Why Does the Law of One Price Fail? An Experiment on Index Mutual Funds

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We evaluate why individuals invest in high-fee index funds. In our experiments, subjects each allocate $10,000 across four S&P 500 index funds and are rewarded for their portfolio's subsequent return. Subjects overwhelmingly fail to minimize fees. We reject the hypothesis that subjects buy high-fee index funds because of bundled nonportfolio services. Search costs for fees matter, but even when we eliminate these costs, fees are not minimized. Instead, subjects place high weight on annualized returns since inception. Fees paid decrease with financial literacy. Interestingly, subjects who choose high-fee funds sense they are making a mistake. (*JEL* C91, D03, D14, G11, G23)

Mutual fund fees vary by an order of magnitude across firms, even though the industry has hundreds of competing providers. There is scant evidence that more expensive funds pick securities well enough to offset their higher fees (e.g., Gruber 1996; Carhart 1997). Hence, it is puzzling that competition has not eliminated high-fee funds. The puzzle is especially acute in the index fund market, where funds tracking a given index offer virtually identical portfolio returns before fees, but price dispersion is no smaller than in the actively managed fund market (Hortaçsu and Syverson 2004). In 2007, retail S&P 500 index fund investors paid $206 million more in expenses (excluding sales loads) than they would have if their entire S&P 500 index fund balance were in the retail no-load S&P 500 index fund with the lowest expense ratio. These excess

This work was supported by the National Institute on Aging (grant numbers T32-AG00186 to J.C., R01-AG021650); the U.S. Social Security Administration (grant number 10-P-98363-2 to the National Bureau of Economic Research as part of the SSA Retirement Research Consortium); and the Mustard Seed Foundation to J.C. We are indebted to Anna Blank, David Borden, Carlos Caro, Ananya Chakravarti, Shaq Chi, Keith Ericson, Christina Jenq, Shih En Lu, Dina Mishra, Kelly Shue, Dmitry Taubinsky, Chelsea Zhang, Fan Zhang, and Eric Zwick for their excellent research assistance. We are grateful to Sally Zeckhauser, John W. Nolan, Ken Toy, and Thomas E. Vautin for facilitating the experiment with Harvard staff. We thank Jeff Brown, Gideon Saar, and seminar participants at the Boston Fed, NBER, University of Connecticut, University of Maryland, University of Pennsylvania, and Yale for helpful comments. The findings and conclusions expressed are solely those of the authors and do not represent the views of NIA, SSA, any other agency of the Federal Government, or the NBER. Send correspondence to James J. Choi, Yale School of Management, P.O. Box 208200, New Haven, CT 06520-8200; telephone: (203) 436-1833; fax: (203) 436-0630. E-mail: james.choi@yale.edu.

doi:10.1093/rfs/hhp097 Advance Access publication November 14, 2009

payments are 58% of total nonload expenses paid to retail S&P 500 index funds in 2007, and 0.12% of total assets under management in retail S&P 500 index funds in 2007.[1]

Some researchers have argued that high index fund fees reduce investor welfare, since they are sustained by investors' search costs (Sirri and Tufano 1998; Hortaçsu and Syverson 2004) or mistakes abetted by mutual fund marketing (Elton, Gruber, and Busse 2004; Barber, Odean, and Zheng 2005; Cronqvist 2006). The mutual fund industry has countered that "S&P 500 index funds themselves are not commodities. These funds differ from one another through the services that are packaged with their securities portfolios and through other characteristics" (Collins 2005, p. 2). These nonportfolio services include financial advice, customer service, and discounted access to complementary investment instruments. Thus, investors in expensive funds may receive higher quality nonportfolio services that fairly compensate them for their lower financial returns.

Elton, Gruber, and Busse (2004) find no evidence for the nonportfolio service hypothesis when they regress index fund net inflows on proxies for service quality. There is no significant correlation of flows with service quality rankings from a Dalbar survey, as well as with several other measures of nonportfolio service quality. Inflows *are* positively related to the number of Morningstar categories covered by the fund's family, perhaps suggesting a demand for complementary investment instruments, but simply investing in low-expense or high-past-alpha funds delivers superior future portfolio returns *and* a higher number of Morningstar categories in the selected families. However, nonportfolio services and their quality are difficult to measure. It is therefore possible that high-fee index fund investors are receiving services not captured by Elton, Gruber, and Busse's proxies. Furthermore, even if it were established that investors were receiving some extra services in exchange for lower portfolio returns, it would remain unclear whether a rational investor would pay such a high price for these services.

This article reports new experimental evidence that sheds light on whether rational demand for nonportfolio services can account for the existence of high-fee index funds. We asked 730 experimental subjects to each allocate a hypothetical $10,000 among four real S&P 500 index funds. All subjects received the funds' prospectuses. To make choices incentive-compatible, subjects' expected payments depended on the actual returns of their portfolios over a specified time period after the experimental session. We offered especially large incentives in one version of our experiment; for each of the 391 subjects in this implementation, choosing the most expensive portfolio instead of the least expensive portfolio reduced his or her wealth by $94.

[1] We use the CRSP mutual fund database to compute these figures. Monthly expenses are calculated using the following formula: Prior month-end total net assets $\times$ $(1 - (1 - \text{expense ratio})^{1/12})$. We then add up monthly expenses to obtain expenses for 2007. Total amount invested in S&P 500 index funds is the average at each month-end from 31 December 2006 to 30 November 2007 of the sum of all relevant funds' total net assets.

Our experimental setting gives us direct control of nonportfolio services. Because the investments were intermediated by the experimenters (and not by the fund companies themselves), no nonportfolio services were provided. Thus, the optimal portfolio allocates everything to the lowest-cost index fund.

The composition of our subject pool made it more likely that we would find support for rational theories. Our largest subject group (which received the largest incentives) consists of Harvard staff members—all white-collar nonfaculty employees—who on average have many years of experience managing their personal finances. Furthermore, 88% have a college degree, and 60% have graduate school education as well. Our next largest group of participants consists of MBA students from Wharton. The remaining subjects are college students recruited on the Harvard campus. Our MBA subjects report an average combined SAT score of 1453, which is at the 98th percentile nationally, and our college subjects report an average score of 1499, which is at the 99th percentile. When we measure financial literacy directly, we find that all three subject groups are more knowledgeable than the typical American investor.

Despite eliminating nonportfolio services, we find that almost none of the subjects minimized fees. On average, staff, MBA students, and college students respectively paid 201, 112, and 122 basis points more in fees than they needed to when they received only the funds' prospectuses to aid their decision. Staff and college students reported in debriefing surveys that fees played relatively little role in their portfolio decision. MBAs claimed that fees were the most important decision factor for them, yet their portfolio fees are not statistically lower than college students' fees. All subject groups reported placing high weight on past returns. This would be sensible if the past returns in the prospectuses were measured over the same horizon. But the mutual funds we offered had differing fund inception dates and prospectus publishing cycles. In fact, we constructed our fund menus so that the longest-horizon annualized historical returns reported in the prospectuses are *positively* correlated with fees. As a result, chasing the past returns reported in the prospectuses lowered future expected returns.

Given that subjects are making mistakes in their portfolio choices, are there information interventions that can alter the magnitude and frequency of these mistakes? We test three such treatments by comparing subjects who were randomly assigned to receive only the fund prospectuses to subjects who were randomly assigned to receive the prospectuses plus additional information.

In one treatment condition, we gave subjects a one-page "cheat sheet" that summarized the funds' front-end loads and expense ratios. If the cost of finding the fees in the prospectus is the principal reason why our subjects invested in high-fee index funds, then receiving the fees sheet prior to making the portfolio decision should cause them to pay nearly the minimum possible fees.

In a second treatment condition, we distributed one page of answers to frequently asked questions (FAQ) about S&P 500 index funds. The sheet

told subjects that all S&P 500 index funds seek to make their prefee investment returns approximate the S&P 500's return. If a failure to understand the commodity nature of S&P 500 index funds lies behind our subjects' decisions, then this FAQ intervention may mitigate portfolio choice errors.

Our third treatment made salient a particular historical return, as some mutual fund advertising strives to do (Jain and Wu 2000; Sapp and Tiwari 2004; Cronqvist 2006; Mullainathan, Schwartzstein, and Shleifer 2008). Subjects in this condition received a summary sheet that showed the longest-horizon historical annualized return reported in each fund's prospectus—usually the fund's return since inception. As noted previously, we constructed our fund menus so that these long-horizon historical returns are positively correlated with fees.

We find that eliminating search costs for fees improved portfolio allocations, but the effect is modest. Among those receiving the one-page fees summary sheet, 90% of staff and college students and 81% of MBAs still failed to minimize index fund fees. It thus appears that search costs play some role in but do not fully account for the willingness to hold high-fee index funds. When we explained what S&P 500 index funds are in the FAQ treatment, portfolio fees dropped modestly, but the statistical significance of this drop is marginal. Finally, highlighting misleading long-horizon historical returns by providing the returns summary sheet caused students to allocate more money to the fund with the highest long-horizon historical return. Staff portfolios, however, did not respond to the returns summary treatment. It appears that the staff members who did not get the summary sheet were motivated enough to find this information without our help, precluding an effect from receiving the special sheet with highlighted returns.

