tag{4.1}$$

where $\boldsymbol{Public\ Info}_{t-1}$ includes all public data among the fundamental variables in equation (1). $\boldsymbol{Macro\ Info}_{t-1}$ includes three-month T-bill rate, stock and bond market returns, the VIX, and default spread, which are found to affect fund flows (Chen and Quin 2017; Fratzscher 2012). The residual from the regression ($\tilde{\eta}_t$) reflects the component of flows driven by investors' private information and other idiosyncratic factors. Then, I measure the private information precision by the coefficient estimate from a regression of one-month-ahead fund performance on $\tilde{\eta}_t$ for each share class in each month with a 12-month rolling window:

$$PERF_{t+1} = \beta\, \tilde{\eta}_t + \Pi\, \boldsymbol{Controls}_t + \upsilon_t, \tag{4.2}$$

where $\boldsymbol{Controls}_t$ include the fundamental variables in equation (1) except lagged flows. Finally, I classify the share class-months with a positive (negative) $\widehat{\beta}$ into those held by investors who possess precise (noisy) private information in that month.[32]

Using these proxies, I find that the post-disclosure increase in redemption risk is smaller for funds held by investors with precise private information. As Table 7 shows, the post-disclosure decrease (increase) in the intercept (slope) of the flow-performance function is smaller for broker-sold funds (columns (1) and (2)) and for institutional-investor funds (columns (3) and (4)). Indeed, neither category of funds shows a statistically significant increase in the slope after disclosures, which suggests that the fundamental role of disclosures are muted for investors with precise private information about fund fundamentals. Similar results are found when the statistical metric is employed (columns (5) and (6)). Overall, these results suggest that both the fundamental and coordination roles of mandatory public disclosures in increasing redemption risk are somehow suppressed when investors possess superior private information.

[32] To estimate the component of flow attributable only to private information, it would be necessary to control for other idiosyncratic factors that can affect investors' investment and withdrawal decisions (e.g., their financial situations and liquidity needs) in equation (4.1). Although it is infeasible to control for such unobservable factors and thus it is unclear how much variation in $\tilde{\eta}_t$ is attributable to private information, two arguments alleviate this concern. First, if $\tilde{\eta}_t$ is driven mainly by other idiosyncratic factors, it would not have predictive power for future fund performance, as those factors are unlikely to be associated with future performance. Second, as private information and other idiosyncratic factors are unlikely to be highly correlated, $\tilde{\eta}_t$ (residual) can be interpreted as the impact of private information plus an orthogonal measurement error on flows. Then, any inference about the effects of $\tilde{\eta}_t$ on future fund performance would be biased toward zero. My estimation shows a substantial cross-sectional variation.

4.6. The Information-Asymmetry-Reducing Role of Mandatory Public Disclosures

My analyses so far suggest that mandatory public disclosures can increase redemption risk. While this inference might appear inconsistent with the information-asymmetry-reducing role of disclosures, it is based on average estimates. Accordingly, I explore the possibility of this role by examining a specific sample of funds in which information asymmetry among investors could be particularly problematic. Specifically, I examine the post-disclosure redemption behavior of less-informed investors (i.e., those who possess noisy private information) in funds owned mainly by more-informed investors (i.e., those who possess precise private information). In such funds, less-informed investors would worry more about their informational disadvantage in the absence of disclosures and be more likely to exit the fund when they observe decreases in asset size on fund websites. Mandatory disclosures, which contain detailed information about the fund, could mitigate such a concern and reduce redemption risk. I also expect that this effect will be stronger when investors bear lower negative externalities from other investors' redemptions (i.e. when the coordination role of disclosures is weaker).

The precision of private information is measured by the investor type (retail or institutional investors) and the statistical metric as explained in Section 4.5. I designate funds with more than 75% institutional ownership as those held mainly by more-informed investors. I use liquid funds as a proxy for weaker negative externalities, as explained in Section 4.4. The same methodology is used with the statistical metric. For comparison purposes, I examine the post-disclosure behavior of less-informed investors in funds held mainly by less-informed investors in which asymmetric information problems among the funds' investors would be small.

Table 8 presents the results. I find that in funds with more than 75% institutional ownership, the flow-performance function of retail investors does not move after disclosures (column (1)); however, in the case of liquid funds, the function shifts upwards (column (2)). In funds with less than 25% institutional ownership, the flow-performance function of retail investors shifts downwards as previously found (column (3)). Similar patterns emerge when I use the statistical metric (columns (4) to (6)). These results indicate that mandatory public disclosures reduce redemption risk to some extent by mitigating the adverse effects of information asymmetry.

5. Conclusion

The redemption risk of mutual funds has been one of the most critical items on the post-crisis financial policy agenda. Despite the potentially crucial yet ambiguous effects of transparency on financial stability, this issue has remained empirically unexplored for the fast-growing mutual fund sector. This paper provides large-sample evidence that an increase in transparency, as captured by mutual funds' mandatory periodic public disclosures, can increase redemption risk by elevating the performance sensitivity of individual fund investors and aggravating the coordination problem among the investors. This paper also identifies a specific situation in which the effect of transparency flips. When information asymmetry among fund investors is particularly problematic but the coordination problem is not severe, disclosures reduce redemption risk to some extent. Although this study does not provide a definitive conclusion on the net desirability of transparency for the entire mutual fund sector (as it does not fully examine the potential benefits of transparency), the multi-faceted role of disclosures documented herein would inform the ongoing debate on the role of transparency in financial stability.

References

Acharya, V.V., Ryan, S.G., 2016. Banks' Financial Reporting and Financial System Stability. Journal of Accounting Research 54, 277–340.

Agarwal, V., Gay, G.D., Ling, L., 2014. Window Dressing in Mutual Funds. Review of Financial Studies 27.

Agarwal, V., Mullally, K.A., Tang, Y., Yang, B., 2015. Mandatory Portfolio Disclosure, Stock Liquidity, and Mutual Fund Performance. Journal of Finance 70, 2733–2776.

Agarwal, V., Vashishtha, R., Venkatachalam, M., 2018. Mutual Fund Transparency and Corporate Myopia. Review of Financial Studies 31, 1966–2003.

Balakrishnan, K., Ertan, A., 2018. Banks' Financial Reporting Frequency and Asset Quality. The Accounting Review 93, 1–24.

Balakrishnan, K., Mukhopadhyay, T., Shivakumar, L., 2018. Disclosure of Mutual Fund Holdings and Insider Trading Profitability. Working Paper.

Banerjee, S., Maier, M., 2016. Public Information Precision and Coordination Failure: An Experiment. Journal of Accounting Research 54, 941–985.

Barber, B.M., Huang, X., Odean, T., 2016. Which Factors Matter to Investors? Evidence from Mutual Fund Flows. Review of Financial Studies 29, 2600–2642.

Barber, B.M., Odean, T., 2012. The Behavior of Individual Investors. Handbook of the Economics of Finance, Volume 2B. Edited by George M. Constantinides Milton Harris Rene M. Stulz.

Benartzi, S, Thaler, R.H., 1995. Myopic Loss Aversion and the Equity Premium Puzzle. The Quarterly Journal of Economics 110, 73–92.

Chen, Q., Goldstein, I., Huang, Z., Vashishtha, R., 2021. Bank Transparency and Deposit Flows. Working Paper.

Chen, Q., Goldstein, I., Jiang, W., 2010. Payoff complementarities and financial fragility: Evidence from mutual fund outflows. Journal of Financial Economics 97, 239–262.

Chen, Y., Qin, N., 2017. The Behavior of Investor Flows in Corporate Bond Mutual Funds. Management Science 65, 1365–1381.

