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The Interdependence between Mutual Fund Managers

and Investors in Setting Fees

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Abstract

In the mutual fund industry, there is a unique endogeneity between managers and investors. If a manager wants to lower fees in the hopes of attracting investors, the investors will not react unless they believe the manager will maintain low fees for a period of time. A binding contract is one way for managers to signal their commitment to low fees. However, in practice, many mutual funds waive fees with no contractual agreement that they will continue to waive fees. We show in a theoretical framework that an equilibrium with waivers can arise without contracts as long as investors' are relatively inert and discount factors are high enough for manager's to care about future fees. Investors are not fooled by waivers and are fully informed of the manager's actions and ability. If past returns have information about future returns, waivers indirectly act as a performance-based salary.

Although most mutual fund managers are paid a contractual fee, a fixed percentage of the net assets, a large number of funds choose to waive some of the contractual fee--almost 60% in money market funds and 40% in equity funds. In many ways, it is surprising that managers waive fees. Presumably, managers waive some current fees in the hope of attracting future investors to the fund and increasing fees in the future. However, from the investor's perspective, it may not be worthwhile investing in a mutual fund that waives fees if there is nothing preventing the manager from removing the waiver the next day. Certainly, the investor can move to the next mutual fund but if there are search costs involved in finding another mutual fund as suggested by Sirri and Tufano (1998), the investor may be better off investing elsewhere. Indeed, the key question is whether contractual arrangements on fees are necessary if managers want to credibly signal fee changes.

Despite the importance of mutual funds and the size of mutual fund fees, there is not a large body of theoretical literature. Chordia (1996) analyzes the load structure in mutual funds and the affect on redemption behaviour among investors while Admati and Pfleiderer (1997) model the affect of fulcrum fees on the portfolio decisions of risk-averse investors. Nanda, Narayanan, and Warther (2000) model the interaction between investor liquidation, the manager's choice to service this liquidation, and management fees. Although these models differ significantly in their objectives and techniques, they all model a strong link between managers and investors. In keeping with this link, we propose an infinite horizon model where the expectations of managers and investors interact to determine optimal management fees.

We show that waivers can exist in an equilibrium without a contractual arrangement if investors exhibit inertia or are slow to move out of a fund. In addition, waivers are fully revealed to the investor so the investor is rational and is not fooled into believing the waiver is part of performance. The model contrasts with most assumptions that the fee decision of the firm is solely determined by the contracts set between the Board of Directors and the manager. Also, if lagged returns contain information about future returns, then waivers act like a performance-based salary where poor performers waive more in the future than good performers. In the model, the existence of a performance-based salary arises from the expectations of managers and investors rather than from a prescribed fulcrum fee. It appears that investors are indirectly regulating the fees received by managers through their aggregate investment decision. This has implications for the Board and regulators in overseeing fees. It suggests that fund managers will waive fees initially in hopes of attracting an inert investor base which can be charged higher fees later. Waiving appears to provide flexible fees and competitive prices but at the expense of long run investors.

In addition to modeling the interaction between investors and managers in setting fees, the paper also provides a theoretical framework that matches empirical evidence. Christoffersen (2000) empirically estimates fee waiving in money market mutual funds by relating investor flows to manager's fee waiving decisions and determines five empirical facts regarding fee waivers that are matched in this model: (1) funds that waive tend to be small; (2) waivers and assets are very persistent with an annual autocorrelation of 0.56 and 0.94 respectively; (3) poor performance over the year results in above average waiving; (4) retail managers tend to waive more when investor sensitivity to performance is high; and (5) higher contracted fees result in higher waivers even after controlling for potential endogeneity.

The remainder of the paper is structured as follows. The first section describes the agents in the model and the manager's maximization problem while the second section solves the equilibrium. The third section outlines the expected signs relating waivers to asset size and lagged returns and links this to empirical findings. It also provides some additional empirical evidence showing that investors react less to a change in waivers than to a change in contracted fees as predicted by the model. The last section concludes.

I. The Theoretical Model and Agents

In our model, there are four agents which shape the fee and waiver decision of the manager: the Securities and Exchange Commission (SEC), the Board of Directors, the manager, and the investors. Only the manager and investor are directly modeled. However, the SEC and the Board are indirectly modeled as they affect the institutional setting which forms the manager's maximization problem. The constraints or lack of constraints placed on the manager by the SEC and the Board are first discussed since they provide the framework for the manager's decision. The second half of this section describes how investor and managerial expectations interact in forming the manager's maximization problem.

A. The Role of the SEC and the Board of Directors

The regulation of mutual funds and mutual fund managers is contained in the Investment Advisors Act of 1940, and the general provisions of the Securities Act of 1933, and the Securities and Exchange Act of 1934. As such, their only regulatory body is the SEC. Although the SEC has authority to limit and regulate prices paid to service providers in the mutual fund industry, it does not.[1] Therefore, the SEC does not cap the amount that an investment manager can receive as a percent of average net assets.[2] The SEC does, however, regulate the incentive contracts that the Board can establish with a manager, allowing the management fee to be a fixed percent of average net asset size. Rule 205-3 allows a fund to establish a performance-based fee with the manager under very restrictive conditions, but no money market funds and only two percent of equity funds awarded incentive fees in 1995.

Although the Board of Directors maintains oversight responsibilities of the fund, the only binding constraint placed on the manager's waiver decision is the fixed contracted fee which serves as a cap on fee waivers. This contracted fee is difficult to change even at the annual Board meetings

[1] See Protecting Investors: A Half Century of Investment Company Regulation and Baumol et al (1990).

because any change has to be approved by the Board while an increase in fees must additionally be approved by shareholders. The next section outlines the manager's maximization problem and investor's behavior. The interaction between the objectives of a fund manager and investor results in an equilibrium with waivers.

B. Returns

The period t net returns for the individual mutual fund are denoted as

$$r_t = GR_t - F + W_t \tag{1}$$

where F is the contracted management fee for the individual fund and is assumed fixed, W is the idiosyncratic risk from waivers, and GR is the gross return of the individual fund. We assume that returns are autocorrelated. Although this assumption is not necessary for an equilibrium, there is evidence of persistence in mutual fund returns. Carhart (1997) and Brown and Goetzmann (1995) document persistence in equity fund returns. Also, money market returns are persistent because funds have the option to report amortized yields rather than mark-to-market returns under Rule 2a-7. We model this persistence as an AR(1) process

$$GR_t = \underline{R} + R_t$$

and (2)

$$R_t = \rho R_{t-1} + u_t$$

where $\underline{R}$ is unconditional expected gross returns of the fund and R_t is an AR(1) shock to gross returns with mean equal to zero, conditional variance equal to σ^2, and unconditional variance equal to $\sigma^2/(1-\rho)$. Expected conditional returns are linear in past returns with an autocorrelation coefficient, ρ, assumed to be less than one, so

$$E_{t-1}[GR_t] = \underline{R} + \rho R_{t-1}. \tag{3}$$

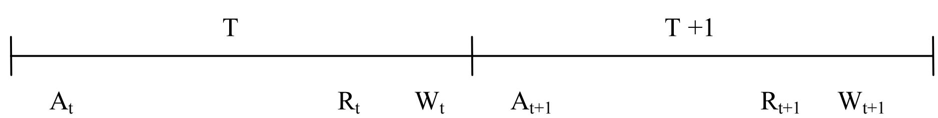
[2] Some states, such as California, Colorado, and Utah, have ``blue-sky" laws which cap state-specific fund fees. These are rarely binding.

