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Demand Curves and the Pricing of Money Management

by
Susan Christoffersen
David K. Musto

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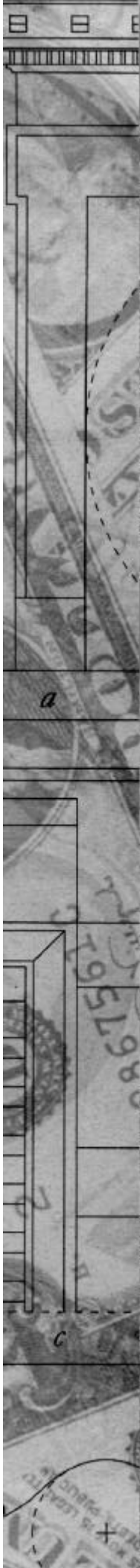

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Demand Curves and the Pricing of Money Management*

Susan Christoffersen
Finance Department
McGill University
1001 Sherbrooke Street West
Montreal, Quebec H3A 1G5
christos@management.mcgill.ca
(514) 398-4012

David K. Musto
Finance Department
Wharton School, U. Penn.
3620 Locust Walk
Philadelphia PA 19104
musto@wharton.upenn.edu
(215) 898-4239

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ABSTRACT

Demand Curves and the Pricing of Money Management

Recent studies (*e.g.* Gruber (1996)) conclude that a subset of investors allocates away from funds with relatively worse prospects, and toward funds with better prospects. The implication for a given fund is that good prospects increase the density of performance-sensitive investors, and bad prospects increase the density of performance-insensitive investors. Since fees come out of performance, this has a straightforward pricing implication: investors remaining in the funds with bad prospects should be charged more, whether by the same fund or by a different fund that absorbs the investors. This dynamic is apparent from several angles in a sample of retail money-funds.

Some individuals refinance their fixed-rate loans when rates drop, and others do not. A pool of mortgages emerges from a low-rate period with some mortgagors remaining, and the valuation of their payments must impute their self-selection. The prepayment opportunity has identified the remaining mortgagors as relatively insensitive to prepayment opportunities, so the present value of their future payments is at a premium to the general population. The better was the opportunity, the bigger is the premium. This well-known element of consumers' liability management should also apply to their assets, including their mutual-fund investments.

Recent studies (*e.g.* Gruber (1996), Zheng (1999)) conclude that a subset of the investing population allocates away from funds with relatively worse prospects, and toward funds with better prospects. The implication for a given fund is that good prospects increase the density of performance-sensitive investors among its shareholders, and bad prospects increase the density of performance-insensitive investors. Since the fees charged to investors come out of performance, this has a straightforward pricing implication analogous to the premium for seasoned mortgages: investors remaining in the funds with bad prospects should be charged more.

We take this demand-side view of management pricing to the American money-fund industry. This venue serves several purposes. We need to observe the cross section of prospects, and this is especially straightforward with money funds given their close relation between fees and performance and persistence in fees. We need funds that can adjust fees up or down at will, which describes most money funds due to the widespread practice of fee-waiving. And we don't want interference from the capital-gains tax.

To test the hypothesis that self-selection influences pricing, we must separate out the influence of pricing on self-selection. This is especially critical in the case of money funds, with their tight link between price and performance. The test designs approach this task from two directions. In parallel with the mortgage-pool example, we ask first whether investors who remain after relatively more attrition pay relatively higher fees. Next, we analyze fee changes around fund mergers, which are especially good opportunities to isolate demand-side effects.

The merger of fund *2* into fund *1* replaces the old shares held by *2*'s investors with new shares of *1*. This is a discrete shift in the distribution of *1*'s shareholders toward the characteristics of *2*'s shareholders. If *2*'s shareholders were relatively performance-insensitive, it is a shift toward lower price sensitivity that indicates a higher price. We test for this effect on the management-price changes around a sample of mergers within the largest money-fund category by estimating, first from pre-merger prices and then from pre-merger attrition, the relative price-sensitivity of *2*'s shareholders, and its implication for *1*'s fee.

Our principal result is that the demand-side model explains a significant portion of price revisions. Unconditionally, mergers appear as likely to raise prices as lower them, but our measures of the change in the surviving funds' price sensitivities reliably identify which funds will charge more or less, and by how much. This connection between investor heterogeneity and fund pricing adds a new dimension to the analysis of delegated portfolio management.

The rest of the paper is in five sections. Section I describes the data. Section II covers the literature, adds some new results on money funds, and motivates our

hypothesis. Section III tests the hypothesis on the cross section of money funds. Section IV tests the hypothesis on a sample of money-fund mergers, and Section V summarizes and concludes.

I. Data

The database for the empirical tests combines data from two sources. The first source is the weekly newsletter *Money Fund Report* (MFR) published by IBC/Donoghue. Among other things, it reports the assets under management and seven-day yield (total return to investors over the past 7 days, times 365/7) as of each Tuesday for all funds that voluntarily report. The publishers estimate that over 95% of funds report, and the data cover November 1987 through July 1997. The largest category of funds tracked is what MFR calls "First Tier" and "Second Tier" retail funds: retail funds that invest in the whole range of money market instruments (*i.e.* not restricted to municipal issues or some combination of Treasury and Agency issues). As of August 31, 1998, there were 293 such funds, managing $538 Billion (out of the $1.229 Trillion managed by all money funds). These data are not survivorship-biased; for each week, they include every fund that chose to report that week.

The publishers inquired after each fund that stopped reporting, and identified all the funds that stopped because they had merged into other funds. They identified 47 mergers of First Tier or Second Tier retail funds into other First Tier or Second Tier retail funds. These mergers, listed in the Appendix, are the ones we study below.

We also use fee data from Lipper Analytical. For each fund tracked by Lipper we have the total fee charged to investors for each fiscal year they have been tracked. These

figures are the actual fees paid by investors, so they combine advisory and administrative fees and are net of any expense waivers applied by the fund.

Some of the mergers occurred too late for our database to show a fee for a fiscal year after the merger. In these cases, we looked up the fee in the SEC filings available on LEXIS/NEXIS. Pre-merger fees for two funds were not in the Lipper data or the SEC filings, so the tests using fee data analyze 45 of the 47 mergers.

II. Self-Selection by Mutual Fund Investors

II.A Equity Funds

The largest part of the finance literature on mutual funds concerns the measurement and prediction of performance. Some of the recent studies demonstrate modest performance persistence among equity funds. For example, both Carhart (1997) and Brown and Goetzmann (1995) show that expected future performance increases in past performance, and that this persistence is especially strong for the worst past performers.