Chevalier, J., Ellison, G., 1997. Risk Taking by Mutual Funds as a Response to Incentives. Journal of Political Economy 105, 1167–1200.

Choi, S.J., Kahan, M., 2006. The Market Penalty for Mutual Fund Scandals. Boston University Law Review 87, 1021–1057.

Christensen, H.B., Floyd, E., Liu, L.Y., Maffett, M., 2017. The Real Effects of Mandated Information on Social Responsibility in Financial Reports: Evidence from Mine-safety Records. Journal of Accounting and Economics 64, 284–304.

Christoffersen, S.E.K., Musto, D.K., Wermers, R., 2014. Investor Flows to Asset Managers: Causes and Consequences. Annual Review of Financial Economics 6, 289–310.

Coval, J., Stafford, E., 2007. Asset Fire Sales (and Purchases) in Equity Markets. Journal of Financial Economics 86, 479–512.

Fratzscher, M., 2012. Capital Flows, Push versus Pull Factors and the Global Financial Crisis. Journal of International Economics 88, 341–356.

FSB (Financial Stability Board), 2017. Policy Recommendations to Address Structural Vulnerabilities from Asset Management Activities, 12 January 2017.

Geoffroy, R., 2018. Electronic Proxy Statement Dissemination and Shareholder Monitoring. Working Paper.

Goldstein, I., Jiang, H., Ng, D.T., 2017. Investor Flows and Fragility in Corporate Bond Funds. Journal of Financial Economics 126, 592–613 .

Goldstein, I., Sapra, H., 2013. Should Banks' Stress Test Results be Disclosed? An Analysis of the Costs and Benefits. Foundations and Trends in Finance 8, 1–54.

Granja, J., 2018. Disclosure Regulation in Commercial Banking: Lessons from the National Banking Era. Journal of Accounting Research 56, 173–216.

Gruber, M., 1996. Another Puzzle: The Growth in Actively Managed Mutual Funds. Journal of Finance 51, 783–810.

Hanouna, P., Novak, J., Riley, T., Stahel, C., 2015. Liquidity and Flows of U.S. Mutual Funds. White Paper, The Division of Economic and Risk Analysis of the U.S. Securities and Exchange Commission.

Hellwig, C., 2002. Public Information, Private Information, and the Multiplicity of Equilibria in Coordination Games. Journal of Economic Theory 107, 191–222.

Huang, J., Wei, K.D., Yan, H., 2007. Participation Costs and the Sensitivity of Fund Flows to Past Performance. Journal of Finance 62, 1273–1311.

ICI (Investment Company Institute), 2006. Understanding Investor Preferences for Mutual Fund Information.

ICI (Investment Company Institute), 2021. Investment Company Fact Book. A Review of Trends and Activities in the Investment Company Industry.

IMF (International Monetary Fund), 2015. Global Financial Stability Report April 2015: Navigating Monetary Policy Challenges and Managing Risks.

Ivkovic, Z., Weisbenner, S., 2009. Individual Investor Mutual Fund Flows. Journal of Financial Economics 92, 223–237.

Lou, D., 2012. A Flow-Based Explanation for Return Predictability. Review of Financial Studies 25, 3457–3489.

Manconi, A., Massa, M., Yasuda, A., 2012. The Role of Institutional Investors in Propagating the Crisis of 2007–2008. Journal of Financial Economics 104, 491–518.

McCabe, P.E., 2009. The Economics of the Mutual Fund Trading Scandal. Finance and Economics Discussion Series, Divisions of Research & Statistics and Monetary Affairs, Federal Reserve Board.

Metz, C.E., 2002. Private and Public Information in Self–fulfilling Currency Crises. Journal of Economics 76, 65–85.

Morris, S., Shim, I., Shin, H.S., 2017. Redemption Risk and Cash Hoarding by Asset Managers. Journal of Monetary Economics 89, 71–87.

Morris, S., Shin, H.S., 1998. Unique Equilibrium in a Model of Self–Fulfilling Currency Attacks. American Economic Review 88, 587–597.

Morris, S., Shin, H.S., 2004. Coordination Risk and the Price of Debt. European Economic Review 48, 133–153.

Morris, S., Shin, H.S., 2006. Global Games: Theory and Applications. Advances in Economics and Econometrics: Theory and Applications, Eighth World, Vol. 1, Edited by Mathias Dewatripont, Lars Peter Hansen, and Stephen J. Turnovsky, Cambridge University Press, 56–114.

Nagar, V., Yu, G., 2014. Accounting for Crises. American Economic Journal: Macroeconomics 6, 184–213.

OFR (Office of Financial Research), 2013. Asset Management and Financial Stability. Analysis Report September 2013, The Office of Financial Research of the Department of Treasury.

Robinson, P.M., 1988. Root-N-Consistent Semiparametric Regression. Econometrica 56, 931–954.

Schmidt, L., Timmermann, A., Wermers, R., 2016. Runs on Money Market Mutual Funds. American Economic Review 106, 2625–2657.

SEC (Securities and Exchange Commission), 2004. Shareholder Reports and Quarterly Portfolio Disclosure of Registered Management Investment Companies. Federal Register Vol. 69, No. 46 .

SEC (Securities and Exchange Commission), 2009a. Enhanced Disclosure and New Prospectus Delivery Option for Registered Open-End Management Investment Companies. Federal Register Vol. 74, No. 15.

SEC (Securities and Exchange Commission), 2009b. Interactive Data To Improve Financial Reporting. Federal Register Vol. 74, No. 26.

SEC (Securities and Exchange Commission), 2014. Money Market Fund Reform: Amendments to Form PF. Federal Register Vol. 79, No. 157.

SEC (Securities and Exchange Commission), 2016a. Investment Company Reporting Modernization. Federal Register Vol. 81, No. 223.

SEC (Securities and Exchange Commission), 2016b. Investment Company Liquidity Risk Management Programs. Federal Register Vol. 81, No. 223.

SEC (Securities and Exchange Commission), 2016c. Investment Company Swing Pricing. Federal Register Vol. 81, No. 223.

Sirri, E.R., Tufano, P., 1998. Costly Search and Mutual Fund Flows. Journal of Finance 53, 1589–1622.

Vives, X., 2014. Strategic Complementarity, Fragility, and Regulation. Review of Financial Studies 27, 3547–3592.