C. Aggregate Fund Flows

Using factors that have been shown empirically to be important in aggregate flows into and out of a fund, we define the aggregate investment decision as

$$A_{t+1} = \lambda A_t + \gamma E_t^{Investor}[R_{t+1} - F + W_{t+1}] - \kappa(r_{rep} - \underline{R}) \tag{4}$$

where λ measures investor inertia, A_t is the asset size of the individual fund at time t, γ measures the sensitivity of investors to net returns of the individual fund, r_{rep} is the *expected* net return of a representative fund, and κ measures the sensitivity of investors to the representative fund. The representative fund can be interpreted as a well-diversified portfolio of funds, like the returns of the portfolio of mutual funds in a comparison group or index. Many fund groups have an index to which individual funds compare themselves; this index would be an example of the return of representative fund, r_{rep}. Although the representative fund is risky, the expected returns are assumed to be constant through time.[3] Also, notice that future assets A_{t+1} are known at the end of time t once information about current returns, waivers, and assets is known since this is the information underlying investors' expectations. Waivers are also decided after gross returns are realized. In terms of a time line, this implies



Empirical and theoretical evidence supports this representation of fund flows finding that past relative performance and past asset size are good predictors of future asset size and flows. From a theoretical perspective, we show in the appendix how a similar flow function can arise from an investor's maximization problem. Empirically, studies such as Patel, Zeckhauser, and Hendricks (1994), Chevalier and Ellison (1995), Ippolito (1992), and Sirri and Tufano (1992) show that new investment depends positively on high past performance for equity funds. Sirri and Tufano (1998) also suggest that search for a mutual fund is costly and may cause investors to respond more slowly when updating their portfolio decision. Therefore, if some investors face search costs and do not update their portfolio on a regular basis, then modeling current asset size as a function of lagged asset size and lagged returns is consistent with investor behavior. The existence of back-end loads would be another practical reason why we would expect investors to exhibit inertia since it is costly for them to remove funds. As will be apparent in the model, investor inertia is critical for the equilibrium. The model assumes that λ is less than one and that $\delta\lambda^2$ is greater than 0.5. Intuitively, this last assumption implies that there has to be a sufficient benefit to waiting for future fees which is captured by the time value of money, δ, and the investor inertia, λ, or the proportion of investors likely to stay in the future.

D. Manager's Decision to Waive

After outlining asset flows, we now turn to the optimal waiver chosen by the manager. The decision of the manager is not a simple one since the manager's actions depend on and determine the investor's expectations. According to the fee structure outlined by the SEC and the Board, contracted management fees are defined as a flat rate, *F*, of the net assets under management, *A*. Mutual fund managers are assumed to be risk neutral and to maximize the present value of total net fees using a discount factor, δ, which is assumed to be less than one. The fees collected by the managers are defined as fees collected on assets, *(F - W)*A,* less fixed costs, *C*, less variable costs, *VC*A*.

In addition, four constraints shape the manager's decision to waive. First, managers recognize that their choice of fees and waivers indirectly affects asset size because a fund with higher fees is less attractive to investors and lowers the asset size of the fund. Second, the maximum amount that a fund can waive is the contracted fee, *F*, because the manager can at most

[3] It is not necessary for r_{rep} to be constant. It is only necessary that $r_{rep} - \underline{R}$ be constant so any time variation in the

forego his own wages. Third, the amount waived has to be greater than or equal to zero given that a negative waiver would imply funds are charging more than the contracted fee. Finally, the optimal choice of waivers is rational in that investors and managers have identical and unbiased expectations of actual waivers. The endogeneity between the investor and manager is captured in the final constraint which equates the manager's expectation of waivers with the investors'. This last constraint mirrors models of rational expectations such as in Lucas (1972). Here, investors know the manager's maximization problem and based on this maximization they formulate expectations of future waivers. By setting the expectations of the investor equal to the manager's expectation, investors are not surprised by the manager's actions. The manager's objective to maximize the total discounted value of fees given these four constraints can be written as

$$
\begin{aligned}
&\max_{W_t} E_t^{Manager}[\sum_{t=1}^{\infty} \delta^t ((F - W_t) * A_t - C - VC * A_t)] \quad \forall t \\
&s.t. \\
&A_{t+1} = \lambda A_t + \gamma E_t^{Investor}[R_{t+1} - F + W_{t+1}] - \kappa * (r_{rep} - \underline{R}) \\
&F \geq W_t \geq 0 \\
&E_t^{Manager}[W_{t+1}] = E_t^{Investor}[W_{t+1}]
\end{aligned} \tag{5}
$$

where the superscripts, Manager and Investor, represent the expectations of the manager and investor.

By assuming the contractual management fee is constant through time, the model does not consider the possibility that managers may adjust both the contracted fee and waiver jointly in some periods. For instance, at an annual board meeting, the manager may decide to lower contracted fees and cease waiving at the same time. In practice, it is rarely the case that a fund changes its contracted fees, even at the annual review, so the simplifying assumption of constant contracted fees seems to match reality. One can also interpret the model as the interim decision to

representative fund is reflected in the unconditional returns of the individual fund.

waive once the contracted fee has been set, not allowing for endogeneity between contracted fees and waivers.

By assuming that the expected index return, r_{rep}, is exogenous and constant we do not allow for the competitive interaction between funds to affect their pricing decision. Because the model focuses on the relation between investors and managers, we did not want to confound this with added structure from competition in the industry where it would be difficult to determine whether optimal fees arose from investor/manager interactions or from fund competition. Also, because there are so many funds competing, it is arguable whether one fund's pricing decision would have an effect on the overall net return for the group so we have abstracted from this possibility.

II. The Equilibrium

The manager's optimization problem in equation 5 is a linear dynamic programming problem with linear constraints, including the posited beliefs of the investor. To solve the model, we posit the beliefs of the investor and posit a linear relationship between waivers and the underlying state variables, A_t and R_t. We then show the beliefs of the investor are consistent with the actions of the manager in keeping with the notion of rational expectations where the posited beliefs of the investor are

$$E_t^{Investor}[W_{t+1}] = \psi_1 + \psi_2 * R_t + \psi_3 * W_t \,. \tag{6}$$

The following proposition defines the optimal waiver that results from solving the dynamic system of first order conditions. There are direct empirical implications that arise from the model and are outlined in the next section. Because the method of solving the dynamic problem for the optimal waiver is involved, it is outlined in the Appendix. However, note that all the solved coefficients are constant functions of the exogenous variables and parameters proving that the posited beliefs are correct.

<u>Proposition 1.</u> For the assumed restrictions on the parameters and constant gross advisory fees, variable costs, and fixed costs, there is an optimal waiver in the set of linear possibilities. The manager's expectation and investor's expectation of optimal waivers are linear and identical and denoted by equations 8 and 9.

$$W_t = \phi_1 A_t + \phi_2 R_t + \phi_3 \tag{7}$$

$$E_t^{Manager}[W_{t+1}] = \phi_1 A_{t+1} + \phi_2 \rho R_t + \phi_3 \tag{8}$$

$$E_t^{Investor}[W_{t+1}] = \psi_1 + \psi_2 * R_t + \psi_3 * W_t \tag{9}$$

where the constant coefficients are functions of the parameters and underlying exogenous variables and defined as

$$\phi_1 = \frac{1}{\gamma} - \frac{\sqrt{\delta}\lambda}{\gamma\sqrt{-1+2\delta\lambda^2}} \tag{10}$$

$$\phi_2 = \frac{1}{(\sqrt{-1+2\delta\lambda^2})(\sqrt{\delta}\lambda + \sqrt{-1+2\delta\lambda^2})} \tag{11}$$

$$\phi_3 = \frac{-\frac{\sqrt{-1+2\delta\lambda^2}}{\sqrt{\delta}}\frac{\kappa}{\gamma}(r_{rep} - \underline{R}) + F(-\lambda + 2\delta\lambda^3 - \frac{\sqrt{-1+2\delta\lambda^2}}{\sqrt{\delta}} + \sqrt{\delta}\lambda^2\sqrt{-1+2\delta\lambda^2}) + VC(\lambda - 2\delta\lambda^3)}{\lambda(-1+2\delta\lambda^2 + 2\sqrt{\delta}\lambda\sqrt{-1+2\delta\lambda^2})} \tag{12}$$

