

Measuring Fiduciary and Investor Losses in 401(k) Plans

Abstract: This is the first study to measure, within a unified framework, the relative costs to investors of limited investment menus, fund- and plan-level expenses, and investor allocation mistakes. Expressing these costs in terms of reduced returns allows us to compare the relative magnitude of costs attributable to plan fiduciaries, which we term fiduciary losses, and losses attributable to mistakes that investors make in choosing how to allocate among menu offerings, which we term investor losses. Using a sample of plans that offer publicly listed mutual funds as investment options, we show that investor losses exceed fiduciary losses. Taken together, these losses consume about twenty percent of the optimal risk premium. The majority of fiduciary losses come from fund and plan level expenses. Large plans have lower fiduciary losses than small plans, but there is substantial variation in plan quality independent of plan size. We show that plan menu design affects investor losses, and that advisor compensation is related to plan quality. We also decompose total losses into the relative proportion of losses which come from excessive fees and from insufficient diversified allocations, and find that excess fees represent more than 60% of total losses.

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KEYWORDS: 401(k) plans; portfolio choice; retirement; investing; law and economics

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Investors in participant-directed 401(k) plans incur losses both from decisions made by the plan fiduciaries and their own suboptimal choices. Fiduciaries, for example, select the menu of investments over which plan participants are permitted to choose. This limitation imposes costs in two ways: it may limit the ability of investors to select an optimally diversified investment portfolio, and it may force investors to choose from among funds that have higher fees than other funds in the marketplace. Investors also pay fees at the plan level to cover the administrative costs associated with the plan. Each of these costs is attributable to choices made by the plan sponsor, which has a fiduciary duty to act with prudence in making decisions regarding the plan menu.¹ Suboptimal investor choice also creates losses. For example, previous studies have shown that investors in 401(k) plans exhibit a number of behaviors in asset allocation that tend to increase risk and reduce return. Provided that the plan menu meets certain requirements,² the plan sponsor is not responsible as a fiduciary for losses that results from participants' own investing decisions. Because losses due to menu limitations and investor portfolio decisions have divergent legal and policy consequences, it is natural to ask how these losses are distributed and whether one type of loss predominates.

This study uses a large proprietary data set of 401(k) plan data, including information on plan menus and plan-level portfolio allocations, to measure the relative costs to plan participants of menu limitations, fees in excess of index fund fees, and investor mistakes. Using this data, we construct a sample of plans that offer only publicly listed mutual funds, allowing us to draw fee and return information from commercial databases. We construct a series of optimal portfolios based on expected risk and return, taking account of the effect of costs on returns. Using these portfolios, we are able to express the utility loss associated with menu limitations, fees, and

¹ 29 U.S.C. § 1104(a)(1).

² These requirements include the inclusion of sufficiently diverse investment alternatives, and the opportunity for plan participants to adjust their portfolio with reasonable frequency. 29 C.F.R. § 2550.404c-1

investor allocation mistakes as losses relative to the risk premium on a benchmark portfolio of index funds.

We find that, on average, investors in 401(k) plans choose from investment menus that are quite efficient in the sense of providing investors with the capacity to sufficiently diversify on a pre-fee basis. We estimate that losses from menu restrictions comprise less than one percent of the optimal risk-premium. In addition to these costs due to restricted diversification opportunities, investors incur fees both at the plan and fund level. The combination of excess plan expenses, fund fees in excess of index fund fees, and diversification limitations account for a loss of 7.7% of the optimal risk-premium. While we observe only aggregate plan portfolios and not investor-level allocations, the loss associated with investor choice, conditional on the offered menus, accounts for an additional 13.2% reduction in the risk-premium. Taken together, these costs consume 21% of the potential excess return that investors might have earned if they invested optimally without menu restrictions and paid fees consistent with low cost index funds.

Losses are particularly high in small plans, which have both higher costs and lower quality menus. In the smallest fifth of plans, losses due to fiduciary decisions are more substantial than losses caused by investor mistakes. Even among plans in the largest quintile of size, nearly ninety basis points' difference separates the plan at the 90th percentile of fiduciary loss from the plan at the 10th percentile. Our results suggest that investors incur unnecessary losses due to fiduciaries' decisions to include a preponderance of costly funds in plan menus. Plans that feature index funds show lower fiduciary losses.

In addition to costs directly imposed on investors through fiduciary choices, we find evidence that menu construction choices made by plan fiduciaries predictably exacerbate investor mistakes with regard to both diversification and excessive fees. Some plans have

optimal portfolios that more closely align with investors' tendency to allocate investments using the 1/N heuristic of Benartzi & Thaler (2001) and aggregate portfolios in these plans have better expected performance. Investors in plans that include a low proportion of index funds have lower expected performance. Moreover, some of the loss attributable to investor mistakes results from a failure to optimize fees rather than failing to optimally diversify. More than 44% of losses due to investor mistakes are attributable to choosing investment options with excessive fees (relative to other funds in the offered menu). If losses due to excess plan-level costs, fund fees, and investor allocation to high-fee funds are aggregated, then fee-related losses are a 50% larger problem, on average, than aggregate diversification losses.

This study has important implications for the policy of participant-directed retirement plans. Employer sponsors of 401(k) plans have fiduciary duties of prudence and loyalty to plan participants. Courts have been clear that these duties extend to the construction of the investment menu. Plaintiffs have won substantial settlements by alleging that investment menus included only options that were too costly. Menus that are insufficiently diversified can also give rise to liability for the plan sponsor. But under ERISA, plan sponsors can escape liability for participants' investing decisions, so long as investors are given a set of diversified investment options that permit them to tailor risk to their specific circumstances and disclosure requirements are met. The law therefore creates a dichotomy between the two types of plan problems: Insufficiently diversified menus and excessive fees can give rise to liability for employers, but mistakes by adequately-informed investors choosing from a menu of quality options constructed with prudence and loyalty cannot.

This dichotomy makes understanding the relative losses attributable to fiduciaries and to investors important. If 401(k) menus are highly efficient and fees low, then improving investor

outcomes becomes entirely a function of improving decision making by investors. Such efforts might include financial education and high-quality default portfolio allocations. If losses attributable to menu construction are negligible, then efforts to increase the scope of fiduciary duties would be misguided. Such a finding might also suggest that much of ERISA litigation relating to menu quality is frivolous and socially costly. Conversely, if fiduciary losses are widespread and substantial, then strengthening the enforcement of fiduciary duties and broadening their application as the Department of Labor has attempted³ might yield improved outcomes for investors. In fact, the results of this study suggest that improving fiduciary decision-making may prove a more tractable problem than educating millions of investors, particularly in light of fiduciaries' duty of prudence. We find evidence that a substantial majority of funds could reduce total losses by (i) offering additional lower-fee index funds, (ii) not offering funds with high fees.

The rest of this paper proceeds as follows: Section one reviews the prior literature. Section two describes the dataset and addresses potential selection issues. Section three describes the methodology for measuring losses. Section four presents results. Section five concludes.

1. Relevant Prior Literature

This paper is part of the literature evaluating the adequacy of options in retirement plans. Prior work on the quality of 401(k) menus has produced conflicting results. Using similar methodology to this study, Tang, et al. (2010) found with regard to Vanguard-managed plans that losses due to limited 401(k) menus were small and that the vast majority of menus were of

³ The Department of Labor has proposed an expansion of the parties that may be considered plan fiduciaries in a rule released October 22, 2010 and subsequently withdrawn under objections from the financial services industry.

high quality. Elton, et al. (2006) found that only about half the plans in their sample provided sufficiently diversified options relative to a benchmark portfolio. Angus, et al. (2007) evaluated menus in academic retirement plans and found that investors in TIAA-CREFF plans were likely to have significantly lower end of period wealth than other investors as a result of menu limitations.

These existing studies differ from this study in their sample construction. The Angus, et al. study is limited to academic plans from a specific, atypical service provider. It is therefore difficult to draw broad conclusions about retirement plans from their results. Elton, et al., used survey data from Moody's Investor Services, to construct a sample of 680 plans. This sample is similar in construction to our own, but is smaller and relies on survey data rather than public filings. The Elton, et al. data, from 2001, is also now somewhat out of date. The Tang, et al. study is the largest by sample size with 1003 plans, but these plans are drawn from a dataset of Vanguard-managed retirement plans. As one of the largest, lowest cost, and best-respected service providers, Vanguard may be associated with plans of particularly high quality. Vanguard would also be unlikely to manage the worst plans.

Work in the menu-quality literature has varied in its attention to fees. Elton et al., use an estimation method that accounts for fund-level costs, and these costs partially account for the inefficiency of many 401(k) plans in their sample. Tang, et al. estimate returns using a zero-alpha factor model that does not account for the impact of fees on performance. They note, however, that the fees of funds in their Vanguard sample are quite low. No existing study of plan efficiency has included plan-level costs as a factor. This is a significant omission because plan service providers sometimes derive part of their compensation for plan administration from

fund fees. Plan-level and fund-level fees should both be understood as part of the total cost of investing in a 401(k) plan.

A more extensive literature has examined investor decision making in 401(k) plans.⁴ These studies have documented that investors are subject to a number of behavioral biases that reduce their returns and increase risk. Most famously, investors tend to follow a naïve diversification strategy, dividing assets equally among funds, regardless of the make-up of the investment menu. (Benartzi & Thaler, 2001). For this project, it is the broad conclusion of this literature that is relevant: Investors in 401(k) plans have a documented tendency to make suboptimal allocation decisions, contingent on the limited menu from which they are able to choose. These biases are the sources of the investor losses we document.

