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$100 BILLS ON THE SIDEWALK: SUBOPTIMAL INVESTMENT IN 401(K) PLANS

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ABSTRACT

It is typically difficult to determine whether households invest optimally. But sometimes, investment incentives are strong enough to create sharp normative restrictions. We identify employees at seven companies who are eligible to receive employer matching contributions in their 401(k) and can make penalty-free withdrawals for any reason. For these employees, contributing less than the match threshold is a dominated action that violates the no-arbitrage condition. Nevertheless, between 20% and 60% contribute below the threshold, losing as much as 6% of their annual pay. Providing employees with information about the free lunch they are foregoing fails to raise contribution rates.

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Do households make investment mistakes? It is typically difficult to prove that they do, despite widespread concern about household financial literacy (e.g. Campbell, 2006; Bernheim, 1994, 1995, 1998; Lusardi and Mitchell, 2007). The household investment problem is sufficiently complex and economic theory sufficiently rich that few restrictions can be imposed on the range of investment behaviors we should observe in the absence of errors. Nearly any choice can be normatively justified by some combination of preferences and information unobserved by the econometrician.

In this paper, we identify a sizeable group of employees at seven companies whose observable choice set *does* include actions that are precluded by normative economic theory. These individuals are over 59½ years old and have their 401(k) contributions matched by their employer; that is, for every dollar they contribute up to a certain threshold, their employer makes an additional proportional matching contribution. They furthermore have virtually unconstrained access to their 401(k) balances because their company allows employees over 59½ to make penalty-free 401(k) withdrawals for any reason, even while still employed by the company.[1] For these workers, a contribution rate below the match threshold is a dominated strategy that violates the no-arbitrage condition for their portfolios. Nevertheless, we find that many of them are not contributing up to the match threshold.

We calculate the arbitrage losses for these individuals by computing the difference between the payoff to the current (dominated) investment strategy and the payoff to an alternative (undominated) strategy. The alternative strategy is simple: *Increase the flow of before-tax 401(k) contributions up to the match threshold and withdraw these contributions soon after they are made*. The contribution increase triggers instantaneous windfall gains because of the employer match. Relative to the original strategy, the alternative strategy raises the employee's wealth inside the 401(k) plan while leaving her resources *outside* the plan unaffected. This "contribute and withdraw" strategy may *not* be an optimal savings strategy, but it nevertheless dominates the original policy of contributing below the match threshold.

[1] In particular, employees do not have to document financial hardship in order to access their balances. There are two potential penalties associated with making a withdrawal. First, there is a 10% (federal) tax penalty levied on individuals under the age of 59½. Second, some companies prohibit employee contributions for a period of time after a withdrawal, which precludes receipt of matching contributions during that time as well. Neither of these penalties applies to the individuals we identify: their firms do not limit future contributions after withdrawals, and they are over the age of 59½.

The arbitrage losses from not contributing at least to the match threshold can be substantial. Consider a 60-year-old employee who does not currently contribute to her 401(k) plan but whose company would match her contributions dollar-for-dollar up to 6% of her salary. If her annual salary is $52,000, then the incremental value of contributing up to the match threshold is $2,000 × 6% = $120 in match money every two-week pay period. Executing the withdrawal strategy, she would end up with an extra $3,120 in her 401(k) account each year. Alternatively, if the firm allows it, she could also withdraw the $3,120 in employer matching contributions as well and increase her consumption by $3,120 (minus taxes) per year without decreasing her assets relative to her non-contributing strategy.

Despite the large risk-free gains from contributing up to the employer match threshold, we find that, depending on the company, between 20% and 60% of older employees picked a dominated contribution rate—one that is below the match threshold. The arbitrage losses for these individuals are bounded above by the total matching contributions available to them. Averaging across employees with a strictly positive loss, the (firm-level) average loss ranges from 24% to 98% of the employees' maximum possible arbitrage loss. As a percent of salary, this translates into an average annual loss that ranges from 0.66% ($160) at the company with the least generous match to 2.32% ($782) at the company with the most generous match. These averages mask much larger losses in the right tail. For example, in the company with the most generous match, the largest loss was $7,596, in 1998, or 6.0% of the worker's salary.

The fact that so many employees in our sample fail to take full advantage of the employer match is especially surprising because one would expect this population to be aware of the benefits of a 401(k) savings plan. Since the people that we study are at least 59½ years old, the need for retirement savings should be salient to them. Having decades of experience managing their money, they should be more financially savvy than their younger counterparts. And with a (firm-level) average length of employment between 5.9 years and 22.5 years, they have had ample time to familiarize themselves with their 401(k) plans.

We have noted that implementing the "contribute and withdraw" strategy is not necessarily the global optimum for an employee. Therefore, the utility loss associated with these arbitrage losses is a *lower bound* on an employee's total utility losses from imperfect optimization. This lower bound may be well below the total utility losses from non-optimizing behavior. If an employee's portfolio fails to clear the minimal hurdle of no-arbitrage, the

employee may be making other (more subtle) optimization errors in her consumption and investment choices.

To better understand why older employees do not take full advantage of their 401(k) match, we conducted a survey/field experiment with the help of Hewitt Associates, the firm that supplied our 401(k) data. We find evidence that employees who are not fully exploiting the employer match are more prone to delay taking other profitable actions, suggesting that time-inconsistent preferences play a partial role in undermining optimal investment choices. Survey responses also indicate that neither perceived direct transactions costs nor utility satiation explain the failure to contribute to the match threshold. Rather, these individuals appear to be much less financially sophisticated and knowledgeable about their firm's 401(k) plan. Nevertheless, highlighting the foregone match money to a randomly selected treatment group—while explaining that there is no loss of liquidity from contributing up to the match threshold—produced only an infinitesimal response, raising 401(k) contribution rates by only one-tenth of one percentage point relative to the control group. In this instance, providing better information did not lead to better choices.

Our findings are related to other research on unexploited arbitrage. Gross and Souleles (2002) document that some households simultaneously hold high-interest credit card debt and low-interest checking balances.[2] Bergstresser and Poterba (2004) and Barber and Odean (2004) identify unexploited tax arbitrage by households who hold heavily taxed assets in taxable accounts and lightly taxed assets in tax-deferred accounts.[3] Amromin, Huang, and Sialm (2007) argue that some U.S. households who pay their mortgages down more quickly than a 30-year amortization schedule requires would be better off saving the prepayment amounts in a tax-deferred account instead.[4] Warshawsky (1987) highlights the unexploited arbitrage opportunities available to individuals with whole life insurance policies who, due to increases in market

[2] Some authors have argued that such holdings are not no-arbitrage violations because demand deposits and credit cards are not perfect substitutes, differing in transaction utility and treatment under bankruptcy (Bertaut and Haliassos, 2002; Lehnert and Maki, 2002; Haliassos and Reiter, 2007; Zinman, 2007).
[3] Theoretical research has been divided on whether such allocations are in fact suboptimal (Amromin, 2003; Dammon, Spatt, and Zhang, 2004; Garlappi and Huang, 2006).
[4] This strategy is vulnerable to interest rate changes, moving-related prepayment risks, liquidity shocks, and tax law changes.

interest rates subsequent to their policy purchase, could borrow against their policy's cash value at rates below what they could earn by investing in similarly risky outside assets.[5]

Our paper proceeds as follows. Section I describes our data and the procedures we used to select our sample. Section II discusses the methodology we use to calculate arbitrage losses in the 401(k) plan. Section III presents the arbitrage loss calculation results and compares the 401(k) contribution behavior of employees over 59½ years of age with their younger coworkers. Section IV presents the survey/field experiment and discusses potential reasons why individuals are reluctant to contribute up to the match threshold. Section V concludes by discussing the efficacy of educational interventions and monetary incentives for raising the savings rate of low savers.

I. Data Description

Our data come from Hewitt Associates, a large benefits administration and consulting firm. The sample consists of a year-end 1998 cross-section of all employees at seven firms.[6] This cross-section contains demographic information such as birth date, hire date, gender, and compensation. The cross-section also contains point-in-time information on each employee's 401(k) outcomes, including participation status in the plan, date of first participation, the elected contribution rate at the time of the snapshot, and total balances. In addition, the cross-section has annual measures of individual and employer contribution flows into the 401(k) plan.

We selected these seven firms because they offer an employer match and it is possible for employees over the age of 59½ to make 401(k) withdrawals for any reason without penalty (such as an ensuing freeze on future contributions or matches), even while still employed at the company. The companies span many different industries: consumer products, electronics, health care, manufacturing, technology, transportation, and utilities.

Table 1 summarizes the 401(k) plan rules at these seven firms. Employees at all firms can make contributions using before-tax money, and some firms also allow contribution of after-tax money. The maximum gain from the company match in our sample is 6% of annual salary for certain employees at Company A who are matched at a 100% rate for the first 6% of their pay

[5] The extent of such unexploited arbitrage depends on assumptions about the rate of return on other assets, individuals' access to outside investments of similar risk, individuals' marginal tax rates, and the amount of measurement error in the survey data used.

