

The Determinants and Consequences of Employer Match Policy in 401(k) Plans

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Abstract: This paper examines why some employers provide matching contribution to 401(k) plans in company stock and explores the implications of match policy for employee retirement wealth. Consistent with the notion that firms consider the retirement security of their workers in making the match decision, we find evidence that firms are more likely to provide the match in company stock if employees are also covered by a defined benefit plan and if company stock price volatility is low. We also find evidence that an employer match is more likely if the firm pays dividends, likely reflecting the potential tax deductions for dividends paid on match stock. Firm match decisions do not appear to be strongly correlated with cash flow or with a measure of the benefits of employee ownership. We next confirm prior research which has shown that the firm's choice to match in company stock influences the decisions of plan participants in a manner that is consistent with an "endorsement effect," namely, that participants contribute *more* of their own contributions to company stock when they are in a plan that matches in company stock. We document for the first time that about 40% of this boost in company stock purchases comes from a reduction in contributions to the lowest-return investment, which is typically a money market fund. Finally, we use simulation methods to assess the effect of match policy on the expected distribution of account balances at retirement for plan participants, incorporating the behavioral responses to match policy documented above. Our results suggest that, for reasonably risk tolerant individuals, participating in a 401(k) plan at a company with a company stock match is often preferable to participating in a plan at a company with a diversified match. However, this advantage is substantially mitigated when the risk of corporate bankruptcy is considered.

JEL Classification: G11, J30, J32

Key Words: Pension, 401(k) plan, ESOP, company stock, tax incentives, equity issuance

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I. Introduction

Company 401(k) plan match policy has been the subject of intense scrutiny by policy makers over the past several years. In the wake of high profile corporate bankruptcies for companies that had a large fraction of 401(k) plan balances invested in company stock, numerous lawmakers began calling for new regulations and restrictions on company stock ownership within 401(k) plans.¹ In part motivated by this policy interest, a growing number of academic papers have begun to examine 401(k) plans in general, and match policy in particular. For example, recent research papers have examined the relative adequacy of retirement wealth for defined benefit versus defined contribution plans (Samwick and Skinner, 2003; Evan and McPherson, 2003a), the importance of plan design and employee inertia (Choi, Laibson, Madrian, and Metrick, 2001), and the effect of 401(k) match policy on employee holdings of company stock (Bernartzi 2001; Liang and Weisbenner, 2002).

Notably absent from this literature, however, is an understanding of why companies choose to provide their match in company stock in the first place.² After all, standard portfolio theory suggests that there are potentially large welfare costs to employees of forcing them to hold part of their portfolio in company stock (Meulbroek, 2002). Presumably, there must be some other benefits of providing a match in company stock to offset these potential welfare costs, or else profit-maximizing companies would not wish to compensate their employees in a manner that their employees would not fully value. Indeed, there are a number of potential benefits to a firm from providing a match in company stock. For example, a match in company stock has lower administrative costs, can free up cash for other uses, boosts employee ownership, and potentially reduces taxes if the firm pays dividends. Alternatively, firms who match in company stock may be those most able to lower the cost to employees of being concentrated in company stock. In other words, firms whose employees also have a defined benefit plan, or firms who have lower stock price volatility, may be more able to provide their match in company stock. We test these alternative hypotheses, providing what is to our knowledge the first evidence of how a company's decision to provide its match in company stock or to offer a

¹ For example, Senators Boxer and Corzine introduced legislation that would place a 20% cap on the share of 401(k) plan balances that could be invested in company stock. (<http://www.kcstar.com/item/pages/business.pat,business/3acd380f.c18,.html>)

² In a paper written concurrently with this one, Even and Macpherson (2003b) examine why company stock is held in defined contribution plans, but do not specifically focus on match policy. Our study focuses on why, conditional on offering company stock as an investment option, firms decide to offer a match in company stock.

diversified match is affected by company characteristics.

Using a sample of all publicly-traded companies that filed an 11-k statement from 1994 to 2001,³ we find evidence that firms with less risky stock prices are more likely to provide the employer match in company stock. In addition, we find that firms that have a defined benefit plan are significantly more likely to provide the employer match in company stock, particularly if the amount of the match is small relative to employee contributions. These findings are consistent with the notion that firms do take into account the effect of match policy on the retirement security of plan participants, either due to a lower risk of the plan sponsor being considered in violation of its fiduciary responsibility or due to simple market forces (employees at riskier firms without DB plans are less likely to fully value a match in company stock).

In addition, we find that the likelihood of an employer match in company stock increases with the dividend yield, likely because of the tax benefit associated with dividends paid on stock in leveraged ESOP plans.⁴ Moreover, we find no evidence that firms match in company stock because of cash flow constraints or to increase incentive alignment and boost productivity.

We then briefly use our data to confirm the findings of prior work about the effect of the 401(k) match on participant behavior. Consistent with past research (Benartzi, 2001; Liang and Weisbenner, 2002), we show that having an employer match in company stock leads employees to *increase* their own purchases of company stock, leading to even more concentrated holdings. This finding has been attributed to a match in company stock being interpreted by employees as implicit investment advice that company stock is a good investment. Further, we document for the first time that this boost in employee contributions to company stock comes disproportionately at the expense of the lowest-return asset; about 40% of the boost in company stock purchases comes from a reduction in contributions to the lowest-return asset, typically a money market fund.

Using our data on firm characteristics and the effect of employer match on employee behavior, we then present simulations of the expected distribution of 401(k) account balances at retirement in order to assess the effect of an employer match in company stock on participant

³ An 11-k statement is an annual report of a firm's defined contribution plan that details changes in plan assets over the past year such as employee and employer contributions to the various investment options. See Section 2 for a further description.

⁴ The firm is allowed to deduct dividends paid on stock contributed to leveraged ESOP plans from taxable income. The match component of a defined contribution plan can be converted to a leveraged ESOP to reap this tax deduction for dividends.

retirement security. We present a number of alternative simulations to capture both the direct effect of the match (i.e., constraining the entire match to be in company stock) and the indirect effects (e.g., individuals contribute more of their own contribution to company stock when the match is in company stock) of match policy. In each case, rather than imposing a strictly optimal portfolio selection, we parameterize the simulations to reflect the best available evidence on how 401(k) plan participants actually behave.

The simulations demonstrate the dual effect of matching in company stock, namely an increase in the mean account balance and an increase in the variance of the distribution. Our simulated account balances for participants at retirement age indicate that reasonably risk-tolerant participants would prefer to participate in a plan that offers a company stock match to a plan that offers a diversified match. This is particularly true if the participant also has some other uncorrelated wealth (e.g., Social Security, home equity, etc.). This preference for plans with a company stock match is maintained until one considers the joint imposition of a substantial reduction in the annual equity premium of 4 percentage points, and a random bankruptcy process that wipes out all company stock account balances with probability of 0.1% per month, which results in roughly a third of firms failing over a 35-year horizon. Even under these extreme assumptions, company stock is still preferred for individuals who are sufficiently risk tolerant (e.g., log utility).

The higher mean and variance of the distribution of account balances at company stock match firms are generated primarily from the fact that participants end up directing more of their contributions to equity securities, and avoid having large shares of their 401(k) assets in lower-yielding and lower risk money market or longer-term Treasury securities. This driven by our empirically supported parameterization in which participants follow a naïve “1/n” diversification heuristic when choosing investment purchases and rarely rebalance assets, which leads to a greater share of assets in equities. Some additional boost to the superior performance of expected balances comes from the lower idiosyncratic risk of company stock match firms relative to choice match firms, as well as lower administrative fees for company stock relative to other assets.

This paper proceeds as follows. In Section 2, we provide further details on the data used for this project. Section 3 presents our empirical analysis of employer match policy. Section 4 traces the effect of employer match policy on plan characteristics and employee behavior. We

provide simulation results in Section 5. Section 6 concludes.

II. Data and Sample Characteristics

Our primary data source is the 11-k form filed with the SEC by 401(k) plans for which the investment option to purchase company stock is deemed an offering of securities. The data we collect from 11-k filings include total participant contributions, participant contributions allocated to company stock, participant contributions allocated to money market or GICs, employer contributions, employer contribution in the form of company stock, total plan assets, company stock assets, number of investment alternatives, and descriptions of limits on purchases of company stock. We collect data for the largest plan at each company. In general, companies that offer participants the choice to purchase company stock with their own contributions and issue shares for the plan, rather than purchase shares on the open market, are required to file an 11-k. While data on plans that exclusively buy shares on the open market for the plan are not publicly available, we document below that repurchase activity at firms in our sample does not appear to differ from that at other publicly-traded firms.⁵

Starting with all U.S. firms listed in Compustat any year from 1993 to 1999, we identify firms that filed an 11-k at least once during 1994 to 2001.⁶ We were able to hand-collect data for 946 companies that offered a match to employee contributions, yielding 3,179 firm-year observations. As reported in table 1, most of the data are in the period 1993 to 1998. On average, there are 3.4 observations per firm, with 42 percent of the firms with 2 observations or less and 58 percent of the firms with 3 or more observations. For this sample, 39.3 percent required that the match be in company stock; the remaining firms allow employees to direct their match as they choose among the offered investment options. The information provided on the 11-k is in accordance with ERISA reporting guidelines. In 1999, there was a change in ERISA reporting requirements that led to fewer companies reporting contributions by asset category, leaving us with contribution data for far fewer plans in 1999 and 2000 than in 1998.

Information on stock prices and standard deviation of returns are from the Center for

⁵ If the employer contribution is in company stock, but the plan does not allow employees to purchase stock, it would generally not be deemed an offer of securities, and thus the plan would not be required to file. In our discussion with SEC staff, the 11-k obligation is almost a fact and circumstance determination, and the company has an obligation to determine whether it needs to file.

⁶ 11-k filings are available on the SEC's Edgar website starting in 1994. The 1994 filing will report plan activity during 1993. Some firms will report not only plan activity during the past year, but plan activity over the past three years. Thus, we have 190 observations for 1992 and 51 observations for 1991.