This project extends the existing literature by measuring the relative magnitude of menu limitations, fees, plan-level expenses, and investor mistakes within a single framework. We compute these losses over a sample of funds substantially larger and less subject to selection issues than existing studies. Taking advantage of these loss measures and large sample, we explore the cross-sectional determinants of plan quality, most notably plan size. These results provide the clearest and most comprehensive picture to date of the relative importance in plan performance of fiduciary decisions and investor decisions.

2. Data, Sample Construction, and Selection Issues

The data used in this study come from a proprietary database of 401(k) plans constructed by Brightscope, Inc. Brightscope collects data from a number of public sources, most notably the Department of Labor's Form 5500, and the data set includes information about plan

⁴ For a brief overview of relevant papers and effects, see Tang, Mitchell, Mottola, & Utkus (2010).

administration and expenses, the menu of investment options offered by the plan, and balance of plan funds invested in each option. The Brightscope data include filings as far back as 2006 in a non-panel dataset. We use data from plans with a plan year ending on December 31, 2009, the most recent date with a significant number of plan filings.⁵ Brightscope has gathered data for 12,475 plans for that date.

One of the primary contributions of this study is to identify the effect of investment management fees on plan quality. Many large 401(k) sponsors, about 70% of plans in the Brightscope database, negotiate management arrangements with financial advisors so that assets of the plan are managed through collective trusts or separate accounts rather than true mutual funds. While these alternative investment vehicles often hold portfolios identical to some publicly available mutual fund, the fee agreements for these accounts are undisclosed. Other plans hold shares of public mutual funds subject to additional service fees through a wrap fee agreement. The expenses associated with the investment options available in such plans cannot be measured from publicly available information. Separate accounts generally have lower fees than the corresponding funds, while wrap agreements would produce higher fees.

Fees for plans that exclusively utilize publicly listed mutual funds for their risky investment options can be calculated using mutual fund expense ratios from the fund prospectuses. Since this study is concerned with the impact of the cost of 401(k) investment options, we restrict our sample to plans that offer publicly-traded mutual funds as their sole risky investment options, and eliminated plans that offer collective trusts or separate accounts.⁶

Potential selection issues related to this restriction are addressed below.

There are three other asset classes in the remaining sample of plans that require

⁵ There are 222 plans with end dates more recent than December 31, 2009 and 12,475 plans with the December 31, 2009 end date. We exclude the former set of plans for simplicity.

⁶ Elton, et al. (2006) also limit their analysis to plans that offer menus of mutual funds.

discussion. The first is company stock. Plans for publicly traded companies frequently offer company stock as an investment option. We hand match the Brightscope data to the CRSP database to draw information on stock return and variance. We exclude plans that include company stock if we could not identify a unique match or if returns data was not available for the dates needed for our estimations.⁷ A second asset class that raises issues is brokerage windows. These are discretionary brokerage accounts held inside a 401(k) plan, but generally making available a vastly greater number of investment options for an additional wrap fee. Investors who elect to place some of their account balance in the brokerage option are not restricted by the plan menu. Our data includes information about total allocations to these accounts, but no detail on investor choices. Since investors must explicitly opt into the brokerage option and the allocation to the option is a small fraction of total assets, we include these include plans offering these options in our sample, but disregard the brokerage options for our analysis.⁸ Finally, some plans offer Guaranteed Investment Contracts that offer fixed returns. Since these are not risky assets we exclude them from our analysis, but include the plans that offer them.

These restrictions leave 3,552 plans out of 12,475 plans in the Brightscope database with an end date of December 31, 2009.⁹ Plans in our sample include 28.7% of plans in the unrestricted database, and 17.0% of total assets. Is this remaining sample of plans representative? The selection issue is one that existing studies have not explicitly addressed. The choice to offer mutual funds, as opposed to separate accounts or collective trusts may introduce questions of selection that could raise issues about the external validity of our results.

⁷ 9.5% of plans not using separate accounts offered company stock. Average asset allocation to company stock in such plans is 14%. Our match rate on company stock was 75%.

⁸ Three hundred and thirty nine plans in our sample of 3,552 plans offer this option, and the average allocation is 11%. Tang et al. (2010) also include plans with brokerage windows and similarly exclude investments inside the window from analysis.

⁹ Of the excluded plans, 71% were excluded from our sample because managed trusts or separate accounts. Ninety-two plans were excluded because we could not match their company stock.

One key issue is the size of plans in the sample. It is well-known that the total cost of 401(k) plans is related to the size of the plans. If our sample differs markedly from the universe of plans by size, this would suggest caution in extending our findings to plans not represented in our sample. This concern is compounded by the significant difference in average size between our sample plans, which average \$35.4 million and the all plans in the Brightscope database, which average \$69.7 million in size. This difference in means can be attributed to the relative absence of extremely large plans from our sample, as illustrated in Figure 1.

Figure 1 sorts plans into bins by percentile of plan size then shows the density of plans in our sample relative to the total number of plans in the Brightscope database in each bin. A perfectly random sample would produce a level density distribution. Our sample underrepresents plans in the below the 20th and above the 80th percentile and oversamples plans in between. Very large plans are likely to use separate accounts with privately negotiated fee agreements. Very small plans may be more likely to use mutual funds subject to wrap agreements that increase fees. In either case, fee information would not be available and the fund would be excluded from our sample. Since the largest plans are orders of magnitude larger than the average plan the fact that such plans are underrepresented is sufficient to account for the substantial difference in means.

Of course, size is not the sole criteria that might generate selection effects. Other, unobservable differences between sample and non-sample plans may pose a challenge to the external validity of our conclusions. One basis for comparison is the 2009 Defined Contribution/401k Fee Study by Deloitte and the Investment Company Institute. (ICI 2009). This survey-based study of 130 plans was not restricted to mutual fund-only plans. The study used a measure of “All-in Fee” to measure total plan cost. The All-in Fee is comparable to the

sum of our measures of fee loss, plan expense loss, and fee allocation loss.¹⁰ ICI (2009) found a mean All-in Fee of 0.93%. The comparable measure for our sample is 1.13%, about 20 basis points higher. It is not possible to determine from the summary statistics reported in ICI (2009) whether this difference reflects a difference in the size of sampled plans or a selection effect of our restriction to mutual fund plans conditional on size. Selection issues aside, our sample represents a non-trivial segment of the market in its own right, and, given the dearth of data on the impact of plan design on plan performance, these results provide important new information about the cost and performance of plans.

We match Brightscope data with CRSP mutual fund data by ticker symbol. CRSP provides the monthly return data used to compute the return and variance for each fund. Data on fund fees is taken from Morningstar.

3. Methodology

The goal of this study is to identify the relative impact of menu limitations, investment costs and plan fees, and investor mistakes on investor welfare. To measure the quality of 401(k) plan menus and participant choices we draw on the work of Calvet, Campbell, & Sodini, (2007) and Tang, et al., (2010). The central measure of financial performance in this framework is the expected Sharpe ratio, computed using a factor model as described below. We compute the expected Sharpe ratio of five different portfolios, and use the differences in these Sharpe ratios to derive a return-equivalent loss associated with the difference between them. The five portfolios are:

¹⁰ See section 3.2, *infra*.

- 1) The observed aggregate allocation of investor funds in the plan.
- 2) The portfolio with the highest attainable Sharpe ratio, given plan menu, including mutual fund fees and plan-level fees.
- 3) The portfolio with the highest attainable Sharpe ratio, given plan menu, including mutual fund fees, but excluding plan-level fees.
- 4) The portfolio with the highest attainable Sharpe ratio, given the plan menu, but excluding all fees and expenses.
- 5) The portfolio with the highest attainable Sharpe ratio formed directly on a three factor model (described in next section).

We use the differences in expected performance for these portfolios to express the impact of fees, menu limitations, and investor choices as a change in expected returns at a selected variance.

3.1 Measuring Fund Expected Performance

We begin by implementing a factor model that can be used estimate the moments of return for each fund. Since 401(k) plans include funds other than domestic equity funds, we use a model that includes factors reflecting systematic risks in non-equity markets. The model is as follows:

$$R_{it} = \beta_i^1 * (r_{mkt,t} - r_f) + \beta_i^2 * (r_{bond,t} - r_f) + \beta_i^3 * (r_{intl,t} - r_f) + \varepsilon$$

Here t denotes months and i denotes individual mutual funds. In the model, r_{mkt} is the return on the Russell 3000, r_{bond} is the return on the Barclay's US Aggregate Bond index, and r_{intl} is the return on the MSCI EAFE international equity index. This model is similar to Tang, et al. (2010). We estimate the model for all mutual funds using data between 1/2002 and 12/2009. If

mutual funds are missing more than 3 years of data during this period those funds, and their associated plans, are excluded from the sample.

We estimate the mean return of the factors, $\hat{\mu}$, and the variance covariance matrix of the factors, $\hat{\Sigma}$. The absolute levels of fiduciary and investors loss are sensitive to choice of estimating window for the factor moments.¹¹ One option, used in Tang, et al. (2010), would be to estimate the factor moments over the same window as the fund betas. However, we find that the portfolio weights suggested by the factor moments over the period of 2002 to 2009 are historically anomalous. The Sharpe ratio optimal portfolio during that time would have shorted domestic equities and put more than 90% of the portfolio into bonds. Estimating plan quality using these weights produces very large menu losses, since very few plans include funds that negatively correlate with domestic equities. While it is fair to question whether current plan menus are well-attuned to challenging market conditions,¹² we believe a more conservative choice of factor loadings for our purposes is one that reflects conventional advice about portfolio allocation, and therefore reflect the likely approach of plan fiduciaries in constructing plans. Canner, Mankiw, & Weil (1997) review brokerage advice regarding asset allocation and find that brokerages recommend ratios of bonds to stocks of 0.25 to 1.5. We estimate factor moments over the window 1980 to 2000, which yields factor moments with an optimal portfolio where the ratio of bonds to equities is 1.2, on the conservative side of the Canner, et al. range.