[6] At one of these companies, we were also able to conduct a field experiment. At this company we have additional cross-sectional snapshots for August 1, 2004 and November 1, 2004.

contributed to the 401(k) plan. Company C offers the smallest potential gain of 0.75% of annual salary, as it only matches 25 cents per dollar for the first 3% of pay contributed.

Employees do not have access to their employer match money until it is vested. If an employee is only 80% vested when he leaves the company, he forfeits 20% of the balances accrued in his employer match account. If the employer allows withdrawals from the match account, an employee can only withdraw the vested amount. The fraction of match money vested is typically a function of an employee's tenure at the company. In our sample of firms, Companies C, F, and G use a graded vesting schedule in which the fraction of match balances vested increases gradually with years of service until the employee is 100% vested. In contrast, Companies A, B, and E have cliff vesting schedules in which employees are not vested at all before achieving five years of tenure and are 100% vested thereafter. Employer match contributions at Company D are fully vested immediately. Four of the companies with graded or cliff vesting schedules fully vest employees who reach a certain age even if they would not be fully vested based on their tenure (Companies B, C, E, and G).

Not being vested can eliminate the arbitrage gains from contributing up to the match threshold. If an employee is not vested and knows that she will leave the company before becoming even partially vested, then the employer match is worth nothing to her.[7] On the other hand, the employer match should be fully valued if the currently unvested employee is completely confident that she will stay at the company until she is fully vested. It turns out that the vast majority of our over-59½ sample is *already* fully vested at the beginning of 1998, so vesting is not an issue. Nonetheless, we account for incomplete vesting in our computation of potential arbitrage gains (the methodology for doing so is described in Section II).

The effort and time cost of executing the "contribute and withdraw" strategy could reduce or eliminate potential arbitrage gains. These costs, however, are minimal since all seven firms allow participants to request withdrawals by calling a toll-free number. Four of our companies have 401(k) plan documents that even report check processing times; three of these companies indicate that they issue checks within a week of the request, and the fourth mails checks in two to three weeks. Our survey evidence—reported in Section IV—indicates that employees do not believe transactions in their 401(k) are time-consuming. Furthermore, the financing cost of withdrawing infrequently—e.g. once every three months rather than every pay

[7] These employees may still realize some tax benefit if they participate in the 401(k).

cycle—are small. Even if the cost of capital is calibrated with a typical credit card interest rate (e.g. 15%), an employee with a $50,000 annual salary and a 6% 401(k) contribution rate will pay only $14 per quarter to borrow the funds necessary to finance the savings plan contributions.[8] If the cost of capital is the foregone after-tax earnings in a money market account (5% interest), this costs less than $3 per quarter. Because the "carrying cost" is small, the "contribute and withdraw" policy can be implemented on a quarterly basis without substantial loss of efficiency.[9]

Table 2 reports summary demographic statistics as of year-end 1998 for the 5,045 active employees in our sample who were older than 59½ at the beginning of 1998, eligible to receive matching contributions at the beginning of 1998, and whose 1998 salary exceeded that of a full-time worker earning the federal minimum wage.[10] For the sake of comparison, we also present demographic statistics on the match-eligible population younger than 59½ earning more than the salary cutoff at these firms.

II. Calculating Arbitrage Losses

We calculate arbitrage losses as the difference between the matching contributions individuals actually received in 1998 and the maximum possible match they could have received based on their compensation, the employer matching formula, and the IRS contribution limits. This difference represents the additional 401(k) balances they would have accrued (before capital gains) by following the "contribute and withdraw" strategy. There are two relevant IRS contribution limits. First, IRS section 402(g)(3) sets a maximum dollar limit on an employee's before-tax contributions, which was $10,000 per year in 1998. Second, IRS section 415(b)(1)(A) prohibits employee 401(k) contributions out of annual compensation above a certain amount, which was $160,000 in 1998. (Both thresholds have increased in subsequent years.) In a plan that matches 100% of contributions up to 5% of salary, an employee who earned $200,000 in 1998

[8] This amounts to (Average debt of 6% of 1.5 months of salary) × (monthly salary of $50,000/12) × (interest rate of 15%) × (1/4 of the year) = $14 per quarter.

[9] Small carrying costs also imply that minimum withdrawal amounts and/or maximum withdrawal frequency restrictions have small costs.

[10] The annual salary cutoff we use is $5.15/hour × 35 hours/week × 50 weeks/year = $9,012.50.

could only receive a maximum of $8,000 that year in matching contributions ($160,000 × 0.05). We take both of these restrictions into account when calculating arbitrage losses.[11]

As previously discussed, an employee's valuation of the match may be significantly affected by her vesting status. Because we do not know each unvested employee's subjective probability of leaving the company before becoming vested, we adopt a conservative approach to incorporating vesting into our loss calculations. The loss from not contributing up to the employer match threshold is calculated as the employer match foregone multiplied by the employee's vested percentage *at the time of the contribution*.[12] For example, consider an employee in a firm with a dollar-for-dollar match up to 5% of pay whose vesting percentage increases from 0% to 20% on July 1, 1998. In calculating the 401(k) losses in calendar year 1998, this approach would not include any foregone matching contributions prior to July 1, 1998. After this date, when the employee's vesting percentage increases to 20%, her calculated losses are only 20% of the foregone employer match. So if this employee contributed 2% of her salary every pay period, then her losses for the year as a fraction of her annual salary would be defined as

$$\frac{1}{2}\left(0\% \times \left(5\% - 2\%\right) \times 100\%\right) + \frac{1}{2}\left(20\% \times (5\% - 2\%) \times 100\%\right) = 0.3\% .$$

Note that this calculation will understate expected losses by ignoring all continuation values from receiving the match. In unreported results, we find that calculating *ex post* losses using the employee's actual subsequent employment history at the company yields numbers that are only slightly greater.[13] The reason for this similarity is that almost all sample employees over 59½ years old are fully vested as of January 1, 1998.

Contributions to 401(k) plans are usually made with before-tax dollars. Withdrawals from before-tax 401(k) balances are taxed at the ordinary income tax rate on the entire withdrawal amount. Thus, in our withdrawal strategy, when the incremental contribution up to the match threshold is withdrawn, its entire amount is taxed as ordinary income. However, if the employee continued to contribute less than the match threshold, the incremental contribution amount would

[11] Because the match threshold for employees in our sample does not exceed 6%, the $10,000 contribution limit does not in practice constrain any employees from receiving the full employer match available under their plan rules once the $160,000 compensation limit is accounted for.

[12] Because we only observe an employee's total contributions for a calendar year, we assume that the contribution rate was constant throughout that year.

[13] We use cross-sectional data from future years at these companies for these alternative calculations.

have been immediately taxed as ordinary income anyway. Therefore, the withdrawal strategy does not affect the employee's current tax liability if both contributions and withdrawals are made to and from the before-tax 401(k) account.

In some of our companies, employees have the option to contribute using after-tax dollars. At Companies A, D, and F, after-tax 401(k) balances must be depleted first when withdrawing money from the plan.[14] Withdrawals from after-tax balances are taxed only on accumulated capital gains. Therefore, if one has after-tax balances, the ability to shift withdrawals from those balances into years when one's marginal tax rate is high is a potentially valuable option.[15] Executing our withdrawal strategy eliminates the option to delay after-tax withdrawals at Companies A, D, and F.

Only 17% of employees older than 59½ who contribute less than the match threshold at these three firms have after-tax account balances. In order to avoid having to calculate the loss caused by early withdrawals from the after-tax account, we simply do not attribute arbitrage losses to anybody at these three firms who had a positive balance in her after-tax account at year-end 1998, regardless of her 401(k) contribution rate. This conservative assumption leads us to understate the fraction of employees who are foregoing a free lunch.

Finally, to allow for the possibility of rounding error, we do not classify an employee as failing to fully exploit the employer match if the gap between the actual and possible match received is less than 0.1% of annual income.

III. Frequency and Magnitude of Arbitrage Losses

Table 3 reports the frequency and magnitude of unexploited 401(k) arbitrage in 1998. Between 20% and 60% (a median of 31%) of match-eligible employees over 59½ at our seven firms did not receive the full employer match despite being at least partially vested and having no after-tax balances. The most an individual can lose due to unexploited arbitrage is the total matching contribution available to them that immediately vests. At Company C, which offers the smallest match, this upper bound is 0.75% of salary. At the other extreme, Company A offers a match as large as 6% of salary for some of its employees. Among those with arbitrage losses, the

[14] Company D no longer allowed after-tax contributions at year-end 1998, so any after-tax balances present are legacies of a prior plan regime.