$$\psi_1 = \frac{-\sqrt{-1+2\delta\lambda^2}\left(\begin{array}{l} -\sqrt{-1+2\delta\lambda^2}(F + \frac{\kappa}{\gamma}(r_{rep} - \underline{R})) + \delta\lambda\sqrt{-1+2\delta\lambda^2}(F + F\lambda + \frac{\kappa}{\gamma}(r_{rep} - \underline{R})) \\ + 2\delta^{\frac{3}{2}}\lambda^3(F - VC) - \sqrt{\delta}(F + F\lambda + \frac{\kappa}{\gamma}(r_{rep} - \underline{R}) - \lambda VC) \end{array}\right)}{\delta\lambda(-1+2\delta\lambda^2 + 2\sqrt{\delta}\lambda\sqrt{-1+2\delta\lambda^2})} \tag{13}$$

$$\psi_2 = \frac{-1+\delta\lambda\rho}{(\delta\lambda + \sqrt{\delta}\sqrt{-1+2\delta\lambda^2})} \tag{14}$$

$$\psi_3 = \frac{\sqrt{-1+2\delta\lambda^2}}{\sqrt{\delta}} \tag{15}$$

Proof. See Appendix.

The appendix shows how the manager's and investor's expectations are set equal to each other but one can readily see this by setting manager's expectations (equation 8) equal to investor's expectations (equation 9) and substituting aggregate fund flows (equation 4) for A_{t+1}, waivers as a function of the state variables (equation 7) for W_t, and the investor's expectations of waivers (equation 6) for $E_t[W_{t+1}]$. More succinctly, the identity of manager's and investor's expectations can be written as

$$E_t^{Manager}[W_{t+1}] = E_t^{Investor}[W_{t+1}]$$
$$\phi_1 A_{t+1} + \phi_2 \rho R_t + \phi_3 = \psi_1 + \psi_2 R_t + \psi_3 W_t \tag{16}$$
$$\phi_1\left(\lambda A_t + \gamma\begin{bmatrix}\rho R_t - F + \psi_1 + \psi_2 R_t \\ +\psi_3\{\phi_1 A_t + \phi_2 R_t + \phi_3\}\end{bmatrix} - \kappa * (r_{rep} - \underline{R})\right) + \phi_2 \rho R_t + \phi_3 = \psi_1 + \psi_2 R_t + \psi_3\{\phi_1 A_t + \phi_2 R_t + \phi_3\}$$

One can easily check in Proposition 1 that the manager's actions and the investors' expectations are equivalent by determining that the coefficient on current assets, A_t, is the same in both equations. After substitution, the coefficient on current assets on the left hand side of the equation is $\phi_1\lambda + \gamma\psi_3\phi_1^2$ and the coefficient on the right hand side is $\phi_1\psi_3$. Equating these two coefficients provides an equation for ψ_3 in terms of ϕ_1, namely $\psi_3=\lambda/(1-\gamma\phi_1)$.

Many intuitive results are hidden in Proposition 1. In the next section, we detail the empirical implications from the model and highlight the intuition. More interestingly, the results highlight how the expectations of the investor and manager interact to determine optimal waivers. Before more closely analyzing the intuitive results and the conclusions that can be drawn from Proposition 1, Corollary 1 describes what variables are important if waivers are not observed, or optimal waivers are zero. This corollary is important because in many instances, funds choose not to waive, so the factors determining non-waiving are pertinent for data analysis.

Corollary 1. For the assumed restrictions on the parameters and constant gross advisory fees, variable costs, and fixed costs, the lagrange multiplier, $L1_t$, on the constraint $W_t \geq 0$ is also a linear function of the underlying state variables, A_t and R_t . The non-waiving characteristics of a fund are defined when $L1_t > 0$ or $W_t = 0$.

$$L1_t = \phi_4 A_t + \phi_5 R_t + \phi_6 \tag{17}$$

$$E_t[L1_{t+1}] = \phi_4 A_{t+1} + \phi_5 \rho R_t + \phi_6 \tag{18}$$

$$\phi_4 = -1 + \frac{\sqrt{\delta}\lambda}{\sqrt{-1+2\delta\lambda^2}} \tag{19}$$

$$\phi_5 = \frac{-\gamma}{(\sqrt{-1+2\delta\lambda^2})(\sqrt{\delta}\lambda + \sqrt{-1+2\delta\lambda^2})} \tag{20}$$

$$\phi_6 = \frac{-\gamma\sqrt{-1+2\delta\lambda^2}\left(\frac{\kappa}{\gamma}(r_{rep} - \underline{R}) - F(-1+\delta\lambda^2 + \sqrt{\delta}\lambda\sqrt{-1+2\delta\lambda^2}) + \sqrt{\delta}\lambda\sqrt{-1+2\delta\lambda^2}VC\right)}{\sqrt{\delta}\lambda(-1+2\delta\lambda^2 + 2\sqrt{\delta}\lambda\sqrt{-1+2\delta\lambda^2})} \tag{21}$$

Proof. See proof of Proposition 1.

As found with optimal waivers in Proposition 1, waivers are determined by the asset size and current gross returns even when waivers are zero. Not surprisingly, the forces which cause waivers to be small are the same ones which cause a fund to choose not to waive. The signs of the coefficients and the relations between waivers and the underlying state variables are explicitly outlined in the next section on empirical hypotheses. Although the equilibrium is not necessarily unique and only holds for specific restrictions on the parameter values, it is interesting because the actions of the manager and expectations of the investor interact and solve an optimal fee structure that depends on both agents.

III. Empirical Results and Implications

For the remainder of this section, recall the definitions of the following parameters: F is the contracted fee, VC is the variable cost, δ is the discount factor, γ is the asset sensitivity to returns, λ is the persistence in assets, and ρ is the autocorrelation of returns. The parameters δ, λ, and ρ are assumed to be less than one, and the discount factor and asset persistence are usually quite high in estimation, 0.95 and 0.94 respectively. The data suggests that the assumption $\delta\lambda^2 > 0.5$ is realistic. The parameters in the investor's expectations are denoted by ψ_i.

1. Relating Waivers and Assets. Waivers are negatively affected by the current asset size of the fund, A_t, since

$$\frac{\partial W_t}{\partial A_t} = \phi_1 = \frac{1}{\gamma} - \frac{\sqrt{\delta}\,\lambda}{\gamma\sqrt{-1+2\delta\lambda^2}} < 0\,. \tag{22}$$

This result suggests that large funds are less likely to benefit from waiving. The dependence between asset size and waivers arises from the persistence in asset size in the flow equation. A large fund today is likely to be a large fund tomorrow. Therefore, the percentage gain in assets from waiving is small compared to the large cost of foregone income on today's asset size. Once a fund is large, a manager is better off trying to reduce waivers and earn fees from the old investors who will stay even after a slight increase in fees. The first empirical finding matches this result.

From Corollary 1, the decision not to waive depends on the size of a fund. In other words, a fund is more likely not to waive if it is large. Mathematically, this result is represented by the lagrange multiplier on the constraint $W_t \geq 0$, $L1_t$, which positively depends on asset size, or

$$\frac{\partial L1_t}{\partial A_t} = \phi_4 = -1 + \frac{\sqrt{\delta}\,\lambda}{\sqrt{-1+2\delta\lambda^2}} \geq 0\,. \tag{23}$$

The positive relation between the lagrange multiplier and assets suggests the constraint $W_t = 0$ becomes more binding once asset size is increased. Like a shadow price, this implies it is more costly for a large fund to start waiving.