We conclude that mistakes driven by financial illiteracy are the primary source of the demand for high-fee index funds. Interestingly, investors in high-cost index funds have some sense that they are making a mistake. Those paying higher fees also reported having less confidence that their choice was optimal for them, a higher anticipated likelihood of changing their portfolio in response to professional investment advice, and less general investment knowledge. Our results add to a growing body of evidence that individual investors make suboptimal asset allocation decisions (e.g., Benartzi and Thaler 2001; Cronqvist and Thaler 2004; Barber, Odean, and Zheng 2005; Choi, Laibson, and Madrian 2005; Cronqvist 2006; Choi et al. 2009).

The article proceeds as follows. Section 1 describes our experimental design. Section 2 discusses the characteristics of our subject pool. Section 3 describes the main results from the experiment, and Section 4 interprets the results. Section 5 explores the link between portfolio choices and subject characteristics. We conclude in Section 6. The experimental materials we distributed to subjects are available on the *Review of Financial Studies*' online appendix page.

1. S&P 500 Index Fund Experiment Design

We ran two versions of our investment experiment. During the summer of 2005, we recruited MBA students at Wharton and college students at Harvard to participate.[2] Harvard staff members were recruited for the experiment in the summer of 2007. In both versions, subjects allocated a hypothetical $10,000 across four real S&P 500 index funds. They received a modest fee up front for participating and were eligible for an additional delayed payment that depended on how their chosen portfolio actually performed after the experimental session. By basing payments on the future returns of real funds (instead of artificial funds constructed for the experiment), we made it clear to subjects that we had no private information about how their portfolio choices would affect their payments.

Student subjects were told that one participant would be selected at random to win any positive return his or her chosen allocation earned from 1 September 2005 through 30 August 2006. Implementing the portfolio-based payment as a call option with a strike price of $10,000 rather than a fixed percentage of the final portfolio value increased the marginal impact of subjects' choices on their expected payment while keeping the experimental budget reasonable.

In response to concerns that our student results are driven by the subjects' low expected portfolio-based payment, we promised *every* subject in the 2007 Harvard staff experiment the upside return of their $10,000 portfolio, but only for the month of September 2007 rather than for a full year. We were writing a call option on $4 million of underlying securities, so we hedged our short position by buying calls on our own outside account. Because of the high cost of this hedge, we used an investment horizon of only one month for the staff experiment.

All subjects received photocopies of four S&P 500 index funds' prospectuses. Prospectuses are often the only document sent to potential investors requesting information about a fund. Subjects also received a "choice sheet" on which they recorded their chosen investment allocation. Participants had to satisfy the real-life minimum opening balance requirement for any fund to which they made an allocation. These minimums were shown on the choice sheet.

We randomly divided our participants into four information conditions. Subjects in the prospectus-only condition received only the choice sheet and prospectuses for each of the funds. Subjects in the fees treatment condition also received a one-page "fees sheet." The fees sheet explained that mutual funds charge fees, showed how to calculate the impact of loads and expense ratios on portfolio value, and listed the load, expense ratio, and dollar cost of the load and expense ratio for a one-year $10,000 investment in each of the

[2] The MBA students were mostly first-year students recruited during their pre-term orientation. Therefore, they had completed very little (if any) MBA coursework at the time of the experiment. Nonetheless, we believe this group to be very sophisticated relative to the typical individual investor.

four funds participants could select. All of the fees sheet information was also contained in the prospectuses.

Subjects in the returns treatment condition received the choice sheet, prospectuses, and a one-page "returns sheet" listing the longest-horizon annualized historical returns net of all fees (including the load) reported in each of the four funds' prospectuses. For student subjects, these long-horizon returns were all returns since the fund's inception. For staff subjects, three of the long-horizon returns were returns since inception, and one was a ten-year return. (The reason for this discrepancy is explained later in this section.) The sheet showed the dates over which the returns were calculated, as well as the disclaimer "Past performance is no guarantee of future results." The date ranges of the long-horizon returns varied across funds. Thus, long-horizon return variation was driven almost entirely by the S&P 500's performance during the date range and should be ignored when predicting future relative returns. There is extensive evidence that mutual fund investors chase past returns (Ippolito 1992; Hendricks, Patel, and Zeckhauser 1993; Chevalier and Ellison 1997; Sirri and Tufano 1998), but the rationality of such behavior is a subject of debate (Gruber 1996; Carhart 1997; Zheng 1999; Sapp and Tiwari 2004; Berk and Green 2004). Our experiment tests returns-chasing rationality by varying exposure to past return information that should have *no* effect on fund allocation decisions.

In addition to the fees and returns treatment conditions described above, the Harvard staff experiment also included a frequently asked questions (FAQ) treatment condition. In this condition, subjects received the choice sheet, prospectuses, and one page of answers to the following questions: (1) What is a mutual fund? (2) What is an S&P 500 index fund? (3) What is the S&P 500 Index? If prospectus-only subjects choose high-cost funds simply because they do not understand that all S&P 500 index funds seek to imitate the same portfolio's return, supplying these answers may shift subjects' portfolios to lower-cost funds.

In total, there were ten experimental groups: four staff groups (prospectus-only, fees treatment, returns treatment, FAQ treatment); three MBA groups (prospectus-only, fees treatment, returns treatment); and three college student groups (prospectus-only, fees treatment, returns treatment).

Subjects in all groups were given as much time as they wanted to make their investment allocations. They were not allowed to confer with each other. After participants submitted their investment allocation, they completed a debriefing survey that measured demographics, financial literacy, self-reported time spent reading the prospectus, and motivations behind their portfolio choice. Students were also asked for their SAT scores.

We used the following criteria to choose the four S&P 500 index funds offered to *student* subjects: (1) they were front-end load funds with wide variation in the total fees charged; (2) they were less than ten years old, and hence reported annualized returns since fund inception in their prospectus; (3) annualized

returns since inception were positively correlated with fees across funds; and (4) their prospectus was available as a PDF document online. Slightly different criteria were used for staff subjects, as explained later.

We wanted wide variation in the fees charged by the funds we offered so that subjects' decisions would meaningfully affect their expected returns. The largest source of S&P 500 index fund fee variation is their loads, which vary in the CRSP mutual fund database from 0% to 5.75% of invested funds. There is also substantial variation in annual expense ratios, which vary from 6 to 200 basis points. We restricted the set of funds under consideration to those with loads because we did not want to confound sensitivity to total fees with sensitivity to the mere presence of a load. We opted to include only front-end load funds (rather than also offering back-end load funds) in order to facilitate explaining the funds' fees on only one page. Barber, Odean, and Zheng (2005) present evidence that mutual fund investors are more sensitive to loads than expense ratios. Therefore, subjects are likely to be *more* sensitive to our experiment's fund fees than to fees in the general index fund universe, where there are many no-load funds.

By requiring that funds offered to student subjects be less than ten years old, we ensured that their prospectuses reported annualized returns since inception. Because we wanted to distinguish irrational returns-chasing behavior from rational fee-avoiding behavior, we searched for a fund menu where fees were positively correlated with annualized returns since inception.

After imposing the above criteria, the set of suitable S&P 500 index funds was remarkably small. The four funds we offered students are the Allegiant S&P 500 Index Fund, the Mason Street Index 500 Stock Fund, the Morgan Stanley S&P 500 Index Fund, and the UBS S&P 500 Index Fund. For all four funds, we specified that subjects could only invest in the Class A shares. The funds offered to students, their ticker symbols, inception dates, minimum opening balance requirements, fees, historical returns, and results from a performance evaluation regression are listed in columns two through five of Table 1. With the exception of the annualized return standard deviation and regression results, these numbers are taken from the most recent prospectuses available at the time of the student experimental sessions, which listed returns through 31 December 2003. The return standard deviations are calculated using returns excluding loads and taxes, starting in the first full calendar month in which all the students' funds were operating and ending in the last full calendar month before the student experimental sessions took place. The performance evaluation regressions run fund excess returns excluding loads and taxes on S&P 500 excess returns over this same time period.