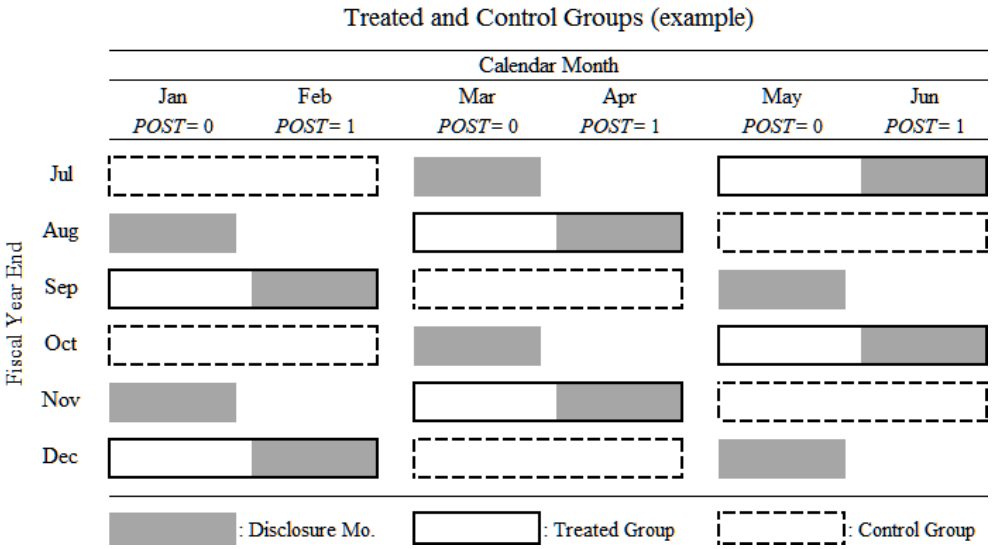
Appendix A
Variable Definition

Variable	Definition
FLOW	Percentage change in total net assets from the prior month, excluding the effects of fund returns and fund mergers (estimated for each share class in each month): $FLOW_{i,t} = [TNA_{i,t} - TNA_{i,t-1} - (TNA_{i,t-1} \times RET_{i,t}) - MGN_{i,t}] \div TNA_{i,t-1}$, where $TNA_{i,t}$ is total net assets of share class i at the end of month t, $RET_{i,t}$ is its return during month t (rate of change in its net asset value including reinvested dividends, i.e., price per share), and $MGN_{i,t}$ is an increase in total net assets that arises from fund mergers in month t.
PERF	Three-month average of monthly style-adjusted returns in percentages (estimated for each share class in each month). The monthly style-adjusted return of each share class is its return minus the cross-sectional average of returns of all other share classes that follow the same investment style.
DISC	An indicator that switches on in the month of mandatory public disclosures.
POST	An indicator that switches on in either even or odd calendar months.
TREAT	An indicator that switches on when the fund is required to disclose in the even or odd month, depending on the fund's fiscal year-end.
***Fundamentals*:**	
Size	Natural log of total net assets in million dollars.
Age	Natural log of the number of years since the fund's inception.
Expense	Management fee and operating expenses (marketing and distribution expenses and general administrative expenses) as a percentage of total net assets.
Front Load	Average sales charge as a percentage of total net assets.
Rear Load	Average redemption fee and contingent deferred sales charge as a percentage of total net assets.
Distribution	Capital and dividend distribution amount as a percentage of total net assets.
Return Volatility	Standard deviation of fund returns over 12 months in percentages.
Portfolio Holdings	Natural log of the number of securities held by the fund.
Portfolio Turnover	Aggregated security sales or purchase amounts (the minimum of the two amounts) divided by average total net assets.
Cash Govi Portion	The percentage of fund assets held in cash and government securities.
Illiquid Securities	An indicator that switches on if the fund invests primarily in the following assets: small and micro-cap equities (domestic and foreign), foreign equities in China and emerging markets (India, Latin America, and the Asia-Pacific region excluding Japan), high yield corporate bonds, and emerging market debts.
***Information*:**	
Public Disc Precision	An indicator that switches on if a certified shareholder report is disclosed.
Private Info Precision	Measured by three proxies: (i) broker funds (an indicator that switches on if the fund is sold by brokers); (ii) institutional investors (an indicator that switches on for institutional share classes); (iii) a statistical metric that estimates the extent to which the component of fund flows driven by private information predicts future fund performance. (See Section 4.5 for details.)

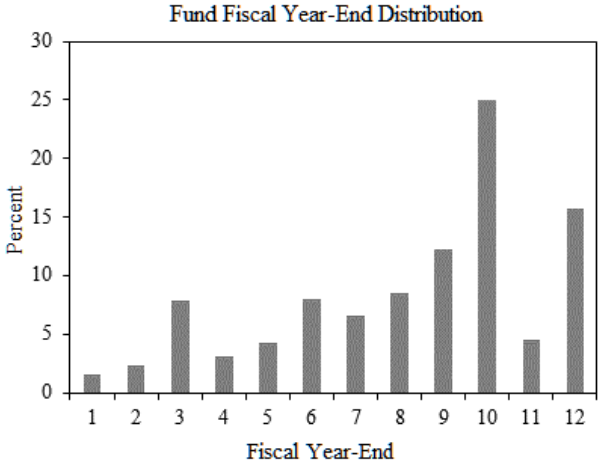
Data source: CRSP Mutual Fund Database, EDGAR index files, Kenneth French's website, the Chicago Board Options Exchange, and the Federal Reserve Statistical Release.

Appendix B

Quasi-Experiment Design



Note: *POST* is an indicator that switches on in even calendar months. For the two-month period from January to February (during which *POST* turns on in February), funds with a December fiscal year-end are classified into the treated group as they are required to disclose in February. In contrast, funds with an October fiscal year-end fall into the control group as they do not have disclosure requirements over the period (they disclosed in December, and the next disclosure month is March). The treated and control groups trade places in the next periods. From March to April (during which *POST* turns on in April), the December year-end funds become the control group since they do not disclose over the period (they disclosed in February, and the next disclosure month is May). The October year-end funds are excluded from the sample as their disclosure occurs in the pre-period (i.e., March). Similarly, from May to June (during which *POST* turns on in June), the October year-end funds become the treated group, and the December year-end funds are excluded from the sample. The same procedure applies to funds with other fiscal year-ends and the two-month periods ending in odd calendar months.



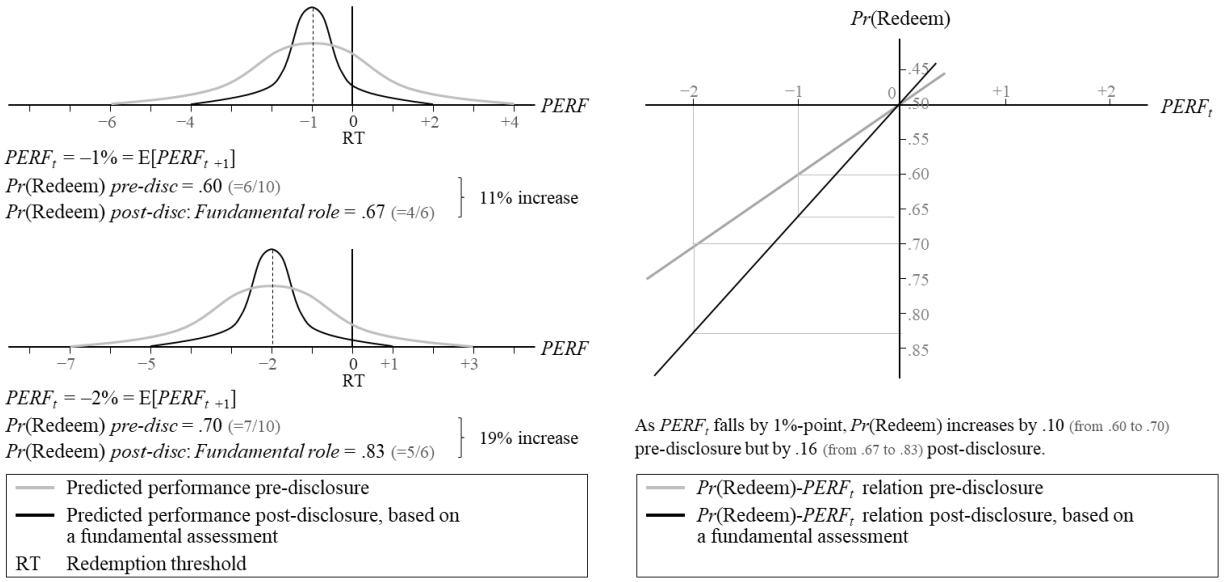
Note: Funds' fiscal year-ends are relatively well distributed, except the large portion of October fiscal year-ends. Section 4.2.2 performs a sensitivity analysis that excludes October year-end funds.