2. Persistence in Waivers. Waivers are a positive predictor of future waivers because expected waivers increase with current realized waivers, or

$$\frac{\partial E_t[W_{t+1}]}{\partial W_t} = \psi_3 = \frac{\sqrt{-1+2\delta\lambda^2}}{\sqrt{\delta}} > 0\,. \tag{24}$$

At first glance, waivers appear to be an empty promise by managers to lower fees since waivers can change without warning. Therefore, it seems inconsistent that current waivers should predict future waivers. On the contrary, the "inertia" in assets, λ, results in a persistent waiver decision. For example, a large fund may not waive this period because there is no incentive to build the asset size of the fund. Because asset size is persistent, the same large fund is likely to maintain a good portion of its investors and as a result is less likely to waive the next period. For this reason, asset size predictability implies waivers are positive predictors of future expected waivers. In the model, the derivative of the persistence in waivers, ψ_3, with respect to the persistence in assets, λ, also shows that the persistence in assets positively affects the predictability of waivers.

$$\frac{\partial \psi_3}{\partial \lambda} = \frac{4\delta\lambda}{\sqrt{\delta}\sqrt{-1+2\delta\lambda^2}} > 0 \tag{25}$$

In contrast, the persistence in waivers is unrelated to the persistence in returns since the derivative of ψ_3 with respect to return persistence, ρ, is zero. Therefore, the difference in return persistence between funds should not influence the predictability of waivers. One of the key questions addressed by the model is what investors should expect in terms of future waivers. Equation 24 suggests that observed waivers positively influence the investor's portfolio decision since they are positive predictors of future waivers. Even though managers can stop waiving at any time, they do not do so because they want to increase the asset size of the fund by creating a consistent pattern of waiving. In game theory, this result is comparable to a tit-for-tat strategy (Gibbons 1992) where a manager that cheats by not waiving is punished by investors who will not react to waivers in the future.

One other related observation about persistence in waivers is the persistence in the decision to either waive or not waive. Those funds which do not waive fees are likely not to waive fees in the future since

$$\frac{\partial E_t[L1_{t+1}]}{\partial W_t} = \phi_4 \gamma \psi_3 \geq 0 \,. \tag{26}$$

3. Relating waivers and performance. Actual waivers are negatively affected by lagged returns of the fund, R_{t-1},

$$\frac{\partial W_t}{\partial A_t}\frac{\partial A_t}{\partial R_{t-1}} = \phi_1 \gamma \rho < 0 \,. \tag{27}$$

Increasing past returns increases the asset size of the fund at time t since more people want to invest in a fund that has performed well in the past. This makes it costly for the fund to waive fees since managers are foregoing a larger amount of money. A high amount of foregone income from waiving reduces the incentive to waive. The relation between lagged returns and waivers is dependent on the assumption that lagged returns predict future returns. If returns were not persistent, $\rho=0$, then a change in the return realization would not affect asset size of the fund or the incentive to waive at a later time period so the derivative of waivers with respect to past returns would be zero in this case. The empirical evidence shows that poor performance over a year results in higher than average waivers. Because performance is measured over a year, it is likely to pick up the relationship between lagged returns and waivers.

For the same conditions outlined above, a similar prediction relates how current returns affect expected waivers

$$\frac{\partial E_t[W_{t+1}]}{\partial R_t} = \psi_2 = \frac{-1 + \delta\lambda\rho}{(\delta\lambda + \sqrt{\delta}\sqrt{-1 + 2\delta\lambda^2})} < 0 \,. \tag{28}$$

This suggests that a fund that has performed poorly is expected to waive in the future to boost the performance of the fund and attract more investors. Note that this relation holds and is even stronger if returns are uncorrelated.

The less intuitive result is the relation between current waivers and current returns which is positive, $\phi_2>0$. The positive relation between current waivers and current returns results from the interaction between the manager and investor expectation. Managers know that good performance today will lower investors' expectations of waivers tomorrow. Therefore, a high performing manager will continue to waive more to smooth the investors' expectations of waivers in the future since current waivers and current returns have offsetting effects on expected waivers where $\frac{\partial E_t[W_{t+1}]}{\partial R_t} < 0$ and $\frac{\partial E_t[W_{t+1}]}{\partial W_t} > 0$.

Waivers are sometimes viewed as an indirect performance based fee structure where a high performing manager is paid more than a poor performing manager. If one looked at the relation between lagged returns and waivers, it appears this is true. However, short term efforts to smooth the investors' expectations of waivers may give a high performing manager incentive to increase waivers. In the longer term, one would expect to see waivers acting like a performance based fee structure, but only if current performance is persistent and provides information about future performance.

4. Relating waivers and investor sensitivity. Waivers are positively influenced by increases in investor sensitivity, γ, to net returns since

$$\frac{\partial W_t}{\partial \gamma} = -\frac{\phi_1}{\gamma} > 0 . \tag{29}$$

Increases in the sensitivity of investors to net returns means that moving ahead in net returns can greatly increase the number of investors attracted to the fund. Since the waiver improves net returns vis-à-vis the representative index, a higher sensitivity of investors to net returns makes waivers more effective in attracting new funds. This is supported by the data.

5. Investor response to waiver uncertainty. Unlike gross contractual fees, F, observed waivers are not perfect predictors of future fees since the coefficient, ψ_3, is less than one. In the model, the perfect predictability of contracted fees is evident since contracted fees are assumed to be constant. Waivers are not perfect predictors since

$$\frac{\partial E_t[W_{t+1}]}{\partial W_t} = \psi_3 = \frac{\sqrt{-1+2\delta\lambda^2}}{\sqrt{\delta}} < 1. \tag{30}$$

Therefore, waivers are less effective in attracting investors to a fund than adjusting contracted fees since $\frac{\partial A_{t+1}}{\partial W_t} = \psi_3 \gamma < \frac{\partial A_{t+1}}{\partial F} = \gamma$. This highlights the trade-off between waivers and binding contractual fees. The second empirical result suggests that waivers are persistent and good for the investor because they provide information that the manager is likely to discount contracted fees in the future. On the other hand, this result shows that waivers should be interpreted differently than contractual fees because waivers are inherently more risky than contractual fees. The different response to waivers and contracted fees imposes a cost on managers in using waivers as a method of setting net fees. For example, the manager can choose to lower net fees in two ways: (1) by lowering the contracted fee; or (2) by increasing waivers. Investors will be more responsive to the first method of changing fees since the lower contracted fee sends a stronger signal of future net returns than higher waivers.[4]

[4] An important caveat to this result is considering λ>1. In this case, waivers may provide a stronger signal about future expected net fees than contracted fees since it is possible for ψ_3>1. Intuitively λ>1 implies the waiver is effective in attracting investors who not only keep their investment in the fund but also reinvest their income over time. Therefore, observing waivers sends a positive signal to investors who know they will reinvest and stay in the fund. Managers are tied more strongly to their waiver decision because it has implications for investors who not only stay in the fund but also reinvest.

To illustrate this point, a fund[5] recently changed its waiver decision recognizing the cost of using waivers to set net fees. The fund had initially been charging a contracted fee of 15 bp and waiving 7 bp, resulting in a net advisory fee of 8 bp. The fund abandoned this fee structure and simply lowered the contracted advisory fee to 8 bp and ceased waiving. Although the net fee to the investor remained the same, the Board argued that a lower contracted fee would be more effective in attracting investors than waiving because investors were wary of the possibility for waivers to change over the investment horizon. The argument used by this fund to change its fee structure reflects the cost to the fund of maintaining an uncertain waiver.

Empirically, we can determine how costly it is to maintain a high waiver versus lowering contractual fees and not waiving. Recall from equation 4, the investor's sensitivity to contracted fees is measured by γ and the investor's sensitivity to waivers is measured by $\gamma\psi_3$. The difference between these two investor sensitivities is the *cost of waiving*, or $\gamma - \gamma\psi_3 > 0$. For $\psi_3 < 1$, it is evident that more assets are attracted to the fund if the manager simply lowers contracted fees.