The model provides estimated betas for every fund in each plan, $\hat{\beta}_i^1, \hat{\beta}_i^2, \hat{\beta}_i^3$. The model also provides a variance-covariance matrix of idiosyncratic risk, $\hat{\Sigma}_{idio}$, computed as the variance-covariance matrix of the residuals,. For each plan we define $\hat{\beta} = (\hat{b}_1, \dots, \hat{b}_i)'$, where i indexes

¹¹ See the discussion of robustness of details of how we address this sensitivity with respect to the relative and cross-sectional results.

¹² The future of equities has been a subject of recent public discussion. PIMCO's Bill Gross has argued that the conventional weight given to equities is no longer appropriate (Gross, 2012) while Malkiel (2012) has defended the traditional approach to allocation.

funds in the plan and $\hat{b}_i = (\hat{\beta}_i^1, \hat{\beta}_i^2, \hat{\beta}_i^3)$. Let ϕ_i be the management fee for each fund in the plan as of 2009. We compute two sets of expected returns, a vector of pre-fee expected excess returns on each fund in the plan:

$$\hat{\mu}_p = \hat{\beta} \hat{\mu}$$

And the vector of after-fee expected excess returns

$$\hat{\mu}'_p = \hat{\beta} \hat{\mu} - \phi$$

The inclusion of fund fees in the returns computation is a notable difference from (Calvet et al., 2007) and Tang, et al., (2010). For fund options that carry front-end sales loads, we add 1/7th of the sales load to the fees, following the standard practice in the mutual fund literature. (Sirri & Tufano, 1998). Since the fund management fees are constant, they do not affect the variance-covariance matrix, given by

$$\hat{\Sigma}_p = \hat{\beta} \hat{\Sigma} \hat{\beta} + \hat{\Sigma}_{idio}$$

For a given portfolio over plan options, w , we are now equipped to compute the Sharpe ratio of the plan portfolio:

$$\widehat{SR}(w) = \frac{\hat{\mu}_p}{\sqrt{w' \hat{\Sigma}_p w}}$$

The post-fee Sharpe ratio is computed using equivalent methodology.

To compute the optimal pre-fee portfolio, w_p , for each plan, we use an optimization package to find the no-short-sale portfolio that maximizes $\frac{\hat{\mu}_p}{\sqrt{w' \hat{\Sigma}_p w}}$ where the sum of the portfolio weights is one. Similarly, to find the post-fee portfolio, w_f , we solve the same maximization

problem using post-fee returns. Finally, the actual expected Sharpe ratio is the computed using the observed balances for each fund in the plan, w_a .

Note that the optimization problem is solved separately for the pre- and post-fee returns. This means that the optimum portfolio weights change to underweight high-cost funds. This is in contrast to simply deducting fees from the pre-fee optimum portfolio weights. Repeating the optimization will lead to a lower cost of fees, since weights can shift to reduce the impact of expensive funds.

Using this procedure, we compute the Sharpe ratios for the five portfolios listed above: global optimum formed directly on the factors, pre-fee menu optimum, post-fee and expense menu optimum, and actual plan portfolio including expenses. Figure 2 illustrates the mean-variance spaces of the portfolios. The upper curve is the mean-variance frontier of portfolios formed directly on the three factors. The tangency line to this portfolio gives the Sharpe ratio of the globally optimum portfolio. The second curve is the pre-fee mean variance space for portfolios formed over a given plan menu with the associated tangency line. The lower curve is the mean-variance frontier of the post-fee portfolios. Below the post-fee mean-variance frontier is the point corresponding to the mean and variance of the observed portfolio.

3.2 Measuring Plan Losses

To provide a simple framework for comparing losses from different sources, we use the Sharpe ratios of these portfolios to render all losses as *return-equivalent losses*. That is, given the difference between the Sharpe ratio of two portfolios, we compute the corresponding difference in returns for a fixed level of portfolio risk. In particular, we use the average expected standard deviation of returns of all observed portfolio held by plan participants, $\bar{\sigma}_a$ (which in

Table 3 is estimated to be 11.3%), as our benchmark risk measure. To determine the return-equivalent loss between two portfolios w_a and w_b we compute:

$$SR(w_a) * \bar{\sigma}_a - SR(w_b) * \bar{\sigma}_a$$

This difference is the change in returns to portfolio b that would be required to give it the same Sharpe ratio as portfolio a , given that both portfolios are leveraged to have the same risk, $\bar{\sigma}_a$.

Figure 2 illustrates our approach. The mean returns for each portfolio, leveraged to standard deviation $\bar{\sigma}_a$ (11.3%) are denoted by μ_g , μ_p , μ_f and μ_a , for the global optimum, pre-fee menu optimum, post-fee menu optimum, and actual portfolios, respectively. Since each portfolio has, by construction, the same variance, the differences in these returns provide a means of comparing the losses due to the limitations of investing through a 401(k) plan.

The difference between the global optimum portfolio and the pre-fee optimum portfolio provides a measure of the costs of being limited to a specified menu of funds. We term this *menu loss*. Menu loss occurs when menus do not provide investors with sufficient options to diversify. Because a limited set of funds cannot span the space of factor loadings as completely as a more generous menu, investors choosing from a limited set of funds will do worse than the global optimum. Even an extensive menu of funds may produce a low optimum Sharpe ratio if the funds are highly correlated, or if they are missing exposure to an important systematic risk factor. The global optimum Sharpe ratio is computed by optimizing directly on factor-loadings, and is therefore not a directly investible portfolio. Nonetheless, a number of plans in the sample achieve this optimum, up to rounding error, on a pre-fee basis. It therefore provides a reasonable pre-fee benchmark for plan menus.

To measure the losses due to mutual fund expenses, we compute the difference between the pre-fee and post-fee optimum portfolio and deduct the fees associated with an optimized

benchmark portfolio of low cost index funds.¹³ The difference between the pre- and post-fee optimums reflect the impact of mutual fund fees, while deducting the fees of a low-cost portfolio reflects the reality that fund expenses will not be zero. We term the return-equivalent loss associated with the difference between these two portfolios *menu excess fee loss*. Since some plans offer lower fees than the benchmark portfolio of retail index funds, fee loss for some plans is negative. The effect of fees on obtainable Sharpe ratio captures both the direct cost of fees and the distortive effect of fees on investment decisions. For example, if a fund carries low weight in the pre-fee portfolio, then its fees should have slight effect on the post-fee optimum. Conversely, if a fund is heavily weighted, relatively modest fees may have a substantial effect on the pre-and post-fee optimum Sharpe ratios.

We also compute the loss due to administrative expenses, *excess plan expense loss*. This is the difference between the return on the post-fee optimal portfolio when a competitive plan-level expense of 8 basis points is included and the return on the optimal portfolio when both fund and plan level fees are included.¹⁴ The plan level fees are those itemized expenses reported on the Form 5500 that are not associated with specific investment choices. They include investment plan management, book-keeping and administrative fees.

Finally, we term the difference between the adjusted returns on the optimum post-fund fee and post plan-level expense portfolio and the actual portfolio *investor loss*. This difference reflects losses from the failure of plan investors, in aggregate, to optimize their portfolios within

¹³ The benchmark portfolio consists of retail shares of all currently available Vanguard index funds. Since these funds are available to individuals, they provide a reasonable cost benchmark for even very small plans.

¹⁴ The majority of plans report that they pay no plan-level expenses. Service providers for these plans are compensated from mutual fund expenses. Since compensation paid from fund fees is not currently disclosed, it is absent from our data. A very-low cost service provider, Employee Fiduciary LLP, reports that it charges \$30 per employee plus 0.08% of plan assets for administrative services for small plans. Vanguard offers services to plans under \$20 million through its small-business program. While pricing information is not publicly available, Vanguard estimates that a \$5 million dollar plan would feature an all-in fee of about 32 basis points, including fund fees, which corresponds well with Employee Fiduciary's 8 basis point administration-only fee. Given the very low level of administrative fees available, even for small plans, we use a benchmark of zero for plan fee losses.

the limitations of the menu.¹⁵ This loss can be further decomposed into fee mistakes and allocation mistakes. Since the optimal portfolio accounts for fees, any additional fees incurred by investors are incurred in deviating from the optimal strategy and over-allocating funds toward menu offerings with higher fees. We term any fees incurred by investors over the fees on the optimal post-fee and post-expense portfolio *excess fee optimization loss*. Note that this quantity can be negative if investors pay lower fees than in the optimal portfolio. For example, investors might over-allocate to a money-market fund resulting in a portfolio with lower fees than the optimal portfolio, but also lower returns. The balance of investors' loss arises from mistakes investors make in factor allocation, which we term *diversification loss*. Diversification loss results if investors expected return (net of their excess fee loss) is lowered by allocating plan funds in ways that reduce the expected Sharpe ratio as measured by the factor model. We emphasize that these diversification losses are lower bound estimates as we only observe the aggregate participant allocations in plans. Some participants may incur additional diversification losses by investing solely in bond funds, while others may invest solely in International equities. But our Form 5500 only observes the aggregate plan investments.