Figure 1

Three Roles of Mandatory Public Disclosures

This figure explains how a representative investor L would change her redemption decision after the fund's mandatory public disclosures due to the fundamental, coordination, and information-asymmetry-reducing roles of disclosures. The corresponding empirical predictions are provided. (For simplicity, the probabilities of redemption are calculated assuming that L's predicted fund performance follows a uniform distribution.)

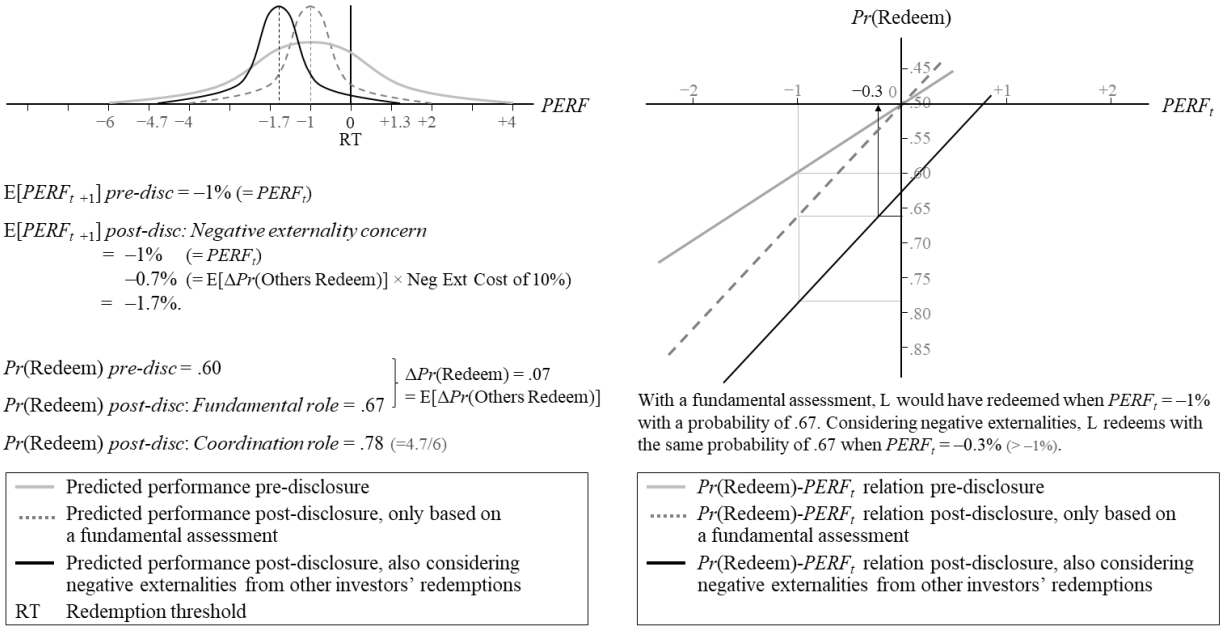
Panel A. Fundamental Role



Note: The fund reports a loss of 1% in the current period ($PERF_t$) on its website (see the left-upper side of the figure). Using this information, L predicts the next period fund performance ($PERF_{t+1}$) to range from −6% to +4%, with the mean of −1% (the best predictor of the near-future performance is the past performance due to the momentum feature of fund performance). L's redemption threshold (RT) is 0%. Then, L redeems her fund shares with a probability of .60 (=6/10). L now receives the fund's mandatory financial report that contains detailed fundamental information, such as the portfolio holdings schedule. Using this additional information, L narrows her prediction down to −4% to +2%, with the same mean of −1% (L does not shift the mean in a particular direction as she already knows the most recent performance, the best predictor; historical yet more detailed information in the financial report helps a more precise prediction). Then, L redeems with a probability of .67 (=4/6). Note that L's redemption probability increases by 11% from .60 pre-disclosure to .67 post-disclosure. Also note that if the fund incurs a larger loss of 2% (see the left-bottom side of the figure), her redemption probability will increase by 19%, which is higher than 11%. To draw the relation between redemption probability and past performance (see the right side of the figure), the post-disclosure increases in redemption probability correspond to the increase in the slope of the line. We can also see that as performance falls by 1%-point, L's redemption probability increases by .10 before the disclosure but by .16 after the disclosure. L becomes more sensitive to bad performance after the disclosure as she makes a more precise performance prediction based on a better fundamental assessment. From the fund's perspective, the fund suffers increasingly more outflows as performance gets worse.

To empirically identify this fundamental role of disclosures, I estimate the relation between flow and past performance, i.e., the flow-performance function, in which the estimated net outflow approximates the average redemption probability in the sample, and test if the slope of the function increases after disclosures. (Its intercept would not significantly change in one particular direction, because investors *on average* should make an unbiased prediction after disclosures.) See Figure 2 for the estimated flow-performance functions.