The expense ratio across the four student funds varies from 0.59% to 0.80%, and the load varies from 2.50% to 5.25%.[3] The total annual fee (expense ratio

[3] The expense ratio associated with each of these funds is not unambiguous because all four funds have in the past waived part of their stated expenses on an ad hoc basis each year. In this article, we use the expense ratio from

Table 1
Characteristics of S&P 500 index funds used in experiment

	MBA and college students (2005)				Harvard staff (2007)			
	Allegiant	Mason Street	Morgan Stanley	UBS	Allegiant	Morgan Stanley	Phoenix Insight	UBS
Ticker symbol	AEXAX	MISAX	SPIAX	PSPIX	AEXAX	SPIAX	HIDAX	PSPIX
Inception date	15/10/1998	31/3/1997	26/9/1997	2/10/1998	15/10/1998	26/9/1997	19/4/1996	2/10/1998
Minimum opening balance	$500	$1000	$1000	$1000	$500	$1000	$500	$1000
Expense ratio[a]	0.59%	0.80%	0.64%	0.70%	0.60%	0.64%	0.73%	0.70%
Front-end load	2.50%	4.75%	5.25%	2.50%	2.50%	5.25%	5.75%	2.50%
Approximate fee on $10,000 investment	$309	$555	$589	$320	$255	$530	$581	$356[b]
1-year return reported in prospectus[c]	23.23%	21.57%	21.11%	24.58%	1.62%	−1.16%	9.77%	1.69%
5-year return reported in prospectus[c]	−1.88%	−2.19%	−2.34%	−1.74%	−0.56%	−1.18%	4.75%	−0.60%
Longest-horizon return reported in prospectus	1.28%[d]	5.90%[d]	2.54%[d]	2.54%[d]	3.08%[d]	3.64%[d]	7.34%[e]	3.80%[d]
Annualized return standard deviation	15.49%	15.49%	15.51%	15.51%	14.11%	14.11%	14.08%	14.12%
Monthly alpha	−0.047%	−0.057%	−0.057%	−0.053%	−0.046%	−0.054%	−0.039%	−0.054%
R^2	99.99%	99.98%	99.99%	99.99%	99.99%	99.99%	99.96%	99.99%

[a]After fee waivers.
[b]Includes 1% early redemption fee.
[c]Annualized returns before taxes but after loads and fees.
[d]Return since fund inception.
[e]10-year return.

This table shows information on the S&P 500 index funds offered to student and staff subjects. With the exception of the last three rows, this table's information is taken from the most up-to-date prospectuses available at the time of the applicable experimental sessions. All information is for the funds' Class A shares. The approximate fee on a $10,000 investment is calculated for the applicable investment horizon: one year for the students, and one month for the staff. The last three rows do not reflect loads or taxes and are calculated starting in the first full calendar month in which all the experimental session's funds were operating and ending in the last full calendar month before the experimental session took place (November 1998 to July 2005 for student subjects, and November 1998 to July 2007—excluding April 2006, when the Phoenix fund received a one-time payment—for staff subjects). The alpha and R^2 are from a regression of the fund's monthly return in excess of the risk-free rate on the S&P 500 return (including dividends) in excess of the risk-free rate.

plus front-end load) on a $10,000 investment held for one year varies from a low of $309 for the Allegiant fund to a high of $589 for the Morgan Stanley fund.[4] Though the Allegiant fund is the lowest-cost fund, the total fee for the UBS fund is only $11 more. The other two, the Mason Street and Morgan Stanley funds, have substantially higher loads and expense ratios.

The annualized returns since inception net of all fees reported in the prospectuses vary from a low of 1.3% for the Allegiant fund to a high of 5.9% for the Mason Street fund. All four student funds were established during a nineteen-month window, but the S&P 500 Index level ranged from 757 at the Mason Street fund's inception to 1047 at the Allegiant fund's inception. This variation in the S&P 500 Index value at inception is largely responsible for the differences in the reported return since inception. Note that the fund with the highest annualized return since inception (the Mason Street fund) is one of the two high-cost funds, whereas the fund with the lowest reported return since inception (the Allegiant fund) is the lowest-cost fund. The last two rows of Table 1 show that even excluding the impact of the sales load, the low-cost Allegiant fund has the highest historical alpha during the period in which all four funds were operational, and the funds' tracking errors are nearly identical.

We wanted to offer the same funds to the staff subjects, who were recruited two years after the student subjects. However, the Mason Street fund was acquired by American Century Investments in 2006 and incorporated into an existing American Century index fund. Therefore, we replaced the Mason Street fund with the Phoenix Insight Index Fund, which also has high fees and historical returns. The last four columns of Table 1 show the characteristics of the funds offered to staff subjects.

The three funds offered to both students and staff—the Allegiant, Morgan Stanley, and UBS funds—had similar expense ratios and front-end loads in 2005 and 2007. The total fees paid by staff subjects were generally lower, however, because their investment horizon was only one month, so they were charged for only one month of ongoing expenses rather than a full year. The liquidation of staff subjects' portfolio after one month also triggered a 1% early-redemption fee for the UBS fund, raising its cost to staff subjects relative to its cost to student subjects. Whereas the Morgan Stanley fund was the most expensive fund offered to student subjects, the Phoenix fund was the most expensive fund offered to staff subjects.

Because the Phoenix fund had been in operation for more than ten years at the time of the staff experiment, its prospectus did not list an annualized return

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the prior year after any expense waivers, as stated in the prospectus, unless the fund guarantees the waiver level in the following year. Morningstar uses net-of-waiver expense ratios to rate funds. See Christoffersen (2001) for a discussion of mutual fund fee waivers.

[4] We calculate fees on a one-year $10,000 investment with the formula $10,000 × (expense ratio + load) for simplicity, since that was the total fee implicitly presented to subjects in the fees treatment condition. Calculating fees using the formula ($10,000 × load) + ($10,000 × (1 − load) × expense ratio) yields almost identical results for all of the article's analyses. We use the formula $10,000 × (expense ratio/12 + load) to calculate fees on a one-month investment.

since inception, but instead listed a ten-year historical return. We reported this ten-year return for the Phoenix fund on the staff subjects' returns sheet. The Phoenix fund's 7.3% ten-year return is significantly higher than the other staff funds' returns since inception, which are between 3.1% and 3.8%. In addition, the 9.8% one-year historical return (including the sales load) listed in the Phoenix fund's prospectus is much higher than the other staff funds' one-year returns of less than 2%. This is because the most recent prospectus for the Phoenix fund listed returns through 2006 (a good year for the market), whereas the other prospectuses only listed returns through 2005.[5] In the last two rows of Table 1, we find that despite its high current expense ratio, the Phoenix fund has the highest historical alpha. It also has the highest tracking error. These findings are due to the fact that the Phoenix fund's expense ratio used to be much lower and changed multiple times during its history.[6] During September 2007 (the investment period that determined staff payouts), the Phoenix fund had the lowest return (3.66%) and the Allegiant fund had the highest return (3.74%), as predicted by the current expense ratios.

Recall that *every* staff subject was effectively given a call option whose strike price was \$10,000 and whose underlying asset's initial value was \$10,000 $\times$ (1 $-$ portfolio load). This created large incentives for the staff subjects to make optimal choices. Based on the yield of the 30-day Treasury bill and the implied S&P 500 volatility given by the Chicago Board Options Exchange Volatility Index (VIX) at the close of 21 August 2007—the day before the first staff sessions began—the Black-Scholes value of allocating 100% to the Allegiant fund was \$170, whereas the value of allocating 100% to the Phoenix fund was \$76. Therefore, each staff subject stood to gain \$94 by moving from the worst portfolio to the best portfolio.

2. Subject Characteristics

Our subjects are 391 Harvard staff members, 252 Wharton MBA and Ph.D. students, and 87 students recruited primarily on the Harvard campus. Although we aimed to recruit only MBA subjects on the Wharton campus, we did not explicitly prohibit non-MBA students from participating in the experiment, so our Wharton campus subject pool included 15 college students and two Ph.D. students.[7] We group the MBA students with the Ph.D. students and refer to

[5] The 2006 S&P 500 return was 15.78%, in contrast to the Phoenix fund's 16.47% return before loads. The end of the prospectus reveals in a long table that excluding a nonrecurring payment by the fund's former administrator, the fund's 2006 return was only 15.18%. The Phoenix fund's annual report discloses that the payment was made because the administrator had previously been charging Phoenix more than had been contractually agreed upon. Even if one were to believe that similar payments were to be regular occurrences for Phoenix investors going forward, the expected payment over a one-month investment horizon is surely swamped by the fund's 5.75% load.

[6] For example, the annualized expense ratio was 0.45% after fee waivers in the second half of 2005.

[7] We confirmed the Harvard staff and Wharton student affiliations by checking their school-issued identification cards.

them collectively as the "MBA sample." We group the college students on the Wharton campus with the student subjects at the Harvard campus and refer to them collectively as the "college sample."