The predictability begs the question as to how investors' allocations across funds respond to past returns. This has been the subject of several studies, including Ippolito (1992), Goetzmann and Peles (1996), Chevalier and Ellison (1997) and Sirri and Tufano (1998), all of which show allocations increasing with past returns, particularly in the region of better past returns. Gruber (1996) and Zheng (1999) find that the net flows earn above-market returns, and propose that some investors are more active or sophisticated than others, benefiting from chasing persistence while the less active or sophisticated stay put and earn below the market.

The existence and significance of inactive investors is especially apparent with the worst performers. The canonical example is the Steadman family of funds, which performed well and attracted many investors in the 1960s but which later placed consistently last or near last in performance rankings while losing many but not all investors (see *e.g.* Brandstrader (1992)). The remaining investors could in principle have expected improved management performance, but with fees exceeding 20% per year,[1] the underperformance was all but guaranteed.

The Steadman combination of higher fees and worse prospects is not an isolated case. Carhart (1997) shows that funds with past performance in the lowest two deciles have not only worse average future performance *gross* of fees than the other deciles, but also higher fees. Whatever the reason for the higher fees, the remaining investors have distinguished themselves from the population in general, and the funds' original investors in particular, as relatively more willing to pay high prices for bad prospects.

II.B Analogous Results for Money Funds

The interaction between fees, assets and prospects is richer among money funds since the cross section of fees is, to a close approximation, the cross section of underperformance. Figure 1 is a histogram of the fees charged by money funds[2] in the 1996 fiscal years, showing most fees between 40 and 100bp (bp = basis points, 1/100 of 1%), but also a fat tail ranging up to 200bp and two funds charging nothing. Market commentators (*e.g.* Malkiel (1996), Bogle (1994), Fredman and Wiles (1998)) often

[1] In its fiscal year ended June 30, 1998, the Steadman American Industry Fund had an expense ratio of 22.57%. Of the 1.347M shares held by investors at the beginning of that fiscal year, 1.138M remained at the end.

mention that this dispersion in fees is the major source of dispersion in performance. Domian and Reichenstein (1998) tests this proposition and find that fees (plus a dummy variable indicating government-only funds) explain 84% of the variation in performance.

For our sample, if we plot the FY96 performance of the funds in Figure 1 (*i.e.* total return[3] of FY96 minus the value-weighted average total return of all other money funds over the same months) against the fees, we get Figure 2, which shows an extremely close relation. Regressing performance *PERF* on *FEE*, we get (t-statistics in parentheses):

$PERF_f$	=	0.610	-1.031FEE_f	+ ε_f	R^2 = 94%
		(44.9)	(-60.4)		N(obs)=224

The slope of –1 and the R^2 of 94% confirm that the funds all generate approximately the same gross return, then deliver different net returns to investors by charging different fees. So the persistence of money-fund performance reflects whatever persistence there is in fees.

We can gauge the actual persistence in money fund performance by comparing adjacent years. For each money fund in each year from 1989 to 1995, we calculate performance (total return less the value-weighted index) in that year and also in the next. Figure 3 plots the latter against the former, showing persistence far stronger than that of equity funds. For example, Brown and Goetzmann (1995) find that 993 of 2401 "winner" years of equity funds were followed by "loser" years, whereas in Figure 3, only

[2] Unless otherwise specified, all money funds from this point onward are Tier 1 and Tier 2 retail funds, as defined by MFR.
[3] The annual total return used here is the average of the 7-day yields over the weeks in that year.

87 of 615 winner years precede loser years. Because fees tend to persist, performance persists too.

Do investors impute this persistence into their allocations, the way they appear to with equity funds? With the weekly data we can examine this issue at a high resolution. Every other week, we calculate for each fund the current performance and the percentage change in assets under management over the next two weeks.[4] We sort into performance bins, and report the bin medians as Figure 4.

The relation takes the convex form already detected in equity funds. Flows are positive and sensitive to past performance in the region of good past performance, and negative but relatively insensitive in the region of bad past performance. It is worth noting that this asymmetry is unrelated to the capital-gains tax; there are no capital gains, realized or unrealized, with money funds.

Figures 2 through 4 illustrate some of the rich strategic environment of a money fund's pricing decision. A very low fee would presumably generate operating losses but it almost guarantees very high performance that induces inflow, especially from active investors. Higher fees increase current profits but they almost guarantee lower performance that induces outflow by active investors, to the extent that the fund still has active investors. So the pricing decision simultaneously affects current profits, net inflow, and the performance-sensitivity of shareholders.

The operating history of the Dreyfus Worldwide Dollar Fund (DWDF) is perhaps the largest-scale example of this interaction. Figure 5 shows the fees charged (left axis,

[4] This yields 56,981 non-overlapping observations. We take medians, rather than means, because the smallest funds generate some enormous outliers, and some other funds jump abruptly in size due to exogenous events such as the mergers discussed below. We get a very similar picture if we take means after eliminating asset-increases above 50%.

by fiscal year) and assets managed (right axis, weekly) by this fund over the sample period. This fund charged very little in its first two years, during which time its yield regularly ranked at or near the top of all money funds, and its assets grew to $10 billion. Over time it raised its price, and assets fell to $2 billion. The low early fees were interpreted at the time as a "loss leader" strategy, the putative goal being to "lure investors into the fund family with an above-average yield in the hope that they can be sold other products later."[5] Indeed, a Dreyfus executive called the fund a success because "75% of the customers attracted were new to Dreyfus, and 50% had never before invested in a mutual fund."[6]

But whatever its motive, the pricing strategy had a potentially important effect on the price-sensitivity of current shareholders. After two years of low fees, shareholders were a price-sensitive group that left quickly when the fund charged 23 and then 47bp, both below the average of about 60bp. After several years of much higher fees and a total of 80% attrition, assets under management barely reacted to 75bp. Apparently, the remaining 20% was self-selected to be performance-insensitive.

From its investors' point of view, a fund's fee is simply a direct reduction of performance, so performance-insensitivity implies price-insensitivity which, other things equal, implies a higher optimal price. Given the other determinants of the demand curve it faces, such as its marketing to potential investors, a fund should charge relatively more if its current investors are relatively less price-sensitive. The rest of the paper explores the significance of this dynamic to management pricing.

[5] *Los Angeles Times*, March 22, 1990, p. D2.

III. Fund Flows and Future Fees

We are interested in how the self-selection of a fund's current investors relates to its future price. For this purpose, we need to estimate self-selection somehow. We could try to estimate the relation between a fund's operating history, the operating histories of its competitors and the self-selection of its current investors, but this is presumably quite complex. Instead, in the spirit of the mortgage-pool and Dreyfus examples, we focus simply on the fund's attrition: the relation between its current size, and the largest size it achieved. Taking attrition as a rough proxy for the performance-insensitivity of its remaining investors, we should see higher fees after greater attrition. We examine this relation in the cross section of all funds. Because this test requires more temporal alignment and higher frequency than the fee data provide, we conduct it instead on relative performance, banking on the fee/performance relation illustrated above.