[15] As an extreme example, suppose that the tax rate on 401(k) withdrawals next year jumped to 100%. Then before-tax 401(k) balances cannot fund consumption in that year, whereas after-tax balances could still be used.

average loss as a fraction of the maximum potential loss ranges from 24% to 98%, with a median of 72%. Conditional on having a loss, the average loss was 0.66% of salary ($160) at Company C, and 2.32% of salary ($782) at Company A. The proportion lost relative to the maximum possible loss is driven largely by the fraction of employees who contributed nothing at all. Companies D and G are notable for having a relatively small number of non-participants; at the other five companies, at least half of those with arbitrage losses gave up the entire match.

The bottom half of Table 3 shows the distribution of arbitrage losses among those whom we classify as having an arbitrage loss. In companies with a generous match, the losses at the right tail of the distribution are considerable. For example, the 75th percentile arbitrage losses at Companies A, E, and G are around $1,000 and at least 3% of salary. At the 90th percentile, arbitrage losses at Company D and F also exceeded $1,000, or 4.5% and 2.1% of salary, respectively. The maximum dollar arbitrage loss ranges from $947 (2% of salary) at Company B to $7,596 (6% of salary) at Company A.

Three of the seven firms in our sample (Companies A, D, and F) invest the match in employer stock and restrict diversification for those over age 59½. Since a match in employer stock is worth less than a match that can be diversified, our calculations for these four companies may overstate the money metric utility loss from unexploited arbitrage.[16] However, it is not clear how to quantify this bias. First, employees do not seem to regard diversification restrictions as particularly onerous. Benartzi (2001) documents that among companies that match in employer stock, participants voluntarily hold an average of 29% of their *own* contributions in employer stock as well. Benartzi et al. (2004) report that 20% of their survey respondents would paradoxically prefer $1,000 of employer stock which they could not diversify until age 50 to $1,000 invested without restrictions. Second, the diversification restrictions only partially affect the over-59½ employees at these three firms. Company A allows complete diversification after a two-year holding period or five years of plan participation; Company D allows complete diversification after a two-year holding period; and Company F allows salaried employees to diversify half of the match after age 55 or five years of service at the company. All of the employees in our sample are at least 59½ years old, and their average tenure in these three firms ranges from 16.0 years to 22.2 years.

[16] Several papers calculate discounts for portfolios that are partially invested in employer stock (Poterba, 2003; Meulbroek, 2002; and Brennan and Torous, 1999).

Even after accounting for any discount employees might place on a match in employer stock, Table 3 is likely to grossly understate the cumulative magnitude of arbitrage losses over time because the losses in Table 3 are calculated over a period of only one year. Most of those with arbitrage losses in our sample have had several years of tenure with their firm since age 59½. Thus, they have been forfeiting matching contributions for many years, leading to much larger cumulative losses. For example, among those who contributed nothing to their 401(k) plan in 1998, between 27% and 71% have *never* contributed to the plan.[17] We do not attempt an exact calculation of these cumulative amounts because doing so would require information on 401(k) eligibility, the 401(k) match, employee compensation, and employee contribution rates for many years before 1998, which we do not have. But a simple extrapolation from Table 3 suggests that substantial cumulative losses are probable for many of these individuals.

Table 4 displays similar calculations using a much simpler loss definition than that in Table 3. In Table 4, we include the full amount of *any* matching contribution foregone, without regard to the employee's age, vesting status, or the impact of capital gains taxes on after-tax account withdrawals.[18] Note that the arbitrage losses in Table 3 are a strict subset of the matches foregone in Table 4.

We present Table 4 for two reasons. First, we would like to compare the behavior of employees older than 59½ to that of employees younger than 59½. However, the "contribute and withdraw" strategy is largely infeasible for employees younger than 59½ because they must demonstrate financial hardship in order to withdraw money from their 401(k).[19] Thus, the arbitrage losses calculated in Table 3 for employees older than 59½ do not extend in a straightforward way to younger workers. We can, however, simply compare the total matching contributions foregone by older and younger employees. Second, other 401(k) datasets may not contain all of the information needed to calculate arbitrage losses as we have here. The simpler

[17] We calculate these numbers by dividing the fraction of those with arbitrage losses who have never enrolled in the 401(k) by the fraction of those with arbitrage losses who contributed nothing in 1998.

[18] To allow for rounding error, we continue not to classify as losers those who lost less than 0.1% of annual salary in matching contributions.

[19] Firms are not required to allow employees to make hardship withdrawals, although many do so. Withdrawals are subject to a 10% tax penalty for employees younger than 59½. There are some circumstances under which younger employees can avoid the penalty. These include permanent disability, a court order pursuant to a divorce, medical expenditures in excess of 7.5% of income, and some cases of early retirement or permanent layoff. Home purchases, educational expenses, or general financial hardship do not exempt employees from the tax penalty on early withdrawals.

measure in Table 4 allows for easier comparability of this paper's results with tabulations from other data sources.

The top half of Table 4 presents statistics on employees older than 59½. Between 20% and 72% of employees over 59½ contribute below the match threshold. Note that at most of our companies, these fractions are not that much higher than the fractions with arbitrage losses in Table 3. This is because most older employees not contributing up to the match threshold are able to unambiguously profit from the "contribute and withdraw" strategy: they are almost all vested in the employer match, and only a small minority have after-tax balances. The average employer match foregone in Table 4 among older employees is thus similar to the average arbitrage loss in Table 3.

The bottom half of Table 4 presents statistics on match-eligible employees younger than 59½. Interestingly, the fraction of employees contributing below the match threshold is generally similar among younger and older employees; this proportion differs by no more than 11 percentage points across the age divide with the exception of Company G. There is, however, one notable difference between those older and younger than 59½: employees younger than 59½ under the match threshold are more likely to be contributing something to the 401(k), whereas older employees under the match threshold are more prone to contribute nothing at all. There is no systematic tendency for younger employees under the threshold to forego more match dollars as a percent of their salary than older employees under the threshold. However, the absolute dollar amounts forfeited by younger employees under the threshold are usually higher.

In Figure 1, we pool all of the match-eligible employees in our seven companies and plot, by age, the fraction of employees over the age of 59½ with arbitrage losses, as well as the fraction of employees who contribute below the match threshold. Consistent with the results in Tables 3 and 4, these two series are similar for employees above age 59½. Over the entire working life, the likelihood of contributing below the match threshold is U-shaped, declining with age until the mid-50s and increasing thereafter. One might have expected a discrete drop in the likelihood of contributing below the match threshold at age 59½, when the 401(k) essentially becomes a liquid asset. It is thus surprising that the failure to exploit the match begins to increase at precisely the age when the economic reasons for 401(k) participation become most

compelling.[20] This may arise from a selection effect generated by low savers who are less able to afford to retire and thus remain in the labor force longer. Alternatively, this phenomenon may reflect consumption smoothing by older employees whose wages are falling and who are unaware of the 401(k) withdrawal privileges available only to older workers. (Table 2 shows that the older employees at our firms usually have a lower median wage than their younger counterparts). We discuss other potential explanations for older workers' failure to exploit the 401(k) match in Section IV.

To explore the characteristics associated with the failure to fully exploit the employer match, we present in Table 5 the results of probit regressions for the likelihood that employees are leaving matching contributions on the table. We pool the match-eligible employees in our seven firms and include firm fixed effects in these regressions. The sample in the first four columns is match-eligible employees older than 59½. The dependent variable in the first two columns is a binary indicator for having arbitrage losses in 1998, whereas in the third and fourth columns, the dependent variable is a binary indicator for simply contributing below the match threshold. In the final two columns, the sample is match-eligible employees under 59½, and the dependent variable is a binary indicator for contributing below the match threshold. Both the probit coefficients and marginal effects (slopes) at the sample means are reported.

The qualitative effects of most of the variables are similar across all these regressions. Those with higher pay are substantially less likely to leave matching contributions on the table. Men are 6 to 13 percentage points more likely to forego matching contributions than women, while those who are married are 5 to 8 percentage points less likely to forego matching contributions than singles. The two variables with qualitatively different results across the three regression specifications in Table 5 are age and tenure. Among employees younger than 59 ½, age is negatively related to leaving match money on the table, while the reverse is true for employees older than 59½, a pattern consistent with Figure 1. Finally, employees over 59½ with higher tenure are more likely to have arbitrage losses (first two columns), but are less likely to contribute under the match threshold (middle two columns). This apparent anomaly is explained by the fact that individuals with very low tenure tend to be completely unvested and are thus not classified as having arbitrage losses.

[20] This upward turn at age 59 also appears if we instead calculate the fraction under the match threshold separately by company, and then compute an average that equally weights each company. The result is therefore not driven by certain companies having a disproportionate number of employees at certain ages.

IV. Survey/Field Experiment

Given the low direct costs of initiating 401(k) participation, it is surprising that such a high fraction of employees forfeit employer matching contributions, especially among workers over age 59½.