Table 2 gives summary statistics on our subject pools. The average staff subject is about 40 years old, which means that they typically have a couple of decades of experience managing their personal finances. As expected, the student subjects are substantially younger. The majority of our staff subjects are female, whereas both the college and MBA samples have male majorities. The staff subjects are very well educated: 88% have a college degree (almost all of these are bachelor's degrees, not associate's degrees), and 60% have some graduate education or a graduate degree. The "college" sample includes a few high school students who were taking summer school classes on campus, as well as a few college graduates. Both MBAs and college subjects report extraordinarily high average SAT scores (the 98th and 99th percentiles, respectively).[8]

Every subject group is more financially literate than the typical American investor sampled in the John Hancock Defined Contribution Plan Survey (John Hancock Financial Services 2002). Only 8% of John Hancock respondents correctly answered a multiple-choice question about what kinds of assets a money market fund holds. We asked a similar question of our subjects and found that 21% of staff, 40% of MBAs, and 15% of college students answered correctly. John Hancock respondents on average thought that the stock of their own company was *less* risky than an equity mutual fund; on a 5-point scale, the average risk rating was 3.1 for employer stock and 3.6 for an equity mutual fund. In contrast, all ten of our experimental groups on average correctly rated a typical Fortune 500 stock as *more* risky than an equity mutual fund. However, this second comparison is potentially confounded by the fact that John Hancock respondents were asked about the stock of their own employer, whereas our subjects were asked about the stock of a typical Fortune 500 company.

Through the luck of the draw, staff subjects in the fees treatment condition are younger, more likely to be female, and more educated than the other staff subjects. We will show in Section 4 that our treatment estimates are robust to controlling for these demographic differences. In addition, prospectus-only MBAs are less financially knowledgeable than other MBAs when judged by their knowledge of what a money market fund's investments are. In unreported regressions, we find that controlling for whether this question was answered correctly does not qualitatively change our inference about the MBA fees treatment effect and strengthens the statistical significance of the returns treatment effect.

Consistent with their high-powered incentives, staff subjects reported spending the most time reading the prospectuses: about fourteen minutes on

[8] Approximately one-third of the MBAs and one-sixth of the college sample reported not having taken the SAT. Many of these subjects may be foreign students, which raises the concern that poor English skills or unfamiliarity with U.S. financial institutions may cause them to pay high fees. However, we find no significant difference in mean fees between student subjects who did and did not take the SAT (two-sided p-value of 0.54, not reported in a table).

Table 2
Experimental subject characteristics

	Harvard staff				MBA students			College students		
	Prospectus only	Fees treatment	Returns treatment	FAQ treatment	Prospectus only	Fees treatment	Returns treatment	Prospectus only	Fees treatment	Returns treatment
Average age	41.1	39.4	41.5	40.4	27.7	27.4	27.4	21.0	22.0	21.0
Percent male	37%	29%	35%	37%	63%	66%	70%	50%	48%	63%
Highest education										
High school or less	3%	0%	5%	1%	1%	0%	0%	7%	10%	8%
Some college	9%	11%	8%	9%	1%	0%	0%	83%	76%	74%
College degree	30%	22%	28%	34%	98%	100%	100%	10%	14%	19%
Some grad school	19%	15%	20%	19%	–	–	–	–	–	–
Graduate degree	39%	52%	38%	37%	–	–	–	–	–	–
SAT I score										
Average verbal	–	–	–	–	714	717	719	759	760	741
Average math	–	–	–	–	730	741	737	752	752	730
Didn't take SAT	–	–	–	–	30%	35%	33%	20%	17%	11%
Don't remember or don't wish to answer	–	–	–	–	23%	15%	14%	7%	10%	11%
Knows what a money market fund holds	28%	19%	22%	18%	33%	42%	44%	14%	17%	14%
Average risk rating (1 to 5; higher = riskier)										
Fortune 500 stock	3.34	3.49	3.59	3.58	3.02	3.36	3.28	3.57	3.14	2.79
U.S. equity mutual fund	3.12	2.98	3.16	3.14	2.68	2.98	2.74	2.70	2.43	2.25
Average self-reported minutes reading prospectus	13.3	13.4	14.3	14.4	13.6	11.1	10.7	11.2	8.4	8.5
Sample size	$N = 97$	$N = 97$	$N = 100$	$N = 97$	$N = 83$	$N = 85$	$N = 84$	$N = 30$	$N = 29$	$N = 28$

This table shows the characteristics of the subjects. Some fields are blank because certain questions were not asked of all subjects. SAT scores for subjects twenty-seven or more years old are adjusted upward to reflect the April 1995 recentering of SAT scores. See http://www.collegeboard.com/sat/cbsenior/equiv/rt027027.html for the conversion table. Some statistics are calculated with slightly smaller sample sizes than reported in the last row, due to nonresponse.

average. MBAs reported spending about twelve minutes reading the prospectuses, and college students reported spending about nine minutes.[9] Students in both prospectus-only groups spent more time reading the prospectuses than the treatment groups, which seems sensible given that they received only the prospectuses and no additional materials. This pattern is reversed among staff subjects, who spent the least time reading the prospectuses when in the prospectus-only group, but the differences between the staff prospectus-only group and the other staff treatment groups are not statistically significant.

As a whole, these numbers alleviate concerns that subjects simply randomized without exerting any mental effort when making their allocations. The average time spent reading the prospectuses should be enough for a knowledgeable subject to find the expenses in the four documents. Since participants could leave the experiment at any time they wished, time spent in the experiment likely reflects time actually spent in the decision-making process. Additional evidence against the randomization hypothesis comes from Wald tests, which reject equality of subjects' mean allocations to each fund at the 1% level for all ten experimental groups.

3. Main Experimental Results

Table 3 shows the mean portfolio fee (load plus expense ratio plus short-term redemption fee if applicable) paid in each condition by subject type, as well as the average (weighted by dollar allocation) annualized long-horizon historical return of the funds in the portfolios. Despite receiving no nonportfolio services whatsoever, the average fee paid by staff in the prospectus-only condition is \$456, which is higher than the \$431 they would have paid if they had selected randomly, and much higher than the \$255 they would have paid if they had allocated all \$10,000 to the lowest-cost fund, Allegiant. We cannot directly compare staff allocations to student allocations due to differing fund menus, but we can directly compare MBA and college student allocations. Contrary to our expectations, MBAs did no better than college students when simply provided with the mutual fund prospectuses. MBAs in the prospectus-only condition paid \$421 in fees on average, which is only \$10 less than the average college prospectus-only fee, and we cannot reject the hypothesis that the means are equal (two-sided $p = 0.52$). The fees of the average prospectus-only student's portfolio are only slightly below the \$443 fee they would have paid if they had chosen randomly and well above the \$309 fee of the lowest-cost fund, Allegiant.

The black bars in Figure 1 show the average prospectus-only group allocations across the four funds. Staff and MBA prospectus-only groups allocated

[9] When a subject reported a range of time, such as "10 to 15 minutes," we assigned the midpoint of that range to the subject. The staff and MBA figures are close to those calculated from our own records of how much time elapsed between a subject's receiving the experimental materials and his or her returning them to receive the debriefing survey. Unfortunately, we did not keep our own records of how much time college subjects took, so we cannot independently corroborate their reports.

Table 3
Average portfolio fees and historical returns

	Harvard staff		MBA students		College students	
	Average fees	Average long-horizon past return	Average fees	Average returns since inception	Average fees	Average returns since inception
Prospectus only group	\$456	4.96%	\$421	3.06%	\$431	2.86%
Fees treatment group	\$432	4.80%	\$366	2.30%	\$410	2.61%
Returns treatment group	\$450	4.90%	\$440	3.53%	\$486	4.03%
FAQ treatment group	\$441	4.82%	–	–	–	–
Two-sided *p*-values from *t*-tests of equality of means (unequal variances)						
Prospectus only = fees treatment	0.045	0.346	0.000	0.000	0.290	0.152
Prospectus only = returns treatment	0.612	0.690	0.164	0.012	0.002	0.000
Prospectus only = FAQ treatment	0.186	0.402	–	–	–	–
Fees treatment = returns treatment	0.109	0.538	0.000	0.000	0.000	0.000
Fees treatment = FAQ treatment	0.454	0.926	–	–	–	–

The top half of the table gives the average (weighted by dollar allocation) fees and historical returns of the funds chosen by each experimental group. For staff, the historical return is the longest-horizon annualized return reported in the fund's prospectus. For students, the historical return is the annualized return since fund inception. The bottom half of the table reports two-sided *p*-values of *t*-tests for the equality of mean fees and historical returns, allowing for each group to have a different variance. The null hypothesis is listed in the first column, and each subsequent column corresponds to a different subject population and variable whose equality is being tested. For example, the second column in the row containing "Prospectus only = fees treatment" reports the *p*-value for the test that the prospectus-only Harvard staff subjects paid the same average fee as the Harvard staff subjects in the fees treatment group.

only 18–19% of their money to both the lowest-cost fund, Allegiant, and the Morgan Stanley fund. But staff allocated 15 percentage points less to the cheap UBS fund than MBAs because they invested 38% of their portfolio in the most expensive fund, Phoenix Insight (which was not offered to students). In contrast, MBAs invested only 23% in their costly fourth option, Mason Street (which was not offered to staff).