3.3 Discussion of the Measure of Plan Losses

Our measure of plan performance has the desirable quality of being computable ex ante. Since the fund and factor moments are measured using historical data, our measure of fiduciary and investor losses uses no information that would have been unavailable to fiduciaries or investors at the time menu and allocation decisions were made. This makes the measure a

¹⁵ We do not observe individual portfolios, and so investor mistakes that, in aggregate, cancel out are not captured by our measure. For example, we cannot distinguish two investors each holding a single fund from two investors holding identical portfolios of two funds. This makes our measure of investor loss less precise than our measure of fiduciary loss, but nevertheless useful, particularly in cross-sectional regressions.

useful evaluation of fiduciaries' and investors' decision making, since we do not impute knowledge of future returns to the fiduciary. The disadvantage of an ex ante measure of plan quality is the difficulty of estimating expected returns, including the sensitivity to the window of estimation for factor moments and choice of factor model. One way to validate the metric is to characterize plans that score poorly in terms of total fiduciary loss to ensure that they are, in fact, low-quality plans. Table 1 lists the investment menus of the two plans that have the highest fiduciary loss, relative to size, in our sample.¹⁶

Plan 1 is striking for two reasons. First, its menu is quite small, offering only five non-money market investment options. With so few funds available, the capacity of plan participants to diversify is limited and the plan is among the highest in our sample in terms of menu loss. Second, Plan 1 has fees well above the average of 401(k) plan mutual funds¹⁷ as well as mutual funds in general and these fees are high across the board, meaning that no available portfolio can do much to reduce the impact of the expenses. Notably, the plan also charges very high front end loads. The combination of factors leads to a plan in which investors have little chance of strong performance. We estimate that the fiduciary loss would sacrifice 60% of the optimal risk premium.

Plan 2 suffers from similar problems. It consists of a small menu and offers only bond funds and a money market fund. It is one of only 3 plans in our sample that is missing an equity fund. With no equity funds in the menu, this plan has a menu loss of 3.0%, the highest in our sample. While the plan has no itemized expenses, its fee loss is roughly twice the average. All of the bond funds are subject to sales loads. The fiduciary loss for this plan is 51% of the optimal risk premium. The degree of fiduciary loss for Plan 2 is particularly striking as it has

¹⁶ Plan losses, as the regression below demonstrate, are strongly related to size.

¹⁷ See Table 4 and accompanying discussion, *infra*

more than \$5,000,000 under management. The plan badly underperforms its similarly-sized peers.

Given the high fees and limited diversification options, neither of these plans, which both score poorly on our measure of performance, provide attractive investment opportunities for participants.

4. Results

Part 4.1 presents summary statistics for the sample, for the optimal and observed portfolios, and for the measured investor and fiduciary losses. Part 4.2 presents cross-sectional regressions that investigate the determinants of investor and fiduciary loss. Part 4.3 examines the impact of menu design on investor loss.

4.1 Summary Statistics for Plans, Optimal Portfolios, and Plan Losses

Table 2 presents the summary statistics for plans in our sample. Of note is that the vast majority of plans offer funds in the U.S. equities, bonds, and international equities categories. Index funds are somewhat less common, but are offered by a majority of plans. Figure 3 is a histogram of the number of investment options offered by each plan showing the distribution of offerings centered on a mean of number of about 23 funds.

Table 3 presents the summary statistics for the pre- and post-fee optimum portfolios and the observed portfolios. All values in this table are annualized. The mean expected standard deviation of observed portfolios, $\overline{\sigma_a}$, is about 11.8%. This is the level of risk used as a baseline to compute the return-equivalent losses. This risk is relatively modest by the standard of US equities, but reflects that most plans include bond and other lower risk asset classes. The expected return on observed plans is 7.0%, which is quite high given the level of risk. This high

expected return reflects the relatively favorable market conditions for the window over which factor moments are estimated. The optimal portfolio allocates 44% to domestic equities, 55% to bonds and 1% to international equities, and has an expected return of 4.8% and only 6% standard deviation. The optimal portfolio is lower risk than most observed portfolios since it weights the bond factor more heavily.¹⁸

Table 4 presents the return-equivalent losses for sample plans. Because the return-equivalent losses are scaled to the 11.8% average risk of observed 401(k) portfolios and measured relative to an optimum factor portfolio, the most natural interpretation of the results is as a percentage of the excess return on the optimum portfolio at this selected risk level. About 21% of the optimum excess return is lost to the combination of fiduciary and investor losses. Fiduciary losses are smaller than investor losses on average, comprising 7.7% (68 basis points) of optimal excess returns compared to 13.3% (116 bps) for investor losses. Fiduciary losses decompose into menu losses, fund fee losses, and plan expense losses. On average, fiduciary losses are mostly due to fund fees, with menu losses accounting for less than a percent of the optimal risk premium and less than a basis point of real return at the average risk level. Menu losses and plan expenses losses are more dispersed than fund fee losses, with the standard deviation exceeding the means for both types of losses.

Overall, we find that 7.7% of total losses come from fiduciaries offering menus that unavoidably expose investors to higher fees or limited diversification opportunities. Our measure of fiduciary loss understates however the the proportion of total loss that might be attributed to poor fiduciary menu construction. As we emphasize below, fiduciaries that offer

¹⁸ The global optimum portfolio has 54.5% allocated to stock and 44.3% allocated to bonds. The optimal pre-fee menu portfolio had substantially less exposure to equity than the optimal post-fee menu portfolio -- as indicated by the substantially lower standard deviation in Table 3. Optimization gave less weight to equity in the pre-fee estimation because the risk-adjusted equity premium of bonds relative to stock is higher on a pre-fee basis than on a post fee basis.

menus that predictably lead to poorer investor choices are a cause of some investor loss. For example, a fiduciary including in a menu a high fee fund that no reasonable investor should invest can predictably lead to unnecessary investor losses.

Table 4 also distinguishes the relative size excess fees and diversification losses without regard to fiduciary/investor attribution (which are labeled in the table as “Total Excess Fee Loss” and “Total Diversification Loss”). We find that excess fee losses are an important component of total losses and account for on average 49 basis points and 61% of total plan losses.

More insight into the relative significance of investor and fiduciary losses is provided in Table 5, Panel A, which breaks out the percentage of plans with larger investor or fiduciary losses by plan size quintile. As discussed below, smaller plans tend to have larger fiduciary loss. While 77% have higher investor losses, nearly half of smallest plans have investor losses that exceed fiduciary losses. Conversely, fiduciary losses are the predominating factor in less than 7% of the largest plans. Panel B disaggregates losses somewhat differently. Rather than assign losses to investors or fiduciaries, Panel B compares the total loss due to excess fees on the observed portfolio relative to the total loss due to insufficient diversification (regardless of whether these losses were caused by menu restrictions or investor choice). In this alternative disaggregation, the total effect of fees exceeds the allocation issues for most plans. The effect is particularly strong in the smallest plans.

4.2 The Cross Section of Return-Equivalent Loss

Do investors in plans with higher expected optimum Sharpe hold better aggregate portfolios than other investors? This is not inevitably the case. Since the optimal portfolio can always assign zero-weight to a fund on the menu, adding funds to a menu can only increase the optimum Sharpe ratio of a plan. Our methodology therefore rewards menus with wider arrays of

investment options. But limited menus may limit bad decisions as well as good ones. While limited investment menus restrict obtainable optimums, such restrictions might be justified if they prevent real investors from making mistakes that wipe out much of their portfolio. When investors are cognitively constrained, menus might at times be improved more by subtraction than by addition. Since our data is limited to aggregate, plan-level portfolio data, we cannot observe the worst outcomes for investors in different plans. We can nevertheless address the threshold question of whether increasing the Sharpe ratio of the optimum portfolio leads to better expected Sharpe ratios in observed portfolios.

Table 6 presents the results of a regression of plans' total loss relative to the optimum portfolio on fiduciary loss and components of fiduciary loss. The results confirm that higher fiduciary loss is associated with worse observed aggregate portfolios. The coefficient on fiduciary loss suggests that investors benefit from lower fiduciary losses on an almost dollar-for-dollar basis, with 98% of the fiduciary loss being passed through to investors. These regressions confirm that the Sharpe ratio of the average observed portfolio is increasing in the Sharpe ratio of the optimal portfolio. Put simply, improving investor options leads to improved aggregate portfolios. Table 6 confirms the normative force of our quality measure by showing that investors hold portfolios with better expected Sharpe ratios in higher-quality plans. Model 2 breaks out the components of fiduciary loss. As might be expected, menu losses have a less than one-to-one relationship with investor losses, since some of the benefit of improved menus is dissipated by investors' mistakes. Nonetheless, the result is strong, with 88% of menu losses impacting the aggregate portfolio. Mutual fund fee losses have an even stronger effect on investor welfare, with a nearly one-to-one relationship. This suggests that investors are less

prone to fee mistakes than allocation mistakes, a suggestion borne out by the summary statistics for the two types of investor losses in Table 4.

The coefficient on plan-level expense loss requires some explanation, as the loss to investors exceeds the direct impact of the fees. This result is robust to additional control variables. The likely explanation is that investors do not adjust their portfolio risk-loading to account for the effect of plan-level fees. Since plan-level expenses have the effect of shifting the mean-variance frontier downward, the optimal portfolio in the presence of these costs has higher mean and variance than without them. To the extent investors fail to adjust accordingly, their portfolios will fall short of the post-fee optimum, and this will result in increased expense losses.¹⁹ The omission of the investor loss measure would bias the effect of plan level expenses upward. Since the goal of the Table 5 regressions is to measure the effect of fiduciary losses on total loss, including the indirect effect through investor decision-making, this effect is intended.