Research in Security Prices (CRSP) database. Other firm financial data, including market-to-book ratios, assets, employees, and cash flow (net income plus depreciation) are from Compustat. Information on defined benefit plans are from both DOL 5500 data and Compustat.

To characterize our sample, we focus on firms in the sample in 1998, one of the more recent years with the largest number of firms. As shown in table 2a, about one-half of the sample was ever a member of the S&P 1500. Thus the firms in our sample are smaller, measured by both market value and employees than S&P 1500 firms, but they are larger on average than the average of all public companies, as available from Compustat. The sample represents a broad cross-section of industries. As noted in the last line of table 2a, about 15 percent of the sample is in the technology sector, somewhat less than the overall market.

Recall that, in general, companies that issue shares for their retirement plan, rather than purchase shares on the open market, are required to file an 11-k. This raises the potential that the sample could be biased to firms that do not repurchase stock at all. However, in unreported analyses, we find that roughly half of the firms in the sample repurchased stock in 1998 (just evidently not in conjunction with their retirement plan). The share repurchase yield (an estimate of the fraction of shares repurchased) for the sample was 1.8 percent in 1998, similar to the yield for the S&P 1500.

We also compare our sample of plans to those at publicly-traded firms as reported on Form 5500 filed with the Department of Labor.⁷ In the aggregate, for our sample of the largest plans at 635 companies in 1998, total plan assets were \$264 billion, representing about 38 percent of the \$698 billion in plan assets at all publicly-traded companies (table 2b). Total contributions by participant and company for our sample totaled \$15.2 billion, just over 30 percent of the \$49.2 billion for publicly-traded firms. Estimates from the Department of Labor for 1998 for all US companies, public and private, are \$1.54 trillion in assets and \$135 billion in contributions.

For our sample of 635 companies in 1998, company stock combined totaled \$97 billion, representing 37 percent of plan assets. One-third of total participant and employer contributions were allocated to company stock (employees in aggregate contributed one-quarter of participant

⁷ Publicly-traded companies on the DOL Form 5500 data set were identified by whether they had a CUSIP, and by matching EINs with those in Compustat.

contributions to company stock). The Department of Labor 5500 data indicate that at public companies, the share of defined contribution plan assets held in company stock was 39 percent, similar to the share for our sample.

III. Empirical Analysis of Employer Match Policy

A. Summary Statistics Regarding the Employer Match in Company Stock

As noted in table 1, 39.3 percent of the 3,179 firm-year observations required that the employer match be all in company stock. Such a requirement has substantial consequences because, for a typical employee who contributes 6 percent of salary and receives a match of \$0.50 per dollar up to this limit, the amount of the match would be $\frac{1}{2}$ of the employee's contributions and $\frac{1}{3}$ of total (employee plus employer) contributions. As we will confirm below, employees appear to respond to a match in company stock by boosting their own voluntary purchases, because they appear to interpret the employer match as implicit investment advice that company stock is a good investment, suggesting that match policy can have an even larger effect.

In row 1 of table 3, we show that in our sample, participants at firms with the employer match in company stock allocated approximately 9 percentage points more of their own contributions to company stock. Thus, after factoring in the match, participants at firms with a company stock match had on average 45.5 percent of their total annual contributions being invested in company stock, as compared to 17 percent at firms with an unrestricted match. Interestingly, the large share of contributions allocated to company stock is not simply the result of employees being constrained to hold this much. Indeed, as shown in row 3, required purchases of company stock at companies with its match in company stock are on average 28 percent of total annual contributions, or only three-fifths of the observed company stock purchases. The annual *contributions* appear to translate into similarly-concentrated asset *holdings*, as shown in row 4: the percent of plan assets held in company stock averaged 42 percent at firms that matched in company stock, versus 18 percent at firms with an unrestricted match.

In addition, the size of the employer match relative to employee contributions does not differ substantially across firms by match policy. If anything, firms that do not match in company stock offer a slightly more generous match. In row 6 of table 3, we see that mean

values are 46 percent at firms that match in company stock, and 53 percent at firms that allow any investments, but the differences are not significant. Median ratios show a similar pattern, 37 and 40 percent respectively, and differences are significant but not large.

Rows 7 and 8 show that, as expected, firms which match in company stock have a significantly higher fraction of their total firm stock located within the 401(k) plan. Finally, in row 9 we see that firms that offer a company stock match also tend to offer, on average, one fewer investment option to their plan participants. This may be consistent with the firm's desire, for reasons we will explore below, to have employees hold a higher fraction of the 401(k) balances in company stock.

B. The Costs and Benefits of Offering a Match in Company Stock

The decision by a firm to provide a match in company stock involves a trade-off between a number of costs and benefits of doing so. There are two related reasons that providing a match in company stock may be costly for a firm. First, elementary portfolio theory makes it clear that an optimizing agent should prefer a diversified portfolio to one that is highly concentrated in a single asset. Therefore, rational employees will recognize that a match in company stock substantially increases the concentration of assets and therefore the volatility of their future retirement wealth. As a result, rational employees may value a match in company stock less than a match in cash, which they can then use to diversify their portfolio.

Second, firms might be concerned that in the case of poor stock price performance, the plan sponsor could be considered by the courts to be in violation of their fiduciary responsibilities if they were to provide a match in company stock.⁸ To the extent that either of these potential costs are important to the firm, one might expect that firms with lower stock price volatility, particularly lower idiosyncratic or firm-specific risk, would be more likely to match with company stock because the additional risk imposed on workers is reduced. In addition, firms might be less concerned about these costs if the firm also provides other retirement benefits, such as from a defined benefit plan, which reduces the importance of 401(k) plan assets for financial security. In particular, the presence of a DB plan means that the 401(k) plan

⁸ If firms do not require investments in company stock, they may receive a safe harbor from fiduciary liability under Section 404(c) of ERISA. Because ERISA provides some special protections to the fiduciary of an ESOP, companies may require investments in company stock in the ESOP portion of the combined 401(k) and ESOP plans, often referred to as a KSOP.

participants also have an additional asset that is largely uncorrelated with company stock performance, because DB plans are prohibited by ERISA to have more than 10 percent of plan assets invested in company stock. In addition, DB plans, unlike 401(k) plans, are insured by the PBGC. While the benefits from DB plans are at some risk if the company fails because of the fact that DB benefits are back-loaded and the PBGC is responsible for obligations incurred only up to the time at which the firm fails, the provision of these benefits mitigates the risk to retirement wealth from a high concentration in company stock. Thus, firms that provide DB plans, as well as firms who have less risky stock, may feel less constrained from providing the employer match in company stock.

Firms must trade-off these costs with several potential benefits to the firm from providing the employer match to 401(k) plans in company stock. First, there may be a tax advantage to firms that match in company stock and pay dividends on that stock. While dividends paid on stock are not usually tax deductible, if firms contribute their employer match to a leveraged employee stock ownership plan (ESOP), meaning the matching contributions are all in company stock, dividends paid on that stock may be tax-deductible (Beatty, 1995; Schultz and Francis, 2002; Iwry, 2003).⁹ Recent business press cites that such tax savings may be significant for some firms (Schultz and Francis, 2002).¹⁰ We test for the importance of this tax advantage by looking at whether a firm's dividend policy helps to explain the likelihood of a company stock match.

Second, a company stock match likely leads to a greater share of the firm being held by employees. There are several potential advantages of this, including having stock in "friendly hands" to help to protect the firm from hostile takeovers (Rauh, 2003). Firms may also encourage or mandate holdings of company stock because of the perceived benefits from aligning workers and stakeholders' interests (Mitchell and Utkus, 2002). Employees as worker-owners may see themselves more aligned with the firm's interests, and will be more productive, leading to an increase in firm value. Lazear (1979, 1983) argues that firms with greater monitoring difficulties, proxied by more employees, might benefit more from aligning incentives. In addition, firms with a larger value in growth opportunities and intangible assets,

⁹ While this benefit is not likely to encourage dividend payments, since most stock is held by outside investors outside of ESOP plans and so is subject to double taxation, the benefit could encourage companies that already pay dividends to provide a 401(k) employer match in company stock for this deduction.

¹⁰ This tax benefit was available to firms even before the Economic Growth and Taxpayer Relief Reconciliation Act of 2001 was passed, which made it easier for firms to qualify for the tax benefit.

due to the asymmetric information between insiders (employees) and outside shareholders may benefit more (Holmstrom and Milgrom (1987)). As applied to our question, their model would predict that firms whose value is comprised of intangible assets and growth opportunities, and hence more uncertainty about true value, would be more likely to offer a match in company stock in order to increase insider ownership.

Third, it may be cheaper for a firm to issue stock to fund its 401(k) match than to raise funds from outside investors to provide an unrestricted match. This argument would predict that firms with less cash flow would be more likely to offer a match in company stock. Low cash flow firms might also be more likely to match in company stock because of less ability to raise debt. Finally, administrative fees for company stock are negligible, and considerably less than fees associated with providing other investment options, such as equity and bond mutual funds.

C. Which Factors Matter? An Empirical Analysis of Match Policy

We are interested in empirically determining which of these potential costs and benefits are most relevant to the firm's decision about whether to offer their match in company stock versus cash. In addition to the general academic interest of this question, knowing the relative importance of these factors may help guide public policy in these areas. For example, if tax policy were the only reason that firms offered this match, then a change to tax policy may be the most effective way to alter firm behavior. Alternatively, if cash constraints are the primary reason for company stock matches, then regulations that prohibited a match in company stock could have the unintended consequence of reducing overall match generosity.

We begin, in table 4, with a simple comparison of characteristics of firms by match policy. Firms that match with company stock appear to have more assets and substantially lower stock price volatility and idiosyncratic volatility. In addition, these firms are considerably more likely to also sponsor a defined benefit plan.¹¹ Among the company stock match firms, 68 percent also offered a defined benefit plan, as compared to only 44 percent at choice match firms. The higher concentration of firms in the S&P 500 Composite index may also signal higher quality firms, since they are recognized by an outside party as an important firm in the industry and economy. Stock returns over the past five years are higher for firms that matched

¹¹ One could envision a scenario in which firms face the choice of offering a 401(k) plans with a match in employer stock or a defined benefit plan as alternative means to tie the worker to the firm. In our sample, however, DB plans have been in place for quite a while and so we are not concerned with potential endogeneity of the DB variable.

with company stock, though there is no difference in firm market betas.