Empirically, we proxy for the cost of waiving by measuring the difference in investor reaction to net fees with waivers, F-W, and without waivers, F. In terms of the notation,

$$\frac{\partial A_{t+1}}{\partial F} = -\gamma = -\gamma^{NW} \quad for\ W_t = 0 \tag{31}$$

while for a waiving fund, the coefficient on F-W is more complicated,

$$\frac{\partial A_{t+1}}{\partial (F - W_t)} = -\gamma \frac{F - \psi_3 W_t}{F - W_t} = -\gamma^{W} \quad for\ W_t > 0\,. \tag{32}$$

The cost of waiving is proxied by estimating the difference between these two coefficients, $\gamma^{NW} - \gamma^{W}$. A negative value of $\gamma^{NW} - \gamma^{W} < 0$ is equivalent to a positive cost of waiving, $\gamma - \gamma\psi_3 > 0$.

Using data from Christoffersen (2000), Table 1 provides the estimates of the cost of waiving for the full sample of money funds 1990-1995 and on a sample of money funds that only

[5] At the request of the fund, the name has been kept confidential.

includes funds with non-advisory fees below the mean. Dividing the sample into low non-advisory fee funds controls for cases where extremely high non-advisory fees explain most of the waiver. Table 1 regresses fund flows on gross returns, fees, lagged assets, and fund characteristics. Most importantly, the regression allows for investors to respond differently to a fund with waivers than a fund without. The difference in investor reaction to the two methods of fee setting is measured by the coefficient on an interaction term of net advisory fee times a waiver dummy variable where the waiver dummy takes the value one for a fund that waives and zero otherwise. In both samples, the difference γ^{NW} - γ^{W} is negative and significant as denoted by negative coefficient on the interaction term of –1.86 in the full sample and –2.15 in the low non-advisory fee sample. This empirical finding supports the hypothesis that investors interpret waivers differently from contracted fees and react less to changes in waivers than to changes in contracted fees.

6. Contracted Fees and Waivers. High values of $\delta\lambda^2$ suggest waivers depend positively on contractual fees. Low values of $\delta\lambda^2$ suggest waivers depend negatively on contractual fees since

$$\frac{\partial W_t}{\partial F} = \frac{\partial \phi_3}{\partial F} = \frac{\left(-\lambda + 2\delta\lambda^3 - \frac{\sqrt{-1+2\delta\lambda^2}}{\sqrt{\delta}} + \sqrt{\delta}\lambda^2\sqrt{-1+2\delta\lambda^2} \right)}{\lambda\left(-1+2\delta\lambda^2 + 2\sqrt{\delta}\lambda\sqrt{-1+2\delta\lambda^2} \right)} <> 0 \tag{33}$$

and

$$\frac{\partial W_t}{\partial F\partial(\delta\lambda^2)} = \frac{\partial \phi_3}{\partial F\partial(\delta\lambda^2)} = \frac{\sqrt{-1+2\delta\lambda^2}\,(2\sqrt{\delta\lambda^2} + \sqrt{\delta})}{2\sqrt{\delta}\sqrt{\delta\lambda^2}\,(-1+2\delta\lambda^2 + 2\sqrt{\delta}\lambda\sqrt{-1+2\delta\lambda^2})} > 0\,. \tag{34}$$

Intuitively, one expects that increasing contractual fees increases the cap on waivers and leads to an increase in the amount waived. However, there is a trade-off between taking the fee now versus later. As the value of $\delta\lambda^2$ becomes smaller, the value of waiving now for future benefits becomes smaller since either value of money in the future decreases or the persistent amount of assets that will be around next period decreases. A low enough value of $\delta\lambda^2$ may encourage the manager to take the money today, so in this case, increasing the cap on waivers, F, encourages the manager to waive less because the manager wants more today. However, if there is a benefit to waiting for later fees, then an increase in contracted fees will increase the waiver. The empirical evidence finds a significantly positive relation between fees and waivers suggesting that there is a large benefit to waiting for future fees.

7. Waivers and costs. Waivers depend negatively on variable costs for all values of δ and λ less than one.

$$\frac{\partial W_t}{\partial VC} = \frac{(\lambda - 2\delta\lambda^3)}{\lambda(-1 + 2\delta\lambda^2 + 2\sqrt{\delta}\,\lambda\sqrt{-1 + 2\delta\lambda^2})} < 0 \tag{35}$$

The fund will not waive if it needs to cover high variable costs. On a related point, the fixed costs a fund should not affect the decision of a fund to waive because they are a sunk cost. However, if the fund is so small that large fixed costs make it likely that the fund will become inoperable and the fund is forced to liquidate, this reduces the future benefits of waiving. This effect of fixed costs is not considered.

IV. Conclusion

The large amount of money that is foregone by waiving begs the questions why managers would want to give up fees and why investors believe a manager's commitment to waiving? In short, managers are willing to give up some portion of fees to improve net performance and attract investors. Investors believe waivers will persist because they know managers have incentive to grow asset size and to persistently waive in achieving this goal. This strategy is only attractive to managers if fund assets are persistent since the investment attracted to the fund by waiving is likely to stay with the fund even after the manager's waiver decision and performance change. In addition, small and new funds are expected to use waivers because waiving increases the net assets by a much larger percentage in small funds than large funds.

The model shows that it is rational for investors to react positively to waivers since waivers are predictable. Although managers can change waivers regularly, they do not. Managers want to build asset size by waiving. If managers radically changed waivers each period, investors would eventually stop reacting to waivers and the waiver would have no effect on the investor's asset decision, rendering the waiver useless in building asset size. The uncertainty of waivers does imply that investors respond less to a change in waivers than to a change in contracted fees. Lowering contracted fees is a more permanent improvement in net returns than increasing waivers.

Empirical evidence is consistent with this model. This study shows that investors react differently to waivers than to contracted fees and that there is a cost to waiving because of the added flexibility and lack of a binding contract. More generally, the model is interesting because it highlights the agency problem between investors and managers in mutual funds. Regulators and legal experts continue to debate whether fees set by funds are excessive. In this model, the interaction between manager's and investors' expectations sets the optimal fee. Still, the profitability of waiving is based on the inertia of investors and some intervention may be warranted to the extent that regulators want to protect the inert investors from high prices in the future.

Appendix

Proof of Proposition 1

Proposition 1 provides the solution to the manager's maximization problem subject to the investor's asset decision and expectation. The manager maximizes the discounted future expected value of net fees subject to aggregate fund flows. Costs of monitoring the fund imply that the investor maximizes returns over several periods and introduces inertia into assets. The manager's maximization problem is defined by Equation 5.

$$\begin{aligned}
&\max_{W_t} E_t^{Manager}[\sum_{t=1}^{\infty} \delta^t ((F - W_t) * A_t - C - VC * A_t)] \quad \forall t \\
&s.t. \\
&A_{t+1} = \lambda A_t + \gamma E_t^{Investor}[R_{t+1} - F + W_{t+1}] - \kappa * (r_{rep} - \underline{R}) \\
&F \geq W_t \geq 0 \\
&E_t^{Manager}[W_{t+1}] = E_t^{Investor}[W_{t+1}]
\end{aligned} \tag{A1}$$

The investor's expectation of waivers is posited to be a linear function of past returns and waivers, which is set equal to the manager's expectation in equilibrium

$$E_t^{Investor}[W_{t+1}] = \psi_1 + \psi_2 * R_t + \psi_3 * W_t \,. \tag{A2}$$

The values of the coefficients ψ_1, ψ_2, and ψ_3 are solved explicitly in terms of the underlying assumed constant parameters, ρ, λ, and δ. We posit a linear relation between waivers and the state variables, assets and returns and show that this posited relation matches the actions of the manager. The posited linear relation between waivers and the state variables is

$$W_t^{posit} = \phi_1 A_t + \phi_2 R_t + \phi_3 \tag{A3}$$

where the subscript *posit* represents that this equation is a posited value of waivers which will be shown to be true in the equilibrium. The coefficients, ϕ_1, ϕ_2, and ϕ_3, are posited to be constant and later shown to be constant functions of the parameters. Also, because waivers are posited to be linear in assets and returns, waivers must also be linear in these state variables when the boundary constraints are binding, $W_t = 0$ or $W_t = F$, or the lagrange multipliers are positive. Therefore, the lagrange multipliers are posited to be linear functions of the state variables, so

$$\begin{aligned} L1_t^{posit} &= \phi_4 A_t + \phi_5 R_t + \phi_6 \\ or &= 0 \end{aligned} \tag{A4}$$

and

$$\begin{aligned} L2_t^{posit} &= \phi_7 A_t + \phi_8 R_t + \phi_9 \\ or &= 0 \end{aligned} \tag{A5}$$

where $L1_t$ is the lagrange multiplier for the constraint, $W_t \geq 0$, and $L2_t$ is the lagrange multiplier for the constraint, $W_t \leq F$.