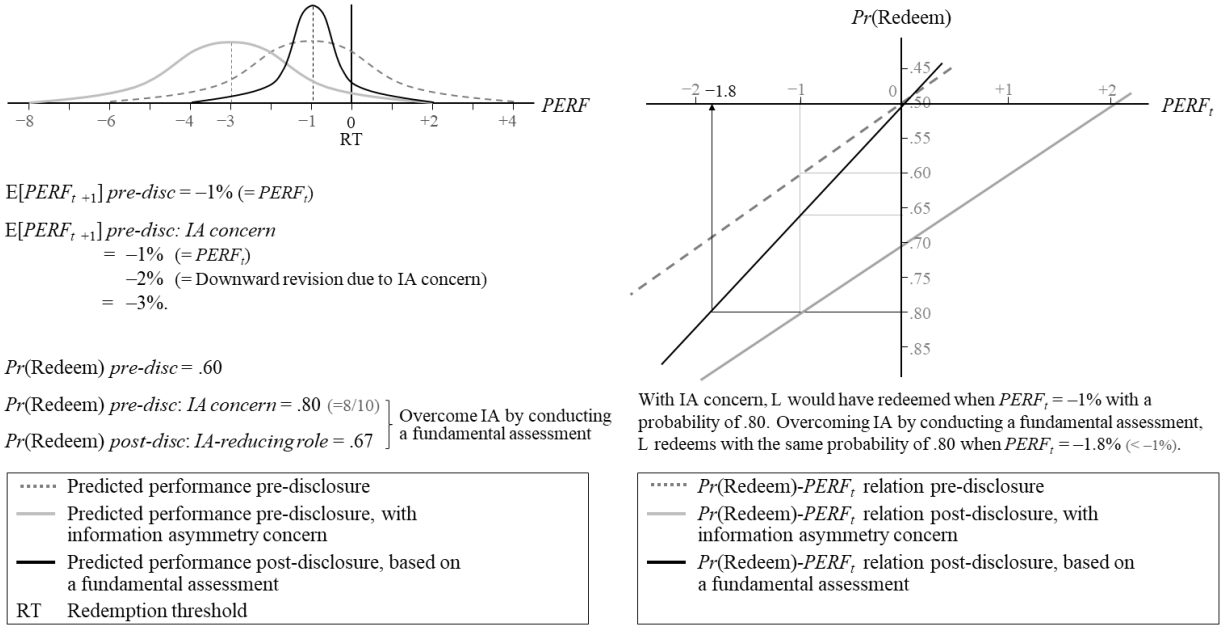
Panel B. Coordination Role



Note: In addition to the fund's fundamentals, L also considers other investors' redemptions and the resulting negative externalities (a potential decline in future fund performance due to asset liquidation costs following others' redemptions). After the disclosure, as L becomes more likely to redeem her fund shares (due to the fundamental role), she expects that other investors will become more likely to redeem their shares as well. Accordingly, L assesses the potential negative externalities as greater and revises her predicted performance downwards, i.e., lowers its mean (note that its post-disclosure distribution moves to the left on the left side of the figure). As a result, L becomes even more likely to redeem. Suppose that the average liquidation cost from investors' redemptions is 10%. As her redemption probability increases by .07 (from .60 to .67) with the post-disclosure fundamental assessment, L expects that others' redemption probabilities will increase by the same degree. Accordingly, L assess potential liquidation cost as higher by 0.7%-point (=.07 × 10%) and deducts this expected cost from the previous predicted performance. The range of predicted performance is revised to −4.7% (−4%−0.7%) to +1.3% (+2%−0.7%), with the mean of −1.7% (−1%−0.7%). L now redeems with a probability of .78 (=4.7/6), which is higher than .67 (the redemption probability only due to the fundamental role). The coordination role amplifies the fundamental role in increasing redemption risk. In the redemption-probability-past-performance space (on the right side of the figure), the downward revision of the predicted performance corresponds to the the downward shift of the line (the decrease in y-intercept, or equivalently the increase in x-intercept). We can also see that considering the negative externalities, L would redeem when the past performance is −0.3% with a probability of .67, which is the redemption probability under the past performance of −1% only based on the fundamental assessment. L redeems at a higher level of performance after the disclosure as she expect other investors will be more likely to redeem and thus worries more about the negative externalities from their redemptions.

To empirically identify this coordination role of disclosures, I test if the y-intercept of the flow-performance function decreases after disclosures. (Its slope would also increase as investors expect others' redemption probabilities to increase as fund performance declines. As this is not clearly discernable from the fundamental role, I focus on the intercept change to identify the coordination role). See Figure 2 for the estimated flow-performance functions.

Panel C. Information-Asymmetry-Reducing Role



Note: L also considers other investors' redemptions, but in a different way from the coordination motive. Before the disclosure, observing a decrease in the fund's asset size on its website, L conjectures that other investors have negative private information about the fund (i.e., others withdraw capital as they privately know that the fund will suffer a larger loss). L does not possess such private information and feels informationally disadvantaged (even when L has such private information, she can still be concerned about the information asymmetry as she cannot observe other investors' private information). Accordingly, L revises her predicted performance downwards, i.e., lowers its mean (note that its pre-disclosure distribution moves to the left on the left side of the figure), and becomes highly inclined to exit the fund. When provided with the mandatory financial report that contains detailed information about the fund, L becomes less concerned about the information asymmetry by conducting fundamental analyses. As a result, L becomes less inclined to exit the fund (note that the distribution of predicted performance moves to the right after the disclosure). Suppose that when the fund reports a loss of 1% in the current period, L predicts fund performance to be –6% to +4% before the disclosure without the information asymmetry concern (as in the Panel A). However, concerned about other investors' informational advantages, L revises her prediction downwards to –8% to +2% (the discount of 2%) and end up redeeming with probability of 0.80 (=8/10). After the disclosure, L performs a fundamental assessment and redeems with a probability of 0.67 (as in the Panel A). Note that L's redemption probability decreases from 0.80 to 0.67. In the redemption-probability-past-performance space (on the right side of the figure), this decrease corresponds to the the upward shift of the line (the increase in y-intercept, or equivalently the decrease in x-intercept). We can also see that with information asymmetry concern, L would redeem when the past performance is −1% with a probability of .80. Examining fund fundamentals, L redeems with the same probability of .80 when the past performance is −1.8%. L redeems at a lower level of performance after the disclosure as she overcomes her informational disadvantages by a fundamental assessment.

To empirically identify this information-asymmetry-reducing role of disclosures, I test if the y-intercept of the flow-performance function increases after disclosures. (It is less clear how the slope will change. As fund performance falls, investors would become more sensitive to performance, but disclosures would help investors overcome information asymmetry to a larger extent. I focus on the intercept change to identify the information-asymmetry-reducing role.) See Figure 2 for the estimated flow-performance functions.

Figure 2

Semiparametric Analysis

This figure plots the pre- and post-disclosure flow-performance functions estimated using semiparametric regressions of fund flows on past fund performance and other fundamental characteristics. The sample includes actively-managed U.S. equity and corporate bond mutual funds from 2000 to 2017. The unit of observation is fund share class-month. The vertical y-axis is $FLOW$, which is net fund flow measured by the percentage change in total net assets from the prior month excluding the effects of fund returns and fund mergers. The horizontal x-axis is $PERF$, which is one-month lagged fund performance measured by the three-month average of monthly style-adjusted returns in percentages. The semiparametric regression technique is introduced by Robinson (1988) and used by Chevalier and Ellison (1997) to study the (non-linear) flow-performance relation of mutual funds.

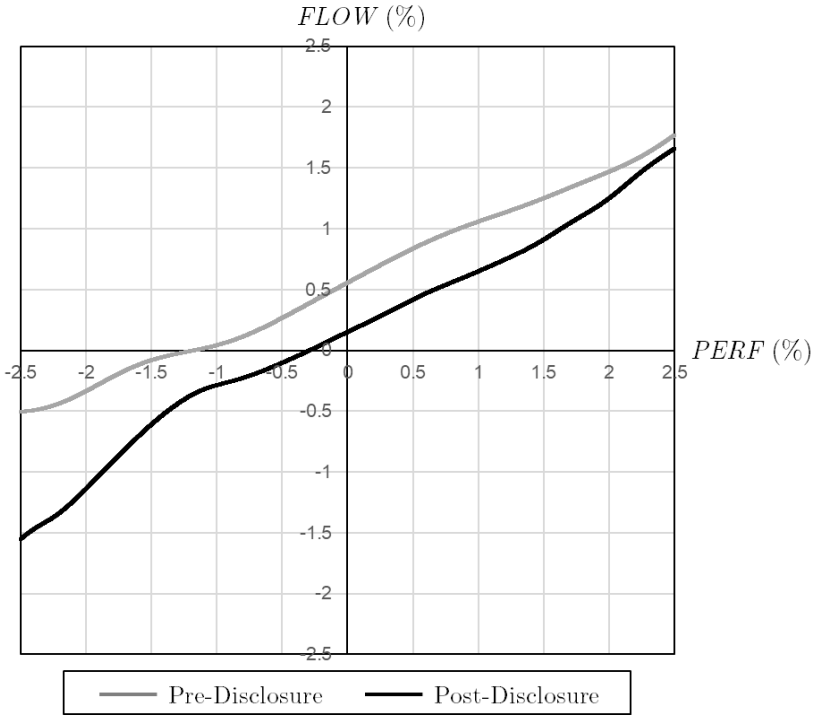


Table 1

Summary Statistics

This table presents summary statistics. Panel A reports descriptive statistics. Panel B reports the correlation matrix in which the lower (upper) diagonal reports Pearson (Spearman) calculations. The sample includes actively-managed U.S. equity and corporate bond mutual funds from 2000 to 2017. The unit of observation is fund share class-month. *FLOW* is fund flow measured by the percentage change in total net assets from the prior month, excluding the effects of fund returns and fund mergers. *PERF* is fund performance measured by the three-month average of monthly style-adjusted returns in percentages. All other variables are defined in Appendix A.