In addition, firms that match in company stock are more likely to pay dividends and have a higher dividend yield, supportive of the hypothesis that tax policy promotes a company stock match. Moreover, firms that match in company stock do not have less cash flow or appear to be subject to more severe asymmetric information problems, as proxied by market-to-book, which would raise external financing costs. Thus, at least in a univariate setting, there appears to be little to no support for the hypothesis that firms match in company stock because they are cash-constrained and so have not other way to make a match. The results regarding increased employee ownership are mixed, as company stock match firms have more employees, suggesting greater monitoring problems, but there is no difference in market-to-book ratios.

Because many of these firm characteristics are correlated, we next turn to a multivariate analysis of whether a firm matches with company stock.¹² Columns 1 through 4 of table 5 essentially confirm the univariate results, suggesting an role for dividend policy, the presence of a DB plan, and return risk. In columns 5 and 6, we report specifications that include all measures simultaneously.

Consistent with the univariate comparisons, whether the firm already provides retirement benefits through a defined benefit plan appears to be very important. The estimated effect is positive and large, suggesting that firms that have a defined benefit plan are substantially more likely, by 22 percentage points, to require the match be in company stock. Our interpretation of this finding is that the provision of retirement benefits through a DB plan significantly mitigates the risk to employee retirement wealth of having 401(k) plan assets concentrated in company stock. It is also consistent with the idea that the firm may view its risk of being considered a poor fiduciary to be lower, and thus be more willing to restrict the employer match to company stock. Columns 3 and 4 show a significant negative relationship between stock price volatility and the probability of matching in company stock, which is also consistent with employers considering the effect of match policy on employee retirement wealth. However, because the provision of a defined benefit plan and stock price risk are highly correlated, the coefficients on volatility and idiosyncratic risk, which are negative and significant on their own, are insignificant once the DB variable is included. On balance, the coefficients suggest that firms may be

¹² We estimate a linear regression to provide an easy-to-interpret estimate of the marginal effects of firm characteristics on the choice of match policy. A Probit model yields very similar results.

concerned about the risk of company stock in retirement portfolios, and provide the match in company stock only when employees have a fall-back retirement plan or when the stock is relatively less risky. In short, firms are more likely to provide a match in company stock when the cost of doing so is lower.

On the benefit side, the tax-based motivation to match in company stock if dividends are paid appears to be important. Coefficient estimates suggest that a one percentage point increase in the dividend yield is associated with a 1.5 to 3 percentage point increase in the probability that a firm's match is all company stock (the sample average is 39 percent). This variable is also highly correlated with stock price volatility, and thus becomes less significant once volatility or idiosyncratic risk is included. This link to dividends likely reflects that when the match is in company stock, then the match contributions can be paid into a leveraged ESOP, and the subsequent dividends paid on the stock can be deducted from a firm's future taxes.

Finally, as in the univariate comparisons, we find no evidence that cash constraints or motives to better align incentives are important factors in setting employer match policy. In particular, there is no significant effect of market-to-book, cash flow-to-assets, or number of employees.

In summary, our evidence suggests that companies are primarily trading off the benefits of the dividend tax advantage with the recognition that lack of diversification may be costly to employees. Firms that pay more dividends are more likely to provide a company stock match, as are firms for which the diversification costs to employees are low, namely, those companies with low volatility and who also offer a DB plan.

D. Further analysis of effect of defined benefit plans

Our most robust finding pertains to the role of the DB plan. Table 6 further explores the relation between the presence of a DB plan and firm match policy. The left panel of table 6 documents that firms are more apt to match in company stock within their 401-k plan if they also offer a DB plan (column (1), which replicates the result in table 5 column (2)), but even more so if the match they are offering is less generous (columns (2) and (3)). For example, among firms that offer a DB plan, as the size of the match relative to employee contributions falls from 50% to 20% of employee contributions, the probability that the firm matches with company stock rises 7-8 percentage points. In contrast, the generosity of the match relative to employee

contributions has no predictive power for match policy for firms that do not offer a DB plan. Thus, firms that both offer a defined benefit pension and whose match is less concentrated are significantly more apt to match in company stock, perhaps because firms take into account the effect of match policy on the retirement security of plan participants, either due to a lower risk of the plan sponsor being considered in violation of its fiduciary responsibility or due to simple market forces (employees at riskier firms without DB plans are less likely to fully value a match in company stock).

A key concern about the interpretation of the positive coefficient on the presence of a DB plan is whether most employees receive both a DB benefits and participate in the 401(k) plan, or if DB benefits apply only to an earlier cohort of workers, and more recent hires are not eligible for the DB plan and are limited to participation in the 401(k) plan. If DB benefits are available only to more tenured workers, then the positive coefficient on the DB plan variable would not be interpreted accurately as firms providing company stock only when workers have an alternative wealth in DB benefits.

Fortunately, in our sample of firms, DB benefits appear to apply to largely the same set of employees as those that contribute to 401(k) plans. Unfortunately, there are no data available from the 11-ks, 5500 forms, or Compustat to establish the fraction of employees that are covered by both types of plans, but other data strongly suggest that it is the case. In the aggregate, data from the 1998 Survey of Consumer Finances indicates that of the roughly 40 million households with a worker at a firm with more than 500 employees and are covered by a DB plan, 62 percent of those workers also participate in a DC plan. Data from the DOL 5500 data present roughly the same picture – 69 percent of wage and salary workers that were covered by a DB plan also were covered by a DC plan.

In the right panel of table 6 we focus attention on the subsample of firms over 1997 and 1998 where it is likely that workers are covered both by a DC and DB plan, if the firm offers both. To construct this sample, we first obtain the number of plan participants from the DOL 5500 form and then compare this number with the number of total employees from Compustat. If the number of participants in the DC and DB plans are at least 50% of total firm employees, then we define the plan to be broad-based, and include the firm in the regression. Relative to the results for the full sample (table 6, left panel), the estimated effect of the presence of a defined benefit plan remains highly significant, with the point estimates little changed. The

results obtained with this subsample of firms with broad-based plans support the conclusion that firms are more likely to match in company stock when workers have alternative wealth in DB benefits.

E. Analysis of changes in match policy – Market timing?

Market-timing behavior has been observed for issuance of equity (Asquith and Mullins, 1986), repurchases of equity (Ikenberry, Lakonishok, and Vermaelen, 1995), and employee stock option grants to top executives (Yermack, 1997). A natural question to ask is whether firms change match policy in advance of favorable stock returns, to the benefit of their employees.

To test market timing in the context of match policy, we examine stock price returns for one year and two years following changes in the company match policy – from total choice to all in company stock and from all in company stock to total choice. There are 22 firms in the sample that switch their match policy from all match required to be in company stock to employee investment choice for all of the match (or vice versa), note the exact date of the switch in the 11-k filing, and have returns on CRSP for at least two years before and two years after the switch.

While our sample size is small, because not many firms have changed their company match policy, we find no evidence that firms market time their change in match policy to benefit their employees (table 7). Returns for companies that switch from choice to company stock do not show an improvement in stock performance after the switch relative to before the change in match policy (top row, table 7). On the other hand, companies that switch match policy from all stock to allowing choice subsequently enjoy large positive returns after the change, both in absolute terms and in excess of predicted returns from a four-factor model, compared with negative excess returns before the change in match policy (middle row, table 7). Again, caution should be exercised when viewing these findings due to the small sample size. At a minimum, though, these results in run counter to the hypothesis that a firm may switch the match to all company stock prior to the public revelation of good news (and the subsequent run up in price) and allow employees to scale back their company stock purchases by eliminating a match all in company stock ahead of bad news (and the subsequent fall in price).

IV. Effects of match policy on employee purchases and other plan features

Given that on average the employer match represents about a third of total contributions, a match in company stock forces employees to hold a substantial share of their retirement portfolio in company stock. Further, as previously documented in table 3, a company stock match leads employees to boost their own voluntary purchases of company stock. Previous research (Benartzi, 2001; Liang and Weisbenner, 2002) have described this result as consistent with employees viewing a match in company stock as the firm's implicit endorsement of company stock as a good investment.

We next estimate the effect of plan characteristics (match policy and number of options), past asset returns, and firm characteristics on the percent of employee contributions invested in company stock, the firm's lowest-return asset (a money market fund, or if not offered, a Guaranteed Investment Contract (GIC)), and all other investment options. The results are displayed in table 8. When the employer match is in company stock, the percent of employees' own contributions allocated to company stock are 7 to 8 percentage points higher. This boost in employee contributions to company stock comes disproportionately at the expense of the lowest-return asset; employees allocate three percentage points less to the money market/GIC fund if the employer matches in company stock. Thus, about 40% of the boost in company stock purchases comes from a reduction in contributions to the lowest-return asset. This finding will be particularly relevant for the simulations of retirement wealth across match policy that follow.

Consistent with Benartzi and Thaler (2001) and Liang and Weisbenner (2002) the regression results indicate that $1/n$ is also a significant predictor of purchases across all asset classes. Company stock purchases are also greater if stock price volatility is lower and the firm is larger, with the contributions to the money market/GIC fund increasing with stock price volatility.

The relation between asset returns and contribution decisions is in general fairly weak, with the exception of the effect of past Treasury bill returns. Past five-year Treasury bill returns are strongly positively correlated with the percent of employee contributions allocated to the money market/GIC fund, while negatively related to contributions to company stock and all other investment options.