To gain further insight into why employees are contributing suboptimally to their 401(k), and to see if providing information about the employer match would increase 401(k) contributions, we conducted a field experiment at Company A in partnership with Hewitt Associates. On August 3 and 4, 2004, we mailed treatment and control surveys to 889 Company A employees over the age of 59½.[21] All surveys were accompanied by a cover letter printed on the employer's letterhead. The 889-person sample includes all 689 employees at Company A who were contributing less than the match threshold as of May 2004, as well as 200 randomly selected employees contributing at or above the match threshold.

We randomly (and unevenly) divided our sample of 889 employees into two subgroups: a control group and a treatment group. We sent control surveys to approximately half of the employees contributing below the match threshold (344 selected at random from the population of 689) and to the 200 randomly selected employees contributing at or above the match threshold. This control survey included questions about the employee's satisfaction with and knowledge about the 401(k) plan, general financial literacy, and savings preferences.

We sent treatment surveys to the other 345 employees contributing below the match threshold. The treatment survey (reproduced in Appendix A) was identical to the control survey, except that it included an additional five questions at the end (Questions 26 through 30). Question 26 explains that the company matched the first 6% of salary contributed to the 401(k). Question 27 explains that transactions in the 401(k) could be made via the Internet, a touch-tone phone system, or by speaking to a benefits center representative on the phone. Question 28 explains that penalty-free withdrawals from the 401(k) are available for any reason for participants over age 59½. Question 29 asks respondents to calculate the amount of employer match money they would lose each year if they did not contribute to the 401(k). Respondents received a matrix of match amounts corresponding to various match rates and salaries to aid in

[21] We also mailed surveys to 4,000 employees below the age of 59½. Results from those respondents are available on request.

this calculation (see Appendix A). Question 30 asks if the employee is interested in raising his contribution rate to 6% in light of the losses calculated in question 29. We estimate that it would take employees about 15 minutes to complete the control survey and 20 minutes to complete the treatment survey.

For 200 employees in each of the three groups (below the match threshold control group, above the match threshold control group, below the match threshold treatment group), we included a $1 bill with the survey and promised to send them a $50 American Express Gift Cheque if they responded no later than August 27, 2004 in an enclosed postage-paid envelope. Appendix B shows the cover letter that accompanied the survey.

Respondents from the remaining 289 people below the match threshold who received the survey were entered into a raffle, along with all respondents younger than 59½, for a personal digital assistant, an MP3 player, and a digital camera.[22] Gift Cheques were sent and raffle prizes awarded on September 17, 2004.

A total of 232 employees over the age of 59½ responded—128 contributing below the match threshold and 104 contributing at or above the match threshold—resulting in an overall response rate of 26%.[23] Interestingly, the response rate among employees contributing at or above the match threshold was much higher (52%) than among employees below the threshold (19%), even though the former group's median income is higher than the latter's. Apparently, the difference in employees' willingness/ability to collect cheap money in 401(k) accounts extends to other domains.

We first examine whether perceived transactions costs keep employees from exploiting the employer match. Responses to Question 3 of the survey indicate that in general, respondents believe that joining the 401(k) plan and conducting 401(k) transactions generates only modest time costs. The average respondent who was not participating in the 401(k) plan believed that it would take 1.7 hours to join the plan, 1.3 hours to change his plan contribution rate for the first time, and 1.5 hours to change his plan asset allocation for the first time. The average respondent who is actually in the 401(k) plan reported even lower averages of 1.4, 0.6, and 0.6 hours,

[22] Budget constraints precluded us from offering a $50 Gift Cheque to all respondents. Assignment to the Gift Cheque and raffle groups was random, and comparing the characteristics (age, compensation, tenure, participation in the 401(k) plan) of employees who received these different response incentives suggests that the two groups are indeed very similar. There were three raffle winners, one for each of the prizes.

[23] For employees older than 59½ and contributing below the match threshold, the response rate was 24% among those receiving the $50 American Express Gift Cheque and 11% among those entered into the raffle.

respectively, for these three actions. Consistent with these responses, among the employees who claimed in question 23 that they did not ever plan on enrolling in the 401(k), none cited in question 25 the time it takes to enroll as a reason for non-participation. Therefore, the perceived time costs of conducting transactions in the 401(k) are not large enough to justify the sizeable amounts of money employees below the match threshold forego. Our survey does not measure the indirect transactions costs of 401(k) participation, such as the costs of figuring out one's optimal 401(k) contribution rate and asset allocation. The evidence on financial literacy discussed below indicates that these may be substantial.

We now consider whether those who were not contributing up to the match threshold felt little need to save more for retirement. Is their current wealth high enough that there is little value to further increasing consumption during retirement? This possibility is rejected by the data. Consistent with other survey evidence on the relationship between actual and perceived-to-be-optimal savings rates (e.g., Choi, Laibson, Madrian, and Metrick, 2002; Bernheim, 1995; Farkas and Johnson, 1997), 86% of employees below the match threshold and 70% of employees at or above the match threshold do not think they are saving enough, according to Question 16. Those under the threshold report in Question 15 an average actual savings rate of 7.4% but believe they should be saving 17.1%. The corresponding averages for those at or above the threshold are 15.3% and 20.0%, respectively.[24] Remarkably, among respondents who think they should be saving more, only 33% of those below the threshold and 22% of those at or above the threshold report being unable to do so in Question 16; the remainder claim they could afford to save at least $520 more per year ($10 per week).

Having ruled out several mechanisms that might explain why so many employees fail to fully exploit their employer match, what does matter? We find striking differences in financial literacy between those contributing under the match threshold and those contributing at or above the match threshold. For example, only 8% of those under the match threshold report themselves to be a very or relatively knowledgeable investor, compared to 20% of those at or above the match threshold. This self-perceived lack of financial expertise is borne out in the answers to more objective questions on financial literacy. For example, in their response to Question 20, 53% of employees below the match threshold incorrectly believe their own employer's stock to

[24] Despite these stated convictions about optimal savings rates, only 30% of those under the threshold and 47% of those at or above the threshold were able to give an answer in Question 18 about how much wealth they would need to live comfortably in retirement.

be less risky than a large U.S. stock mutual fund. Only 26% of employees at or above the threshold share this erroneous belief.[25] Employees below the threshold are less knowledgeable about their 401(k) plan features. In Question 4, only 21% were able to correctly state their employer match rate, and only 27% were able to correctly state the match threshold. In contrast, employees at or above the threshold were able to correctly state these figures 41% and 59% of the time, respectively.

Our survey responses also suggest that procrastination[26] plays some role in keeping people from raising their contribution rate to the match threshold. Recall that a much higher proportion of employees at or above the threshold (52%) than employees below the threshold (19%) collected $50 for completing our 15-minute survey, even though the former group's median income is higher than the latter's. In addition, the average respondent contributing at least up to the match threshold took 15.1 days to mail the survey back to us, while the average respondent below the threshold took 17.2 days. Finally, in Question 10, we find that fewer respondents at or above the match threshold (11%) than respondents under the threshold (16%) report themselves to often or almost always leave things to the last minute. These gaps are likely to understate the true difference in procrastination between the two groups, since the sample is right-truncated; the inveterate delayers never returned the survey, and non-respondents have saving rates that are disproportionately below the match threshold.

The key purpose of the survey was to see by how much those contributing less than the match threshold would increase their 401(k) contributions if the benefits of the employer match and the penalty-free discretionary withdrawal rules were explained to them. Recall that we implemented a treatment condition that added Questions 26 through 30 to the baseline survey. The median respondent to Question 29 calculated that she would lose $1,200 each year by not contributing up to the match threshold.[27]

[25] See John Hancock Financial Services (2002) and Benartzi et al. (2004) for the results from other surveys asking similar questions.

[26] Laibson (1997), O'Donoghue and Rabin (1999), and Carroll et al. (2007) analyze models in which time-inconsistent preferences lead people to undersave and procrastinate.

[27] This is larger than the median arbitrage loss of $747 and average total foregone employer match of $768 reported in Tables 3 and 4 for Company A. However, the $1,200 median response to Question 29 was calculated relative to not participating at all in the 401(k) plan. A comparable calculation using data from 1998 on individuals contributing below the match threshold or not at all gives a median loss of $991. The remainder of the discrepancy is likely accounted for by increases in salaries between 1998 and 2004.