Panel A. Descriptive Statistics

	Mean	Std Dev	P1	P10	P50	P90	P99	N
FLOW	1.012	11.884	-37.726	-1.694	-0.101	2.163	39.336	1,781,135
PERF	0.003	0.764	-2.254	-0.296	0.002	0.305	2.259	1,781,135
Size	3.368	2.357	-1.609	1.668	3.398	5.053	8.638	1,781,135
Age	1.588	1.046	-1.389	0.136	1.767	2.758	3.381	1,781,135
Expense	1.317	0.615	0.050	0.900	1.250	1.720	2.850	1,781,135
Front Load	0.466	1.073	0.000	0.000	0.000	0.000	3.393	1,781,135
Rear Load	0.285	0.517	0.000	0.000	0.000	0.333	2.143	1,781,135
Distribution	4.501	23.862	0.000	0.000	0.000	0.000	35.630	1,781,135
Return Volatility	3.876	2.386	0.291	2.287	3.472	5.088	11.452	1,781,135
Portfolio Holdings	4.756	1.452	1.386	3.045	4.574	6.856	7.628	1,781,135
Portfolio Turnover	0.558	0.376	0.030	0.174	0.519	1.004	1.911	1,781,135
Cash Govi Portion	5.370	28.688	-11.270	1.300	3.239	6.380	57.820	1,781,135
Illiquid Securities	0.238	0.426	.	.	.	.	.	1,781,135

Panel B. Correlation Matrix

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
(1)	*FLOW*		0.09	0.04	-0.21	-0.08	0.01	-0.07	0.03	-0.05	-0.02	-0.05	0.07	-0.01
(2)	*PERF*	0.08		0.05	0.02	-0.01	0.00	-0.03	0.01	-0.01	0.02	0.00	0.00	0.01
(3)	*Size*	0.06	0.04		0.46	0.14	0.03	-0.10	0.05	-0.02	0.10	-0.08	0.00	0.02
(4)	*Age*	-0.18	0.01	0.46		0.18	0.01	0.01	0.02	0.01	0.06	-0.01	-0.07	0.04
(5)	*Expense*	-0.06	-0.01	0.28	0.31		0.06	0.19	-0.12	0.21	0.08	0.06	0.08	0.18
(6)	*Front Load*	0.01	0.00	0.03	0.01	0.02		-0.04	-0.01	0.03	0.01	0.01	0.02	0.01
(7)	*Rear Load*	-0.05	-0.02	-0.08	0.02	0.09	-0.08		-0.02	0.07	0.02	0.02	0.07	0.09
(8)	*Distribution*	0.00	0.01	0.04	0.04	0.03	0.00	0.00		-0.36	0.14	0.07	0.02	0.07
(9)	*Return Volatility*	-0.02	-0.03	-0.02	0.01	0.09	0.03	0.06	-0.03		0.03	0.02	0.00	0.12
(10)	*Portfolio Holdings*	-0.02	0.00	0.08	0.03	0.13	0.01	0.07	0.01	0.08		0.23	-0.02	0.15
(11)	*Portfolio Turnover*	-0.02	-0.02	-0.07	-0.03	0.07	0.01	0.02	-0.02	-0.02	0.19		0.00	0.05
(12)	*Cash Govi Portion*	0.02	-0.01	-0.01	-0.07	0.05	0.02	0.02	-0.01	-0.02	-0.01	0.06		0.08
(13)	*Illiquid Securities*	-0.01	0.00	0.02	0.03	0.13	0.01	0.05	0.02	0.12	0.11	0.01	0.02	

Table 2

Event Study

This table presents the results of the event study that tests changes in the flow-performance function from one month prior to mandatory periodic public disclosures (the pre-disclosure period) to the month of the disclosures (the post-disclosure period). The sample includes actively-managed U.S. equity and corporate bond mutual funds from 2000 to 2017. The unit of observation is fund share class-month. The dependent variable, *FLOW*, is fund flow measured by the percentage change in total net assets from the prior month, excluding the effects of fund returns and fund mergers. *PERF* is one-month lagged fund performance measured by the three-month average of monthly style-adjusted returns in percentages. *DISC* is an indicator that switches on in the month of disclosures. All other variables are defined in Appendix A. Columns (1) and (2) show the results for all ranges of fund performance, without and with fixed effects, respectively. Columns (3) and (4) show the results for negative and positive performance, respectively, with fixed effects (using zero performance as a proxy for investors' redemption threshold). *T*-statistics (in parentheses) are robust to within-share class and within-month correlation as well as heteroscedasticity. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

	All Performance Range		By Performance Sign	
	without FEs	with FEs	$PERF < 0$	$PERF \geq 0$
	(1)	(2)	(3)	(4)
Intercept	1.898***			
	(62.07)			
PERF	0.351***	0.299***	0.196***	0.322***
	(35.34)	(11.27)	(6.12)	(9.10)
DISC	-0.056***	-0.070***	-0.128***	-0.016
	(-4.32)	(-2.73)	(-4.16)	(-0.42)
PERF × *DISC*	0.087***	0.082***	0.061**	0.046
	(6.17)	(3.54)	(2.04)	(1.17)

(Continued overleaf)

(Continued from the previous page)

	(1)	(2)	(3)	(4)
***Fundamentals*:**				
Size	0.427***	0.504***	0.540***	0.445***
	(96.09)	(23.84)	(22.44)	(21.46)
Age	-1.292***	-1.415***	-1.631***	-1.236***
	(-150.03)	(-37.54)	(-37.02)	(-31.13)
Expense	-0.002***	-0.005***	-0.007***	-0.004***
	(-16.36)	(-11.01)	(-11.57)	(-6.61)
Front Load	0.012*	-0.082***	-0.107***	-0.056***
	(1.77)	(-6.01)	(-6.85)	(-3.62)
Rear Load	-0.257***	-0.494***	-0.476***	-0.540***
	(-22.25)	(-15.64)	(-14.29)	(-14.69)
Distribution	0.004***	0.004***	0.003*	0.004***
	(9.44)	(3.34)	(1.92)	(4.12)
Return Volatility	-0.016***	-0.065***	-0.075***	-0.082***
	(-5.70)	(-3.66)	(-3.97)	(-3.64)
Portfolio Holdings	-0.045***	-0.072***	-0.069**	-0.072***
	(-9.65)	(-3.32)	(-2.59)	(-2.89)
Portfolio Turnover	-0.218***	-0.032	-0.111	0.079
	(-11.69)	(-0.52)	(-1.49)	(0.95)
Cash Govi Portion	0.003***	0.011***	0.009***	0.014***
	(4.53)	(7.01)	(4.45)	(6.34)
Lagged Flow	0.216***	0.179***	0.146***	0.187***
	(138.20)	(34.81)	(23.93)	(35.28)
***Information*:**				
Public Disc Precision	0.087***	0.012	0.009	0.016
	(7.11)	(0.67)	(0.43)	(0.68)
Private Info Precision	-0.137***	-0.214***	-0.154***	-0.280***
	(-9.62)	(-5.47)	(-3.50)	(-6.27)
Comp-Fund FEs	No	Yes	Yes	Yes
Nov/Dec-Post FEs	No	Yes	Yes	Yes
Year-Quarter FEs	No	Yes	Yes	Yes
Observations	1,075,204	1,075,204	539,290	535,914
Adj. R-squared	0.127	0.160	0.155	0.171

Table 3

Quasi-Experiment

This table presents the results of the quasi-experiment that tests changes in the flow-performance function of funds that disclose (treated), relative to changes in the flow-performance function of funds that do not disclose (control), over the same two-month periods ending in either even or odd calendar months (see Appendix B for details). The sample includes actively-managed U.S. equity and corporate bond mutual funds from 2000 to 2017. The unit of observation is fund share class-month. *POST* is an indicator that switches on in either even or odd calendar months. *TREAT* is an indicator that switches on if the fund discloses in the month when *POST* switches on. The dependent variable, *FLOW*, and the independent variable, *PERF*, are the same as in Table 2, and all other regressors are included. See Appendix A for variable definitions. Columns (1) to (3) (columns (4) to (6)) shows the results for the two-month periods ending in even (odd) calendar months. *T*-statistics (in parentheses) are robust to within-share class and within-month correlation as well as heteroscedasticity. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