Comparing MBA allocations to college student allocations is more straightforward because the two groups were offered the same set of funds. Both student prospectus-only groups' allocations to the two cheap funds, Allegiant and UBS, are similar—19% and about 40%, respectively. The groups' allocations differ primarily in the way they decided to allocate the portion of their portfolio devoted to expensive funds: MBAs allocated more to Mason Street than Morgan Stanley (23% versus 18%), whereas the relative proportions are flipped (17% versus 27%) for the college students. The slightly lower average fees paid by MBAs are not, however, primarily driven by their preference for Mason Street over Morgan Stanley. The more important factor is that MBAs allocated 59% to the two cheap funds in total, whereas college students allocated a slightly lower 56%. This total is an important determinant of portfolio fees because the two cheap funds' fees are only 11 basis points apart, and the two expensive funds' fees are only 34 basis points apart, but over 200 basis points separate the cheap funds from the expensive funds.

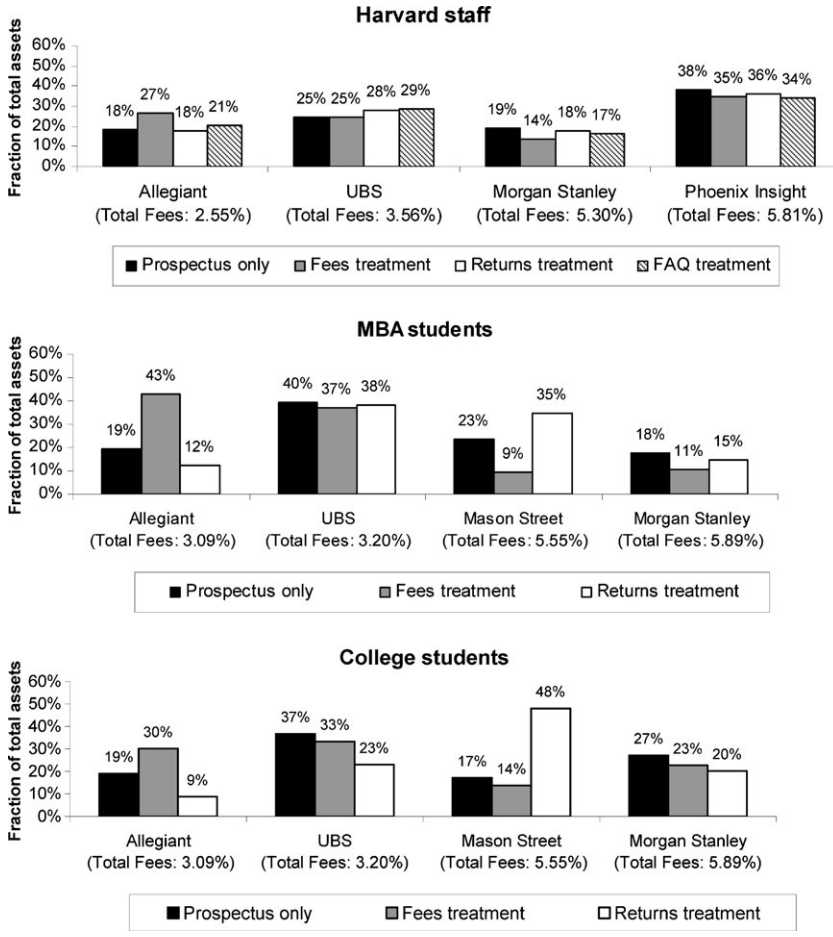

Figure 1
Average fund allocations by subject type and experimental condition

The second row of Table 3 shows that providing the fees sheet lowered the average fee paid by \$24 for staff, \$55 for MBAs, and \$21 for college students. The drop is significant at the 5% level for the staff and the 1% level for the MBAs, but it is insignificant for the college sample, both because of the smaller magnitude of the effect and the fact that the college sample is only a third of the size of the staff or MBA sample.[10] It seems that the MBAs' sophistication manifested itself in their greater responsiveness to useful information.

[10] Holding fixed the point estimate of the fee treatment effect size and the variance of subject fees, tripling the college sample size to match the MBA or staff sample size would result in the college fee treatment effect becoming significant at the 10% level.

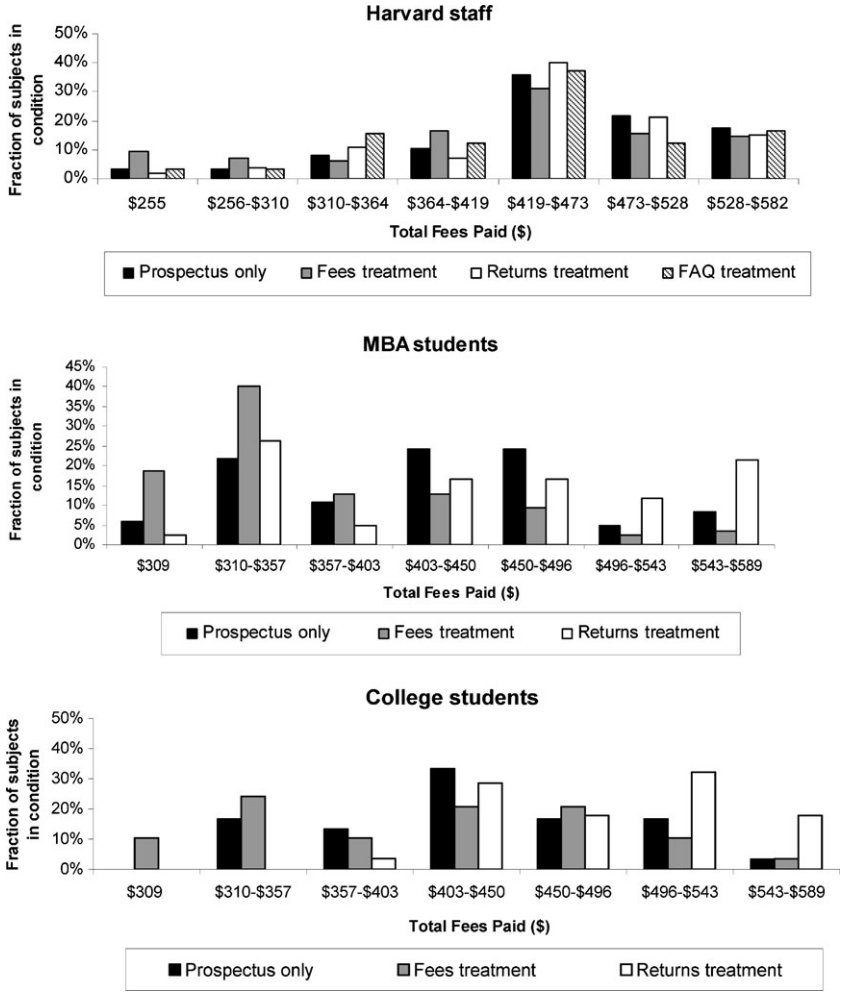

Figure 2
Histogram of fees paid by subject type and experimental condition

Nonetheless, most MBAs did not use the information optimally. The gray bars in Figure 1 show a shift to the lowest-cost fund for the fees treatment groups relative to the prospectus-only groups. But the staff, MBA, and college subjects in the fees treatment groups still allocated 49%, 20%, and 37% of their assets to the two high-cost funds, respectively. The histograms in Figure 2 show that only 9% of staff subjects, 19% of MBA subjects, and 10% of college subjects in the fees treatment allocated all of their money to the lowest-cost fund. While these proportions are higher than the 3% of staff, 6% of MBAs, and 0% of college students in the prospectus-only groups who allocated all

their money to the cheapest fund, they are far from the 100% one would expect under optimal choice. This result suggests that search costs for fees alone cannot explain the tendency to invest in high-fee index funds, since the fees sheet brings these search costs close to zero.[11] Instead, subjects seem to value normatively irrelevant characteristics.

Given the existing evidence on mutual fund returns-chasing, a likely candidate for a nonfee characteristic that subjects desire in their index funds is high past returns. The third row of Table 3 shows portfolio statistics for subjects who received the returns summary sheet that highlighted normatively irrelevant long-horizon past returns. The returns sheet increased returns-chasing among students. MBAs' average long-horizon historical return rose from 3.06% in the prospectus-only group to 3.53% under the returns treatment, a difference that is significant at the 1% level. The college sample responded even more strongly to the irrelevant information in the returns sheet; the average return increased from 2.86% to 4.03%, a change that is also significant at the 1% level. The white bars in Figure 1 show that the Mason Street fund, which has the highest long-horizon historical return offered to students, gained portfolio share at the expense of every other fund. Because we had constructed the fund menu so that fees would be positively correlated with returns since inception, chasing past returns reduced expected future returns. The MBA returns treatment group paid $19 more on average than the MBA prospectus-only group, while the college returns treatment group paid $55 more than the college prospectus-only group.