Given this posited relation for waivers and the lagrangians, the expected value of future waivers can be expressed in terms of the state variables, so

$$E_t^{Manager}\ [W_{t+1}] = \phi_1 A_{t+1} + \phi_2 \rho R_t + \phi_3 \tag{A6}$$

since future assets, A_{t+1}, are known once R_t and W_t are known at time t and since we assume returns follow an AR(1) process. Although relative returns are assumed to be autocorrelated, this assumption is not necessary for waivers to exist. The most important assumption driving the results is the persistence in assets which makes an investor's reaction to waivers consistent with the manager's behavior.

In solving the manager's maximization problem, both the investor's expectation of waivers and the posited relation between waivers, assets and returns are substituted into the first order conditions. The explicit value of waivers which result from this maximization is then matched against the original posited value of waivers to see if it is a linear function in the underlying state variables. The manager's maximization problem can be written as a Bellman equation,

$$
\begin{aligned}
&V_t = \max_{W_t} (F - W_t) * A_t - C - VC * A_t + \delta E_t^{Manager}[V_{t+1}] \quad \forall t \\
&s.t. \\
&A_{t+1} = \lambda A_t + \gamma E_t^{Investor}[R_{t+1} - F + W_{t+1}] - \kappa * (r_{rep} - \underline{R}) \\
&F \geq W_t \geq 0 \\
&E_t^{Manager}[W_{t+1}] = E_t^{Investor}[W_{t+1}]
\end{aligned}
\tag{A7}
$$

The general first order condition for this problem with respect to W_t is

$$
0 = -A_t - L1_t + L2_t + \delta\gamma\psi_3 \begin{pmatrix} F - \rho\phi_2 R_t - \phi_3 - VC \\ + \dfrac{\lambda}{\gamma\psi_3} \begin{Bmatrix} \rho\phi_5 R_t + \phi_6 + \lambda A_t (1 + \phi_4 - \phi_7) - \rho\phi_8 R_t - \phi_9 \\ -\gamma(1 + \phi_4 - \phi_7)(F + \dfrac{\kappa}{\gamma}(r_{rep} - \underline{R}) - \psi_1 - \psi_2 R_t - \rho R_t - \psi_3 W_t) \end{Bmatrix} \\ -\phi_1(\lambda A_t + \gamma(-F - \dfrac{\kappa}{\gamma}(r_{rep} - \underline{R}) + \psi_1 + \psi_2 R_t + \rho R_t + \psi_3 W_t)) \end{pmatrix}
\tag{A8}
$$

The first order condition is derived after substituting the posited expectations of the investor and the posited relation between waivers and the underlying state variables into the Bellman equation. Three cases arise for different values of W_t which imply three different first order conditions for each case.

Case 1. Neither constraints are binding so $0<W_t<F$.

Case 2. Waivers are equal to zero.

Case 3. Waivers are equal to the contracted fee.

To find the optimal value of waivers in Case 1, we let $L1_t$ and $L2_t$ equal zero and solve the first order condition above for W_t.

$$W_t^* = \frac{-\left(-A_t + \delta\gamma\psi_3\left(\begin{array}{l} F - \rho\phi_2 R_t - \phi_3 - VC \\ + \dfrac{\lambda}{\gamma\psi_3}\left\{\begin{array}{l} \rho\phi_5 R_t + \phi_6 + \lambda A_t(1+\phi_4-\phi_7) - \rho\phi_8 R_t - \phi_9 \\ -\gamma(1+\phi_4-\phi_7)(F + \dfrac{\kappa}{\gamma}(r_{rep} - \underline{R}) - \psi_1 - \psi_2 R_t - \rho R_t) \end{array}\right\} \\ -\phi_1(\lambda A_t + \gamma(-F - \dfrac{\kappa}{\gamma}(r_{rep} - \underline{R}) + \psi_1 + \psi_2 R_t + \rho R_t)) \end{array}\right)\right)}{\delta\gamma\psi_3(-\psi_3\gamma\phi_1 + \lambda(1+\phi_4-\phi_7))} \quad \text{(A9)}$$

To find the values of the lagrange multipliers, plug in the values of W_t for each of the respective constraints and solve.

$$L1_t^* = -A_t + \delta\gamma\psi_3\left(\begin{array}{l} F - \rho\phi_2 R_t - \phi_3 - VC \\ + \dfrac{\lambda}{\gamma\psi_3}\left\{\begin{array}{l} \rho\phi_5 R_t + \phi_6 + \lambda A_t(1+\phi_4-\phi_7) - \rho\phi_8 R_t - \phi_9 \\ -\gamma(1+\phi_4-\phi_7)(F + \dfrac{\kappa}{\gamma}(r_{rep} - \underline{R}) - \psi_1 - \psi_2 R_t - \rho R_t) \end{array}\right\} \\ -\phi_1(\lambda A_t + \gamma(-F - \dfrac{\kappa}{\gamma}(r_{rep} - \underline{R}) + \psi_1 + \psi_2 R_t + \rho R_t)) \end{array}\right) \quad \text{(A10)}$$

and

$$L2_t^* = A_t - \delta\gamma\psi_3\left(\begin{array}{l} F - \rho\phi_2 R_t - \phi_3 - VC \\ + \dfrac{\lambda}{\gamma\psi_3}\left\{\begin{array}{l} \rho\phi_5 R_t + \phi_6 + \lambda A_t(1+\phi_4-\phi_7) - \rho\phi_8 R_t - \phi_9 \\ -\gamma(1+\phi_4-\phi_7)(F + \dfrac{\kappa}{\gamma}(r_{rep} - \underline{R}) - \psi_1 - \psi_2 R_t - \rho R_t - \psi_3 F) \end{array}\right\} \\ -\phi_1(\lambda A_t + \gamma(-F - \dfrac{\kappa}{\gamma}(r_{rep} - \underline{R}) + \psi_1 + \psi_2 R_t + \rho R_t + \psi_3 F)) \end{array}\right) \quad \text{(A11)}$$

Although the above equations define the optimal values of waivers and the lagrange multipliers for each of the constraints, we still have to confirm the two conjectures hold for this optimum: (1) waivers are a linear function of the two underlying state variables; and (2) the investor's expectations about waivers are identical to the manager's actions. To confirm that the conjectures and actual values match, the next step solves explicitly for the coefficients in terms of the underlying parameters by setting the conjectured waiver equal to the optimal values of waivers. The investor's expectations about waivers are also set equal to the manager's actions to solve endogenously for the investor's expectations, ensuring the manager’s actions are compatible with the investor’s expectations. Using these identities, we can solve for the twelve posited coefficients, ϕ_1, ϕ_2, ϕ_3, ϕ_4, ϕ_5, ϕ_6, ϕ_7, ϕ_8, ϕ_9, ψ_1, ψ_2, and ψ_3. The linearity of the problem allows the system to be solved in parts. I start by solving ϕ_1, ϕ_4, ϕ_7, and ψ_3 using the following four equations.