To establish whether funds charge more to investors who remain after more attrition, we divide the sample period into two periods: the last 26 weeks, or half-year (1/15/1997 to 7/15/1997), and the previous 478 weeks (11/24/1987 to 1/15/1997). The empirical question is whether performance in the later period is lower for funds that experienced more attrition over the earlier period. There are 267 funds with data covering the last 26 weeks. For each, we calculate its average 7-day yield over this period, as well as its asset retention – its 1/15/1997 size divided by the maximum size reported up to then, which is one minus its attrition. The results are sorted into bins and plotted as Figure 6.

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[6] Laderman (1992), p. 114, indirectly quoting Dreyfus president and chief operating officer Joseph DiMartino.

Returns increase, and so fees decrease, as attrition decreases from left to right. The statistical significance of the relation is apparent in a regression of one (*YIELD*) on the other (*SIZE*/*MAX*) (t-statistics in parentheses):

$YIELD_f$	=	4.627	+0.291$SIZE/MAX_f$	+ ε_f	R^2 = 5.6%
		(75.8)	(3.98)		N(obs)=267

The funds charging more tend to be the ones that have lost more assets under management. We can separate this effect from any size-related effect by including both size and attrition, and taking logs:

log($YIELD_f$)	= 0.664	+0.010log($SIZE_f$)	+0.024log($SIZE_f/MAX_f$)	+ ε_f	R^2 = 15.4%
	(121)	(5.11)	(2.97)		N(obs)=267

Controlling for size, which correlates with lower fees, the relation between past attrition and future prices still holds. These results support the view that self-selection influences pricing, but they don't rule out a passive scenario where some funds simply charge more than others year after year without regard to self-selection, experiencing attrition along the way. We can't be sure if the fees drive the seasoning or *vice versa*.

One way to sort out this chicken-and-egg problem is to look instead at fee changes around fund mergers. In a merger, a fund absorbs shareholders selected by a different operating history, so the empirical question is whether this difference induces a revision in the surviving fund's pricing. In other words, a merger is a discrete shift in the demand curve it faces, and the operating histories of the two funds should indicate the direction and magnitude of the shift, which in turn implies the direction and magnitude of the price revision. The next section runs two such tests on the merger database.

IV. Price Changes around Mergers

The goal of this section is to estimate, for each merger in the database, the difference between the current shareholders of the surviving and disappearing funds and its implication for the re-pricing of the surviving fund. To this end we solve a simple model which infers the funds' pre-merger demand curves and combines them to predict the optimal price revision. The predicted revisions are compared with the actual price revisions that occurred. We also test directly for the seasoning effect motivated above, though without imposing any structure with a formal model. All tests are conducted on both the actual fees and on fees estimated from relative returns.

But before these tests, it is worth noting that we are not analyzing *why* funds merge, and that in fact if price-sensitivity were the *only* consideration in management-pricing, funds would not degrade their price-discrimination by merging. The presumption is that some unmodeled efficiency gain motivates the merger with a benefit exceeding the discrimination-related cost. It is potentially important that money-fund mergers generally result from financial institution mergers (see the Appendix), and an institution can reduce the mismatch between merger-partners' shareholders to the extent it has a variety of partners to choose from. Nations Funds, for example, has 65 money funds of all types, including 7 in the Tier 1/Tier 2 retail category, whereas Legg Mason lists 3 total, with only 1 in the Tier 1/Tier 2 retail category,[7] suggesting that Nations can merge shareholders with relatively more similar shareholders than can Legg Mason.

We can get some sense of the shareholders' pre-merger similarity by comparing the fees they were paying. For each merger, let fund 1 be the surviving fund (as identified by MFR), charging f_1 before the merger, and fund 2 be the disappearing fund,

charging f_2. Figure 7 plots one on the other, showing a generally positive relation. Its statistical significance is apparent in a simple regression (t-statistics in parentheses):

$$f_{1,i} = \underset{(4.97)}{0.470} + \underset{(2.47)}{0.288 f_{2,i}} + \varepsilon_i \qquad R^2 = 10.3\%, \ N(obs)=45$$

The pre-merger similarity is significant, but so is the residual mismatch that is the focus of our analysis. A description and motivation of the estimated fees is next, followed by the empirical tests.

IV.A Fees and Pseudofees

The fee data is by fiscal year, so f_1 and f_2 are the fees charged by Fund 1 and Fund 2, respectively, in their last complete fiscal years before the merger, and f_{12} is the fee charged by Fund 1 in its first complete fiscal year after the merger. For one merger, f_1 is missing, and for another f_2 is missing, so there are 45 mergers with complete data.

In addition to the missing observations, the fee data have the drawback of being poorly synchronized with the mergers. Consider, for example, the June 18, 1993 merger of the Daily Income Fund (DIF) into the Short Term Income Money Market Portfolio (STIMMP). The last DIF fiscal year before 6/18/93 ended 6/30/92, and the last STIMMP fiscal year before 6/18/93 ended 8/31/92. The first STIMMP fiscal year *after* the merger began 9/1/93. So our pre-merger price data covers 11 to 22 months before the merger in the case of DIF and 9 to 20 months before in the case of STIMMP. The post-merger price data covers 3 to 14 months afterward. This distance from the events we analyze could obscure the results.

[7] As reported by IBC/Donoghue at www.ibcdata.com for the week ending July 13, 1999.

The solution is again to use fees estimated from relative performance, which to avoid confusion with reported fees we call pseudo-fees. The tests analyze absolute, not relative fees so, following the regression, we take a fund's pseudo-fee over a period to be its average under-performance (its average 7-day yield subtracted from the average across all funds) over the weeks in that period, *plus* 60bp. This calculation estimates the fee over any period when yield-data is available, so it addresses the synchronization problem. It also ameliorates the missing-observation problem, since there is sufficient data to calculate pseudo-fees for 46 of the 47 mergers.[8]

There is one potential econometric problem we must account for in using fee estimates. Suppose p_1, p_2 and p_{12} are our estimates of f_1, f_2 and f_{12}, where we measure p_1 and p_2 over a span of weeks just before the merger, and p_{12} just after, so p_2-p_1 estimates f_2-f_1 and p_{12}-p_1 estimates f_{12}-f_1. The problem is that the estimation error in p_1 will affect both differences in the same direction; an underestimate (overestimate) would bias us toward overestimating (resp. underestimating) both f_2-f_1 and f_{12}-f_1. Since we test below whether f_2-f_1 and f_{12}-f_1 are positively related, this could induce us to incorrectly reject the null hypothesis. The way around this bias is to calculate p_1 twice, in disjoint periods, and use one calculation for p_2-p_1 and the other for p_{12}-p_1. We divide the year around the merger into three subperiods: the first half-year (*i.e.* 26 weeks) after the merger (subperiod *C*), the last quarter before the merger (*B*), and the quarter before that (*A*). In *A* we calculate p_{1A} and p_{2A}, in *B* we calculate p_{1B} and in *C* we calculate p_{12C}, and our estimates of f_2-f_1 and f_{12}-f_1 are p_{2A}-p_{1A} and p_{12C}-p_{1B}, respectively.