V. Does it Matter? The Effect of Match Policy on Retirement Wealth

Employees at companies with a company stock match end up with a highly undiversified portfolio. However, our empirical results also indicated that these employees are more likely to work for firms that have lower idiosyncratic risk and provide other retirement income through defined benefit plans. A higher concentration of retirement wealth in company stock brings more risk. However, company stock has a higher expected return than many of the other investment alternatives, namely money market and government bond funds. Past research finds that individuals investment consistent with naïve $1/n$ diversification strategies, rarely rebalance plan assets, and that individuals in firms which match in company stock tend to place more of their own contributions in company stock. As a result of these many countervailing forces, the net effect of company match policy on the distribution of possible retirement wealth levels is complex. In this section, we use simulation methods to compare the distribution of retirement wealth under alternative assumptions.

We first present simulation results comparing retirement wealth assuming median sample characteristics of firms with and without a company stock match. By focusing on a stylized firm with median risk characteristics, we can more easily illustrate the importance of differences in firm idiosyncratic risk and market betas on retirement account balances. We then simulate distributions for every firm, incorporating difference in administrative costs, indirect effects of match policy on employee contributions, bankruptcy, and the level of the equity premium.

1. Key assumptions and procedures

We assume that an individual begins contributing to a 401(k) plan at age 27 and contributes 6 percent of wages annually until age 62. The company matches this contribution at a rate of 50 cents on the dollar, meaning that the company contributes an additional 3 percent of wages each year. The individual's lifetime wage path is taken from Munnell & Sunden (2003).¹³ In particular, wage growth is a composite of two factors: the first is the growth in wages across the economy, which is assumed to be 1.1% real, consistent with projections of the Office of the Actuary of the Social Security Administration. The second is an age-earnings profile based on career earnings profiles for men and women born between 1926 and 1965. Salary at age 50 is set to \$44,000, which is the median wage for a 50-year old covered by a pension plan in the 2001

¹³ For more details on the calculation of the wage profiles, we refer readers to page 30 of Munnell & Sunden (2003). We are grateful to these authors for providing us with the wage profiles for use in our simulations.

Survey of Consumer Finances.

As indicated by our 11-k data, we assume that the median firm offers 7 investment options – company stock, large-cap equities, money market, long-term government, a balanced fund (which is invested in a monthly rebalanced mix of 50% stocks and 50% bonds), long-term corporate and small-cap equities. Based on our results from table 8 and previous research findings (Benartzi and Thaler, 2001; Liang and Weisbenner, 2003), we assume initially that participants invest their own contributions using a simple $1/n$ diversification heuristic. We also assume that when the company matches with cash, the individual invests the match in the same manner as their own account contributions. In our base case simulation, we assume that the company's decision to match in company stock has no effect on an employee's own contribution allocation, although we alter this assumption in later specifications. As such, for many of the simulations presented, the difference in annual purchases of alternative assets arises solely from a difference in the employer match. These assumptions roughly approximate the actual contribution data to money market and company stock that we observe for these firms. Consistent with previous research (Samuelson and Zeckhauser, 1988; Ameriks and Zeldes, 2001), we assume that participants do not rebalance their accounts.

Specifically, our assumptions of $1/n$ and 7 investment options lead to one-half of annual employee and employer contributions directed toward equities and one-half toward fixed income securities at firms who match in cash. For firms that match in company stock, two-thirds are directed toward equities and one half toward fixed income. These contributions suggest that participants do not offset the employer match in company stock by reducing investments in other equities, and is in line with asset holdings reported in other studies. For example, Benartzi and Thaler (2001) document that among plans that offer company stock, equities account for 71 percent of assets, and when company stock is not offered, 50 percent are invested in equities (see also Choi, et al, 2003; Holden and VanDerhei, 2001).

To estimate retirement wealth, we need to specify processes for asset returns. Monthly returns to the assets --- large-cap equity, small-cap equity, money market, long-term government, and long-term corporate bonds --- are based on Ibbotson from January 1927 through December 2001. The historical annual returns have averaged approximately 12 percent for large-cap equities, 15 percent for small cap equities, 4 percent for money market, 7 percent for long-term government, and 8 percent for corporate bonds.

We draw randomly (with replacement) from the historical distributions of monthly returns, where the returns for the assets other than company stock and an inflation rate are drawn as a package for a given month in order to retain all within month, cross-asset correlations. For company stock returns, we simultaneously draw the 4 factor portfolio returns (the three Fama-French factors and the momentum factor) for the same month, and use these to generate an expected return on company stock using the individual firms' estimated betas. The estimated betas for the four factor model is determined by drawing rates of return from CRSP for 1991 to 2001. For each of the 867 firms that had at least 24 months of stock returns over this period, we estimate regressions of stock returns on four factors. Specifically, the excess stock return (stock return less the risk-free rate) is related to the market return (also in excess of the risk-free rate), the return of small cap minus big cap stocks (SMB), the return of high book-to-market minus low book-to-market stocks (HML), and the returns of stocks that have risen the past 11 months minus those that have fallen (UMD). As shown in table 9, average raw returns and excess returns computed from the four-factor model do not differ significantly across match policy. The SMB beta is significantly smaller for firms with a company stock match, reflecting that firms that match with company stock tend to be slightly larger. Total risk, the standard deviation of monthly returns, and idiosyncratic risk, the standard deviation of the residual from the four-factor return model, are both significantly lower for firms with a company stock match, on the order of 1.5 to 2.1 percentage points per month.

After using the estimated coefficients and the monthly draw from the historical return distribution to compute the expected return on company stock, we then draw randomly from the company stock return error distribution, a normal distribution with variance based on the estimated idiosyncratic risk of the firm, and apply it to the expected return to generate the realized return for that month. These rates of return are then applied to existing account balances and new contributions, and is repeated for each month that the individual is contributing from age 27 through age 61, or a total of 420 months. We then save the total account balance at age 62, and repeat this process 100,000 times for each of the 867 firms in our sample.¹⁴

¹⁴ Through repeated experimentation, we found that 100,000 simulations was sufficient for the distribution of returns to stabilize. When we report results in Table 11, based solely on median characteristics, we increase the number of simulations to 250,000, but found virtually identical results using a sample of 100,000.

1. Simulations of 401(k) Account Balances using Median Firm Characteristics

We first present results based on a hypothetical “median” firm that matches with company stock versus a hypothetical “median” firm that allows choice of how to invest the employer match. These results are somewhat stylized in the sense that no such “median” firm exists, because we choose the median Fama-French coefficients independently from each other. In other words, we construct a firm using the median coefficient on the SMB portfolio, the median coefficient on the UMD portfolio, and so on. While purely hypothetical, this approach allows us to more easily present evidence on the importance of differences in firm betas and idiosyncratic risk on final retirement wealth. Below, we will compute these measures on a firm-by-firm basis. In table 10, we present numerous statistics to compare the distribution of terminal wealth values under two alternative match assumptions – choice, and company stock. In particular, we report the percent of times that an individual would have more wealth with company stock than with choice. We then report the mean account balance for each match policy, as well as nine key points in the distribution. Finally, in the bottom panel we report a coefficient of relative risk aversion (CRRA) such that an individual would be indifferent between the two distributions. We report these results conditional on having varying amounts of additional uncorrelated wealth.

Across the columns, we compare four scenarios. In scenario 1, we compare the company stock match to a diversified match for our hypothetical median choice firm. Thus, the differences in account balance arise entirely from differences in how the contributions are directed, not from differences in risk factors across choice and company stock firms. In this base case, we assume that all own-account contributions follow the 1/n rule, with no behavioral adjustment for match policy, and that there are not administrative costs to any of the investments. Thus the only difference arises from the fact that the match policy allocation differs.

We see that the company stock match outperforms the choice match in 56.5% of cases. The difference in the mean outcome is substantial, with a company stock match having a mean outcome of over \$1.9 million while the mean for the choice match is just over \$1.1 million. The higher expected balances reflect the greater concentration of assets in company stock, which historically and in expectation yields a higher return than the other investment choices. An examination of the full distribution illustrates the basic result of having a match in company stock, namely that the mean is higher but there is substantially increased dispersion. At the first

percentile of the distribution, the company stock match results in retirement wealth that is 22 percent lower than under a choice match, whereas at the 99th percentile, the company stock match outcome is more than double that of the choice outcome.

Recognizing that most investors are risk averse, and therefore have a non-linear valuation of the possible distribution of outcomes, in the bottom panel of the table we report the coefficient of relative risk aversion such that the individual would be indifferent between the two distributions. Specifically, we use a utility function of the form:

$$U(W) = \frac{W^{(1-\gamma)} - 1}{(1-\gamma)}$$

We then search for the value of γ such that the expected utility from the two distributions is the same. Note that up to this point we have made no assumptions about utility or maximizing behavior. Rather, the entire point of the simulation exercise is to better understand the likely effects of match policy on retirement wealth, given our empirical estimates of how plan participants actually respond to match policy. As such, it is important to keep in mind in evaluating the indifference level of risk aversion that it is meant to be a mechanism through which we can provide a useful summary statistic on a non-linear valuation on the distribution of outcomes, rather than a strict statement about risk aversion of optimizing agents.

For CRRA utility, what matters is the size of the gains and losses relative to total wealth. In addition to the wealth from the 401(k) plan, we recognize that most retirees have additional wealth in the form of Social Security, defined benefit plans, home equity and so forth. If this other wealth is perfectly correlated with 401(k) wealth, then the results would be identical to the case in which considered only 401(k) wealth. To the extent that some of this wealth is uncorrelated, such as Social Security wealth, it increases one's tolerance for risk within the 401(k) plan. To illustrate the quantitative importance of this, we report the risk aversion coefficient assuming the individual has additional uncorrelated wealth ranging from 0 to \$1 million. As shown in figure 2, the indifference risk aversion level is linear with the level of other wealth. For our base case scenario, we find that individuals working for a company with the risk characteristics of our stylized median choice firm would prefer company stock to choice only if their risk aversion level was 1.5 or lower if they have no other uncorrelated wealth. At \$1 million of uncorrelated wealth, the risk aversion level rises to 4.

In interpreting these results, it is important to note that the level of uncorrelated wealth

may differ between individuals across match policy assumptions. For example, as shown earlier, individuals in companies whose 401(k) plan matches in company stock are more likely to also have a defined benefit plan. By comparing our match and choice assumptions at equivalent levels of uncorrelated wealth, we may in fact be biasing these calculations against the company stock match.