On the other hand, the returns sheet had no effect on staff. Staff in the returns treatment chose portfolios with an insignificantly lower average historical return than staff in the prospectus-only condition. We will discuss in Section 4 a potential explanation for why the returns sheet affected students but not staff.

The possibility that subjects are confused about the nature of S&P 500 index funds motivated our final treatment condition, in which subjects were given a page with answers to frequently asked questions about S&P 500 index funds. The fourth row of Table 3 shows portfolio statistics for staff subjects in this treatment group. Fees for this group are lower by $15 relative to staff prospectus-only subjects, although the result is statistically significant at the 10% level only under a one-sided test. Despite the weak statistical significance, the hashed bars in the top panel of Figure 1 suggest that this drop is not just due to random variation. Both cheaper funds received more money in the FAQ treatment than in the prospectus-only condition, and both expensive funds received less money. The hashed bars in the top panel of Figure 2 show, however, that the FAQ treatment was not successful in increasing the number of subjects who chose the cheapest possible portfolio.

[11] The fee summary sheet did not contain information on the UBS fund's early-redemption fee, which affected only staff portfolios, although it did warn subjects, "Other fees may apply. Please check the fund's prospectus for more details." Even without the early-redemption fee, however, the UBS fund was more expensive than the Allegiant fund, so a cost-minimizing investor's decision would not be affected by ignorance of the early-redemption fee.

4. Interpretation

In order to gain insight into what motivated subjects' decisions in the four experimental conditions, we asked them in the debriefing survey to rate how important eleven factors were in shaping their portfolio decision. We assign the integers 1 through 5 to the five possible ratings, with 1 corresponding to "not very important at all" and 5 corresponding to "very important." Table 4 reports the average rating of each factor's importance with the associated ordinal ranking in parentheses (lower numbers indicate greater ordinal importance).

The staff and college prospectus-only groups ranked fund performance over the past year and fund performance since inception as the first- and second-most important factors, respectively. Fund fees, expenses, and loads were ranked fifth by prospectus-only staff and eighth by prospectus-only college students. In light of this ranking, it seems unlikely that these subjects' search efforts were primarily directed toward finding the most relevant information about the funds—their cost.

In contrast, MBA prospectus-only subjects ranked fees as the most important factor in their portfolio decision. As previously noted, however, their fees are not significantly lower on average than the college prospectus-only subjects' fees. The minimal gain that the MBAs reaped from their prioritization of fees suggests that the cost of accurately finding fees in the prospectuses is relatively high even for MBAs and/or that the false allure of fund returns over the past year and since inception—ranked second and third by prospectus-only MBAs—and other factors is strong enough to offset the benefits of prioritizing fees.

None of the prospectus-only groups ranked brand recognition or past experience with the fund companies as higher than their sixth most important factor in their decision. In addition, customer service quality was ranked no higher than ninth, suggesting that subjects were not mistakenly applying decision rules that are perhaps relevant in the real world but not in the experimental task.[12]

Providing the fees sheet elevated the ranking of fees relative to their ranking in the prospectus-only condition. Staff subjects raised fees' ordinal importance from fifth to second, and college subjects from eighth to first. MBAs in both conditions ranked fees as their most important factor, but the cardinal rating of fees in the fees treatment is higher. Staff subjects receiving the FAQ sheet also increased their relative rating of fees' importance slightly, raising their ordinal rank to fourth (versus fifth in the prospectus-only condition), although the cardinal rating of fees is lower than in the prospectus-only condition.

The returns sheet similarly elevated the relative ranking of long-horizon past returns for students. College students in the returns treatment condition ranked

[12] Most of the prospectuses had no meaningful mentions of nonportfolio services. The exception was the Phoenix fund's prospectus, which discussed the availability of check-writing against one's account; the ability to exchange shares by calling into the customer service number; and services that would automatically deduct money from one's bank account and invest it in fund shares at a regular interval, automatically exchange a predetermined amount from one Phoenix fund to another at a regular interval, and automatically redeem a predetermined amount from the fund and deposit the proceeds in one's bank account at a regular interval.

Table 4
Importance of various factors in subjects' investment decision

	Harvard staff				MBA students			College students		
	Prospectus only	Fees treatment	Returns treatment	FAQ treatment	Prospectus only	Fees treatment	Returns treatment	Prospectus only	Fees treatment	Returns treatment
Quality of prospectus	2.61 (7)	2.80 (6)	2.65 (7)	2.65 (7)	2.27 (9)	2.46 (9)	2.65 (8)	2.75 (5)	2.93 (4)	2.96 (5)
Brand recognition	2.36 (8)	2.32 (8)	2.36 (8)	2.29 (8)	2.75 (6)	2.77 (6)	2.75 (7)	2.63 (7)	2.79 (5)	3.00 (4)
Past experience with fund companies	2.20 (9)	2.15 (9)	2.25 (9)	1.96 (9)	2.39 (8)	2.74 (7)	2.57 (9)	1.43 (11)	2.11 (9)	2.26 (8)
Fund fees, expenses, and loads	3.05 (5)	3.41 (2)	2.92 (5)	2.94 (4)	3.72 (1)	4.19 (1)	3.53 (3)	2.59 (8)	3.39 (1)	2.54 (7)
Minimum opening balance requirements	1.96 (11)	2.10 (10)	1.86 (11)	1.89 (10)	1.77 (11)	2.07 (11)	1.80 (11)	1.60 (10)	1.97 (10)	1.68 (11)
Investment objectives	3.18 (3)	3.39 (4)	3.08 (4)	3.23 (3)	3.24 (4)	3.52 (4)	3.41 (4)	3.00 (4)	2.76 (6)	2.79 (6)
Fund performance over the past year	3.57 (1)	3.88 (1)	3.58 (1)	3.52 (1)	3.54 (2)	3.73 (2)	3.78 (1)	4.17 (1)	3.17 (2)	3.54 (2)
Fund performance since inception	3.40 (2)	3.40 (3)	3.45 (2)	3.30 (2)	3.45 (3)	3.63 (3)	3.72 (2)	3.87 (2)	2.97 (3)	3.86 (1)
Fund performance over different horizon	2.89 (6)	2.63 (7)	2.73 (6)	2.68 (6)	2.67 (7)	3.16 (5)	2.88 (5)	2.72 (6)	2.18 (8)	2.22 (9)
Customer service of fund	2.02 (10)	2.06 (11)	1.94 (10)	1.85 (11)	1.87 (10)	2.17 (10)	1.90 (10)	1.97 (9)	1.93 (11)	1.82 (10)
Desire to diversify across funds	3.07 (4)	2.81 (5)	3.18 (3)	2.75 (5)	2.89 (5)	2.73 (8)	2.78 (6)	3.33 (3)	2.76 (6)	3.39 (3)
Sample size	$N = 97$	$N = 97$	$N = 100$	$N = 96$	$N = 83$	$N = 84$	$N = 83$	$N = 30$	$N = 29$	$N = 28$

Each cell reports the average importance the factor had on the relevant subsample's investment decision, as elicited in the debriefing surveys. There are five possible responses, from "not important at all" to "very important." We assign integers 1 through 5 to each possible response, with *higher* integers corresponding to greater importance. Each factor's ordinal rank for the relevant subsample is in parentheses, with *lower* integers corresponding to greater ordinal importance. The last row lists the greatest number of observations used to calculate each column's average ratings; some factors' average ratings use slightly fewer observations due to nonresponse.

Table 5
Effect of factor importance ranking on portfolio fees and historical returns