	POST = Even Calendar Month			*POST* = Odd Calendar Month		
	All *PERF*	*PERF* < 0	*PERF* ≥ 0	All *PERF*	*PERF* < 0	*PERF* ≥ 0
	(1)	(2)	(3)	(4)	(5)	(6)
PERF	0.896***	0.191***	1.292***	1.046***	0.195**	1.730***
	(22.05)	(2.66)	(9.12)	(21.36)	(2.07)	(11.69)
TREAT	0.089**	0.116	-0.085	0.147***	0.142*	0.161*
	(2.14)	(1.55)	(-0.92)	(3.19)	(1.73)	(1.68)
PERF × *TREAT*	-0.033	-0.099	0.170	-0.137*	-0.016	-0.178
	(-0.67)	(-1.14)	(1.27)	(-1.74)	(-0.16)	(-1.21)
POST	-0.028	0.020	-0.143	0.002	0.046	0.138
	(-0.74)	(0.28)	(-1.17)	(0.05)	(0.60)	(1.22)
PERF × *POST*	0.013	0.097	0.039	-0.098*	0.111	-0.071*
	(0.26)	(1.12)	(0.18)	(-1.72)	(1.09)	(-1.67)
TREAT × *POST*	-0.274***	-0.208**	-0.085	-0.183***	-0.277***	-0.146
	(-5.41)	(-2.27)	(-0.68)	(-3.55)	(-2.91)	(-0.27)
PERF × *TREAT* × *POST*	0.149**	0.251**	0.013	0.121*	0.217*	0.056
	(2.08)	(2.16)	(0.07)	(1.74)	(1.80)	(0.80)
Fundamentals	Yes	Yes	Yes	Yes	Yes	Yes
Information	Yes	Yes	Yes	Yes	Yes	Yes
Comp-Fund FEs	Yes	Yes	Yes	Yes	Yes	Yes
Nov/Dec-Post FEs	Yes	Yes	Yes	Yes	Yes	Yes
Year-Quarter FEs	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,173,112	582,996	590,116	1,086,714	538,524	548,190
Adj. R-squared	0.139	0.126	0.161	0.134	0.120	0.154

Table 4

Sensitivity Analyses and Examination of Disclosure Contents

This table presents the results of sensitivity analyses for the event study presented in Table 2 and the result of the examination of disclosure contents. The sample includes actively-managed U.S. equity and corporate bond mutual funds with negative performance (except columns (4) and (5)) from 2000 to 2017. The unit of observation is fund share class-month. The dependent variable, *FLOW*, and the independent variables of interest, *PERF* and *DISC*, are the same as in Table 2 (except the alternative performance measures used in columns (2) and (3)). All other regressors are included as in Table 2 (except the public disclosure precision in columns (8) and (9)). See Appendix A for variable definitions. Column (1) shows the result for a subsample of funds that are closed to new investors and thus have no inflows. Columns (2) and (3) show the results for alternative performance measures, one-month style-adjusted return and alpha from a one-factor market model, respectively. Columns (4) and (5) show the results for performance below and above the estimated investors' redemption thresholds (the estimated x-intercept from rolling regressions of flow on performance for each share class and month), respectively. Columns (6) and (7) show the results for subsamples that exclude October fiscal year-end funds and the global financial crisis period, respectively. Columns (8) and (9) show the results for funds that release certified shareholder reports and portfolio holding schedules, respectively. T-statistics (in parentheses) are robust to within-share class and within-month correlation as well as heteroscedasticity. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

PERF < 0	*FLOW*	*PERF*		Redemption Threshold		Sample		Disclosed Report Type	
except columns (4) and (5)	No inflows	One-month style-adj return	Alpha (one factor)	*PERF* < x-intercept	*PERF* ≥ x-intercept	Oct FYE funds excluded	2007-2009 excluded	Shareholder report	Holdings schedule
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
PERF	0.365***	0.055***	0.068***	0.193***	0.353***	0.272***	0.181***	0.180***	0.220***
	(4.89)	(3.69)	(2.91)	(5.52)	(9.12)	(16.25)	(5.30)	(5.10)	(6.66)
DISC	-0.170*	-0.161***	-0.165***	-0.115***	-0.009	-0.113***	-0.125***	-0.159***	-0.127***
	(-1.82)	(-5.52)	(-5.61)	(-3.43)	(-0.21)	(-4.27)	(-3.84)	(-3.67)	(-3.57)
PERF × *DISC*	0.048*	0.052***	0.043**	0.069**	0.056	0.059**	0.088***	0.077*	0.064*
	(1.67)	(3.00)	(2.13)	(2.16)	(1.33)	(2.57)	(2.63)	(1.91)	(1.66)
Fundamentals	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Information	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes, except *Public Disc Precision*	
Comp-Fund FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Nov/Dec-Post FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year-Quarter FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	34,034	539,290	539,290	522,564	519,674	406,168	477,044	297,252	242,038
Adj. R-squared	0.362	0.155	0.155	0.153	0.169	0.117	0.155	0.141	0.152

Table 5

The Fundamental Role of Mandatory Public Disclosures

This table presents the results of the event study that explores the fundamental role of mandatory public disclosures in increasing redemption risk. The sample includes actively-managed U.S. equity and corporate bond mutual funds with negative performance from 2000 to 2017. The unit of observation is fund share class-month. The sample is partitioned by three sets of proxies for the level of difficulty in assessing fund fundamentals. Columns (1) and (2) show the results for subsamples median-split by the number of portfolio holdings; columns (3) and (4) by portfolio turnover; columns (5) and (6) by the volatility of past returns. The dependent variable, *FLOW*, and the independent variables of interest, *PERF* and *DISC*, are the same as in Table 2, and all other regressors are included (except each variable used to partition the sample). See Appendix A for variable definitions. *T*-statistics (in parentheses) are robust to within-share class and within-month correlation as well as heteroscedasticity. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

PERF < 0	Portfolio Holdings		Portfolio Turnover		Return Volatility	
	High	Low	High	Low	High	Low
	(1)	(2)	(3)	(4)	(5)	(6)
PERF	0.108***	0.280***	0.102**	0.338***	0.189***	0.300***
	(2.79)	(5.54)	(2.56)	(7.18)	(5.21)	(4.85)
DISC	-0.132***	-0.133***	-0.121**	-0.148***	-0.140***	-0.125***
	(-3.10)	(-2.92)	(-2.18)	(-3.03)	(-3.00)	(-3.30)
PERF × *DISC*†	0.077**	0.047	0.135***	-0.037	0.088**	0.014
	(1.98)	(0.95)	(3.19)	(-0.80)	(2.40)	(0.28)
Fundamentals	Yes, except each variable used to partition the sample					
Information	Yes	Yes	Yes	Yes	Yes	Yes
Comp-Fund FEs	Yes	Yes	Yes	Yes	Yes	Yes
Nov/Dec-Post FEs	Yes	Yes	Yes	Yes	Yes	Yes
Year-Quarter FEs	Yes	Yes	Yes	Yes	Yes	Yes
Observations	269,568	269,722	270,442	268,848	269,644	269,646
Adj. R-squared	0.147	0.144	0.136	0.156	0.140	0.161
† *p*-value (coeff. dif.)	< 0.05		< 0.01		< 0.01	