Table 6 presents the average 401(k) contribution rates on August 1, 2004 (immediately prior to the survey mailing) and November 1, 2004 (approximately two months after the response deadline) for employees who were under the match threshold in May 2004 (when the survey mailing list was finalized).[28] The average contribution rates of the control group and the treatment group increase over this period, but by a very small amount (0.08% of pay for the control group and 0.16% of pay for the treatment group).[29] The average difference in the contribution rate changes between the two groups was only 0.08% of pay and statistically insignificant. Using receipt of the treatment survey as an instrument for reading and returning the treatment survey, we estimate the treatment effect to be a 0.53 percentage point increase in the contribution rate (*t*-statistic 0.87). Consistent with other financial education research that tracks participant behavior in administrative data (Madrian and Shea, 2005; Choi, Laibson, Madrian, and Metrick, 2002; Duflo and Saez, 2003), it appears that giving workers information does not meaningfully raise their 401(k) contribution rates, even when the recommended action exploits a free lunch. We note, however, that our results are for a selected sample. Individuals older than 59½ who are not contributing up to their 401(k) match threshold may be particularly insensitive to financial education. Other groups may be more responsive.

V. Conclusion

Despite the presence of employer matching contributions in 401(k) plans, a substantial fraction of employees fails to contribute up to their employer's match threshold. For many employees, it is possible to rationalize their willingness to leave employer 401(k) matching contributions on the table by appealing to factors such as liquidity constraints, early withdrawal penalties, and incomplete vesting of the match. In this paper, we examine the 401(k) contribution choices of a group of employees for whom these explanations do not apply. These employees are older than 59½, receive employer matching contributions, are largely fully vested, and can withdraw their 401(k) balances at any time without penalty. For these employees, contributing below the match threshold violates the no-arbitrage condition for their portfolio. Nevertheless, across a sample of seven firms, between 20% and 60% of the employees do so. The average

[28] There are fewer than 689 employees in the table because some employees left the company before November 1, 2004.

[29] Seven members of the control group increased their contribution rate, while 8 members of the treatment did. One control and no treatment group members decreased their contribution rate over this same period.

arbitrage loss in 1998, conditional on having a positive arbitrage loss, ranges from $160 to $782 at the seven firms in our sample, or between 0.66% and 2.32% of annual pay. The arbitrage losses over a longer time horizon are likely much larger. The widespread failure to exploit arbitrage opportunities in this context suggests that there may be additional utility losses from imperfect optimization in other aspects of the employees' investing and saving problems.

We examine several possible explanations for the failure of those over the age of 59½ to optimally exploit the employer match. Based on survey evidence, we rule out direct transactions costs and satiation. We find evidence that employees who fail to exploit the employer match are less financially literate than those at or above the match threshold, which may indicate substantial indirect transactions costs (i.e., decision-making costs) associated with 401(k) participation. We also find evidence for procrastination.

Many financial education interventions are intended to increase savings rates by describing the benefits of saving. Consistent with previous evidence, our survey finds that most employees already believe that they should be saving more than they currently are. However, even though employees think they should save more, our effort to facilitate such savings had no effect. This is intriguing because we described a highly profitable savings strategy that generates no liquidity costs, whereas most educational interventions promote savings strategies that are not as easy or costless to pursue. Some employees apparently need more than just good advice. However, the group we study may be a particularly intractable population.

Our results are also cause for pessimism about the ability of monetary incentives alone to increase savings in the left tail of the savings distribution. Despite offering costly matching programs with strong marginal financial incentives, the firms studied here were unable to induce many of their older employees to contribute up to the match threshold. Although matching alone does not appear sufficient to increase savings in the left tail, it may be more effective when combined with other interventions that account for employee passivity (Madrian and Shea, 2001; Benartzi and Thaler, 2004; Choi, Laibson, Madrian, and Metrick, 2002, 2004; Carroll et al., 2007) or that sharply reduce the complexity of the savings and investment decision (Choi, Laibson, and Madrian, 2005; Beshears et al., 2006; Duflo, et al., 2005; Mitchell, Utkus, and Yang, 2005).

Finally, the results in this paper speak more generally to the role of the no-arbitrage condition in economic equilibria. Among the population studied in this paper, *unexploited*

arbitrage opportunities are commonly observed, despite the fact that the potential gains are large and the necessary strategy to capitalize on these gains is simple and widely socially encouraged. Our evidence suggests that in non-competitive domains like retirement saving where the failure to maximize cannot be exploited by others, arbitrage opportunities may persist in equilibrium.

Appendix A: Treatment Survey

1. What percentage of your pay are you currently contributing to your 401(k)? If you aren't contributing, write "0" in the blank. Don't count employer contributions to your plan.
   (a) Before-tax contributions: _____% of pay ☐ I don't know
   (b) After-tax contributions: _____% of pay ☐ I don't know

2. For each statement, please check the box that best represents your views.

	Strongly Agree	Somewhat Agree	Neither Agree nor Disagree	Somewhat Disagree	Strongly Disagree
(a) I have enough information about the rules of my 401(k)					
(b) I have a good under-standing of the investment choices my 401(k) offers					
(c) I'm satisfied with the investment choices my 401(k) offers					
(d) My 401(k) meets my retirement needs					
(e) I'd rather save for retirement in my 401(k) than outside my 401(k)					
(f) My company's 401(k) plan is better than other companies' 401(k) plans					

3. We want to know how long it took you to do certain things in the 401(k) for the first time. If you haven't done these things, we want to know how long you *think* they would take you. Check the appropriate box and fill in the blanks for each of parts (a) through (c).

   (a) It ☐ **would take me/** ☐ **actually took me** about ____ hours and ____ minutes to join my 401(k) plan.

   (b) It ☐ **would take me/** ☐ **actually took me** about ____ hours and ____ minutes to change my contribution rate for the first time after joining the 401(k) plan.

   (c) It ☐ **would take me/** ☐ **actually took me** about ____ hours and ____ minutes to change the funds I'm invested in for the first time after joining the 401(k) plan

We want to find out how well your company has communicated its 401(k) plan features to you. Please answer the questions <u>without</u> looking at your 401(k) plan documents.

4. Please fill in the following blanks, or indicate that you don't know the answer.

   For every before-tax dollar I contribute to the 401(k) up to _____% of my salary, my employer makes a matching contribution to the plan of _____ cents.

   ☐ I don't know how much my employer matches my contributions

5. Does your company's 401(k) plan offer the following investment options?

(a) US stock market fund	☐ Yes	☐ No	☐ I don't know
(b) Stable value fund	☐ Yes	☐ No	☐ I don't know
(c) Bond fund	☐ Yes	☐ No	☐ I don't know
(d) Commodities fund	☐ Yes	☐ No	☐ I don't know
(e) International stock fund	☐ Yes	☐ No	☐ I don't know
(f) Your employer's stock	☐ Yes	☐ No	☐ I don't know
(g) Real estate investment trust	☐ Yes	☐ No	☐ I don't know

6. Which of the following statements best describes your beliefs about the withdrawal rules that currently apply to you in your 401(k)? (*Please check only one box.*)
   ☐ If I have money in my 401(k), I can't withdraw it
   ☐ If I have money in my 401(k), I can withdraw it, but I will pay taxes plus a penalty on the withdrawal
   ☐ If I have money in my 401(k), I can withdraw it without any penalty, but I will pay taxes on the withdrawal
   ☐ I don't know

7. Which of the following statements best describes your beliefs about the loan rules that currently apply to you in your 401(k)? (*Please check only one box.*)
   - ☐ If I have money in my 401(k), I can't take out any loans from it
   - ☐ If I have money in my 401(k), I can have a limited number of loans from it at one time
   - ☐ If I have money in my 401(k), I can take out as many loans as I want from it at a time
   - ☐ I don't know

8. How knowledgeable an investor would you consider yourself? (*Please check only one box.*)
   - ☐ Very knowledgeable
   - ☐ Relatively knowledgeable
   - ☐ Somewhat knowledgeable
   - ☐ Less than knowledgeable
   - ☐ Not at all knowledgeable

9. Which of the following statements best describes how often you think about your retirement savings? (*Please check only one box.*)
   - ☐ I think about my retirement savings a great deal
   - ☐ I think about my retirement savings sometimes
   - ☐ I rarely think about my retirement savings
   - ☐ I never think about my retirement savings

10. Which of the following statements best describes you? (*Please check only one box.*)
    - ☐ I never leave things to the last minute
    - ☐ I rarely leave things to the last minute
    - ☐ I sometimes leave things to the last minute
    - ☐ I often leave things to the last minute
    - ☐ I almost always leave things to the last minute

11. Which of the following best describes your level of education? (*Please check only one box.*)
    - ☐ Some high school
    - ☐ High school degree
    - ☐ Some college
    - ☐ College degree
    - ☐ Some graduate school
    - ☐ Graduate school degree

12. What is your marital status?
(*Please check only one box.*)

- ☐ Single
- ☐ Married
- ☐ Separated
- ☐ Divorced

13. Imagine that you just won a $500 prize in a raffle. What would you do with your winnings? (*Please check only one box.*)

- ☐ I would save the entire prize.
- ☐ I would use the entire prize to pay down my debts.
- ☐ I would spend the entire prize.
- ☐ I would save _____%, pay down debts with _____%, and spend _____%.
  (These percentages should add up to 100%)

14. Suppose that you decided to save an *extra* $1,000 of your annual income, and you had a financial planner who would help you do this. Where would you instruct your planner to make this investment? The dollar amounts below should sum to $1,000. (*Please check all boxes that apply and fill in amounts to the right.*)

- ☐ The checking account at my bank or other financial institution $ _____
- ☐ The savings account at my bank or other financial institution $ _____
- ☐ An Individual Retirement Account (IRA) $ _____
- ☐ My employer's 401(k) plan $ _____
- ☐ A college savings account (for example, 529 plan) $ _____
- ☐ A brokerage account $ _____
- ☐ A stock mutual fund outside a 401(k) plan $ _____
- ☐ A bond mutual fund outside a 401(k) plan $ _____
- ☐ Other (please indicate) _____ $ _____

15. (a) What percent of your household income do you think you should *ideally* be saving for retirement right now? If you don't know, answer with your best guess.