[8] There is no yield data on Dreyfus/Laurel Prime 1 MMF/ Investor Class for the period before the merger with Dreyfus/Laurel Cash Management / Investor Class.

IV.B Pricing Model

The model assumes that a fund maximizes its current profits given its current investors' price-sensitivity, which is assumed linear. The marginal cost of managing an extra dollar is fixed at zero, so the managers' programs are simply to maximize total revenue f_iQ_i, where Q_i is fund i's assets under management. Downward-sloping demand curves drive the maximizations; before the merger, fund i faces the demand curve

$$Q_i(f_i) = a_i - (b_i/2)f_i \qquad (1)$$

where a_i and b_i are positive numbers. Some familiar math shows the optimal fee and assets for fund i to be $f^*_i = a_i/b_i$ and $Q^*_i = a_i/2$, so our estimate of fund i's demand curve, given our observations of f^*_i and Q^*_i is

$$Q_i = 2Q^*_i - (Q^*_i/f^*_i)f_i \qquad (2)$$

The merger combines the demand curves of the funds, so the resulting demand curve relating the post-merger price f_{12} and quantity Q_{12} of fund 1 is

$$Q_{12} = (2Q^*_1+2Q^*_2)-(Q^*_1/f^*_1+Q^*_2/f^*_2)f_{12} \qquad (3)$$

implying the optimal fee

$$f^*_{12} = (Q^*_1f^*_2f^*_1+Q^*_2f^*_1f^*_2)/(Q^*_1f^*_2+Q^*_2f^*_1) \qquad (4)$$

A little algebra shows

$$f^*_{12}-f^*_1 = [(Q^*_2f^*_1)/(Q^*_1f^*_2+Q^*_2f^*_1)](f^*_2-f^*_1) \qquad (5)$$

This is the predicted price revision of the surviving fund as a function of the variables we can observe. The optimal price revision is in the direction of the disappearing fund's fee, and the magnitude depends on the funds' relative sizes.

Some comments on the modeling choices:

We assume zero marginal cost for cash management. Of course there *is* some cost to a money fund from handling more money and shareholder accounts, but we can't observe it, or how it varies across funds. Solving the model without marginal costs delivers predictions in terms of observable information, and is a strong departure from the alternative hypothesis that variation in fees reflects variation in costly services. In any case, our focus on the price change of a given fund minimizes the influence of differential service costs.

The linear demand curves keep the model tractable and transparent, and they have the useful feature of being recoverable from observable price and quantity data. One way to map this model to the question of relative price sensitivity is to assume that a given investor i has demand curve $q_i = \alpha - (\beta_i/2)f_i$. Everybody has the same demand α at zero price, but different price sensitivities. If the average β_i of the n investors remaining in a fund's investor base is b, then the optimal fee is $(n\alpha)/(nb) = \alpha/b$, so a higher average price sensitivity corresponds to a lower fee.

The assumption that funds can move prices up or down from one day to the next reflects the widespread practice of fee waiving. Christoffersen (1998) shows over 60% of money funds waiving fees between 1991 and 1995. These funds can start charging more or less on any day, without approval from shareholders.

Modeling the managers as maximizing the current profits of their money funds abstracts from the profits of the family's other funds and the tradeoff between current and future profits, both of which appear important to the DWDF case. A usable model of the

pricing problem's extensive form may be solvable, but is beyond the scope of this paper and our database.

IV.C Empirical Tests

First, we simply test whether the surviving fund revises its fee in the direction of the fee that its new investors had been paying at their old fund. Table I summarizes this non-parametric test.

By either measure, the surviving fund's price moves significantly in the predicted direction; when a fund absorbs new investors who had been paying more, it charges more. One way to read this table is that 14 of the 17 times a fund absorbed the shareholders of a better-performing fund, its own performance subsequently improved, and that 19 of the 29 times it absorbed a worse-performing fund, its own performance deteriorated.

A simple regression tests the magnitude and direction of the price revision. The independent variable is the predicted value of the surviving fund's price change, and the dependent variable is the actual change. We run the regression twice – once with the 45 mergers with fee data, and again with the 46 mergers with pseudo-fees. The results are in Table II, which shows that, either way, the t-statistics for the coefficient on the prediction indicate high statistical significance, and the R^2 is around 14%.

The data bear out the model, but they would also bear out a model where funds just set fees equal to costs, and the surviving fund changes its menu of costly services in the direction of the disappearing fund's menu. A fund's transfer agent services its shareholders, and the average transfer-agent charge for a money-fund account in 1995

was $22.18[9] which corresponds, given the concurrent average money-fund account balance of $24,980,[10] to 9bp of the fee. This is not a large part of the total fee, but service menus vary so it is worth addressing this possibility.

We searched the SEC filings on LEXIS/NEXIS and found information on pre- and post-merger service offerings for 30 of the 47 surviving funds. Services were usually unchanged, but there were a few additions and deletions. To test for a connection to fee changes, we calculated the change in the number of services[11] for each merger, and compared it to the fee change, f_{12}-f_1. The correlation, -0.197, has the wrong sign and is not significantly different from zero. This does not support a connection between service changes and fee changes.

Another possibility is that, holding the menu constant, some investors cost more than others. In this scenario, a fund raises its price when it adds shareholders who had been paying more because they raise the per-dollar cost of running the fund. Depending on how much of the cost of servicing an account is fixed, the cost could be higher than 9bp for funds with smaller average balances, and for any fund that inherits those accounts.

One way to address this potential confusion is to estimate the relative price-sensitivity of fund 2's shareholders without reference to the price they were charged.[12] Following the seasoning intuition from above, let $R_i = SIZE/MAX$, defined as before, of

[9] As calculated by the Investment Company Institute and Coopers & Lybrand, and reprinted in Pozen (1998).
[10] As of 12/1995 there was $753.018 billion in money fund assets, and there were 30,144,344 money-fund accounts (Investment Company Institute (1999)).
[11] We counted checking, systematic withdrawals, dividend reinvestment, exchange privileges, automatic investment plans, wire redemption, telephone redemption, wire transfer, sweep accounts, 403B plans, 401K plans, IRA, SEP and Keogh plans.

fund *i* just before the merger, so that R_2/R_1 estimates the relative attrition of the two funds: the smaller the ratio, the greater fund 2's attrition was relative to fund 1's. A simple model for fund 1's price revision upon absorbing fund 2's shareholders is

$$f_{12}/f_1 = K(Q_2/(Q_1+Q_2))^{\alpha}(R_2/R_1)^{\beta}$$

The percentage price change varies with the size of fund 2 relative to the merged fund, and with the relative attrition. This model is admittedly *ad-hoc*, but it captures the intuition that the explanatory variables enter multiplicatively. Results for fees and pseudo-fees are in Table III.