$$\begin{aligned}
\frac{\partial W_t^*}{\partial A_t} &= \frac{\partial W_t^{posit}}{\partial A_t} = \phi_1 \\
\frac{\partial L1_t^*}{\partial A_t} &= \frac{\partial L1_t^{posit}}{\partial A_t} = \phi_4 \\
\frac{\partial L2_t^*}{\partial A_t} &= \frac{\partial L2_t^{posit}}{\partial A_t} = \phi_7 \\
\frac{\partial E_t^{Manager}[W_{t+1}]}{\partial A_t} &= \frac{\partial E_t^{Investor}[W_{t+1}]}{\partial A_t}
\end{aligned} \tag{A12}$$

The first three equations identify that the coefficients in front of assets in the posited values of waivers and the lagrange multipliers, ϕ_1, ϕ_4, and ϕ_7. The last equation identifies ψ_3 by ensuring that the coefficient on assets in investor's expectations of waivers is the same as the manager's coefficient on assets the expectation of waivers. To derive the last equation in the system, we start from the identity

$$\begin{aligned}
E_t^{Manager}\ [W_{t+1}] &= E_t^{Investor}\ [W_{t+1}] \\
\phi_1 A_{t+1} + \phi_2 \rho R_t + \phi_3 &= \psi_1 + \psi_2 R_t + \psi_3 W_t
\end{aligned} \tag{A13}$$

after substituting the fund flow function for A_{t+1} and the posited value of waivers for W_t the resulting identity is

$$\phi_1\left(\lambda A_t + \gamma \begin{bmatrix} \rho R_t - F + \psi_1 + \psi_2 R_t \\ + \psi_3 \{\phi_1 A_t + \phi_2 R_t + \phi_3\} \end{bmatrix} - \kappa * (r_{rep} - \underline{R}) \right) + \phi_2 \rho R_t + \phi_3 = \psi_1 + \psi_2 R_t + \psi_3 \{\phi_1 A_t + \phi_2 R_t + \phi_3\} \tag{A14}$$

.

The coefficient on assets for the manager's expectation of waivers is $\phi_1\lambda + \gamma\psi_3\phi_1^2$ while the coefficient on assets under the investor's expectation is $\psi_3\phi_1$ so the last equation in equation A12 is simply $\phi_1\lambda + \gamma\psi_3\phi_1^2 = \psi_3\phi_1$. Solving the four equations for four unknowns, ϕ_1, ϕ_4, ϕ_7, and ψ_3, reveals two possible equilibria which satisfy the linear relation between waivers and the underlying state variables. This arises because the system of equations is quadratic in the parameters. One of the equilibria can be discarded because the value of ψ_3 is less than 0. A negative value of ψ_3 implies that the optimization problem of the manager is decreasing in waivers and so the optimal waiver minimizes rather than maximizes manager's profits. In this case, the manager maximizes fees by choosing waivers equal to zero. This case is not interesting since waivers are observed in equilibrium. By default, the only values of ϕ_1, ϕ_4, ϕ_7, and ψ_3 which are feasible are those where $\psi_3>0$.

To completely identify each of the endogenous coefficients, a similar system of equations determines the values of ϕ_2, ϕ_5, ϕ_8, and ψ_2, by equating the coefficients on R_t in the posited and optimal values of W_t, $L1_t$, and $L2_t$, or

$$\begin{aligned}
&\frac{\partial W_t^*}{\partial R_t} = \frac{\partial W_t^{posit}}{\partial R_t} = \phi_2 \\
&\frac{\partial L1_t^*}{\partial R_t} = \frac{\partial L1_t^{posit}}{\partial R_t} = \phi_5 \\
&\frac{\partial L2_t^*}{\partial R_t} = \frac{\partial L2_t^{posit}}{\partial R_t} = \phi_8 \\
&\frac{\partial E_t^{Manager}[W_{t+1}]}{\partial R_t} = \frac{\partial E_t^{Investor}[W_{t+1}]}{\partial R_t}
\end{aligned} \qquad \text{(A15)}$$

where the final constraint identifies ψ_2. From the identity of manager and investor expectations in equation A14, the final constraint is equal to $\rho\phi_2 + \gamma\phi_1(\psi_2 + \rho + \psi_3\phi_2) = \psi_3\phi_2 + \psi_2$. Finally the values of ϕ_3, ϕ_6, ϕ_9, and ψ_1 are determined by the following system of equations.

$$W_t^* - \frac{\partial W_t^*}{\partial A_t} - \frac{\partial W_t^*}{\partial R_t} = \phi_3$$

$$L1_t^* - \frac{\partial L1_t^*}{\partial A_t} - \frac{\partial L1_t^*}{\partial R_t} = \phi_6 \qquad \text{(A16)}$$

$$L2_t^* - \frac{\partial L2_t^*}{\partial A_t} - \frac{\partial L2_t^*}{\partial R_t} = \phi_9$$

$$E_t^{Manager}[W_{t+1}] - \frac{\partial E_t^{Manager}[W_{t+1}]}{\partial A_t} - \frac{\partial E_t^{Manager}[W_{t+1}]}{\partial R_t} = E_t^{Investor}[W_{t+1}] - \frac{\partial E_t^{Investor}[W_{t+1}]}{\partial A_t} - \frac{\partial E_t^{Investor}[W_{t+1}]}{\partial R_t}$$

Again, the final constraint comes from the constraint that investor expectations match manager's actions. In terms of the coefficients and parameters, the final constraint identifies ψ_1 and is written as

$$-\gamma\phi_1 F + \phi_1\gamma\psi_1 + \phi_1\gamma\psi_3\phi_3 - \phi_1\kappa(r_{rep} - \underline{R}) = \psi_1 + \psi_3\phi_3 . \qquad \text{(A17)}$$

As shown in Proposition 1, the explicit values of the coefficients ψ_i and ϕ_i are constant functions of the underlying parameters and the exogenous variables, λ, ρ, δ, F, VC, r_{rep}, and $\underline{R}$. This proves waivers are a linear function of the underlying state variables and the posited expectation of the investor matches the actions of the manager.

Solving the investor's problem to determine aggregate fund flows

We can show that the aggregate fund flow function is consistent with a risk averse individual investor facing search costs and choosing a portfolio according to the problem

$$\max_{a_t} \; a_t^{'} E_t[r_{t+1}] - \frac{\theta}{2} a_t^{'} Var_t[r_{t+1}] a_t \qquad \text{(A18)}$$
$$s.t \; a_t^{'} i = Wealth$$

The investor maximizes the above problem by choosing between the constant risk free asset, r_f, the representative fund with risky returns that have a constant *expected* return of r_{rep}, and the individual fund with risky net returns $r_{i,t+1}$. Therefore, a_t is a 3x1 vector of portfolio holdings, θ measures risk aversion, *Wealth* denotes the wealth of the individual, and *i* is a 3x1 vector of ones. An investor's demand for the individual fund can be written as

$$
\begin{aligned}
a_{i,t} &= k(E_t[r_{i,t+1}] - r_{rep}) \\
&= k(E_t[R_{i,t+1} - F + W_{i,t+1}] - (r_{rep} - \underline{R}))
\end{aligned} \tag{A19}
$$

where we substitute net returns as a function of gross returns, contracted fees and waivers, and k is a constant function of risk aversion and conditional variance. Note that the conditional variance of net returns will be constant if the conditional variance of waivers is constant because individual gross returns, representative returns, and the risk free rate have constant conditional variances. From the solution of waivers in Proposition 1, we show that waivers do in fact have a constant conditional variance since

$$
Var_t[W_{t+1}] = Var_t[\phi_1 A_{t+1} + \phi_2 R_{t+1} + \phi_3] = \phi_2{}^2 \sigma_u^2 . \tag{A20}
$$