Moving across the columns of table 10, we are able to compare how the results are affected by the fact that firms with a company stock match differ from choice match firms in terms of their risk characteristics. In particular, the second set of results shows what happens when one takes into account the fact that companies who match in company stock have lower idiosyncratic risk than choice companies, holding the Fama-French betas constant at the level of the choice firms. This reduction in idiosyncratic risk for the company stock match firms makes the company stock match even more attractive by improving the outcomes in the lower part of the distribution. As a result of this improvement of the worst outcomes, the cross-over point in the distributions moves down to the 18.1 percentile, so that the wealth distribution resulting from the company stock match now beats the choice match distribution 81.9% of the time. And because the distribution has tightened up, the indifference level risk aversion parameter increases accordingly. For example, with \$250,000 in uncorrelated wealth, individuals with a CRRA of 4.8 or below would prefer a 401(k) in the company stock matching firm.

The next set of columns allows the systematic risk to differ, but keeps the idiosyncratic risk the same. Relative to the initial case, the change in systematic risk slightly improves the outcome for company stock match relative to choice match, although the difference is not nearly as substantial as the difference in systematic risk. The final set of columns shows the combined effect, where we allow choice companies to have both the systematic and idiosyncratic risk of choice companies, and allow company match firms to have their own characteristics. In this case, the company stock distribution beats the choice distribution everywhere above the 12th percentile of the distributions. As expected, the indifference level of risk aversion rises accordingly, to 6.4 with wealth of \$250,000. The major take-away from this table is that most of the “advantage” from company stock firm characteristics arises from the differences in idiosyncratic risk; very little advantage derives from difference in betas.

These simulated account balances for the “median” firms suggest that the superior performance of the retirement portfolio at company stock match firms is generated primarily

from the fact that more contributions are directed toward higher-yielding assets. That is, more of the assets are invested in company stock, whether desired or not, at firms that match in company stock, which implies that less is invested in lower-yielding assets. In addition, there is an additional boost to performance because unrestricted match firms have higher idiosyncratic risk, which increases the likelihood that the portfolio balance at these firms will fall below the balance at company stock match firms. Of course, these results, while useful for showing the relative contribution of systematic and idiosyncratic risk, overstate the superiority of a company stock match because of the manner in which we constructed our hypothetical median firm characteristics. Thus, we now turn to an analysis of the full set of companies.

3. Simulated account balances based on individual firm characteristics

To construct table 11, we run the simulation exercise for each of our 574 choice companies and each of our 293 firms who match in company stock. For each firm, we simulate 100,000 outcomes and sort them into a distribution from lowest to highest account balance at age 62. In order to make our comparisons in table 11, we then compare, for example, the median across firms of the 1st percentile of choice firms to the median of the 1st percentiles of company stock firms.

In column (1), we repeat our base case scenario from the previous section, in which we assume a simple 1/n rule for own-account contributions, and no administrative costs. The results indicate account balances from choice firms are larger than the account balances from company match firms 30.5% of the time. In the upper 70.5 percent of the distribution, however, an account with the company stock match firm beats the choice firm. The indifference level of risk aversion when there is \$250,000 of additional wealth is approximately 3.

In column 2, we add administrative costs, which would make company stock even more attractive since it is generally thought to have very low or zero costs, while other investment options have higher costs. We assume zero costs for company stock, 20 basis points for money market, 38 basis points for bond funds, 10 basis points for broad-based equity fund, 60 basis points for a small cap stock fund, and 51 basis points for a blended 50/50 equity/bond fund. These assumptions are in line with costs reported in a study for the Committee on Investment of Employee Benefit Assets (CIEBA).¹⁵ As expected, the lower relative costs of company stock

¹⁵ These costs are slightly lower than the costs assumed in Samwick and Skinner (2003) which are 92, 71, and 42

makes the company stock match even more preferred. The company stock match portfolio underperforms the choice match only 27.7 percent of the time; at the 1st percentile, the balance at the company stock match firm is \$21,000 less than the \$124,000 balance at the choice match firm. Participants with a CRRA up to 2.0 now prefer the match, even when there is no outside wealth. As outside wealth increases, the preference for company stock becomes even greater (see figure 2).

The next two scenarios incorporate the indirect effects of a company stock match policy that were discussed in Section IV. Scenario 3 recognizes that the employer match in company stock leads participants to increase their own voluntary purchases of company stock, and scenario 4 makes the additional assumption that firms that match in company stock typically offer one fewer alternative investment choice in their plan. These indirect effects lead on balance to greater purchases of company stock. The incorporation of these effects, even jointly, does not change the basic result that most reasonably risk tolerant participants would still prefer the company stock match. However, while the additional company stock raises the mean account balance (from \$1,182,000 in scenario 2 to \$1,266,000 in scenario 4), it also slightly raises the risk that the portfolio will underperform the choice match portfolio (from 27.7 to 30.5 percent). Thus, the net effect of these additional effects is to reduce the utility of participants, but not by much.

One concern about these simulations is that we have used historical returns to characterize expected returns. There are numerous reasons to believe that the equity premium has fallen, and that the equity premium going forward may be lower than it is today. (Fama and French, xxxx; Blanchard, xxxx; Campbell 2001; Diamond 2001). To account for the possibility that the equity premium will be lower in the future, we reduce the historical gap between the equity return and Treasury bill rate of approximately 8 percentage points to approximately 4 percentage points for our simulations.¹⁶ Campbell (2002) and Diamond (2002) have argued that an equity premium going forward of about [3 to 5] percentage points appears reasonable.¹⁷

basis points for equity, long-term bond, and short-term bond assets, respectively. Using higher costs will only increase the advantage of company stock relative to these alternative assets.

¹⁶ In a similar exercise, Samwick and Skinner (2003) reduce the equity premium by only 2 percentage points.

¹⁷ The equity premium reduction of 32.5 basis points per month is applied to all equity instruments, including large cap, small cap, company stock, and the equity portion of the balanced fund. We have not altered the return on money market or bond investments, even though in general equilibrium one might expect these returns to change if the equity premium is reduced.

This 4 percentage point cut dramatically reduces expected retirement account balances, and more so for company stock match firms since a larger part of their holdings are in equities. The median balance for the company stock match firms is \$237,000 (versus \$468,000 before the change), just about equal to the balance for the choice match firm of \$236,000. As has been the case, the mean balance for the company stock match firm of \$518,000 still exceeds that for the choice match firm balance of \$452,000. In this scenario, the company stock match exceeds the choice match 51.4 percent of the time. The indifference level of risk aversion with no additional wealth falls from 1.9 to 1.3, suggesting many participants will no longer prefer the company stock match. However, when additional uncorrelated wealth of \$250,000 is assumed, the CRRA bounces back to 2.4, suggesting that participants do not need huge amounts of outside wealth to once again prefer the company stock match.

A second important omission from our simulations thus far is the possibility of bankruptcy of one's employer. Indeed, it was the bankruptcy of firm's like Enron that precipitated much of the public policy interest in the question of firm match policy in the first place. To address this, we introduce a bankruptcy probability at a monthly rate of 0.1 percent for all firms. We base the 0.1 percent monthly rate on an aggregate business failure rate for 1990 to 1997 reported by Dunn and Bradstreet (they stopped reporting this rate in 1998), and it also roughly matches an average corporate bond default rate of 1 to 1.5 percent per year. However, because we currently give *every* firm a 0.1% bankruptcy rate – meaning that we set company stock account balances equal to zero for the worst 0.1% of return draws for that company – and do not relate the bankruptcy rate to firm characteristics (e.g. stock volatility), we currently bias this calculation *against* firms that match in company stock, because these match firms tend to be larger, well established firms with lower stock volatility.

As shown in column 6 (moving the equity premium back up to its historical level), the reductions in the mean and median account balances from random bankruptcy are notable, but not as severe as those from reducing the equity premium to 4 percentage points. However, the distributions remain considerably wider since equity returns have not been suppressed. As a result, balances for the company stock match portfolio beat the choice match portfolio less than half the time – 44.8 percent of the time. The indifference CRRA level drops to 1.0 (log utility). And it takes a significant amount of wealth (\$500,000) to get the CRRA coefficient back up to a level (1.7) comparable to the base case with zero wealth.

The final simulation combines these last two worst-case scenarios – jointly reducing the equity premium and allowing random bankruptcy. As expected, the company stock match portfolios perform worse than when considering the effects together. In over 60 percent of the cases, the company stock match portfolio loses out to the choice match, suggesting that the likelihood of a bad outcome is quite high. Recall that in the base case with administrative costs, the likelihood of a company stock match losing out is only about 28 percent. This underscores that the primary source of risk to company stock match policies is the risk of corporate bankruptcy.

On balance, these simulations suggest that under many alternative realistic situations, reasonably risk-tolerant participants would prefer the company stock match portfolio to the choice match. This conclusion is not because participants prefer to surrender their ability to optimize their portfolio along a risk-return frontier. Rather, it reflects that participants follow naïve diversification rules in making investment decisions and then rarely rebalance their accounts. Thus, a match in company stock leads participants to hold more equity-type instruments in their accounts. When given the choice to invest the match as they choose, participants appear to direct more of their investments to money market and Treasury bonds, and these assets have historically yielded far lower returns than equities. Under the simulations that the equity premium going forward will be much smaller than its historical average, fewer participants prefer the company stock match, but our assumptions are extreme. Only when we consider both a cut in the equity premium and random bankruptcy does the company stock match become undesirable for most participants.

4. Do firms choose the appropriate match policy?

Our earlier results suggest that the choice of employer match policy is negatively related to firm stock price volatility and is more likely if the firm also offered additional retirement benefits in the form of a DB plan. We hypothesized that these effects owed to fewer concerns by these firm that participants would have inadequate retirement wealth. We use our simulations to explore this result further by considering several “counterfactual” scenarios. For example, we test whether account balances at choice firms are higher with choice than with the company stock match for these same choice firms. Similarly, we compare the distribution of outcomes for company stock match firms with the match to these same companies under an assumption of

choice. The point of these comparisons is to see if firms appear to choose the “right” employer match given their characteristics.