	Harvard staff		MBA students		College students	
	Portfolio fees	Long-horizon past return	Portfolio fees	Returns since inception	Portfolio fees	Returns since inception
Fund fees, expenses, and loads	−19.15**	−0.208**	−18.11**	−0.239**	−15.11*	−0.086
	(2.94)	(0.042)	(4.35)	(0.061)	(6.56)	(0.080)
Fund performance over the past year	11.20**	0.288**	−6.74	−0.046	−12.80	−0.065
	(3.85)	(0.054)	(4.82)	(0.068)	(9.36)	(0.114)
Fund performance since inception	9.79*	0.084	5.90	0.145*	2.30	0.147
	(3.83)	(0.054)	(4.76)	(0.067)	(6.68)	(0.081)
Fund performance over different horizon	4.61	0.033	−5.21	−0.043	6.45	0.092
	(3.32)	(0.047)	(4.48)	(0.063)	(7.35)	(0.090)
Customer service of fund	0.53	0.002	14.08*	0.139	−7.32	−0.210
	(4.56)	(0.065)	(5.76)	(0.081)	(8.80)	(0.107)
Brand recognition	−5.30	−0.240**	−0.48	−0.158*	2.39	−0.015
	(3.93)	(0.056)	(4.92)	(0.069)	(6.29)	(0.077)
Past experience with fund companies	−2.36	−0.017	3.49	0.097	11.50	0.198*
	(3.49)	(0.049)	(4.26)	(0.060)	(6.38)	(0.078)
Quality of prospectus	6.72	0.033	0.32	0.018	−4.31	−0.130
	(3.84)	(0.054)	(5.04)	(0.071)	(7.14)	(0.087)
Minimum opening balance requirements	1.31	−0.013	−2.07	−0.050	6.73	0.110
	(3.87)	(0.055)	(5.24)	(0.074)	(8.65)	(0.105)
Investment objectives	−0.22	0.027	−2.58	−0.002	−2.75	−0.094
	(3.50)	(0.050)	(3.75)	(0.053)	(5.92)	(0.072)
Desire to diversify across funds	−2.50	−0.048	8.88*	−0.002	9.41	−0.035
	(3.09)	(0.044)	(4.05)	(0.057)	(6.90)	(0.084)
Fees treatment	−21.58*	−0.194	−44.27**	−0.697**	−20.74	−0.368
	(10.80)	(0.153)	(12.50)	(0.176)	(21.19)	(0.258)
Returns treatment	−0.27	0.006	16.00	0.401*	30.25	0.873**
	(10.65)	(0.151)	(12.13)	(0.170)	(20.34)	(0.248)
FAQ treatment	−18.18	−0.228				
	(10.68)	(0.151)				
Constant	431.19**	4.770**	394.14**	3.728**	405.39**	3.374**
	(19.66)	(0.278)	(28.21)	(0.396)	(37.47)	(0.457)
Adjusted R^2	0.2139	0.2272	0.2078	0.2250	0.1847	0.4198
Sample size	$N = 365$	$N = 365$	$N = 239$	$N = 239$	$N = 78$	$N = 78$

*Significant at the 5% level. **Significant at the 1% level.
This table reports regressions where the dependent variable is portfolio fee or average fund historical returns (dollar-weighted). For staff, the historical return is the longest-horizon annualized return reported in the fund's prospectus. For students, the historical return is the annualized return since fund inception. The first eleven rows report coefficients on the importance each respective factor had on the subject's investment decision, as elicited in the debriefing surveys. There were five possible responses to these questions, from "not important at all" to "very important." We assigned integers 1 through 5 to each possible response, with higher integers corresponding to greater importance. *Fees treatment*, *Returns treatment*, and *FAQ treatment* are dummies for being in the fees treatment, returns treatment, and FAQ treatment condition, respectively. Standard errors are in parentheses.

returns since inception as their most important factor (versus second for the prospectus-only group), downgrading the more sensible one-year return factor to second place. MBAs in the returns treatment ranked the two past performance factors first and second (versus second and third for the prospectus-only group). On the other hand, consistent with the weak effects we saw in Table 3, staff's ranking of returns' importance does not seem to have responded to the returns sheet.

These factor rankings appear to contain real information. Table 5 presents regressions—run separately for staff, MBAs, and college students—where the

dependent variable is portfolio fees or long-horizon past returns. The explanatory variables are treatment group dummies and the cardinal coding of how highly the subject ranked the eleven factors. Even after controlling for the information treatments, we find that within each subject group, those who rated fees as more important paid significantly less in fees. Increasing the numerical rating of fee importance by one is associated with a decrease in fees of between 15 and 19 basis points.

We also find that those who rated past returns as more important chose portfolios with higher long-horizon historical returns. The magnitude of the returns since inception effect is similar for MBAs and college students: a one unit increase in the reported importance of fund performance since inception is associated with a 15 basis point increase in the portfolio's annualized returns since inception, and this effect is significant at the 5% level for MBAs and the 10% level ($p = 0.07$) for college students. The returns since inception effect is positive but half the size for staff members, and misses significance at the 10% level ($p = 0.12$). Instead, for staff, importance placed on fund performance over the past year is a strongly significant correlate, with each unit rating increase associated with a 29 basis point increase in long-horizon past returns.

Examining the other factor rankings, there is nothing that is consistently correlated with portfolio fees paid. In particular, importance placed on the fund's customer service has a significant positive correlation with MBAs' portfolio fees—perhaps suggesting a misapplication of a real-life heuristic in the experimental setting—but the coefficient is small, positive, and insignificant for staff, and negative and insignificant for college subjects.

The fees and returns treatment effects are consistent with the summary sheets' lowering search costs for subjects who value low fees and high past returns but observe both with considerable noise when given only prospectuses. When a valued characteristic is observed with more precision due to the summary sheets, subjects place more weight on it.

Under this interpretation, the returns sheet's null effect on staff—despite staff subjects' high weight on past returns—implies that prospectus-only staff observed past long-horizon returns relatively precisely. This may be because staff were highly motivated by their large incentives and thus expended more effort than students in finding the past returns information. Staff, however, either did not expend as much effort finding the fees in the prospectuses or had a hard time finding them, so they did not precisely observe fees. Hence, the fees sheet had scope to shift staff portfolios toward lower-cost funds.

The fact that highly motivated investors are able to accurately identify past returns in the prospectus does not necessarily imply that mutual fund advertising highlighting past returns has no effect on investment decisions. In the real world, investors must contend with thousands of mutual funds instead of just four, so even very highly motivated investors are likely to observe most funds' past returns imprecisely prior to seeing an advertisement.

The search cost effects of the summary sheets may have been augmented by implicit advice effects, where subjects inferred that the information on the summary sheet is normatively important simply because it had been given to them by the experimenters. But if one chooses to interpret the treatment effects as arising *entirely* through the implicit advice channel, it is not obvious why staff heeded the implicit advice of the fees sheet but not the returns sheet.

Finally, the failure of the FAQ treatment to move subjects close to the minimum-fee portfolio may be due to the answers not being clearly understood, or our not explicitly stating that the optimal portfolio allocates 100% to the lowest-cost fund.[13] Alternatively, the fees may have been too difficult to accurately identify in the prospectuses, causing subjects to place little weight on them in their portfolio decision. Subjects may also have continued to believe that there is a significant amount of active management in an index fund, leading to predictable outperformance unrelated to lower fees. Fund companies may intentionally contribute to this confusion in order to soften price competition (Gabaix, Laibson, and Li 2005; Gabaix and Laibson 2006; Carlin 2009). For example, the Allegiant fund's 2006 prospectus states: "However, the Adviser believes that employing certain active management strategies for a percentage of the Fund's assets, if successful, will result in net returns after expenses that may more closely approximate the returns of the S&P 500 Index."

5. Relationship between Portfolio Choices and Subject Characteristics

In this section, we examine how subject characteristics affected their portfolio choices. We first consider the impact of basic demographics. Table 6 regresses portfolio fees and long-horizon historical returns on age, gender, education dummies, and treatment dummies, run separately for staff, MBA, and college subjects.

Among staff subjects, we find that women paid higher fees, but there is surprisingly no relationship between education and fees. If anything, subjects who had only a high school education or less (the omitted educational category) paid the lowest fees on average. This is because low-education subjects were more prone to distribute their portfolios evenly among the four investment options instead of chasing the Phoenix Insight fund's high past returns. However, we cannot reject the hypothesis that all educational groups paid the same fees on average (p-value $= 0.16$). We do reject at the 10% level the hypothesis that all educational groups chose portfolios with the same average long-horizon past return (p-value $= 0.07$), a finding primarily driven by the high returns-chasing tendencies of those with some graduate education but no graduate degree. The significant negative coefficient on the fees treatment dummy in the fees regression indicates that the staff fees treatment effect does not arise simply because

[13] We did not include such an explicit statement because of the experimenter demand effect it would produce, which would make the FAQ treatment effect difficult to interpret.

Table 6
Demographic correlates of portfolio fees and historical returns

	Harvard staff		MBA students		College students	
	Portfolio fees	Long-horizon past return	Portfolio fees	Returns since inception	Portfolio fees	Returns since inception
Age	0.06	0.001	3.58	0.081*	−1.84	0.013
	(0.35)	(0.005)	(2.63)	(0.034)	(1.89)	(0.021)
Female	25.95**	0.164	18.39	0.317*	11.04	−0.031
	(8.58)	(0.124)	(11.17)	(0.146)	(15.27)	(0.173)
Some college	29.23	0.484	−159.00	−3.336*	40.38	0.264
	(29.78)	(0.431)	(115.50)	(1.508)	(26.52)	(0.300)
College degree	16.99	0.579			18.40	−0.186
	(27.81)	(0.402)			(34.11)	(0.386)
Some graduate school	43.35	1.001*	−148.65	−3.128**		
	(28.51)	(0.412)	(82.08)	(1.072)		
Graduate degree	22.54	0.691				
	(27.57)	(0.399)				
Fees treatment	−26.90*	−0.189	−51.46**	−0.699**	−20.72	−0.234
	(11.51)	(0.166)	(12.69)	(0.166)	(18.04)	(0.204)
Returns treatment	−7.13	−0.086	23.04	0.554**	59.75**	1.214**
	(11.32)	(0.164)	(12.75)	(0.167)	(18.30)	(0.207)
FAQ treatment	−16.65	−0.180	–	–	–	–
	(11.41)	(0.165)				
Constant	412.40**	4.124**	461.85**	3.796**	351.81**	2.400**
	(32.15)	(0.465)	(106.21)	(1.387)	(44.47)	(0.504)
Adjusted R^2	0.0261	0.0089	0.1312	0.2143	0.1677	0.3760
Sample size	$N = 389$	$N = 389$	$N = 250$	$N = 250$	$N = 87$	$N = 87$

*Significant at the 5% level. **Significant at the 1% level.
This table reports regressions where the dependent variable is portfolio fee or average fund historical returns (dollar-weighted). For staff, the historical return is the longest-horizon annualized return reported in the fund's prospectus. For students, the historical return is the annualized return since fund inception. *Female* is a dummy for female gender. *Some college*, *College degree*, *Some graduate school*, and *Graduate degree* are dummies for the highest educational attainment reported by subjects; "high school or less" is the omitted category. *Fees treatment*, *Returns treatment*, and *FAQ treatment* are dummies for being in the fees treatment, returns treatment, and FAQ treatment condition, respectively. Standard errors are in parentheses.

staff who were randomized into the prospectus-only group were somewhat less educated than staff who were randomized into the fees treatment group.