By either fee measure, the coefficient on relative attrition is significant in the predicted direction. When a fund adds assets that remained after more attrition, it raises its price.

[12] Another way is to analyze average account size, but this is unavailable for many of the mergers. And the numbers that *are* reported are unreliable due to funds' practice of reporting a master account, such as all sweep accounts at a particular brokerage, as one shareholder.

V. Summary and Conclusion

A fund's past influences its future by selecting its present investors. We illustrate some of the influence on management pricing. A past that selected performance-insensitive investors encourages higher pricing, whether by the same fund or by a different fund that absorbs the investors. This dynamic is apparent from several angles in a sample of retail money-funds.

This paper provides some simple examples of the potential and empirical significance of shareholder self-selection. It is not intended to be exhaustive, and indeed there are many directions one could take this line of reasoning, not only to other fund-types but also to other determinants and implications of self-selection. The characteristics of a fund's investors would presumably reflect the marketing that brought them in, and, given the ease of transferring balances, the marketing, performance and pricing of the family's other funds. For example, when Putnam Investments attracted little new money with a price cut, one explanation was that fee-sensitive investors "probably don't do business with load-fund companies such as Putnam."[13]

The seasoning logic may also have some relevance to the proliferation of funds. Just as a fund family would prefer not to merge inactive investors with active ones, it may also prefer not to alter a fund's management, marketing or pricing in a way that brings active investors into a fund with only inactive investors remaining. The profit-maximizing strategy may be to leave the old fund alone, with its track record still visible, and start a new fund for the new investors. A fund that has done badly is an embarrassment but also an asset.

[13] *Wall Street Journal* (1999)

Appendix: List of Mergers

Fund 1	Fund 2	Date	Q_1	Q_2	f_1	f_2	f_{12}
Princor Cash Mgmt Fund	EGT Money Market Trust	12/2/88	70	26	1.02	1.34	1.00
Shearson Daily Dividend	Hutton Cash Reserve Mgt.	12/2/88	4932	2789	0.80	0.59	0.70
Shearson Daily Dividend	Hutton AMA Cash Fund	12/2/88	4932	1735	0.80	0.60	0.70
Shearson Daily Dividend	Shearson FMA Cash	12/2/88	4932	1942	0.80	0.66	0.70
Shearson Daily Dividend	Lehman Management Cash Res.	12/2/88	4932	288	0.80	0.71	0.70
Franklin MF	BIRR Wilson Money Fund	12/30/88	1429	11	0.80	1.12	0.73
Emblem Prime Portfolio	Seagate Prime Obligations Fund	5/18/90	311	81	0.61	0.66	0.62
RBB MMP/Bedford Class	Home Cash Reserves	6/1/90	151	554	0.93	0.93	0.92
Centennial Cash Reserves	Massmutual Money Market Fund	3/29/91	52	83	1.00	1.13	1.25
Cortland Trust Gen MMF	Parkway Cash Fund	9/6/91	847	63	1.01	1.00	1.00
Dreyfus Worldwide Dollar MMF	Daiwa Money Fund	9/20/91	8989	9	0.01	1.10	0.47
Prime Cash Series	So Farm Bureau Cash Fund	11/15/91	756	23	0.94	1.24	0.99
T Rowe Price Prime Reserve	Bell Atlantic MMP	12/27/91	4229	13	0.75	0.75	0.75
Prime Value Cash Inv Fund	Altura Prime Oblig Port	1/17/92	1111	191	0.51	0.67	0.50
Smith Barney Cash Portfolio	Vantage Cash Money Market Fund	6/26/92	1805	1120	0.52	0.56	0.64
T-Rowe Price Prime Reserve	USF&G Cash Reserve Fund	8/21/92	3844	28	0.78	0.97	0.74
Hanover Cash Mgmt Fund	CBC Cornerstone Prime MMF	10/2/92	234	309	0.67	0.58	0.58
Nations Prime MMF/Inv A	Nations MMF/Investor A	11/13/92	283	2	0.65	0.43	0.65
Ambassador MMF	St. Clair MMF/Prime Oblig	11/20/92	334	231	0.44	0.79	0.53
Ivy MMF	American Investors Money Fund	1/29/93	17	3	0.85	0.63	0.85
Pacific Horizon Prime Fund	First Funds of America MMF	2/26/93	1160	111	0.56	0.55	0.52
Short Term Income/MMP Cl A	Daily Income Fund	6/18/93	791	340	0.83	0.70	0.91
Pioneer Cash Reserves Fund	Pioneer Money Market Account	7/1/94	63	107	0.75	1.29	0.88
Prime Cash Series	Voyageur Money Market Fund	10/28/94	834	17	0.99	0.85	0.99
Dreyfus/Laurel Prime I MMF/ Inv Cl	Dreyfus/Laurel Cash Mgmt/Inv	11/4/94	123	4	0.71	0.97	0.70
Smith Barney Cash Port/Cl A	Smith Barney Shearson Daily Div	11/18/94	3041	14658	0.64	0.70	0.62
Evergreen MMT/Cl Y	First Union MMP/Cl Y Shrs	7/7/95	247	56	0.32	0.41	0.45
American Capital Reserve Fund	Van Kampen Merritt MMF/Class A	9/22/95	342	20	1.00	1.08	1.02
Galaxy MMF/Retail	Shawmut Prime MMF/Invmt Shrs	12/1/95	610	271	0.74	0.71	0.71
Evergreen MM/Cl A	FFB Cash Management Fund	1/19/96	864	598	0.81	0.66	0.79
PaineWebber RMA MF/MMP	Kidder Peabody Premium Account	2/16/96	6401	516	0.59	0.70	0.59
PaineWebber RMA MF/MMP	Kidder Peabody Cash Reserve	2/16/96	6401	856	0.59	0.74	0.59
CoreFunds Cash Reserve/Cl C	Conestoga Cash Mgmt/Cl A Investor	4/12/96	19	2	0.73	0.56	0.75
Vista Global MMF/Vista Shrs	Hanover Cash Management	5/3/96	117	1451	0.57	0.58	0.59
Pegasus MMF	Prairie Money Market Fund/Cl A	9/13/96	1851	402	0.75	0.51	0.74
Transamerica Cash Reserve	Transamerica Premium Cash Acct	11/30/90	434	127	0.45	0.45	0.57
Transamerica Cash Reserve	Transamerica Money Market Fund	5/31/91	330	16	0.46	1.30	0.63
Boston Company Cash Mgmt	American Express MMF	2/7/92	270	41	0.86	#N/A	0.97
Woodward MMF	Bison MMF/Money Market Port	1/1/93	1118	335	0.52	0.45	0.47
Evergreen MMT/Cl A	First Union MMP/Cl A Invmt Shrs	7/7/95	3	566	#N/A	0.61	0.75
Stagecoach MMF/Cl A	Pacifica Money Market Fund	9/6/96	3542	182	0.75	0.64	0.75
Nations Prime Fund/Primary A	Peachtree Prime MMF/Invmt Shrs	9/27/96	2467	39	0.3	0.5	0.3
1784 Prime MMF	BayFunds MMP/Investment Shrs	12/6/96	97	45	0.62	0.87	0.65
Legg Mason Cash Reserve	Bartlett/Cash Reserves Fund	12/20/96	1270	39	0.75	0.78	0.78
Franklin Money Fund	Templeton Money Fund	12/31/96	1237	115	0.75	0.96	0.68
Stepstone MMF	HighMark Dvsfd Oblig/Cl A	4/25/97	529	141	0.73	0.75	0.75
Nations Prime/Inv B	Pilot S-T Divsfd Assets/Admin	5/16/97	358	263	0.55	0.52	0.55