_____% of my household income

(b) What percent of your household income are you *actually* saving for retirement right now?

_____% of my household income

16. If you think you are already saving enough for retirement, check here. ☐

If not, how much more do you think you could commit to saving than you currently are?
(*Please check only one box.*)

- ☐ I can't afford to save any more
- ☐ $10 per week
- ☐ $20 per week
- ☐ $40 per week
- ☐ $50 or more per week

17. Suppose you decided to cut your spending by $2 a day in order to save more for retirement. (This comes out to saving $730 more per year.) Where would you cut your spending the most?

- ☐ Food
- ☐ Clothing
- ☐ Entertainment
- ☐ Alcohol/cigarettes
- ☐ Other (please indicate) _____

18. About how much would your household need to have saved by the time you retire in order to live comfortably in retirement?

I/we would need to save $_____ ☐ I don't know

19. After you retire, do you expect your household's monthly spending to be lower than, about the same as, or higher than your monthly spending right before you retire?
(*Please check only one box.*)

- ☐ Lower
- ☐ About the same
- ☐ Higher

20. Rate each of the following investments' riskiness on a scale of 1 to 5.
1 indicates "no risk" and 5 indicates "very high risk."

	No risk				Very high risk	
(a) A large US stock mutual fund	1	2	3	4	5	☐ Don't know
(b) Your employer's stock	1	2	3	4	5	☐ Don't know
(c) A savings account at your bank	1	2	3	4	5	☐ Don't know
(d) Bonds	1	2	3	4	5	☐ Don't know
(e) Stable value/money market fund	1	2	3	4	5	☐ Don't know
(f) Stock of a typical *Fortune* 500 company	1	2	3	4	5	☐ Don't know
(g) An international stock mutual fund	1	2	3	4	5	☐ Don't know
(h) An emerging markets stock mutual fund	1	2	3	4	5	☐ Don't know

SKIP THIS PAGE IF YOU'RE NOT CONTRIBUTING TO YOUR COMPANY 401(k) PLAN RIGHT NOW.

21. For each of questions (a) through (d), please check the box that best describes your plans.
In the next two months:

(a) I plan to ☐ ***raise*** / ☐ ***lower*** / ☐ ***maintain*** my 401(k) contribution rate
(b) I ☐ ***plan*** / ☐ ***do not plan*** to make a withdrawal from my 401(k) plan
(c) I ☐ ***plan*** / ☐ ***do not plan*** to take a loan out of my 401(k) plan
(d) I ☐ ***plan*** / ☐ ***do not plan*** to change the mix of funds in which I am invested

22. If you're *not* planning on making any of the changes in question 21, check here. ☐

If you *are* planning on making some changes, when are you planning on making them?
(*Please check only one box.*)
☐ In the next few days
☐ In the next week
☐ In the next two weeks
☐ In the next month
☐ In the next two months

SKIP THIS PAGE IF YOU ARE CONTRIBUTING TO YOUR COMPANY 401(k) PLAN RIGHT NOW.

23. When do you plan to begin contributing to your company's 401(k) plan?
(*Please check only one box.*)
☐ In the next few days
☐ In the next week
☐ In the next two weeks
☐ In the next month
☐ In the next two months
☐ In the next _____ (more than two months)
☐ I do not plan on ever contributing to the 401(k) plan

24. If you're *not* planning on ever contributing to the 401(k) plan, check here. ☐

If you *are* planning on contributing some day, what percent of your salary do you expect to contribute when you start?
_____% of my salary

25. If you *are* planning on contributing to the 401(k) plan some day, check here. ☐

If you're *not* planning on ever contributing to the 401(k) plan, what are the main reasons?
(*Please check all boxes that apply.*)
☐ I don't want to save right now
☐ I can't afford to save right now
☐ I'd rather save in accounts outside of the 401(k)
☐ I don't have enough information to know how much to save
☐ I don't understand my company's 401(k) plan
☐ It takes too long to sign up for my company's 401(k) plan
☐ There's always a chance I might be changing jobs or retiring soon
☐ My company 401(k) match isn't high enough
☐ I'm worried about the state of the stock market/financial markets
☐ I'm worried about corporate scandals and accountability
☐ Other. Please specify

_____

In this section, you will be told some facts about your 401(k) plan.

26. Your company offers its employees a matching contribution on the first 6% of salary contributed to their before-tax 401(k) account. When did you become aware of this fact?
(*Please check only one box.*)
☐ I just became aware of this fact
☐ I may have known this fact before, but I'm not sure
☐ I definitely knew this fact before

27. Your company lets you make transactions in your 401(k) by using the Internet. You can also call a toll-free number, where you can use an automated touch-tone system or speak to a benefits center representative. When did you become aware of these facts?
(*Please check only one box.*)
☐ I just became aware of at least one of these facts
☐ I may have known these facts before, but I'm not sure
☐ I definitely knew these facts before

28. If you ever need the money in your 401(k) for any reason, you can withdraw it without penalty once you're over 59½ years old. You'll pay ordinary income tax on any money withdrawn that hasn't already been taxed. When did you become aware that penalty-free withdrawals are available?
(*Please check only one box.*)
☐ I just became aware of these facts
☐ I may have known these facts before, but I'm not sure
☐ I definitely knew these facts before

29. Suppose you're contributing $0 to your before-tax 401(k) account. How much employer match money would you lose *each year* from not contributing 6% of your salary?
(*Use the table below to get an approximate answer. If you aren't sure what your employer match rate is, use your best guess.*)

Example: If your salary is $30,000 and your match rate is 50%, then your annual loss is $900.

I would lose $_____ in matching contributions every year from contributing 0% instead of 6% of my salary to my before-tax 401(k) account.

Annual employer match lost from not contributing										
Annual	**Employer match rate**									
Salary	0%	16.7%	25%	30%	40%	50%	60%	65%	75%	100%
$10,000	$0	$100	$150	$180	$240	$300	$360	$390	$450	$600
$20,000	$0	$200	$300	$360	$480	$600	$720	$780	$900	$1,200
$30,000	$0	$301	$450	$540	$720	$900	$1,080	$1,170	$1,350	$1,800
$40,000	$0	$401	$600	$720	$960	$1,200	$1,440	$1,560	$1,800	$2,400
$50,000	$0	$501	$750	$900	$1,200	$1,500	$1,800	$1,950	$2,250	$3,000
$60,000	$0	$601	$900	$1,080	$1,440	$1,800	$2,160	$2,340	$2,700	$3,600
$70,000	$0	$701	$1,050	$1,260	$1,680	$2,100	$2,520	$2,730	$3,150	$4,200
$80,000	$0	$802	$1,200	$1,440	$1,920	$2,400	$2,880	$3,120	$3,600	$4,800
$90,000	$0	$902	$1,350	$1,620	$2,160	$2,700	$3,240	$3,510	$4,050	$5,400
$100,000	$0	$1,002	$1,500	$1,800	$2,400	$3,000	$3,600	$3,900	$4,500	$6,000

30. Does your answer to the previous question make you interested in raising your contribution rate to 6% so you won't lose any more employer match money?
- ☐ Yes. I plan to do so in the next _____ weeks.
- ☐ No, I'm already contributing 6% or more before-tax to the 401(k) plan.
- ☐ No, my losses aren't large enough.
- ☐ I don't know.

Appendix B: Cover Letter Sent to Treatment Subjects

Dear <Company A employee>:

Would you like to earn $50 for about 15 minutes of your time?

Company A wants to better understand the retirement saving and investment issues facing its employees. We are inviting you to participate in a survey that Company A is conducting with researchers from Harvard University, the Wharton School of the University of Pennsylvania, and Hewitt Associates, the company that performs the recordkeeping for Company A Savings Plan.