Among student subjects, we find that MBAs who are older and female chase past returns since inception more aggressively. We find no significant demographic correlates among the college students. Although there is little meaningful variation in educational attainment within each student group, we are able to examine the correlation between portfolio choices and SAT scores. In unreported regressions, we include total SAT scores (math plus verbal) as a control variable for student subjects, which causes our sample size to drop in half due to missing score data. We find no significant relationship between SAT scores and fees; the point estimate indicates that a 100 point rise in combined SAT score is associated with only a 3 basis point decline in fees among MBAs and a 3 basis point rise in fees among college students.[14]

[14] In contrast, Korniotis and Kumar (2009) argue that among discount brokerage investors who hold undiversified portfolios, trade frequently, or have a strong preference for local stocks, portfolios held by those with high cognitive ability outperform portfolios held by those with low cognitive ability. However, they find that high cognitive ability investors have no advantage when they hold diversified, passive portfolios.

Table 7
Portfolio fees and historical returns by investor confidence and knowledge

	Harvard staff			MBA students			College students		
	Proportion of answers	Average portfolio fee	Average historical return	Proportion of answers	Average portfolio fee	Average returns since inception	Proportion of answers	Average portfolio fee	Average returns since inception
How likely is it that you would change your decision if you consulted a professional investment advisor?									
Not at all likely	13%	$456	4.42%	20%	$389	2.76%	6%	$395	2.60%
Somewhat likely	50%	$513	4.94%	54%	$409	2.96%	41%	$435	3.00%
Very likely	37%	$519	4.95%	26%	$424	3.12%	53%	$453	3.33%
How confident are you that the decision you made is the right one for you?									
Very confident	8%	$454	4.56%	12%	$356	2.64%	5%	$443	3.34%
Relatively confident	28%	$497	4.71%	47%	$384	2.98%	25%	$420	2.91%
Somewhat confident	39%	$521	5.01%	25%	$413	2.99%	31%	$441	3.07%
Less than confident	19%	$520	4.99%	13%	$414	2.89%	23%	$458	3.29%
Not at all confident	7%	$505	4.90%	4%	$439	3.63%	16%	$458	3.43%
How knowledgeable an investor do you consider yourself to be?									
Very knowledgeable	2%	$422	4.37%	6%	$427	3.20%	1%	$320	2.50%
Relatively knowledgeable	12%	$476	4.66%	22%	$397	2.89%	10%	$412	2.90%
Somewhat knowledgeable	40%	$510	4.91%	35%	$408	2.87%	24%	$430	2.95%
Less than knowledgeable	31%	$518	4.90%	30%	$409	2.94%	28%	$432	3.09%
Not at all knowledgeable	15%	$519	5.00%	6%	$450	3.68%	37%	$470	3.42%
Which of the following types of investments are found in a money market fund?									
Correct answer (short-term U.S. government bonds)	21%	$500	4.94%	40%	$393	2.80%	15%	$442	3.24%
Incorrect answer (corporate bonds, stocks, none of the above)	79%	$509	4.85%	60%	$420	3.06%	85%	$445	3.15%

This table reports the frequency of responses to four debriefing survey questions and the average (weighted by dollar allocation) portfolio fee or fund historical returns of those who gave each response.

In addition to questions about basic demographic characteristics, the debriefing survey included questions designed to gauge financial knowledge and investment confidence. The second, fifth, and eighth columns of Table 7 show the distribution of responses to questions about the likelihood of changing one's decision in response to professional advice, confidence that one's decision was optimal, self-assessed investment knowledge, and the types of investments found in a money market fund. MBAs score the highest on investment confidence and both the objective and self-assessed measures of financial knowledge. Staff subjects have intermediate levels of confidence and knowledge, and college students score the lowest on these measures.

The third, sixth, and ninth columns of Table 7 display striking negative relationships between fees and confidence, and between fees and knowledge. For example, in all three subject groups, the average fee increases monotonically with the self-reported likelihood that subjects would change their decision after consulting a professional investment advisor. The subjects who paid the highest fees themselves doubted that they were making the best portfolio allocation. Fees also generally fall with self-assessed confidence that the portfolio decision was the right one for the subject, self-assessed investment knowledge, and knowledge of the types of investments found in a money market fund. The most notable nonmonotonicities occur among MBAs who consider themselves "very knowledgeable" investors and college subjects who are "very confident" about their portfolio decision; these extremely confident subjects paid higher fees than many of their less confident peers, but represent a small fraction of their respective samples (6% of MBA and 5% of college subjects). Staff who were "not at all confident" about their decision paid lower fees than "somewhat confident" and "less than confident" staff (due to the tendency of the least confident staff to distribute their allocations more evenly across funds than their slightly more confident peers), but this group too represents only a small fraction (7%) of the staff sample.

In unreported regressions, we find that the negative relationship between financial knowledge/confidence and fees is generally present even after controlling for gender, education, and information treatment.[15] Therefore, responses to these survey questions are useful for predicting portfolio choice quality beyond what demographics and information conditions can tell us.

6. Conclusion

The wide variation of fees in the S&P 500 index fund universe has been rationalized as reflecting heterogeneity in the value of nonportfolio services

[15] The self-reported confidence and knowledge variables are assigned an integer from 1 to 3 or 1 to 5 in the regressions. For Harvard staff, self-assessed investment knowledge, confidence, and likelihood to change one's decision are significant. For MBAs, knowledge of money market fund investments and likelihood to change one's decision are significant. For college students, self-assessed investment knowledge and confidence are significant, and likelihood to change one's decision has a p-value of 0.13.

bundled with each index fund. We test this hypothesis by offering experimental subjects access to four S&P 500 index funds' returns stripped of these non-portfolio services. The optimal portfolio allocates everything to the lowest-cost fund.

Despite this unbundling, subjects overwhelmingly failed to minimize index fund fees. Instead, they placed heavy weight on irrelevant attributes such as funds' annualized returns since inception. Highlighting these misleading historical returns caused student subjects (in one of our randomized experimental treatments) to chase those returns even more intensely, despite the negative future return consequences such behavior had. Even subjects who claimed to prioritize fees in their portfolio decision showed minimal sensitivity to the fee information in the prospectus. Subjects apparently do not understand that S&P 500 index funds are commodities. In our experiment, fees paid are increasing in financial illiteracy. In the real world, this problem is likely to be exacerbated by the financial advisors whose compensation is increasing in the fees of the mutual funds they sell to their clients. When consumers in a commodity market observe prices and quality with noise, a high degree of competition will not drive markups to zero (Gabaix, Laibson, and Li 2005; Carlin 2009). Our results suggest that such noise helps account for the large amount of price dispersion in the mutual fund market.

Natural policy responses to suboptimal choices are to improve disclosure and educate investors. We test two such interventions and find that portfolio allocation improves modestly but remains far away from the optimum. Beshears et al. (forthcoming) test another disclosure intervention that provides experimental subjects a simplified summary of the prospectus and find that such an intervention yields little change in allocations among actively managed funds relative to when subjects simply receive the statutory prospectus. In sum, although better disclosure and financial education may be helpful, the evidence in this article and Beshears et al. (forthcoming) indicates that their effect on portfolios is likely to be modest.

Our results also suggest that developing reliable ways of eliciting agents' confidence in their *own* actions may prove to be a fruitful way of identifying areas in which optimization errors are economically important. We show that subjects who pay higher fees tend to be less sure that they are maximizing their own utility. Students taking a math exam can roughly predict whether they correctly answered a question. Economic agents may also know when they are likely to have made an error in a real-life maximization problem. Regrettably, having a sense that your choice is wrong does not necessarily tell you how to fix it.

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