We do this counterfactual exercise for scenarios 1, 4 and 7 from the prior section. Recall that scenario 1 was a base case with no administrative costs and no indirect effects of match policy on own contribution allocations. Scenario 4 included administrative costs and indirect effects, while scenario 7 adds to scenario 4 the reduced equity premium and the bankruptcy risk. For each scenario, we first simulate balances for choice match firms, allowing an unrestricted match (column 1), but then requiring that it make its employer match in company stock (column 2). Similarly, we simulate balances for company stock match firms, allowing a company stock match (column 3), but then requiring that it make an unrestricted match (column 4).

In the first scenario, if the choice match companies had been forced to match in company stock, the lower 51 percent of the distribution would have worse outcomes. Because over half of the outcomes are worse, this clearly suggests that these companies are, on average, correct not to force the match in company stock. In contrast, the companies that actually do match in company stock end up with higher account balances nearly 60% of the time. This evidence is at least consistent with the notion that companies are selecting their match policy in a manner that takes into account the risk/reward trade-off for their employees. Similar results are found with the scenario that includes both administrative costs and indirect effects.

Once one jointly considers the substantially reduced equity premium and the risk of bankruptcy, it is clear that the typical choice firm is making the right decision to offer choice. However, the evidence also suggests that the median company stock firm is forcing employees into a inferior distribution for all but the most risk tolerant employees. While the cost of forcing employees into company stock is less costly for the firms that actually do it than for the choice firms, it is nonetheless the case that, once one incorporates a reduced equity premium and the risk of bankruptcy, the comparison of the distributions is highly unfavorable to the company stock match.

On net, the evidence is consistent with the idea that firms are, at least in part, sorting themselves based on how the match policy decision affects the distribution of employee retirement wealth. In all scenarios, the decision to match in company stock is a better decision for those that actually do match in company stock than it would be for those who currently provide choice.

V. Summary and Implications

Employers must trade-off a number of costs and benefits that arise from requiring that employees hold their 401(k) match in company stock. This paper provides what is to our knowledge the first evidence on which of these costs and benefits appear to matter most to firms. We find substantial evidence that firms consider the cost side of the equation, namely, the additional risk that portfolio concentration poses for plan participants. As such, firms with lower stock price volatility, and firms that also offer defined benefit retirement plans, are more willing to provide their match in company stock. Further, firms that both offer a defined benefit pension and whose match is less concentrated are significantly more apt to match in company stock. We interpret these findings as consistent with firms considering the effect of match policy on the retirement security of plan participants, either due to a lower risk of the plan sponsor being considered in violation of its fiduciary responsibility or due to simple market forces (employees at riskier firms without DB plans are less likely to fully value a match in company stock).

On the benefit side, we find that an employer match is more likely if the firm is in a position to take advantage of a tax benefit for dividends paid on stock in leverage ESOP plans. Cash flow constraints do not appear to be an important explanation, nor do we find strong evidence that the match is provided to achieve benefits from more employee ownership.

Using empirically justified parameterizations, we also simulate account balances at retirement under alternative scenarios. In particular, we assume investment rules based on observed behavior, such as the assumption of naïve $1/n$ behavior and infrequent rebalancing of their accounts. These rules led to contributions and assets shares that closely approximate reality. As a result, the superior performance of company stock match firms owes largely to the greater share of assets in equity securities at these firms, which have historically yielded higher returns than the other investment options. Some additional boost to performance of company stock match firms owes to their lower idiosyncratic risk as well as lower administrative fees for company stock relative to other assets. Finally, because these firms are more likely to provide other benefits as well, all but the most risk averse participants would prefer this portfolio to one offered at a match firm.

A match in company stock rather than an unrestricted match (which is distributed equally across investment options) yields higher expected account balances at retirement age, but it has a

much wider distribution. In most scenarios, there are much greater odds that account balances at a company stock match firm will be greater than the realization at a choice match firm. Only when random bankruptcy and a substantially lower equity premium are incorporated jointly are the odds unfavorable. The implied level of risk-aversion required for an employee to prefer the company stock to the unrestricted match that is invested equally across seven investment choices is generally in the range of 3 to 4, assuming the individual also has additional uncorrelated wealth (such as Social Security) of \$250,000, except when a reduced equity premium and bankruptcy are considered, in which case it drops below 2. If we also allow for higher outside wealth that is not correlated with 401(k) assets, such as from private savings, Social Security, or another retirement plan, the indifference level of risk-aversion is even higher, and comfortably within the range of plausible measures of risk-aversion.

Consistent with our empirical work on the fact that firms consider the costs to employees, we find evidence in our simulations that firms, on average, appear to sort themselves into match policy in part based on the implications for participant retirement wealth. That is, the expected distribution of retirement wealth at firms that require the match in company stock dominates the distribution simulated under the assumption that the same firms provide a cash match. This result suggests that across-the-board limitations on company stock match may not be appropriate for all firms.

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Table 1: Sample Composition

Data collected for all U.S. companies listed in Compustat any year from 1993 to 1999 that filed an 11-k at least once during 1994-2001. See text for further details.

Year	Number of observations	% that Require All Match be in Co. Stock	Number of years in sample	Number of firms	Number of observations
1991	49	55.1%	1	195	195
1992	174	53.4%	2	204	408
1993	288	48.6%	3	179	537
1994	338	42.9%	4	113	452
1995	432	39.1%	5	84	420
1996	537	37.1%	6	73	438
1997	597	35.0%	7	63	441
1998	635	31.7%	8	29	232
1999	89	46.1%	9	4	36
2000	40	62.5%	10	2	20
TOTAL	3179	39.3%	TOTAL	946	3179

Table 2a: Characteristics of 1998 Sample, S&P 1500, and Public Firms

Data are from Compustat. Mean market value and employees are reported in first row, 10th percentile – median – 90th percentile are in second row. Public firms include 7,501 U.S. firms.

	1998 Sample	S&P 1500	Public Firms
Market Value (\$ millions)	5,435	7,283	2,438
	69 – 734 – 9,574	238 – 1,329 – 14,211	26 – 192 – 3,260
Employees (000s)	13.1	19.9	5.4
	0.5 – 4.3 – 30.3	0.9 – 6.6 – 45	0.02 - 0.5 – 10.2
Member of S&P 1500 (%)	51	100	20
Technology Sector (%)	15	19	24

Table 2b: Aggregate 401-k Plan Assets and Contributions for 1998 Sample, Public Firms, and All Firms

Data on 401-k assets for public firms are from 1998 5500 filings with the Department of Labor. Data for all firms (public and private) are estimated by the Department of Labor. Company stock for public firms and all firms excludes stock indirectly held in trusts and pooled accounts. Employer contributions constitute 30 percent of total contributions for the 1998 sample and 31 percent for all public firms.

	1998 Sample: 635 firms	Public Firms	All Firms
Total 401-k Assets (\$ billions)	264	698	1541
Total 401-k Assets in Company Stock (\$ billions)	97	273	273
Employee and Employer Contributions (\$ billions)	15.2	49.2	134.7
Contributions in Company Stock (\$ billions)	4.9	NA	NA

Table 3: Relationship between Match Policy and 401(k) Asset Allocation, Full Sample

***, **, * Significance at the 1 percent, 5 percent, and 10 percent levels, respectively.

	Mean			Median		
	Match All Co. Stock	Match Choice	Difference	Match All Co. Stock	Match Choice	Difference
% of Employee Contributions Invested in Company Stock	25.0	15.5	9.5***	19.9	11.3	8.6***
Percent of Total Contributions Invested in Company Stock	45.5	17.0	28.5***	43.8	12.2	31.6***
Percent of Total Contributions Required in Company Stock	28.1	1.8	26.4***	26.8	0.0	26.8***
Percent of Total Assets Invested in Company Stock	42.4	18.2	24.2***	39.7	11.7	28.0***
Percent of Total Assets Required in Company Stock	13.0	0.7	12.3***	10.1	0	10.1***
Ratio of Total Employer to Total Employee Contributions	46.0	52.8	-6.8	36.7	39.7	-3.0***
Percent of Total Firm Stock Held in 401(k) Plan	4.5	1.6	2.9***	2.9	0.8	2.1***
Percent of Total Firm Stock Used for 401(k) Contributions	0.56	0.20	0.36***	0.36	0.11	0.25***
Number of Investment Options Offered	6.8	8.0	-1.2***	6.0	7.0	-1.0***

Table 4: Relationship between Match Policy and Firm Characteristics, Full Sample

***, **, * Significance at the 1 percent, 5 percent, and 10 percent levels, respectively.

	Mean			Median		
	Match All Co. Stock	Match Choice	Difference	Match All Co. Stock	Match Choice	Difference
S&P 500?	35.0	21.9	13.1***	0.0	0.0	0.0
Firm Market Cap (\$ mil)	4191	4258	-67	1068	619	452***
Firm Assets (\$ mil)	8261	6828	1433	1469	900	570***
Total Employees (000s)	18.0	13.0	5.0	5.0	4.0	1.0***
Cash Flow / Assets	7.2	7.0	0.2	7.7	7.3	0.4
Market-to-Book Ratio	1.68	1.73	-0.06	1.30	1.33	-0.03
Pay Dividends?	70.6	57.5	13.1***	100.0	100.0	0.0
Dividend Yield	1.94	1.36	0.58***	1.57	0.63	0.94***
Defined Benefit Plan?	68.3	44.0	24.3***	100.0	0.0	100.0***
Total Monthly Volatility	9.3	10.2	-0.9***	8.2	9.5	-1.3***
Idiosyncratic Monthly Risk	8.5	9.5	-1.0***	7.3	8.8	-1.5***
Market Beta	0.86	0.88	-0.02	0.86	0.87	-0.01
Return Over Past 5 Years	137.4	177.0	-39.5*	95.0	92.8	2.6

Table 5: Regression of Match Policy on Firm Characteristics, Full Sample

Coefficient estimates (standard errors) from regressions of whether the employer match is required to all be in company stock on firm explanatory variables. The match policy regressions are estimated using firm-year observations where the employer made contributions to the plan. Standard error calculations in the pooled cross-section regressions allow for heteroskedasticity as well as correlation across observations of the same firm.