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Table I
Non-parametric tests of fee changes following mergers

This table summarizes the fees charged by Tier 1 and 2 retail money funds around mergers. f_1 and f_2 are the fees charged by the surviving and disappearing funds, respectively, in their last fiscal years before the merger, and f_{12} is the fee charged by the surviving fund in its first complete fiscal year after the merger. p_{2A} and p_{1A} are estimated fees two quarters before the merger, p_{1B} is estimated one quarter before, and p_{12C} is estimated the half-year after the merger.

Panel A:	*Actual Fees*			
	f_{12}-f_1:	<0	=0	>0
f_2-f_1				
<0		11	5	2
=0		1	1	1
>0		7	3	14
Pearson Chi-Squared Test:		10.1204		
Prob(χ^2>χ^2(.05))		0.038		
Panel B:	*Pseudo-Fees*			
	p_{12C}-p_{1B}:	<0	=0	>0
p_{2A}-p_{1A}				
<0		14	0	3
=0		0	0	0
>0		10	0	19
Pearson Chi-Squared Test:		9.8424		
Prob(χ^2>χ^2(.05))		0.002		

Table II
Regressions of actual on predicted price changes

$f_{1,i}$ and $f_{2,i}$ are the fees of the surviving and disappearing fund, respectively, in the i^{th} money fund merger, in their last complete fiscal years before the merger. $f_{12,i}$ is the fee of the surviving fund in the first complete fiscal year after the merger. $Q_{1,i}$ and $Q_{2,i}$ are the assets under management of the funds before the merger. The second regression uses pseudo-fees; p_{2A} and p_{1A} are estimated fees two quarters before the merger, p_{1B} is estimated one quarter before, and p_{12C} is estimated the quarter after the merger. T-statistics are in parentheses.

Actual Fees:			
$f_{12,I}$-$f_{1,i}$ =	0.0155 +	0.683[$Q_{2,i}f_{1,i}$/($Q_{2,i}f_{1,i}$+$Q_{1,i}f_{2,i}$)]($f_{2,i}$-$f_{1,i}$)	R^2=13.8%
	(1.11)	(2.62)	N=45
Pseudo-fees:			
$p_{12C,i}$-$p_{1B,i}$ =	-0.009 +	0.539[$Q_{2,i}p_{1A,i}$/($Q_{2,i}p_{1A,i}$+$Q_{1,i}p_{2A,i}$)]($p_{2A,i}$-$p_{1A,i}$)	R^2=14.0%
	(-0.71)	(2.68)	N=46

Table III
Regressions of price changes on relative attrition and size

$f_{1,i}$ and $f_{2,i}$ are the fees of the surviving and disappearing fund, respectively, in the i^{th} money fund merger, in their last complete fiscal years before the merger. $f_{12,i}$ is the fee of the surviving fund in the first complete fiscal year after the merger. $Q_{1,i}$ and $Q_{2,i}$ are the assets under management of the funds before the merger. The second regression uses pseudo-fees; p_{2A} and p_{1A} are estimated fees two quarters before the merger, p_{1B} is estimated one quarter before, and p_{12C} is estimated the quarter after the merger. On the left-hand side, p_{2A} and p_{1A} fill in for f_2 and f_1, and on the right-hand side, p_{12C} and p_{1B} fill in for f_{12} and f_1. $R_{1,I}$ and $R_{2,I}$ are the assets under management of the two funds, just before the merger, divided by the respective maximum assets under management reported to MFR over the sample period. T-statistics are in parentheses.

Actual Fees:				
$\log(f_{12,i}/f_{1,i}) =$	-0.061	$-0.059\log(Q_{2,i}/(Q_{1,i}+Q_{2,i}))$	$-0.267\log(R_{2,i}/R_{I,i})$	R^2=21.9%
	(-1.26)	(-1.22)	(-2.08)	N=45
Pseudo-fees:				
$\log(p_{12,i}/p_{1,i}) =$	-0.019	$-0.006\log(Q_{2,i}/(Q_{1,i}+Q_{2,i}))$	$-0.079\log(R_{2,i}/R_{I,i})$	R^2=18.0%
	(-1.81)	(-0.45)	(-2.32)	N=46

Figure 1. Net fees of Tier 1 and Tier 2 retail money funds charged in FY96, in annual percent.