As a way of saying thanks in advance for your help with this effort, we've enclosed a dollar bill in this mailing. You will receive an additional $50 American Express® Gift Cheque from the researchers, simply by

1) Reading the Official Gift Check Rules on the reverse side of this letter
2) Completing the enclosed questionnaire
3) Mailing the questionnaire with your name and current address to Hewitt Associates in the postage-paid envelope provided by no later than 8/27/2004

Gift Cheques are accepted at over a million locations—virtually everywhere American Express® Travelers Cheques are welcome. Returning the enclosed questionnaire indicates that you've fully read and agreed to the Official Gift Check Rules.

Your participation in the survey is important. The responses you provide, combined with those provided by other employees eligible to participate in Company A Savings Plan, will help the researchers understand the barriers to saving and investing for retirement. All gift checks will be mailed three weeks after the survey closing date.

Your responses and information are completely confidential. Company A will never see your individual responses to the questionnaire, and answers to questions will not be used to identify individuals. Hewitt will report results to Company A only in aggregate form.

We look forward to your participation!

Sincerely,

Jane Doe
Director, Retirement Benefits
Company A

Official Gift Check Rules

American Express® Gift Cheques will be awarded only to those invited to participate in this survey. American Express® Gift Cheques are accepted virtually everywhere American Express® Travelers Cheques are welcomed. For further details regarding rules, policies and limitations that may apply to the use of American Express® Travelers Cheques, visit "www.aeis.com/American_Express_Gift_Cheques.html" via the internet or call (888) 853-9899. Hewitt Associates and the Researchers are not responsible for lost, late or misdirected mail. Hewitt Associates and the Researchers reserve the right to cancel American Express® Gift Cheque payments if the package containing the Cheque is returned undeliverable.

If you have questions regarding your American Express® Gift Cheque, please write to the following address:

<Address>

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Table 1. 401(k) Plan Rules of Seven Firms in 1998

This table shows the 401(k) plan rules at our sample firms as of 1998, according to the firms' 401(k) plan documents.

	Company A	Company B	Company C	Company D	Company E	Company F	Company G
Eligibility	Immediate	Only non-union employees after 1,000 hours of service in a year	January 1 following hire	3 months of service	Non-temporary employees after 1 month of service	Salaried employees immediate; union employees after 3 months of service	Immediate
Contribution types allowed	Before-tax and after-tax	Before-tax and after-tax	Before-tax	Before-tax (after-tax contributions discontinued)	Before-tax and after-tax	Before-tax and after-tax	Before-tax
Employer match rate	25% to 100% match on first 6% of pay contributed, depending on employee group	50% match on first 4% of pay contributed	25% match on first 3% of pay contributed (before-tax contributions only)	100% match on first 3% of pay contributed; 50% match on next 3% contributed	75% match on first 2% of pay contributed; 50% match on next 3% contributed	20% to 35% match on first 6% of pay contributed, depending on employee group	100% match on first 3% of pay contributed; 50% match on next 3%. No match in 1st service year.
Match invested in employer stock	Yes; diversification restricted	No	No	Yes; diversification restricted	Yes; diversification restricted if < 50 years old	Yes; diversification restricted	No
Vesting	5-year cliff	5-year cliff, or 100% at age 65	5-year graded from 3 to 7 years of tenure, or 100% at age 65	Immediate	5-year cliff, or 100% upon retirement at or after age 55	5-year graded from 1 to 5 years of tenure	4-year graded from 2 to 5 years of tenure, or 100% at age 60
Withdrawal restrictions	$250 minimum; no more than 1 per month. Order of account depletion: after-tax, match, before-tax	No restrictions	Matching contributions not available for withdrawal	No more than 1 per month. Order of account depletion: after-tax, match dollars that have been in plan for more than 2 years, rollover, before-tax	1-year contribution suspension after withdrawals from matched after-tax dollars. Can withdraw match only if the money has been in plan for 2 years	$100 minimum; no more than 6 per year. Order of account depletion: after-tax, before-tax, match	Order of account depletion: match, before-tax
Withdrawal procedures	Call toll-free number. Checks mailed next week	Call toll-free number. Checks cut within 2 business days	Call toll-free number. Checks mailed in 2-3 weeks	Call toll-free number. Check processing time not in plan documents	Call toll-free number. Withdrawals processed within 1 week	Call toll-free number. Check processing time not in plan documents	Call toll-free number. Check processing time not in documents

Table 2. Demographic Characteristics of Seven Firms at Year-End 1998

The sample for all rows but the first is employees who are eligible to receive a 401(k) matching contribution at the beginning of 1998 and whose 1998 salary is more than that of a full-time minimum wage worker. The first row includes all employees at each company, whether or not they meet the eligibility and salary requirements. We sort employees into age subsamples based on their age at January 1, 1998. However, all statistics are reported as of year-end 1998. To maintain the confidentiality of the companies analyzed, we report only the approximate number of total active employees, and we do not report the number of employees under the age of 59½.

	Company A	Company B	Company C	Company D	Company E	Company F	Company G
Total active employees	Over 20,000	Over 4,000	Over 50,000	Over 10,000	Over 20,000	Over 30,000	Over 10,000
Match-eligible employees older than 59½							
Number of employees	816	537	2,084	142	383	841	242
Fraction male (%)	91.7%	82.7%	16.7%	70.4%	73.3%	65.2%	58.9%
Average age (years)	62.6	68.2	64.4	62.6	62.7	63.0	63.6
Average tenure (years)	16.0	5.9	14.9	18.4	22.5	22.2	12.1
Median salary	$32,444	$11,829	$24,704	$57,788	$40,830	$45,812	$43,711
401(k) participation rate	82.8%	32.8%	51.2%	97.2%	68.1%	78.2%	90.1%
Median 401(k) balance of participants	$46,830	$7,635	$16,259	$47,382	$117,151	$90,983	$69,440
Match-eligible employees younger than 59½							
Fraction male	81.7%	49.5%	19.1%	76.9%	70.6%	65.7%	66.0%
Average age (years)	43.7	38.2	41.3	50.0	42.3	43.2	39.2
Average tenure (years)	10.9	5.5	8.3	17.7	14.1	15.3	7.7
Median salary	$32,326	$23,229	$29,267	$62,111	$38,605	$46,854	$44,932
401(k) participation rate	81.0%	44.5%	46.6%	96.7%	72.3%	81.8%	79.0%
Median 401(k) balance of participants	$30,258	$11,521	$9,136	$53,078	$45,215	$52,951	$31,669

Table 3. Arbitrage Losses in 1998: Employees Over Age 59½

The sample is employees age 59½ and older on January 1, 1998 who are eligible to receive a 401(k) matching contribution and whose 1998 salary is more than that of a full-time minimum wage worker. Arbitrage losses arise from not contributing at least to the match threshold, being at least partially vested in the match, and having no after-tax 401(k) balances. The proportion of pay lost and dollar amounts lost are sorted separately to compute the percentiles.

	Company A	Company B	Company C	Company D	Company E	Company F	Company G
Number with arbitrage losses	196	320	915	36	78	263	102
Fraction of sample who have arbitrage losses	24.0%	59.6%	43.9%	25.4%	20.4%	31.3%	42.1%
Maximum possible loss as a fraction of pay	1.5 to 6%	2%	0.75%	4.5%	3%	1.2 to 2.1%	4.5%
Among those with arbitrage losses:							
Average fraction of maximum possible loss realized	72.4%	97.5%	96.8%	23.7%	69.2%	81.4%	34.9%
Fraction contributing nothing	54.1%	95.0%	93.7%	11.1%	73.1%	69.6%	21.6%
Fraction who have never enrolled in the 401(k)	20.9%	32.5%	66.4%	5.6%	38.5%	49.4%	5.9%
Average loss, percent of annual pay	2.32%	1.71%	0.66%	1.07%	2.07%	1.63%	1.57%
Average loss, $	$782	$215	$160	$350	$722	$677	$660
Distribution of losses as a percent of annual pay ($)							
Maximum	6.00% ($7,596)	2.00% ($947)	0.75% ($1,200)	4.50% ($1,182)	3.00% ($2,651)	2.10% ($3,360)	4.50% ($6,357)
95th percentile	4.45% ($1,521)	2.00% ($379)	0.75% ($361)	4.50% ($1,168)	3.00% ($1,560)	2.10% ($1,756)	4.50% ($2,083)
90th percentile	3.00% ($1,098)	2.00% ($320)	0.75% ($280)	4.50% ($1,004)	3.00% ($1,397)	2.10% ($1,412)	4.50% ($1,650)
75th percentile	3.00% ($938)	2.00% ($252)	0.75% ($196)	1.44% ($489)	3.00% ($1,048)	2.10% ($859)	3.50% ($997)
Median	2.51% ($747)	2.00% ($204)	0.75% ($135)	0.25% ($121)	3.00% ($662)	2.10% ($582)	0.52% ($282)
25th percentile	1.50% ($429)	1.57% ($181)	0.75% ($91)	0.17% ($80)	0.88% ($262)	1.05% ($257)	0.17% ($65)
10th percentile	0.91% ($262)	0.75% ($93)	0.31% ($66)	0.17% ($60)	0.41% ($126)	0.37% ($173)	0.17% ($49)
5th percentile	0.45% ($132)	0.42% ($42)	0.22% ($42)	0.17% ($48)	0.24% ($89)	0.33% ($106)	0.17% ($47)
Minimum	0.13% ($40)	0.11% ($11)	0.10% ($11)	0.17% ($47)	0.10% ($36)	0.15% ($41)	0.11% ($33)

Table 4. Foregone Employer Matching Contributions in 1998

The sample is all employees eligible to receive the 401(k) matching contribution and whose 1998 salary is more than that of a full-time minimum wage worker. The ages used to sort employees into subsamples are computed as of January 1, 1998. To maintain the confidentiality of the companies analyzed, we do not report the number of employees under the age of 59½.