***, **, * Significance at the 1 percent, 5 percent, and 10 percent levels, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
Dividend Yield	3.30 ^{***} (0.97)				1.63 (1.40)	1.55 (1.40)
Defined Benefit Plan		22.3 ^{***} (3.3)			22.2 ^{***} (4.9)	22.0 ^{***} (4.9)
Stock return over past 5 years			-0.45 (0.28)	-0.38 (0.28)	-0.34 (0.32)	-0.31 (0.32)
Monthly standard dev. of returns			-126.2 ^{**} (57.4)		26.1 (69.5)	
Monthly idiosyncratic risk				-114.1 ^{**} (57.6)		36.8 (72.5)
Beta				-3.9 (3.5)		-1.9 (3.7)
S&P 500					7.7 (6.3)	8.1 (6.3)
Market-to-book ratio					0.6 (1.6)	0.6 (1.6)
Cash Flow-to-Assets					27.3 (21.5)	27.0 (21.3)
Log (Assets)					-1.2 (2.0)	-1.0 (2.1)
Log (Employees)					-2.1 (2.2)	-2.0 (2.2)
Dummies for Firm Age	No	No	No	No	Yes	Yes
Year effects	Yes	Yes	Yes	Yes	Yes	Yes
R ²	0.0359	0.0708	0.0257	0.0266	0.0723	0.0727
Number of observations	3,170	3,179	2,240	2,240	2,132	2,132

Table 6: Regression of Match Policy on Firm Characteristics, Focus on Broad Based Plans

Coefficient estimates (standard errors) from regressions of whether the employer match is required to all be in company stock on firm explanatory variables. The match policy regressions are estimated using firm-year observations where the employer made contributions to the plan. Other covariates include stock return over the past five years, monthly stock volatility, S&P 500 indicator, market-to-book ratio, cash-flow-to-assets ratio, log assets, log employees, and dummies for the age of the firm. Standard error calculations in the pooled cross-section regressions allow for heteroskedasticity as well as correlation across observations of the same firm.

***, **, * Significance at the 1 percent, 5 percent, and 10 percent levels, respectively.

	<i>Full Sample</i>			<i>Sample Restricted to Broad-Based DC and DB Plans (Participants in DC/DB Plan are at least 50% of Total Firm Employees), 1997 - 1998</i>		
	(1)	(2)	(3)	(4)	(5)	(6)
Defined Benefit Plan	22.3 ^{***} (3.3)	31.9 ^{***} (4.3)	34.7 ^{***} (5.5)	26.7 ^{***} (5.9)	40.9 ^{***} (11.3)	32.8 ^{**} (13.9)
Ratio of Match to Own Contributions		-0.6 (2.4)	0.1 (1.8)		-6.3 (4.0)	-12.0 ^{**} (5.1)
DB Plan* Ratio of Match to Own		-19.1 ^{***} (5.4)	-22.8 ^{***} (5.9)		-31.3 (22.3)	-24.8 (24.7)
Year Effects	Yes	Yes	Yes	Yes	Yes	Yes
Other Covariates	No	No	Yes	No	No	Yes
R ²	0.0708	0.0851	0.0935	0.0758	0.0933	0.1372
No. of observations	3,179	3,087	2,063	430	418	293

Table 7: Raw & Excess Stock Returns Surrounding a Change in Company Match Policy
Average monthly raw and excess stock returns (in percent) over period reported

There are 22 firms in the sample that switch their match policy from offering a match required to all be in company stock to offering a match with employee investment choice for all of the match (or vice versa), note the exact date of the switch in the 11-k filing, and have returns on CRSP for at least two years before and two years after the switch. Excess returns calculated from a four-factor model. Standard error reported in parentheses.

***, **, * Significance at the 5 percent, 10 percent, and 20 percent levels, respectively.

	Average Monthly Raw Return			Average Excess Monthly Return		
	Two years prior to change	Two years after change	Difference	Two years prior to change	Two years after change	Difference
Switched from choice to all stock (10 firms)	1.07* (0.63)	1.18 (0.96)	0.11 (1.06)	0.11 (0.79)	0.53 (0.72)	0.42 (1.05)
Switched from all stock to choice (12 firms)	0.41 (1.01)	2.18*** (0.90)	1.77* (1.29)	-0.86 (0.68)	2.50* (1.71)	3.36* (2.02)
Difference	0.66 (1.19)	-1.00 (1.31)	-1.66 (1.67)	0.97 (1.04)	-1.97 (1.86)	-2.94 (2.28)

Table 8: Regression of Percent of Own Contributions in Company Stock, Money Market, and Other Options on Plan Characteristics, Past Asset Returns, and Firm Characteristics

Coefficient estimates (standard errors) from regressions of the percent of employee contributions allocated to various investment options on pension plan characteristics, past asset returns, and firm characteristics. Standard error calculations in the pooled cross-section regressions allow for heteroskedasticity as well as correlation across observations of the same firm.
 ***, **, * Significance at the 1 percent, 5 percent, and 10 percent levels, respectively.

<i>Variable</i>	Percent of Own Contributions in Company Stock		Percent of Own Contributions in Money Market		Percent of Own Contributions in Other Options			
					Average per option		Other options in total	
Match required to be in company stock?	8.1***	6.9***	-2.9***	-2.8***	-1.6***	-1.2***	-5.5***	-4.2***
	(1.2)	(1.3)	(0.9)	(1.1)	(0.4)	(0.4)	(1.2)	(1.3)
1 / # of investment options	79.8***	98.3***	84.6***	52.5***	82.4***	77.9***	-177.0***	-167.6***
	(8.6)	(12.4)	(7.5)	(10.7)	(4.3)	(5.2)	(7.5)	(10.0)
Safest option is GIC (rather than money market)?			10.3***	11.2***				
			(0.9)	(1.1)				
Monthly standard deviation of past stock returns		-33.8**		27.8**		5.6		17.8
		(14.5)		(13.2)		(5.1)		(15.1)
Own Company Stock return over past five years		0.5		-0.1		-0.1		-0.4*
		(0.3)		(0.1)		(0.1)		(0.2)
Value-Weighted Market return over past five years		-1.1		-4.8***		0.5*		5.2***
		(0.9)		(0.9)		(0.3)		(1.0)
Treasury Bill return over past five years		-24.7**		78.8***		-12.5***		-49.4***
		(11.6)		(9.5)		(4.3)		(10.5)
Gov't Bond return over past five years		-0.6		2.7*		0.8		-2.1
		(1.6)		(1.4)		(0.6)		(1.7)
Market-to-book ratio		1.3***		-0.1		-0.5***		-1.0**
		(0.4)		(0.4)		(0.2)		(0.5)
Log (Assets)		2.6***		0.8**		-0.8***		-3.4***
		(0.4)		(0.4)		(0.1)		(0.4)
Constant	3.1**	-9.1**	0.8	-21.0***	2.0***	10.9***	92.9***	124.3***
	(1.3)	(3.9)	(1.1)	(3.9)	(0.6)	(1.5)	(1.3)	(4.3)
R ²	0.1830	0.3059	0.2729	0.3707	0.4766	0.5082	0.3339	0.4959
Number of observations	3,133	2,207	3,133	2,207	3,117	2,196	3,117	2,196

Table 9: Relation between Match Policy and Stock Return/Risk, Full Sample

***, **, * Significance at the 1 percent, 5 percent, and 10 percent levels, respectively.

	Mean			Median		
	Match All Co. Stock 293 firms	Match Choice 574 firms	Difference	Match All Co. Stock 293 firms	Match Choice 574 firms	Difference
Average Monthly Return (in %)	1.58	1.60	-0.02	1.51	1.53	-0.02
Average Monthly Excess Return (in %)	0.32	0.29	0.04	0.32	0.25	0.07
Market Beta	0.98	1.04	-0.06	1.01	1.02	-0.01
Size (small minus big) Beta	0.37	0.59	-0.22 ^{***}	0.28	0.50	-0.22 ^{***}
Book-to-Market (high minus low) Beta	0.47	0.53	-0.06	0.55	0.61	-0.06
Momentum (up minus down) Beta	-0.17	-0.18	0.01	-0.10	-0.12	0.02
Standard Deviation of Monthly Returns (%)	11.4	13.0	-1.6 ^{***}	9.9	11.9	-2.0 ^{***}
Monthly Idiosyncratic Risk (in %)	10.1	11.6	-1.5 ^{***}	8.6	10.7	-2.1 ^{***}

Table 10: Distribution of 401(k) Plan Assets by Match Policy, Median Firm Characteristics by Match Policy

	Same idiosyncratic risk and same systematic risk*		Different idiosyncratic risk and same systematic risk		Same idiosyncratic risk and different systematic risk		Different idiosyncratic risk and different systematic risk	
	<i>Choice</i>	<i>Co. Stock</i>	<i>Choice</i>	<i>Co. Stock</i>	<i>Choice</i>	<i>Co. Stock</i>	<i>Choice</i>	<i>Co. Stock</i>
% times have higher wealth	43.5	56.5	18.1	81.9	34.1	65.9	11.7	88.3
<i>Account Balance at Age 62 (\$000s)</i>								
Mean	1,137	1,936	1,137	1,987	1,137	2,054	1,137	2,048
1 st %	133	104	133	111	133	107	133	115
5 th %	174	143	174	156	174	147	174	162
10 th %	207	176	207	195	207	181	207	203
25 th %	295	270	295	310	295	281	295	327
50th %	494	512	494	608	494	539	494	648
75 th %	964	1,187	964	1,437	964	1,260	964	1,527
90 th %	2,045	3,091	2,045	3,597	2,045	3,265	2,045	3,785
95 th %	3,425	5,921	3,425	6,596	3,425	6,244	3,425	6,857
99 th %	10,529	23,542	10,529	22,075	10,529	24,152	10,529	22,628
<i>Constant Relative Risk Aversion such that Indifferent Across Match Policy, Additional Uncorrelated Wealth (\$000s)</i>								
0	1.5		2.6		1.8		3.2	
250	2.2		4.8		2.8		6.4	
500	2.8		6.9		3.7		9.5	
1000	4.0		11.0		5.5		15.7	

* Base case uses betas and idiosyncratic risk of firms that allow choice.