It is well understood that larger 401(k) plans have lower fees than smaller plans. This is often credited to the economies of scale and bargaining power associated with large plans. Table 7 presents regressions of elements of plan loss on two measures of plan size: the log of total plan size and the balance of each account. Plans may be large either because they include many participants or because the participants have large average balances. While having a substantial pool of assets under management ought to lead to lower per-dollar administrative costs through economies of scale, plans with many participants may have high cost despite their size if there are per-participant costs that scale with the number of accounts. Adding a control for average account size implicitly controls for the difference between plans with large accounts and plans

¹⁹ Unreported regressions of Investor Loss on Plan-Level Expenses Loss shows that expenses are in fact associated with higher investor loss. We also find that Plan-Level Expenses Loss is not associated with a higher risk observed portfolio. These results support this explanation.

with many small accounts. The results suggest that account size is unimportant, as the coefficients on average account size are statistically insignificant and economically tiny.

For the main variable of interest, total plan size, results confirm that it is an important predictor of fiduciary and total loss, with the total impact of size being both statistically and economically significant. Doubling the assets in a plan is associated with a decrease of 25 basis points in fiduciary loss. Interestingly, investor loss is also lower in large plans though this effect is economically small, with a doubling of plan size associated with only four basis points of loss. Nevertheless, the result is statistically robust to the inclusion of controls for plan expense loss. One possible reason for this effect is discussed at the end of this section, where we examine the impact of menu design on investor loss. Briefly, certain fiduciary choices are likely to induce poor investor choices, and design problems may be more prominent in small plans.

As measured by total loss, investors in large plans do better, with a doubling of plan size associated with a 29 basis point decrease in total loss. While economies of scale can justify a price differential between large and small plans Figure 5 shows a wide dispersion of costs at every level of plan size, suggesting that the market for 401(k) services may not be fully competitive. Being a participant in a large plan is not a guarantee of low fee losses. Twenty percent of plans in the largest decile of total assets have fees losses that exceed the median for all plans.

4.3 Menu Design

While fiduciary losses are the most direct source of costs to investors, other costs arise from the construction of the plan menu. One of the central lessons of behavioral economics is that the design of a menu can influence choices over that menu. This section investigates aspects

of plan menu design and shows that plan menus are subject to design issues that reduce investor welfare.

Investors are subject to behavioral biases in their allocation of portfolio assets. This includes the 1/N heuristic of Benartzi & Thaler (2001) who show that investors tend naively to diversify by allocating funds equally to each option in a 401(k) plan. A corollary of this finding is that the inclusion of poor choices in an investment menu will leave investors worse off, even if they are free to pick other funds. To investigate the impact of low-quality menu choices on investor welfare, we construct two measures of menu quality. The first measure is the distance in N-space between the optimal portfolio and the 1/N portfolio. Let $\mu_N = (\frac{1}{N}, \frac{1}{N}, \dots, \frac{1}{N})$, the equal-weight portfolio of all funds in a plan. Then we define the *diversification distance* as

$$\|\mu^* - \mu_N\|$$

Where μ^* is the post-fee optimal portfolio for the plan. This distance which ranges between 0 and 1 is a measure of difference between the optimal portfolio and an equally-weighted portfolio, suggested by the 1/N heuristic. The average and standard deviation of diversification distance in our data are 0.66 and 0.10, respectively. Since investors tend to the equally weighted portfolio, plans that are robust to this tendency should produce lower investor losses, and this measure is designed to capture that.

Table 8 presents the results of regressions of this measure of menu quality, as well as the percentage of index funds offered, on investor loss, menu size, and plan asset size controls. The results suggest that choices made by the fiduciary in structuring the menu can substantially affect the losses from investor choices over the menu. Both the diversification distance and the percentage of low-weighted funds in the optimal portfolio are associated with increased investor losses. The effect is economically significant. For example, a menu consisting of 50% low-

weighted choices is associated with a 65 basis point reduction in returns due to investors' failure to optimize around the low-weighted funds. Menus that include more index funds also show substantially lower investor choice loss, even after controlling for plan size. This is likely a result of index funds' relatively low fees, combined with investors' tendency to choose all available menu options. Models 5 and 6 show that investor choice loss is increasing in the number of options. Since investors may hold expensive funds that the optimal portfolio avoids plans with large menus of high-cost funds are associated with worse expected performance for investors.

The results presented in Table 8 imply that the impact of fiduciary decisions on investor welfare is not limited to direct fiduciary losses. Fiduciary decisions also have a predictable impact on investor choices. Menus that are robust to the 1/N heuristic are associated with better outcomes for investors than menus that require more careful portfolio selection.

How does the compensation of service providers affect the structure of menus? Fiduciaries are responsible for the design of plan menus, but the choice of investment options is heavily influenced by the plan service providers. One concern of policy makers has been that service providers have a conflict of interest. Since service provider compensation comes, in part, through the fees of funds on the menu, service providers may encourage fiduciaries to include menu choices that are profitable for the provider, but not beneficial to plan participants. This conflict of interest may be reduced if service providers are paid a percentage of plan assets rather than indirectly through the fees of the funds included in the plan menu.

Do investors in plans that compensate their fiduciary directly feature better menus than plans that record no plan-level expenses, but compensate advisors indirectly through fund fees? Our data includes the expenses paid for investment management by each plan for those plans that

record such an expense. About 13% of plans in the sample record such a cost. Table 9 reports the results of regressions of direct investment management compensation on the measures of menu quality from Table 8. While there is no significant relationship between direct compensation and diversification distance, the amount of direct compensation is associated with an increase in the fraction of index funds offered. Fee loss is also lower as direct compensation to investment advisors increases. The number of funds in the plan is also decreasing in direct compensation, an interesting result in light of the finding in Table 8 that plans with more funds are associated with higher investor losses. An important caveat to these results is that total loss and fiduciary loss are both increasing in direct compensation: the improved menu quality does not offset the expense on a dollar-for-dollar basis. In Table 9, a 10 basis point increase in direct management fees is associated with a 3 basis point reduction in fund fees. Nevertheless, these regressions do support the view that the structure of service provider compensation may affect menu structure.

4.4 Robustness

Following Tang (2010) and Calvet, Campbell, & Sodini, (2007), we estimate returns using a factor model with no alpha. To the extent actively managed funds produce persistent positive alpha, this model may overstate the costs of holding such funds. Gil-Bazo & Ruiz-Verdú, (2009) investigate the relationship between mutual fund fees and alpha in domestic equity funds. They find that pre-fee alpha is, on average, negative, and that high-fee funds have lower pre-fee alpha. Both results suggest that, in aggregate, high-cost funds disfavored by our portfolio optimization methodology are likely to be poor choices in a model including alpha.

To investigate the potential impact of alpha on our results, we re-estimate the expected returns model including alpha. Since EGB (2006) document abnormally high historical

performance for funds included in 401(k) plans and show that these returns don't persist, we estimate alpha for each fund in 2010 and 2011, so that the alphas represent returns actually available to investors. Our estimation procedure is analogous to Carhart (1997), with the significant caveat that, unlike the literature on mutual fund performance persistence, we cannot limit our sample of domestic equity funds. This is likely to reduce the precision of our alpha estimates to the extent that our factor model fails to capture, for example, systematic risk associated with commodities prices. Using these estimates of fund-level alphas, we then recompute optimal portfolios and re-run our cross-sectional regressions. We find that, with one exception, our regression results are robust to the inclusion of alphas, so estimated. The exception is the relationship between investor loss and the percentage of index funds included in the plan menu in model 3 of Table 8, which is no longer significant in the alternative regression.

5. Conclusion

Our findings indicate that costs associated with plan investment options should be a crucial consideration in designing policies to guide plan fiduciaries. Fiduciary losses are a source of considerable costs to plan investors, particularly those in smaller plans, and investors cannot avoid these costs except by investing outside the plan. While, on average, fiduciary losses are smaller than investor losses, fiduciary losses exceed investor losses in small plans. Moreover, a comparison to retail index funds suggests that many plans are inefficient in the fees they offer. Reducing fiduciary losses could be a productive point of focus for policy makers: investors benefit nearly dollar-for-dollar from reduced losses.

Our results also point to menu redesign as a potential source of plan improvement. While the law tends to attribute allocation mistakes to investors, menus that include poor choices or few

index funds show higher investor losses. While adding index fund options would benefit most plans, eliminating poor choices would also be a powerful palliative, and our regressions suggesting elimination of poor funds might be a more effective strategy than adding good ones. If fiduciaries adapt their menus to accommodate well-understood investor behavioral biases, investor outcomes may be improved.