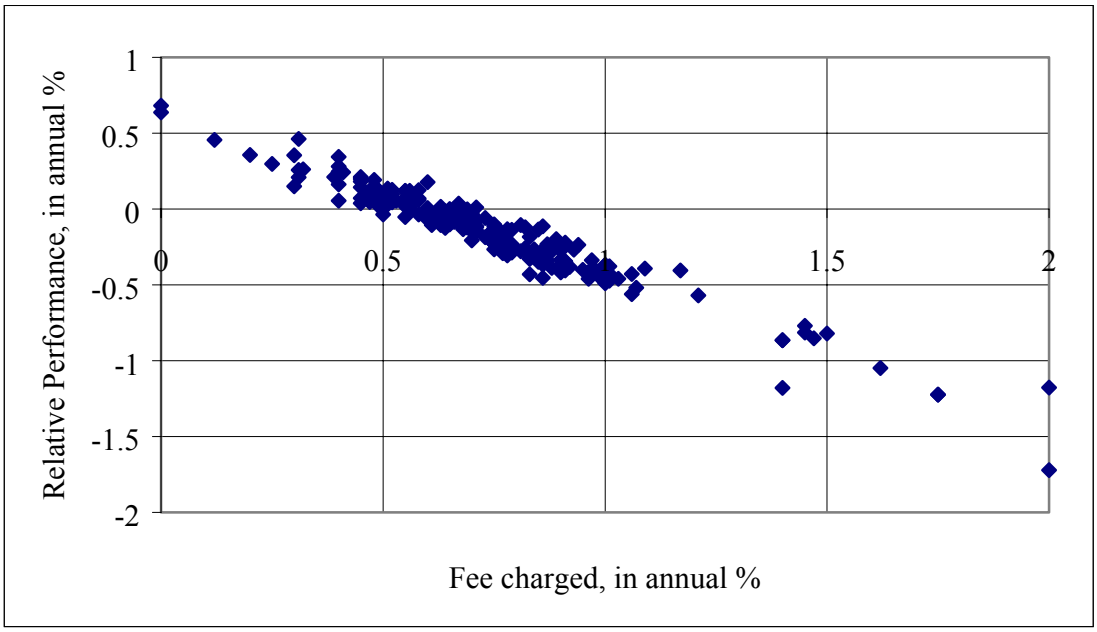

Figure 2. Excess FY96 return *vs.* FY96 fee. The excess return is the total return of the fund, minus the average total return of all Tier 1 and 2 retail money funds over the same weeks.

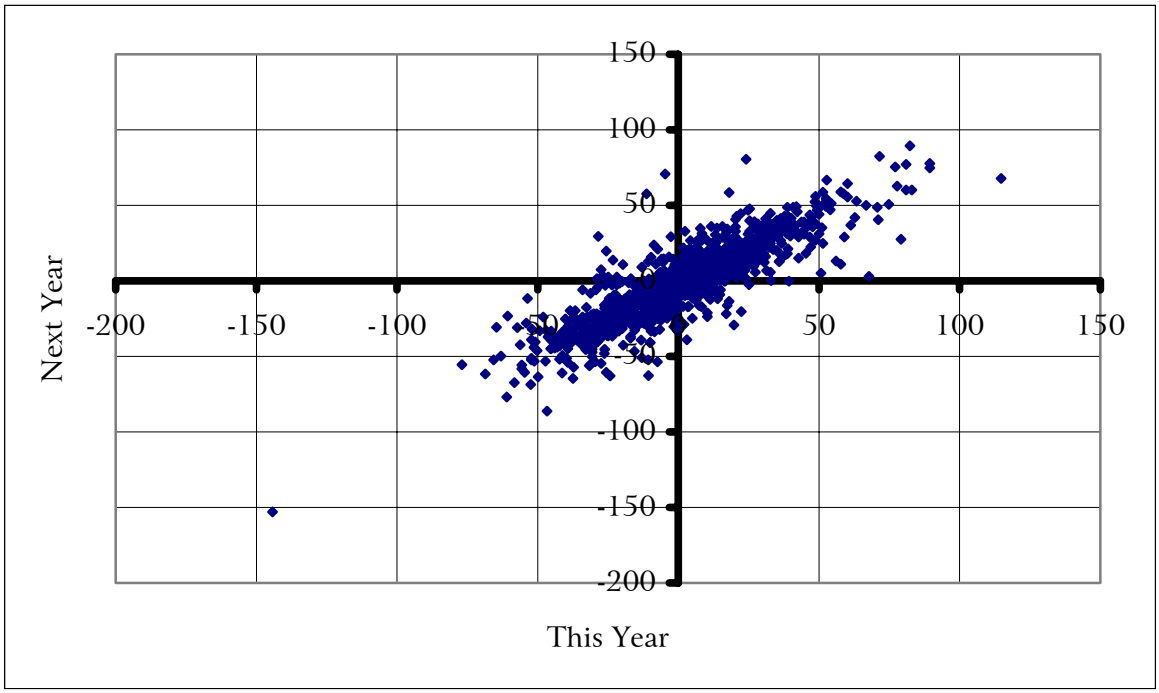

Figure 3. Performance persistence of Tier 1 and Tier 2 retail money funds. Excess return (relative to index of all funds) in one year compared to excess return in the next. In basis points.

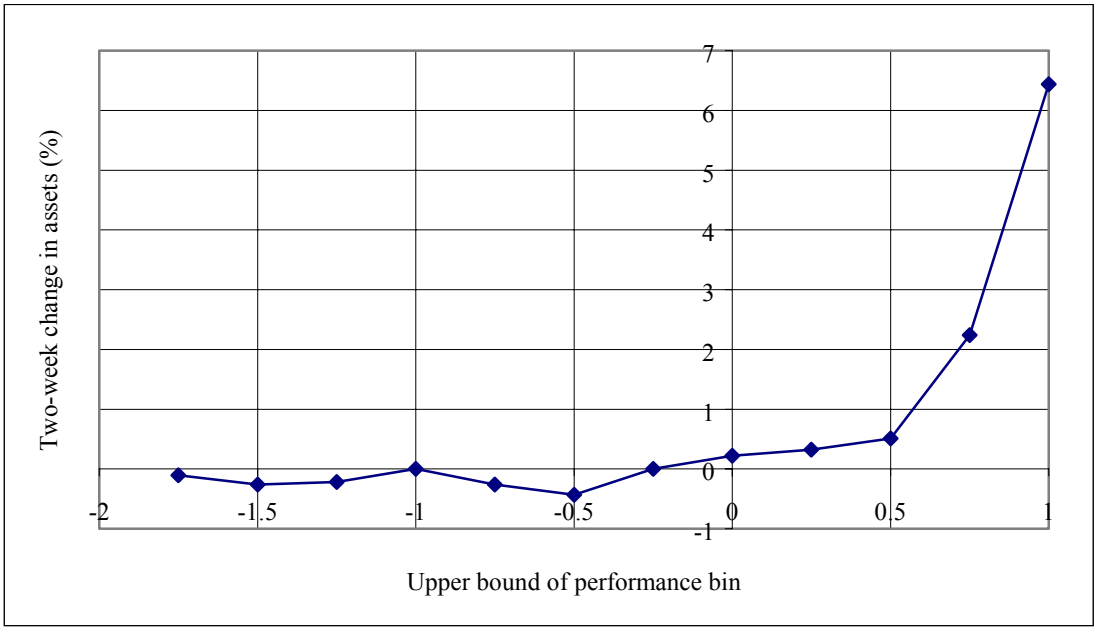

Figure 4. Net two-week flow into money funds, sorted by past performance. Funds are sorted into 25bp-wide bins by their week *w* performance, and the median percentage change in assets under management by week w+2 is calculated for each bin.