Table 11: Distribution of 401(k) Plan Assets by Match Policy, Actual Firms

	(1)		(2)		(3)		(4)		(5)		(6)		(7)	
	Base case		(1) plus administrative costs		(2) plus match in co. stock boosts own contr. to company stock		(3) plus firms that match in co. stock offer one less option		(4) plus lower equity premium by 0.325% per month		(4) plus risk of firm going bankrupt of 0.1% per month		(4) plus lower equity premium & bankruptcy risk	
	<i>Choice</i>	<i>Co. Stock</i>	<i>Choice</i>	<i>Co. Stock</i>	<i>Choice</i>	<i>Co. Stock</i>	<i>Choice</i>	<i>Co. Stock</i>	<i>Choice</i>	<i>Co. Stock</i>	<i>Choice</i>	<i>Co. Stock</i>	<i>Choice</i>	<i>Co. Stock</i>
% times have higher wealth	30.5	69.5	27.7	72.3	30.1	69.9	30.5	69.5	48.6	51.4	55.2	44.8	60.8	39.2
<i>Account Balance at Age 62 (\$000s)</i>														
Mean	963	1,226	895	1,182	895	1,246	895	1,266	452	518	958	1,088	417	456
1 st %	131	108	124	103	124	98	124	96	89	71	113	89	88	68
5 th %	172	151	162	143	162	139	162	137	110	93	149	123	108	87
10 th %	203	185	190	175	190	171	190	170	125	109	177	152	122	101
25 th %	285	279	266	264	266	263	266	260	161	150	251	227	157	136
50th %	465	494	432	466	432	469	432	468	236	237	417	403	225	211
75 th %	872	1,034	802	985	802	1,020	802	1,027	398	451	793	858	372	390
90 th %	1,805	2,301	1,655	2,201	1,655	2,316	1,655	2,348	775	927	1,694	1,953	711	828
95 th %	2,873	3,816	2,656	3,676	2,656	3,920	2,656	3,987	1,226	1,497	2,822	3,372	1,113	1,309
99 th %	8,135	12,274	7,624	12,097	7,624	13,090	7,624	13,451	3,571	4,867	8,806	11,281	3,194	4,168
<i>Constant Relative Risk Aversion such that Indifferent Across Match Policy, Additional Uncorrelated Wealth (\$000s)</i>														
0	1.8		2.0		1.9		1.9		1.3		1.0		0.7	
250	3.0		3.5		3.3		3.2		2.4		1.4		1.1	
500	4.0		4.9		4.6		4.4		3.4		1.7		1.4	
1000	6.1		7.6		7.0		6.7		5.5		2.4		2.0	

Table 12: Distribution of 401(k) Plan Assets by Match Policy, Actual Firms

	Base Case				Add Administrative Costs, and Both Indirect Effects				Also Add Lower Equity Premium and Bankruptcy Risk			
	Choice Firm		Co. Stock Firm		Choice Firm		Co. Stock Firm		Choice Firm		Co. Stock Firm	
	<i>Choice</i>	<i>Co. Stock</i>	<i>Choice</i>	<i>Co. Stock</i>	<i>Choice</i>	<i>Co. Stock</i>	<i>Choice</i>	<i>Co. Stock</i>	<i>Choice</i>	<i>Co. Stock</i>	<i>Choice</i>	<i>Co. Stock</i>
% higher wealth	51.0	49.0			49.1	50.9			74.2	25.8		
% higher wealth			40.6	59.4			36.8	63.2			67.9	32.1
% higher wealth	30.5			69.5	30.5			69.5	60.8			39.2

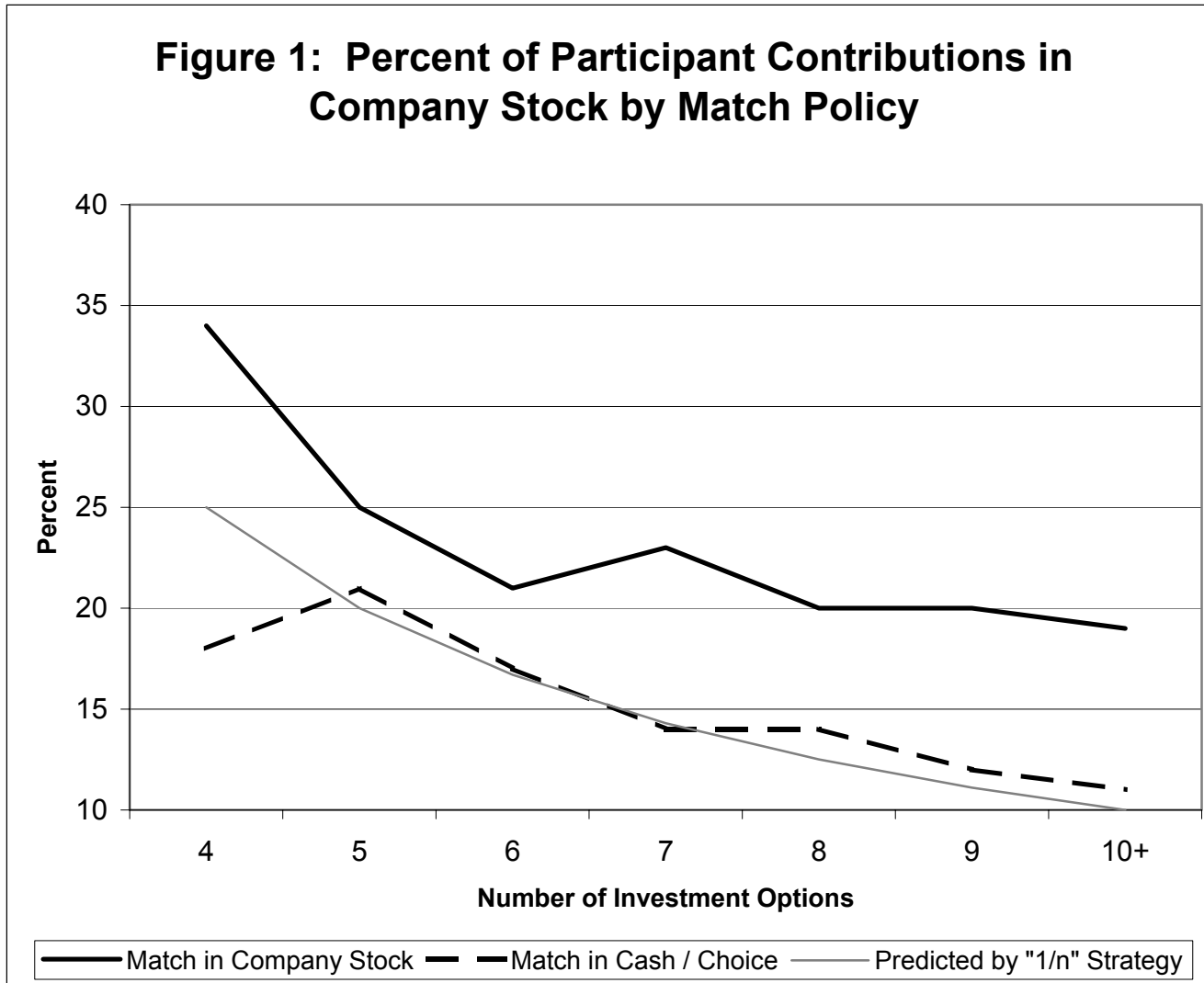
Account Balance at Age 62 (\$000s)

Mean	963	1,414	898	1,226	895	1,481	831	1,266	417	520	385	456
1 st %	131	102	135	108	124	89	127	96	88	66	90	68
5 th %	172	140	177	151	162	124	166	137	108	83	110	87
10 th %	203	169	209	185	190	152	197	170	122	96	125	101
25 th %	285	253	296	279	266	232	277	260	157	128	161	136
50th %	465	462	489	494	432	435	454	468	225	202	233	211
75 th %	872	976	883	1,034	802	958	817	1,027	372	375	379	390
90 th %	1,805	2,381	1,730	2,301	1,655	2,418	1,589	2,348	711	844	673	828
95 th %	2,873	4,281	2,668	3,816	2,656	4,493	2,433	3,987	1,113	1,501	1,014	1,309
99 th %	8,135	15,392	6,972	12,274	7,624	16,941	6,442	13,451	3,194	5,135	2,672	4,168

Constant Relative Risk Aversion such that Indifferent Across Match Policy, Additional Uncorrelated Wealth (\$000s)

	Choice Firm (choice vs. co. stock)	Co. Stock Firm (choice vs. co. stock)	Co. Stock Firm vs. Choice Firm	Choice Firm (choice vs. co. stock)	Co. Stock Firm (choice vs. co. stock)	Co. Stock Firm vs. Choice Firm	Choice Firm (choice vs. co. stock)	Co. Stock Firm (choice vs. co. stock)	Co. Stock Firm vs. Choice Firm
0	1.2	1.5	1.8	1.3	1.6	1.9	0.7	0.7	0.7
250	1.6	2.3	3	1.8	2.6	3.2	1	1.1	1.1
500	2	3	4	2.3	3.4	4.4	1.2	1.4	1.4
1000	2.7	4.4	6.1	3.2	5.1	6.7	1.7	2	2

Figure 1: Percent of Participant Contributions in Company Stock by Match Policy



“1/n” strategy is to invest 1/n of contributions in company stock, where n is the number of investment options in the plan.

Figure 2: Constant Relative Risk Aversion such that Indifferent Across Match Policy