Works Cited

- Angus, J., Brown, W. O., Smith, J. K., & Smith, R. (2007). What's in Your 403(b)? Academic Retirement Plans and the Costs of Underdiversification. *Financial Management*, 36(2), 1–38.
- Benartzi, S. (2001). Excessive Extrapolation and the Allocation of 401(k) Accounts to Company Stock. *The Journal of Finance*, 56(5), 1747–1764. doi:10.1111/0022-1082.00388
- Benartzi, S., & Thaler, R. H. (2001). Naive Diversification Strategies in Defined Contribution Saving Plans. *The American Economic Review*, 91(1), 79–98.
- Bill Gross: We're Witnessing the Death of Equities - MarketBeat - WSJ. (n.d.). Retrieved August 15, 2012, from <http://blogs.wsj.com/marketbeat/2012/07/31/bill-gross-were-witnessing-the-death-of-equities/>
- Burt Malkiel: Even Amid the Current Turmoil, Stocks Still Beat Bonds - WSJ.com. (n.d.). Retrieved August 15, 2012, from <http://online.wsj.com/article/SB10000872396390444184704577585752786129144.html>
- Calvet, L. E., Campbell, J. Y., & Sodini, P. (2007). Down or Out: Assessing the Welfare Costs of Household Investment Mistakes. *The Journal of Political Economy*, 115(5), 707–747.
- Canner, N., Mankiw, N. G., & Weil, D. N. (1997). An Asset Allocation Puzzle. *American Economic Review*, 87(1), 181–91.
- Carhart, M. M. (1997). On persistence in mutual fund performance. *Journal of finance*, 52(1), 57–82.
- Elton, E. J., Gruber, M. J., & Blake, C. R. (2006). The adequacy of investment choices offered by 401(k) plans. *Journal of Public Economics*, 90(6–7), 1299–1314.
- Gil-Bazo, J., & Ruiz-Verdú, P. (2009). The relation between price and performance in the mutual fund industry. *The Journal of Finance*, 64(5), 2153–2183.
- Investment Company Institute & Deloitte (2009). Defined Contribution / 401(k) Fee Study. available at http://www.ici.org/pdf/rpt_09_dc_401k_fee_study.pdf

Sirri, E. R., & Tufano, P. (1998). Costly Search and Mutual Fund Flows. *The Journal of Finance*, 53(5), 1589–1622.

Tang, N., Mitchell, O. S., Mottola, G. R., & Utkus, S. P. (2010). The efficiency of sponsor and participant portfolio choices in 401(k) plans. *Journal of Public Economics*, 94(11–12), 1073–1085.

Figure 1: Density Histogram of In-Sample Plans Relative to All Brightscope Plans

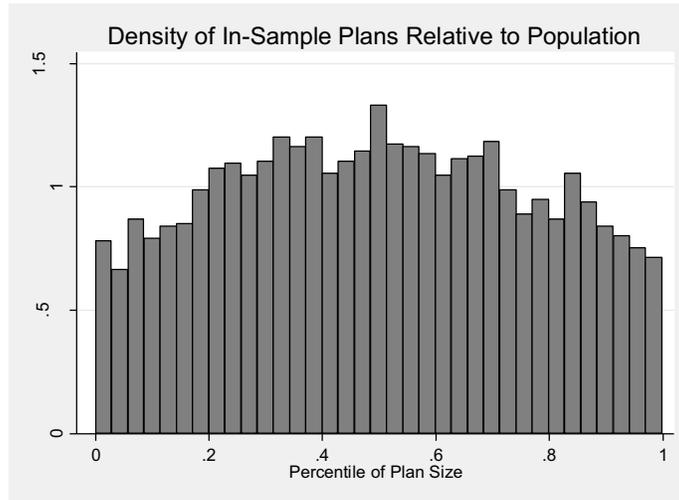


Figure 2: Mean-Variance Diagram of Return-Loss Decomposition

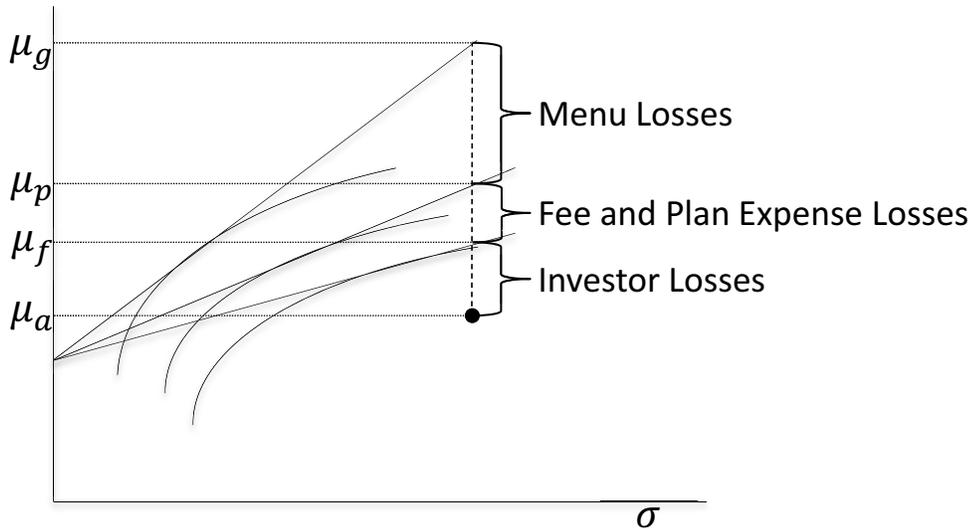


Figure 3: Histogram of Number of Investment Options

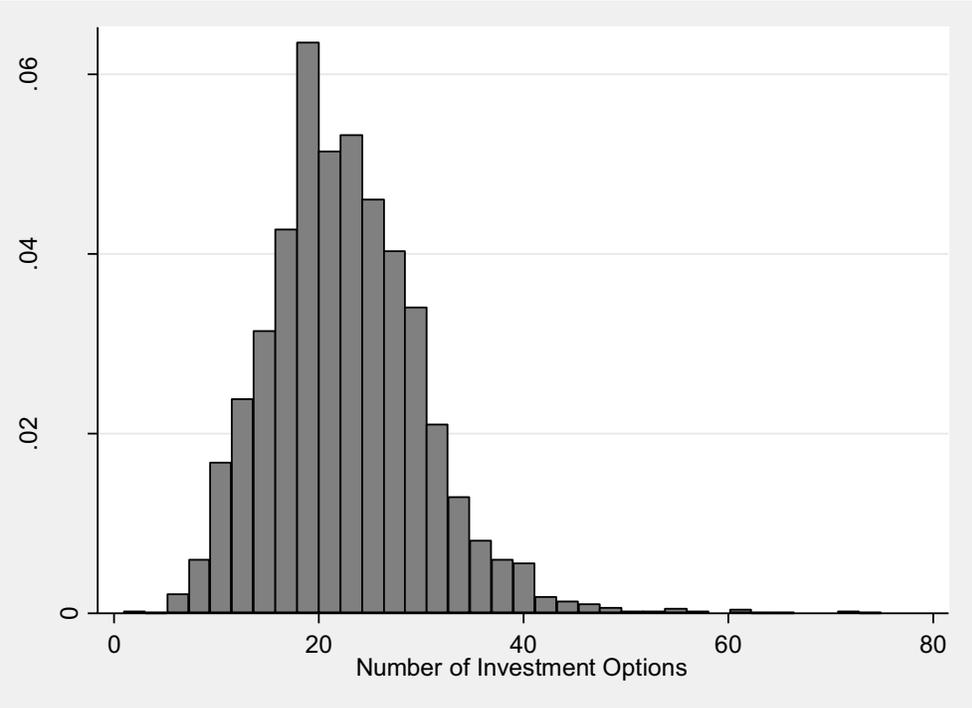
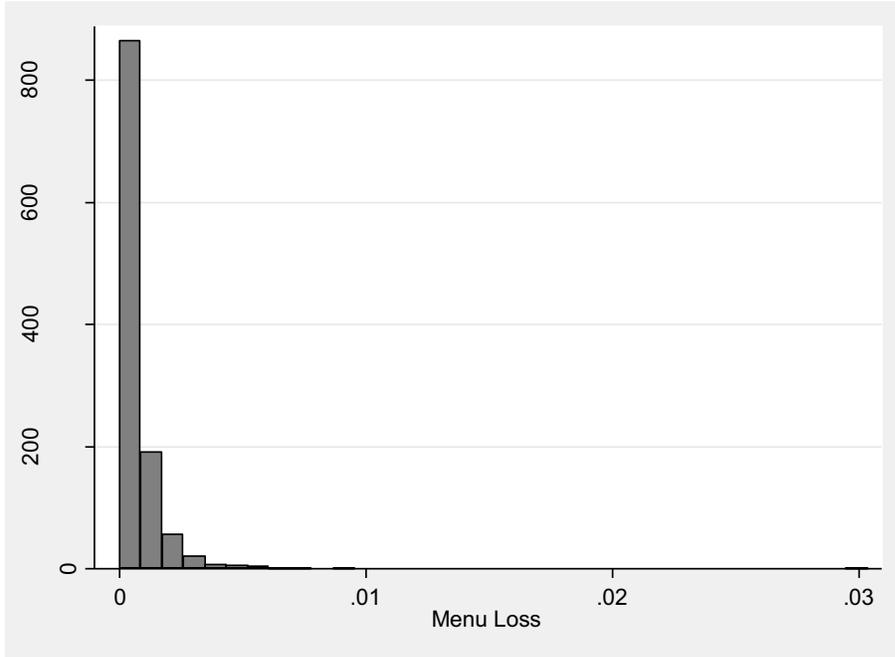
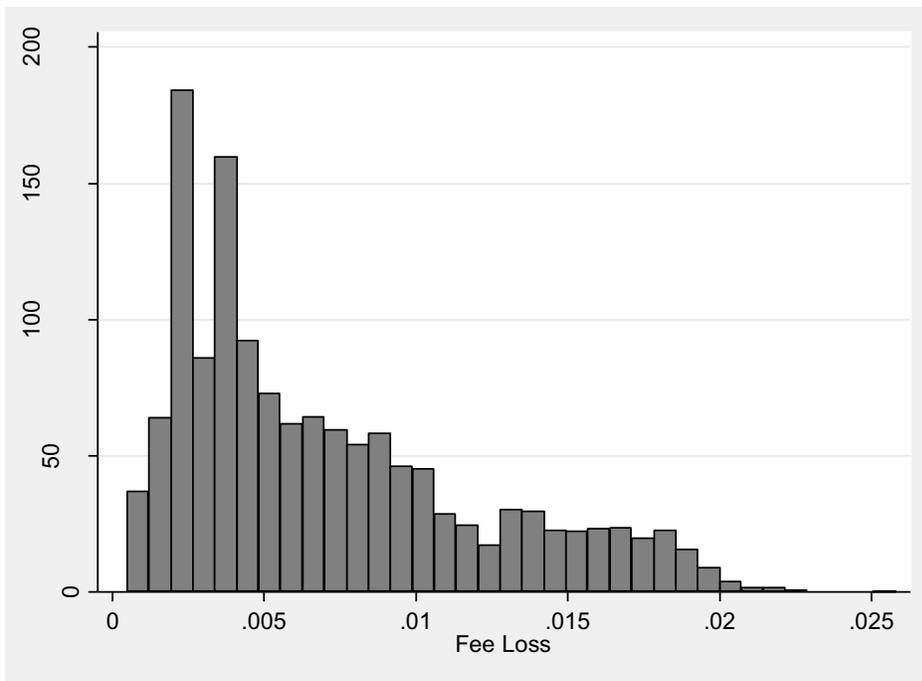