	Company A	Company B	Company C	Company D	Company E	Company F	Company G
Match-eligible employees older than 59½							
Number contributing less than match threshold	246	386	1,088	51	78	267	114
Fraction of ≥ 59½ sample contributing less than match threshold	30.1%	71.9%	52.2%	35.9%	20.4%	31.7%	47.1%
Among those below the threshold:							
Average fraction of maximum possible match foregone	74.0%	96.5%	96.6%	20.2%	69.2%	80.6%	33.9%
Fraction contributing nothing	56.9%	93.5%	93.5%	7.8%	73.1%	68.5%	21.1%
Fraction who have never enrolled in the 401(k)	30.5%	38.1%	68.8%	3.9%	38.5%	48.7%	5.3%
Average match foregone, percent of annual pay	2.38%	1.73%	0.72%	0.91%	2.07%	1.67%	1.52%
Average match foregone, $	$768	$221	$180	$313	$722	$693	$638
Match-eligible employees younger than 59½							
Fraction of < 59½ sample contributing less than match threshold	37.3%	70.6%	61.8%	46.9%	30.6%	37.1%	66.2%
Among those below the threshold:							
Average match foregone as percent of maximum available match	69.6%	87.8%	93.8%	23.2%	67.9%	69.7%	46.0%
Fraction contributing nothing	50.7%	77.5%	86.4%	7.1%	60.2%	48.8%	30.4%
Fraction who have never enrolled in the 401(k)	36.5%	49.5%	68.1%	0.9%	23.5%	35.6%	17.3%
Average match foregone, percent of annual pay	2.53%	1.44%	0.70%	1.04%	2.04%	1.40%	2.06%
Average match foregone, $	$840	$340	$194	$533	$726	$629	$907

Table 5. Predictors of Arbitrage Losses or Foregoing Employer Matching Contributions in 1998

This table presents the results of probit regressions. The dependent variable is either a binary indicator for whether an employee had arbitrage losses in 1998, or a binary indiator for whether an employee contributed less than the match threshold in 1998. Arbitrage losses arise from not contributing at least to the match threshold, being at least partially vested in the match, and having no after-tax 401(k) balances. The sample is restricted to employees eligible for the 401(k) match and whose 1998 salary is more than that of a full-time minimum wage worker. The ages used to sort employees into subsamples are computed as of January 1, 1998. *Male* and *Married* are dummies set for if the participant is male and married, respectively. *Age* is the participant's age on December 31, 1998. *Tenure* is the number of years since the participant's original hire date as of December 31, 1998. *Salary* is the participant's salary in 1998. Firm fixed effects are included, although their coefficients are not reported. The columns labeled "Coefficient" present coefficient estimates from the probits. Those labeled "Slope" present marginal effects evaluated at the means of the explanatory variables. The marginal effect reported for dummy variables is the effect of changing the variables from 0 to 1. Standard errors are in parentheses. ** denotes significance at the 1% level.

	Employees older than 59½				Employees younger than 59½	
	Dependent variable: Has arbitrage losses		Dependent variable: Contributes less than threshold		Dependent variable: Contributes less than threshold	
	Coefficient	Slope	Coefficient	Slope	Coefficient	Slope
Male	0.3212**	0.1194**	0.3374**	0.1317**	0.1530**	0.0608**
	(0.0515)	(0.0190)	(0.0519)	(0.0201)	(0.0081)	(0.0032)
Married	-0.1611**	-0.0604**	-0.2104**	-0.0827**	-0.1138**	-0.0454**
	(0.0445)	(0.0167)	(0.0446)	(0.0175)	(0.0076)	(0.0030)
Age	0.0509**	0.0376**	0.0286**	0.0112**	-0.0069**	-0.0027**
	(0.0056)	(0.0021)	(0.0057)	(0.0023)	(0.0004)	(0.0002)
Log(Tenure)	0.1005**	0.0376**	-0.2405**	-0.0944**	-0.2175**	-0.0866**
	(0.0264)	(0.0099)	(0.0265)	(0.0104)	(0.0043)	(0.0017)
Log(Salary)	-0.8875**	-0.3320**	-0.9451**	-0.3711**	-0.8805**	-0.3507**
	(0.0430)	(0.0160)	(0.0431)	(0.0169)	(0.0083)	(0.0033)
Firm fixed effects	Yes		Yes		Yes	
Sample size	N = 5,043		N = 5,043		N = 158,986	

Table 6. Field Experiment Results

This table shows the average 401(k) contribution rates on August 1, 2004 (pre-survey) and November 1, 2004 (post-survey). The sample is Company A employees contributing under the match threshold in May 2004. The control group received a mailed survey about their 401(k). The treatment group received the control survey plus additional questions that highlighted the loss from not contributing up to the match threshold. The last column gives the *t*-statistic for the null that there is no difference between the two groups.

	Control group	Treatment group	*t*-statistic of difference
Pre-survey contribution rate (8/1/2004)	1.73%	1.48%	1.38
Post-survey contribution rate (11/1/2004)	1.81%	1.64%	0.86
Contribution rate change: 8/1/2004 – 11/1/2004	0.08%	0.16%	0.86
Sample size	N = 341	N = 337	—

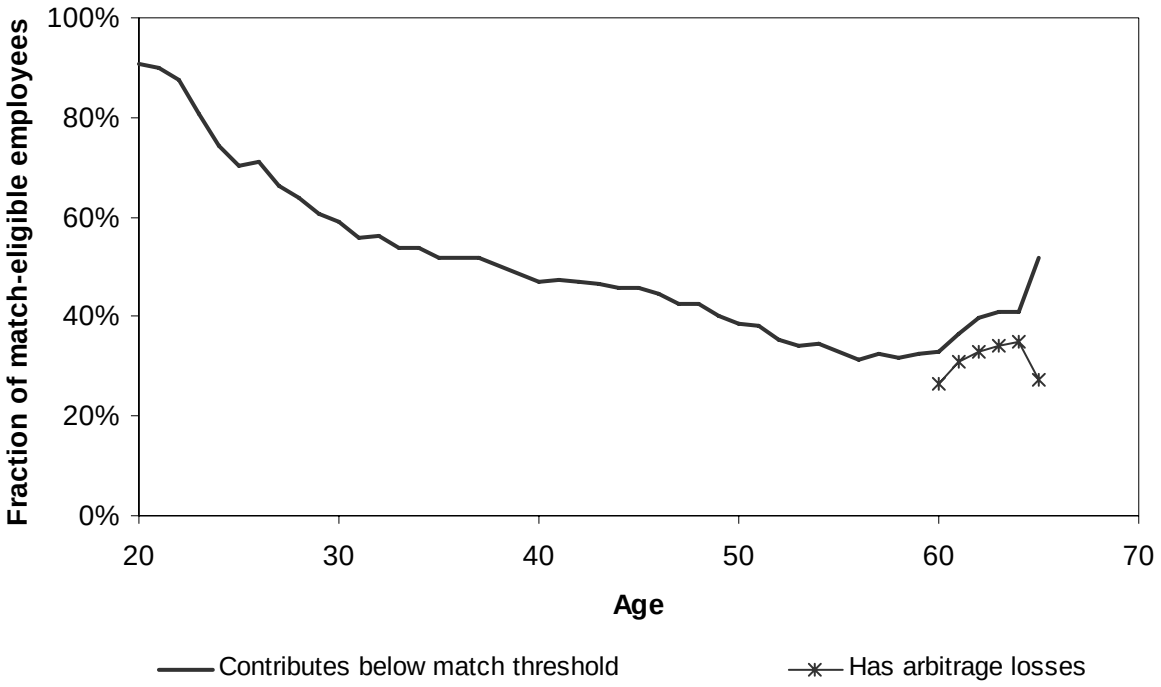

Figure 1. Failure to Fully Exploit the 401(k) Match in 1998, by Age. This graph shows, by age, the fraction of match-eligible employees who either contributed below the match threshold or who had positive arbitrage losses in 1998. Employees in all seven sample firms are pooled in this graph.