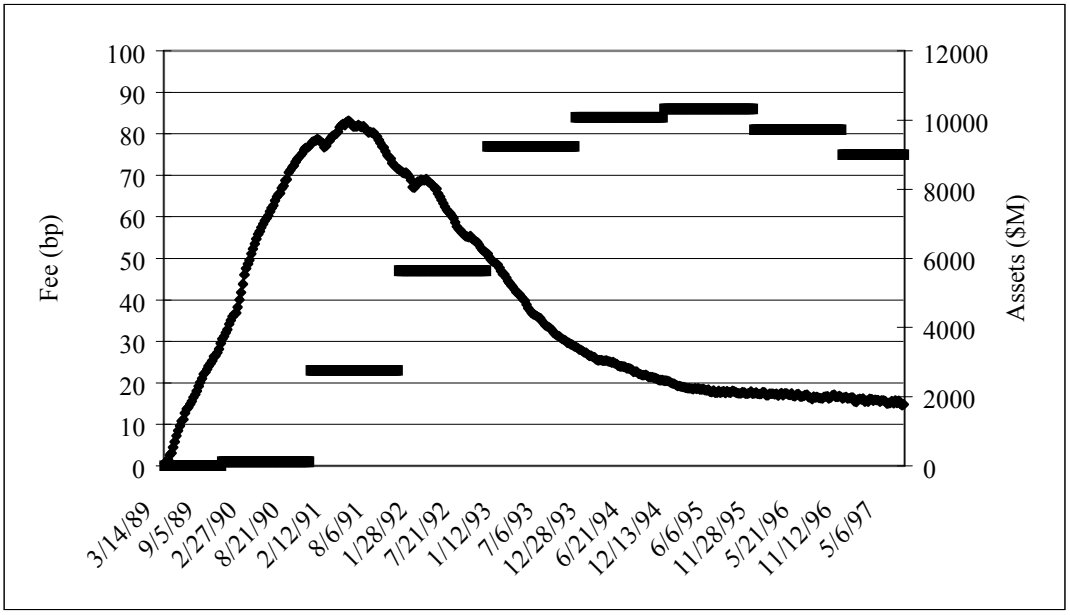

Figure 5. Fees and Assets of the Dreyfus Worldwide Dollar Fund. Fees (disjoint lines) are on the left axis, and assets under management (continuous line) are on the right axis.

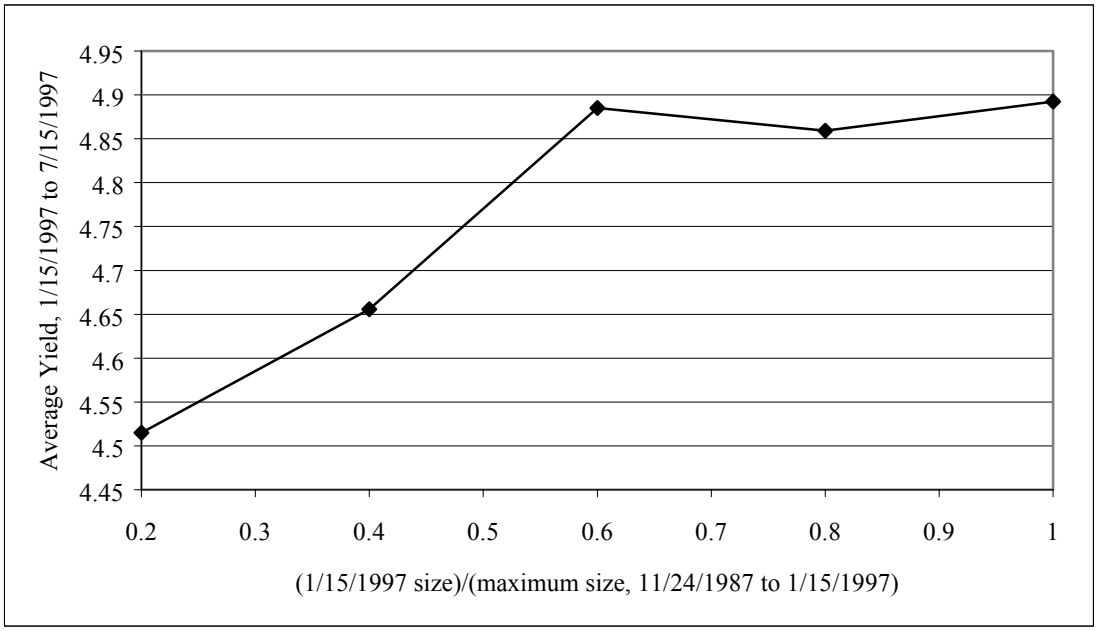

Figure 6. Relative yield *vs.* Attrition of Money Funds. Funds are sorted into five bins by their attrition over the first 478 weeks of the MFR sample period, and the average annualized yield within each bin over the terminal 26 weeks of the period is calculated.

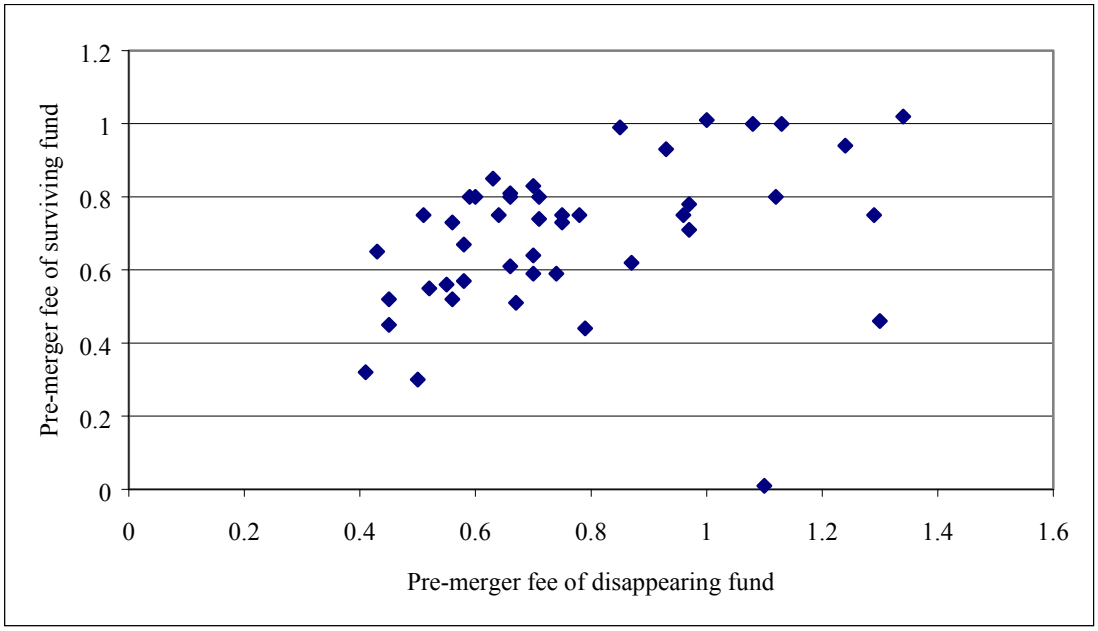

Figure 7. Fees charged by Tier 1 and Tier 2 retail money funds in their last fiscal years before the merger, in annual percent.