Figure 4: Density Histograms of Return-Equivalent Loss

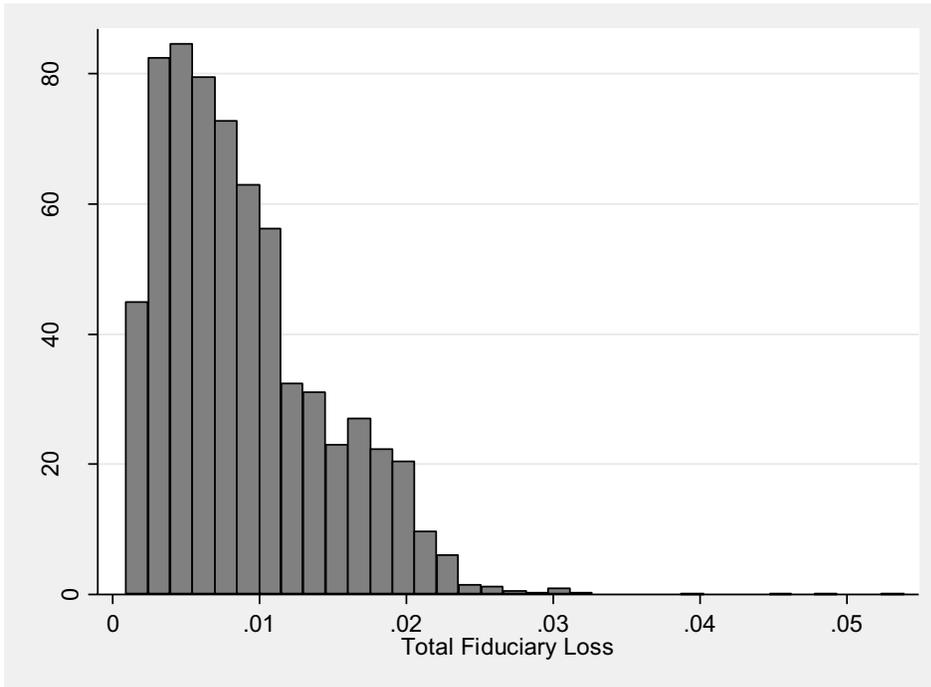
4.A Loss Due to Menu Limitations



4.B Loss Due to Mutual Fund Fees



4.C Total Fiduciary Loss



4.D Loss Due to Investor Portfolio Choice

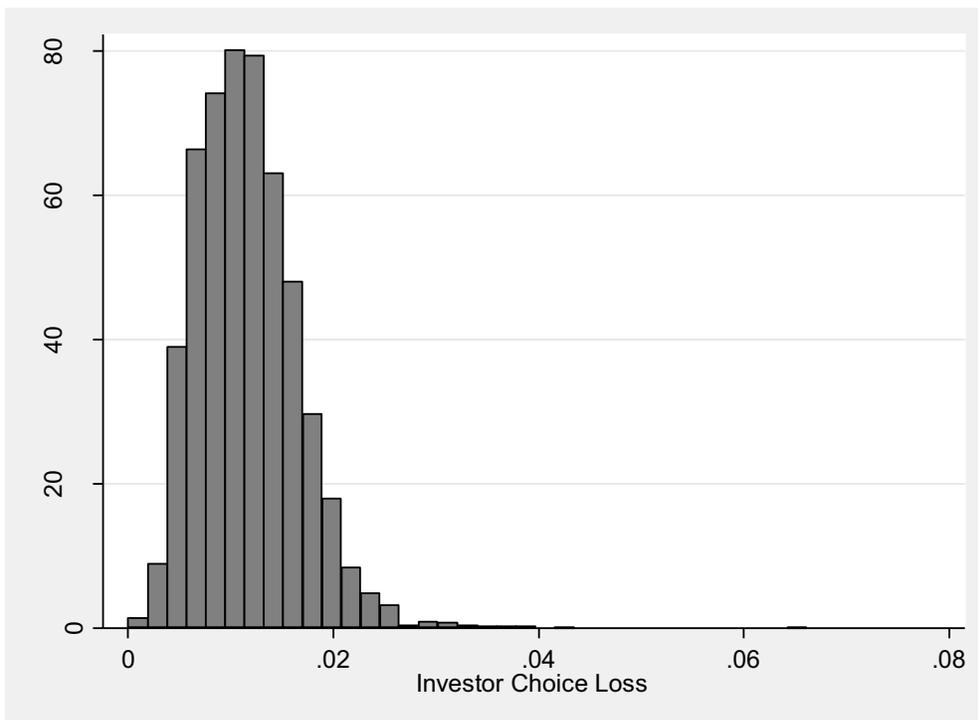


Figure 5: Scatterplot of Fiduciary Loss and Plan Size

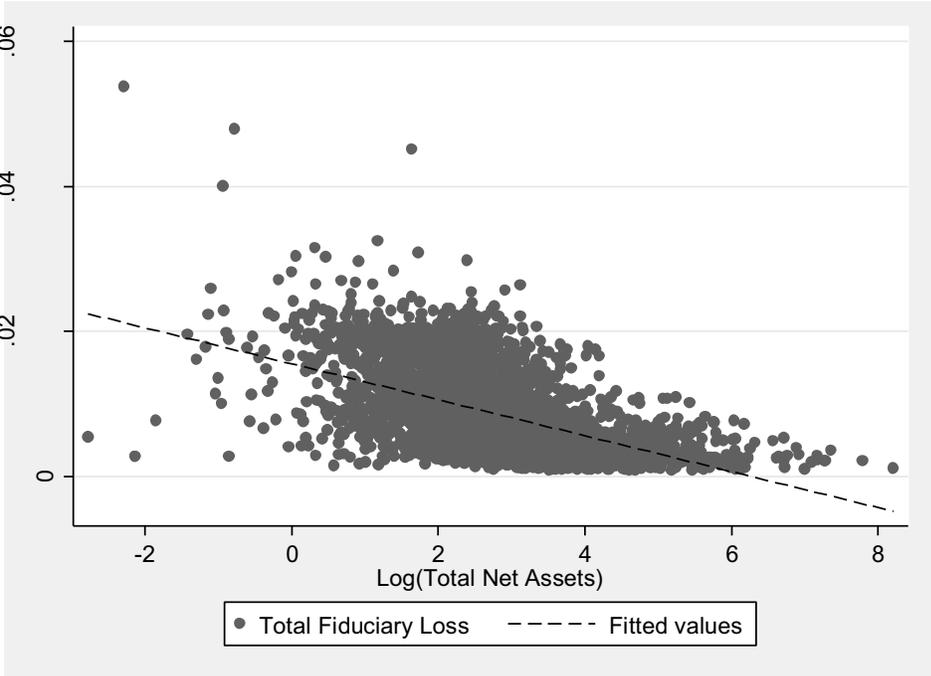


Table 1: Plans with Highest Fiduciary Loss Relative to Size

This table presents all investment options offered by the two plans in our sample with highest residual of fiduciary loss regressed on size.

Plan 1

Plan Participants with Balances = 54; Net Assets = \$101,550

Fiduciary Loss: 5.3%; Plan Expense Loss = 2.4%; Fee Loss: 2.2%; Menu Loss: 0.66%

Fund Name	Provider	Morningstar Category	Net Expense Ratio (%)	Front Load (%)
Lord Abbett Diversified Equity Strategy	Lord Abbett	Large Growth	1.50	5.75
Lord Abbett Balanced Strategy	Lord Abbett	Moderate Allocation	1.29	5.75
Lord Abbett US Government and Government Sponsored Enterprises Money Market	Lord Abbett	Money Market-Taxable	0.70	0
Lord Abbett Growth & Income Strategy	Lord Abbett	Aggressive Allocation	1.54	5.75
Lord Abbett Alpha Strategy	Lord Abbett	Small Growth	1.51	5.75
Lord Abbett Diversified Income Strategy	Lord Abbett	Conservative Allocation	1.20	5.75

Plan 2

Plan Participants with Balances = 110; Net Assets = \$5,184,366

Fiduciary Loss: 4.5%; Plan Expense Loss = 0.0%; Fee Loss: 1.47%; Menu Loss: 3.0%

Fund Name	Provider	Morningstar Category	Net Expense Ratio (%)	Front Load (%)
JPMorgan Short Duration Bond	JPMorgan	Short-Term Bond	0.81	2.25
PIMCO Real Return	PIMCO	Inflation-Protected Bond	0.88	3.00
JPMorgan Core Bond	JPMorgan	Intermediate-Term Bond	0.77	3.75
JPMorgan US Government Money Market	JPMorgan	Money Market-Taxable	0.18	0
PIMCO Total Return	PIMCO	Intermediate-Term Bond	0.86%	3.75
PIMCO Low Duration	PIMCO	Short-Term Bond	0.85%	2.25

Table 2: Plan Summary Statistics

This table presents summary statistics for the plans included in the sample. Total Plan Assets is the sum of balances of all investment options less outstanding participant loans. Number of Options is the number of mutual fund options as well as GIC, brokerage window, and company stock options. The table also summarizes the percentage of plan offering at least one instance of each broad category of investment type. We use the Morningstar asset class designation to derive the broad investment classes.