Table 6

The Coordination Role of Mandatory Public Disclosures

This table presents the results of the event study that explores the coordination role of mandatory public disclosures in increasing redemption risk. The sample includes actively-managed U.S. equity and corporate bond mutual funds with negative performance from 2000 to 2017. The unit of observation is fund share class-month. The sample is partitioned by three sets of proxies for the extent of negative externalities from other investors' redemptions. Columns (1) and (2) show the results for subsamples split by the portion of cash and government securities balance to the fund' total assets (median split); columns (3) and (4) by the liquidity of investment securities determined by the fund's investment style; columns (5) and (6) by the asset class of the fund (corporate bonds vs. equities). The dependent variable, *FLOW*, and the independent variables of interest, *PERF* and *DISC*, are the same as in Table 2, and all other regressors are included (except each variable used to partition the sample). See Appendix A for variable definitions. *T*-statistics (in parentheses) are robust to within-share class and within-month correlation as well as heteroscedasticity. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

PERF < 0	Cash Govi Portion		Liquidity of Securities		Fund Asset Class	
	Low	High	Illiquid	Liquid	Bond	Equity
	(1)	(2)	(3)	(4)	(5)	(6)
PERF	0.245***	0.150***	0.168***	0.213***	0.157*	0.220***
	(5.80)	(3.80)	(3.57)	(8.49)	(1.66)	(9.52)
DISC†	-0.135***	-0.098**	-0.164***	-0.129***	-0.147**	-0.128***
	(-3.39)	(-2.41)	(-2.86)	(-4.70)	(-2.34)	(-4.73)
PERF × *DISC*	0.091**	0.082**	0.064	0.046*	0.184**	0.054**
	(1.98)	(2.18)	(1.20)	(1.68)	(2.10)	(2.06)
Fundamentals	Yes except each variable used to partition the sample					
Information	Yes	Yes	Yes	Yes	Yes	Yes
Comp-Fund FEs	Yes	Yes	Yes	Yes	Yes	Yes
Nov/Dec-Post FEs	Yes	Yes	Yes	Yes	Yes	Yes
Year-Quarter FEs	Yes	Yes	Yes	Yes	Yes	Yes
Observations	269,134	269,156	128,200	411,090	81,280	458,010
Adj. R-squared	0.134	0.153	0.141	0.159	0.157	0.156
† *p*-value (coeff. diff.)	< 0.05		< 0.01		< 0.01	

Table 7

The Role of Investors' Private Information

This table presents the results of the event study that examines the effects of the precision of fund investors' private information on redemption risk. The sample includes actively-managed U.S. equity and corporate bond mutual funds with negative performance from 2000 to 2017. The unit of observation is fund share class-month. The sample is partitioned by three proxies for the private information precision. Columns (1) and (2) show the results for subsamples split by the investors' access to brokers and financial advisors who have superior private knowledge about the fund (investors in broker-sold vs. direct-sold funds); columns (3) and (4) by the investors' access to professional information sources such as in-house research departments and professional networks (institutional vs. retail investors); columns (5) and (6) by the statistical metric developed based on the idea that capital flows from investors who possess more precise private information would predict future fund performance better (see Section 4.5). The dependent variable, *FLOW*, and the independent variables of interest, *PERF* and *DISC*, are the same as in Table 2, and all other regressors are included (except each variable used to partition the sample). See Appendix A for variable definitions. *T*-statistics (in parentheses) are robust to within-share class and within-month correlation as well as heteroscedasticity. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

PERF < 0	Broker vs Direct Funds		Inst'l vs Retail Investors		Statistical Metric	
	Broker	Direct	Inst'l	Retail	Precise	Noisy
	(1)	(2)	(3)	(4)	(5)	(6)
PERF	0.173***	0.193***	0.253***	0.169***	0.155***	0.232***
	(5.27)	(7.49)	(5.55)	(5.90)	(4.62)	(6.84)
DISC†	-0.096***	-0.136***	-0.096**	-0.139***	-0.118***	-0.129***
	(-2.73)	(-4.94)	(-2.02)	(-4.53)	(-3.15)	(-3.40)
PERF × *DISC*††	0.042	0.063**	0.041	0.065**	0.049	0.081**
	(1.21)	(2.26)	(0.74)	(2.27)	(1.28)	(2.16)
Fundamentals	Yes	Yes	Yes	Yes	Yes	Yes
Information	Yes except *Private Info Precision*					
Comp-Fund FEs	Yes	Yes	Yes	Yes	Yes	Yes
Nov/Dec-Post FEs	Yes	Yes	Yes	Yes	Yes	Yes
Year-Quarter FEs	Yes	Yes	Yes	Yes	Yes	Yes
Observations	185,602	353,688	208,554	330,736	268,878	270,412
Adj. R-squared	0.135	0.137	0.105	0.194	0.147	0.144
† *p*-value (coeff. diff.)	< 0.01		< 0.01		> 0.10	
†† *p*-value (coeff. diff.)	< 0.10		< 0.05		< 0.05	

Table 8

The Information-Asymmetry-Reducing Role of Mandatory Public Disclosures

This table presents the results of the event study that explores the information-asymmetry-reducing role of mandatory public disclosures in reducing redemption risk. The sample includes actively-managed U.S. equity and corporate bond mutual funds with negative performance from 2000 to 2017. The unit of observation is fund share class-month. Columns (1) to (3) provides the results of tests that examine the post-disclosure redemption behavior of retail investors in funds owned mainly by institutional investors. Columns (1) and (2) show the results for all funds and liquid funds for which more than 75% of assets are owned by institutional investors (liquid funds are funds that hold cash and government securities above the sample median), respectively. For comparison purposes, column (3) shows the behavior of retail investors in funds owned mainly by such investors. Columns (4) to (6) provides the results of tests that, using the statistical metric for the precision of investors' private information (see Section 4.5), examine the post-disclosure redemption behavior of investors with relatively noisy private information in funds owned mainly by investors with relatively precise private information. Columns (4) and (5) show such results for all funds and liquid funds for which more than 75% of assets are owned by precise-private-information investors, respectively. For comparison purposes, column (6) shows the behavior of noisy-private-information investors in funds owned mainly such investors. The dependent variable, *FLOW*, and the independent variables of interest, *PERF* and *DISC*, are the same as in Table 2, and all other regressors are included (except each variable used to partition the sample). See Appendix A for variable definitions. *T*-statistics (in parentheses) are robust to within-share class and within-month correlation as well as heteroscedasticity. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

PERF < 0	Behavior of retail investors in funds with institutional investor ownership			Behavior of noisy-prvt-info investors in funds with precise-prvt-info investor ownership		
	> 75% (all funds)	> 75% (liquid funds)	< 25% (all funds)	> 75% (all funds)	> 75% (liquid funds)	< 25% (all funds)
	(1)	(2)	(3)	(4)	(5)	(6)
PERF	0.269**	-0.004	0.032	0.188***	0.252***	0.157**
	(2.42)	(-0.03)	(0.81)	(2.78)	(3.46)	(2.57)
DISC	0.092	0.334*	-0.170***	0.339*	0.369*	-0.139**
	(0.69)	(1.83)	(-3.62)	(1.89)	(1.66)	(-2.06)
PERF × *DISC*	0.173	0.138	0.117***	-0.003	-0.083	0.111*
	(1.38)	(0.86)	(2.92)	(-0.02)	(-0.45)	(1.84)
Fundamentals	Yes	Yes	Yes	Yes	Yes	Yes
Information	Yes except *Private Info Precision*					
Comp-Fund FEs	Yes	Yes	Yes	Yes	Yes	Yes
Nov/Dec-Post FEs	Yes	Yes	Yes	Yes	Yes	Yes
Year-Quarter FEs	Yes	Yes	Yes	Yes	Yes	Yes
Observations	31,958	15,966	127,458	35,038	17,506	90,646
Adj. R-squared	0.072	0.075	0.219	0.079	0.092	0.164