Now we want to aggregate the investor's decision and allow for search costs. We assume that search costs imply an investor reevaluates the portfolio every H periods rather than every period. In terms of the individual demand where individuals receive returns each period, this implies

$$
a_{i,t} = k(E_t[\sum_{h=1}^{H} \delta^{h-1} r_{i,t+h}] - \sum_{h=1}^{H} \delta^{h-1} r_{rep}) \tag{A21}
$$

where the investor maximizes returns over H periods rather than over one period. For each H period horizon, we can write the individual demand as a linear function of the one step ahead expectations. For instance, take a simple two step ahead expectation and compare it with a one step ahead expectation

One step: $E_t[r_{t+1}] = E_t[\underline{R} + R_{t+1} - F + W_{t+1}]$ (A22)

Two step:

$$
\begin{aligned}
E_t[r_{t+2}] &= E_t[\underline{R} + R_{t+2} - F + W_{t+2}] \\
&= \underline{R} + \rho E_t[R_{t+1}] - F + \psi_1 + \psi_2 E_t[R_{t+1}] + \psi_3 E_t[W_{t+1}]
\end{aligned}
$$

Notice that each of the individual components of net returns for the two step ahead expectation can be written in terms of the one step ahead expectations. Therefore, in terms of the individual demand, we can rewrite

$$
\begin{aligned}
a_{i,t} &= k(E_t[\sum_{h=1}^{H}\delta^{h-1}(R_{i,t+h} - F + W_{i,t+h})] - \sum_{h=1}^{H}\delta^{h-1}(r_{rep} - \underline{R})) \\
&= k(b_0 + b_1 * E_t[R_{t+1}] - b_2 F + b_3 E_t[W_{t+1}] - b_4(r_{rep} - \underline{R}))
\end{aligned}
\quad \text{(A23)}
$$

where b_i are constant coefficients which are complicated functions of the parameters and map H period expectations into one period ahead expectations. Earlier, we assumed k was constant because conditional variance is constant for a one period horizon but for a H period horizon, the conditional variance will also be constant by the linearity of the problem. For example, take the variance of a two period horizon,

$$
\begin{aligned}
Var_t[W_{t+2}] &= Var_t[\phi_1 A_{t+2} + \phi_2 R_{t+2} + \phi_3] \\
&= Var_t[\phi_1\left(\lambda A_{t+1} + \gamma\begin{bmatrix}\rho R_{t+1} - F + \psi_1 + \psi_2 R_{t+1} \\ + \psi_3\{\phi_1 A_{t+1} + \phi_2 R_{t+1} + \phi_3\}\end{bmatrix} - \kappa * (r_{rep} - \underline{R})\right) + \phi_2 R_{t+2}] \\
&= \left(\phi_1^2\gamma^2(\rho^2 + \psi_2^2 + \psi_3^2\phi_2^2) + \phi_2^2(1+\rho^2)\right)\sigma^2
\end{aligned}
\quad \text{(A24)}
$$

Given the individual demand for an H period horizon, we now want to aggregate across several investors investing in the same fund. If there is a large group of individuals, M, that have the same maximization problem as above but only update every H periods then there will be some individuals using current information and others who hold their portfolio constant, G. In terms of the aggregate portfolio, this implies

$$
A_{i,t} = \sum_{m=1}^{M} a_{m,i,t} = \sum_{m=1}^{G} a_{m,i,t-1} + \sum_{m=G+1}^{M} k(b_0 + b_1 * E_t[R_{t+1}] - b_2 F + b_3 E_t[W_{t+1}] - b_4(r_{rep} - \underline{R})) \quad \text{(A25)}
$$

or using aggregate asset size and proportions of investors where G/M is represented by λ

$$
A_{i,t} = \lambda A_{i,t-1} + (1-\lambda)k(b_0 + b_1 * E_t[R_{t+1}] - b_2 F + b_3 E_t[W_{t+1}] - b_4(r_{rep} - \underline{R})). \quad \text{(A26)}
$$

where M and G may not be constant over time but λ is assumed constant. This between this flow function and equation 4 of the paper is that b_1, b_2, and b_3 are assumed to be the same for simplicity and the constant term *(1-λ)kb₀* is ignored. Although assuming the coefficients, b_1, b_2, and b_3, simplifies the problem it would not change any of the main results or relationships.

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Table I
Fund Flow Estimation for Funds that Waive and Funds that Do Not Waive Fees

An Instrumented Panel Regression estimates differences in fund flows across funds that waive fees and funds that do not waive fees for the entire sample of 3265 funds and a sub-sample of 2240 funds. The sub-sample is defined as those funds with non-advisory fees below he mean non-advisory fee for all funds. The left hand side variable is fund flows defined as the percent change in assets over a year. NON-ADVISORY is the non-advisory fee charged by the fund, including transfer agent costs, custodial fees, postage, and printing. NET ADVISORY is the net advisory fee charged annually by managers. Lagged net advisory fees are used to instrument for net advisory fees to control for any endogeneity between current fees and current flows. WNW is a dummy variable taking the value 1 if the fund waives its fees. Endogeneity between WNW and fund flows is controlled by instrumenting for WNW using lagged WNW. GROSS RETURNS are the gross annual returns differenced from the average of taxable and taxfree funds and from the annual gross return average. GROSS RETURNS are instrumented using lagged gross returns. BANK is a dummy variable taking the value 1 if the fund uses a bank as its distribution channel. INSTITUTIONAL is a dummy variable taking the value 1 if the fund is an institutional fund. TAXFREE is a dummy variable taking the value 1 if the fund offers a taxfree dividend payment. COMPLEX is the number of funds in the fund family divided by 1000. AGE is the number of years the fund has been in existence from the time of its inception to the year the fund is observed. LAGGED ASSET is the one-year lagged asset size of the fund in billions of dollars. INITIAL INVESTMENT is the initial investment size needed for an investor to initiate an account with the fund in billions of dollars. YEAR 91, YEAR 92, YEAR 93, and YEAR 94 are dummy variables taking the value 1 foreach respective year. The hypothesis test that investor sensitivity to waivers and contracted fees is the same is equivalent to Ho:γ^{NW} - γ^{W} =0. The standard errors control for heterskedasticity.

Panel A: Test Results

	Fund Flow			
	All Funds		Low Non-Advisory Fee	
Independent Variables	*Coefficient*	*p-value*	*Coefficient*	*p-value*
Net-Advisory (γ^{NW})	-0.266	(.188)	-0.489	(.024)
WNW*Net-Advisory ($\gamma^{NW}–\gamma^{W}$)	-1.858	(.040)	-2.149	(.028)
Gross Returns (γ)	0.138	(.056)	0.174	(.053)
WNW	0.625	(.013)	0.694	(.013)
Non-Advisory	-0.874	(.022)	-0.094	(.760)
Institutional	-0.314	(.000)	-0.384	(.000)
Bank	0.084	(.136)	0.159	(.013)
Taxfree	-0.183	(.000)	-0.175	(.000)
Complex	0.447	(.053)	0.562	(.020)
Age	-0.038	(.000)	-0.049	(.000)
Lagged Asset	-0.034	(.002)	-0.021	(.007)
Initial Investment	0.267	(.970)	0.534	(.943)
Year 91	0.197	(.003)	0.311	(.000)
Year 92	-0.044	(.412)	0.016	(.747)
Year 93	-0.022	(.751)	0.055	(.462)
Year 94	-0.104	(.079)	-0.051	(.399)
Intercept	0.837	(.000)	0.805	(.000)
No. of Observations	3265		2240	

Panel B: Test Statistics

	F-test	*p-value*	*F-test*	*p-value*
Model Test	12.28	(.00)	10.27	(.00)
H_o: $\gamma=\gamma^{NW}=\gamma^{W}=0$	8.98	(.00)	10.90	(.00)
H_o:$\gamma-\gamma^{NW}=0$	1.62	(.20)	0.27	(.60)