N = 3668	Mean	Median	Std. Dev.	Min	Max
Total Plan Assets (\$ millions)	34.13	12.98	116.5	.06	3,662.5
Number of Participants	927.8	301	4,715.0	0	221,558
Number of Investment Options	22.79	22	7.7	1	75
Percent of Plans Offering Options					
Asset Classes					
Equity Funds	99.9%				
Bond Funds	99.3%				
Balanced Funds	94.1%				
International Equity	99.2%				
Index Funds	79.3%				
Company Stock	5.2%				
Brokerage Windows	9.5%				

Table 3: Portfolio Summary Statistics

This table gives the summary statistics of optimized portfolios. The Pre-Fee Menu Optimum Portfolio is the portfolios with the highest Sharpe ratio computed over the expected mean and variance of the investment options as determined by the factor model without accounting for investment costs. The Post-Fee Menu Optimum Portfolio is the maximum Sharpe ratio portfolio computed over the investment options after deducting fees from expected returns. This optimization is computed independently so that the optimization minimizes the impact of fees. The Observed Portfolios is the aggregate portfolio of the plan with return and Sharpe ratio computed after the deduction of fees.

	N=3522	mean	sd	min	p5	p95	max
Sharpe Ratio							
	Pre-Fee Menu Optimum	0.7303	0.0085	0.4812	0.7166	0.7354	0.7354
	Post-Fee Menu Optimum	0.6604	0.0472	0.2842	0.5709	0.7170	0.7278
	Observed Portfolio	0.5735	0.0581	0.0957	0.4804	0.6694	0.7096
Return							
	Pre-Fee Menu Optimum, μ_p	0.0483	0.0250	0.0005	0.0024	0.0735	0.1707
	Post-Fee Menu Optimum, μ_f	0.0771	0.0158	0.0382	0.0614	0.1028	0.3013
	Observed Portfolio, μ_a	0.0701	0.0118	0.0031	0.0506	0.0876	0.1827
Standard Dev							
	Pre-Fee Menu Optimum	0.0644	0.0331	0.0006	0.0033	0.0976	0.2171
	Post-Fee Menu Optimum	0.1135	0.0249	0.0563	0.0876	0.1581	0.3759
	Observed Portfolio	0.1183	0.0153	0.0209	0.0925	0.1389	0.2960

Table 4: Return-Equivalent Losses

Return equivalent losses are computed as the difference, at the mean level of expected risk on all observed portfolios, between the returns on the benchmark portfolios as determined by their expected Sharpe ratios. All returns are reported as ratios, so that 0.01 is equal to one percent. For menu losses, the benchmarks are the global optimum factor portfolio and the Pre-Fee Optimum. Fund Fee Loss is determined by the Pre-Fee Optimum and Post-Fee Optimum. Plan Expense Loss is directly calculated as total itemized plan expenses (other than fund fees), divided by plan net assets, multiplied by the portion of plan funds held in mutual funds. Total Expense Loss is the sum of Fund Fee Loss and Plan Expense Loss. Total Fiduciary Loss is the sum of Menu Loss and Total Expense Loss. Investor Loss is the difference between the Post-Fee Optimum and Observed Portfolio returns. Total Loss is the sum of Total Fiduciary Loss and Investor Loss. The estimates for excess fee loss assume competitive fund fees of 21 basis points, corresponding to a portfolio of retail index funds, and the estimates for excess plan expense loss assume competitive plan expenses of 8 basis points

(on next page)

Table 5: Relative Magnitude of Losses by Plan Size

Panel A. Investor and Fiduciary Losses		Panel B. Allocation and Fee Losses			
	Investor Losses Predominate	Fiduciary Losses Predominate	Allocation Losses Predominate	Fee Losses Predominate	
All Plans	76.78%	33.22%	18.60%	82.40%	
Size Quintile					
				Size Quintile	
1	54.63%	45.37%	10.55%	1	89.45%
2	69.76%	40.24%	12.68%	2	88.32%
3	79.07%	20.93%	17.86%	3	65.40%
4	86.35%	13.65%	17.33%	4	61.13%
5	94.09%	6.91%	34.36%	5	65.64%
	N=3,552		N=3,552		

Table 6: Regression of Total Loss on Components of Fiduciary Loss

	(1)	(2)
	Total Loss	Total Loss
Total Fiduciary Loss	0.981*** (66.15)	
Menu Loss		0.877*** (10.23)
Fee Loss		0.962*** (54.18)
Plan-Level Expenses Loss		1.158*** (30.75)
Constant	0.0118*** (90.05)	0.0117*** (89.02)
Observations	3552	3552
R^2	0.552	0.555

t statistics in parentheses
 * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 7: Plan Asset Size and Plan Losses

The regressions in this table investigate the relationship between plan size, plan balances, and loss variables of interest. The loss variables of interest are all measured on a return-equivalent basis. The column headers list the dependent variable for each regression. Average account balance is computed as the total plan assets invested in mutual funds divided by the number of participants with account balances.

	(1) Total Fiduciary Loss	(2) Menu Loss	(3) Plan Cost Loss	(4) Investor Choice Loss	(5) Total Loss
Log(Total Net Assets)	-0.00248 (-34.15)	-0.000178 (-12.00)	-0.00230 (-33.82)	-0.000367 (-4.97)	-0.00285 (-28.55)
Average Account Balance (\$ thousands)	-4.78e-08 (-0.12)	-2.90e-08 (-0.37)	-1.88e-08 (-0.05)	-2.06e-08 (-0.05)	-6.84e-08 (-0.13)
Constant	0.0134 (63.79)	0.00107 (25.10)	0.0123 (62.60)	0.0126 (59.23)	0.0260 (90.33)
Observations	3548	3548	3548	3548	3548
R ²	0.249	0.039	0.245	0.007	0.188

t statistics in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 8: Investor Loss and Menu Quality

Regressions in this table measure the effect of menu design on investor losses with and without size controls. The first measure, 1/N portfolio distance, is the distance in N-space between the equally weighted portfolio and the optimal portfolio. This distance captures the effect of the interaction of menu design and the 1/N heuristic on plan losses. Models 3 and 4 measure the impact of the inclusion of index funds, as a percentage of portfolio options, on investor loss.

	(1)	(2)	(3)	(4)	(5)	(6)
	Investor Choice	Investor Choice	Investor Choice	Investor Choice	Investor Choice	Investor Choice
	Loss	Loss	Loss	Loss	Loss	Loss
Diversification Distance	0.0125 ^{***} (17.47)	0.0121 ^{***} (16.94)				
Percent of Index Funds			-0.00666 ^{***} (-7.05)	-0.00559 ^{***} (-5.87)		
Number of Options	0.000170 ^{***} (16.81)	0.000179 ^{***} (17.69)	0.000165 ^{***} (15.73)	0.000176 ^{***} (16.70)	0.000170 ^{***} (16.20)	0.000182 ^{***} (17.29)
Log(TNA)		-0.000447 ^{***} (-6.48)		-0.000478 ^{***} (-6.62)		-0.000549 ^{***} (-7.69)
Constant	-0.000526 (-0.99)	0.000707 (1.26)	0.00843 ^{***} (31.46)	0.00935 ^{***} (31.10)	0.00776 ^{***} (30.76)	0.00894 ^{***} (30.43)
Observations	3552	3552	3552	3552	3552	3552
R ²	0.143	0.153	0.082	0.093	0.069	0.084

t statistics in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 9: Direct Investment Management Fees and Menu Quality

This table presents regressions of measures of menu quality on the percentage of plan assets paid for investment advisory services. Since the first three models have dependent variables that range from 0 to 1, these models are estimated using a two-limit Tobit model, with upper and lower bounds of 0 and 1, respectively. Models 4 through 6 are estimated using OLS.

	(1)	(2)	(3)	(4)	(5)	(6)
	1/N Portfolio Distance	Percent of Index Funds	Fee Loss	Total Fiduciary Loss	Total Loss	Number of Investment Options
Direct Investment Management Fees	2.129 (1.11)	8.171 ^{***} (5.56)	-0.333 ^{***} (-4.22)	0.661 ^{***} (7.77)	0.985 ^{***} (8.44)	-567.6 ^{***} (-4.27)
Log(Total Net Assets)	-0.00981 ^{***} (-6.03)	0.0125 ^{***} (10.01)	-0.00181 ^{***} (-27.01)	-0.00242 ^{***} (-33.41)	-0.00275 ^{***} (-27.73)	0.957 ^{***} (8.47)
Constant	0.686 ^{***} (144.36)	0.0467 ^{***} (12.80)	0.00976 ^{***} (49.91)	0.0130 ^{***} (61.74)	0.0255 ^{***} (88.02)	20.31 ^{***} (61.53)
Observations	3552	3552	3552	3552	3552	3552
R ²	0.011	0.033	0.171	0.261	0.203	0.027

t statistics in parentheses
^{*} $p < 0.10$, ^{**} $p < 0.05$, ^{***} $p < 0.01$

