



ELSEVIER

Journal of Public Economics 90 (2006) 1315–1346

JOURNAL OF
PUBLIC
ECONOMICS

www.elsevier.com/locate/econbase

401(k) matching contributions in company stock: Costs and benefits for firms and workers

Jeffrey R. Brown^{a,b}, Nellie Liang^c, Scott Weisbenner^{a,b,*}

^aUniversity of Illinois, United States

^bNBER, United States

^cBoard of Governors of the Federal Reserve System, United States

Received 18 August 2004; received in revised form 2 May 2005; accepted 3 May 2005

Available online 7 July 2005

Abstract

This paper tests for important determinants of why some employers provide matching contributions for 401(k) plans in company stock. We find that firms that match in company stock have lower stock price volatility and lower bankruptcy risk and are also more likely to offer a defined benefit plan, consistent with a recognition that imposing a concentrated portfolio can be costly for employees. Evidence also indicates that firms match with company stock to help deter takeovers by putting stock into friendly hands. Simulation results suggest that while portfolio-optimizing employees are made worse off by having their match restricted to company stock, sufficiently risk tolerant employees who follow naïve investment strategies might prefer a 401(k) plan at a company with a company stock match to a plan at a company with an unrestricted match.

© 2005 Elsevier B.V. All rights reserved.

JEL classification: G11; J30; J32

Keywords: Pension; 401(k) plan; ESOP; Company stock; Match policy

* Corresponding author. University of Illinois-Department of Finance, 304C David Kinley Hall, MC-706, 1407 W. Gregory Drive, Urbana, IL 61801, United States. Tel.: +1 217 333 0872; fax: +1 217 244 9867.

E-mail address: weisbenn@uiuc.edu (S. Weisbenner).

1. Introduction

The desirability of allowing employers to require employer contributions in 401(k) plans to be held in company stock has come under scrutiny in recent years, largely in response to several high profile bankruptcies of companies that had a large fraction of plan assets invested in company stock. In response, numerous lawmakers have called for new regulations and restrictions on company stock ownership in 401(k) plans.¹

In part motivated by these events, a growing number of academic papers have begun to examine asset holdings in 401(k) plans in general, and the effects of employer match policy in particular. Recent research papers have examined the relative adequacy of retirement wealth for defined benefit versus defined contribution plans (Even and Macpherson, 2003a; Samwick and Skinner, 2004), the importance of plan design and employee inertia (Choi et al., 2001; Agnew et al., 2003), the effect of 401(k) match policy on employee purchases of company stock (Benartzi, 2001; Liang and Weisbenner, 2002), and the role of company stock in 401(k) portfolios (Mitchell and Utkus, 2004; Poterba, 2003; VanderHei, 2002).

Less well understood is why companies choose to provide their match in company stock in the first place. After all, standard portfolio theory suggests that there are potentially large welfare costs from holding company stock in defined contribution plans (Poterba, 2003, 2004; Meulbroek, 2002; Even and Macpherson, 2003b) because it exposes employees to idiosyncratic risk and introduces a positive correlation between labor income and retirement wealth. Presumably, there must be benefits of providing a match in company stock to offset the potential welfare costs, or else profit-maximizing companies would not compensate their employees in a form that may not be valued fully. At the individual level, one such benefit is the potential for preferential capital gains tax treatment of company stock relative to other 401(k) assets at retirement.² From the firm's perspective, a match in company stock has lower administrative costs, frees up cash for other uses, boosts employee ownership, and may reduce corporate taxes if the firm pays dividends. These potential benefits suggest that many firms might prefer to match with company stock, but these benefits have to be weighed against the potential welfare cost to employees due to a high concentration in company stock. Thus, firms that are less risky or provide other retirement benefits may be more likely to match in company stock, as the cost of a concentration of 401(k) wealth in company stock is lower for these types of firms. We test this cost–benefit tradeoff, providing evidence of how a company's decision to provide its match in company stock or to instead offer an unrestricted match is affected by company characteristics.³

¹ For example, Senators Boxer and Corzine introduced legislation that would place a 20% cap on the share of 401(k) plan balances invested in company stock.

² If the company stock is distributed in-kind as a lump sum, only the cost basis, not the market value, of the stock is taxed at the ordinary income tax rate. The net unrealized capital appreciation in company stock qualifies for the capital gains rate, which for many individuals is substantially lower than the ordinary income tax rate that applies to withdrawals of all other assets.

³ 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. Most large publicly-traded corporations offer company stock as an investment option while approximately one-third require that the match be held in company stock (Profit Sharing/401(k) Council of America, 2002).

Using a sample of all publicly traded companies that filed an 11-k statement with the U.S. Securities and Exchange Commission (SEC) from 1994 to 2001,⁴ we find that the firms that match in company stock are less risky, in terms of lower stock price volatility and a lower expected bankruptcy rate, than firms that offer an unrestricted employer match. In addition, we find that firms that have a defined benefit plan are significantly more likely to provide the match in company stock. These findings suggest that firms consider the costs of a company stock match on the retirement security of plan participants, either because firms want to minimize the chance of being considered in violation of their fiduciary responsibility under the Employee Retirement Income Security Act (ERISA) or because employees at these firms more fully value company stock because of the lower firm-specific risk.

On the benefit side, our results suggest that firms may match in company stock to put stock in “friendly hands” to help thwart takeovers. Specifically, firms with multiple classes of stock, which confer superior voting rights to management, are less likely to match with company stock. This reinforces the findings of Rauh (2003) who found that state takeover laws and the company stock holdings in defined contribution (DC) plans of firms incorporated in those states are substitutes. Learning which factors do *not* appear to explain variation in match policy is also valuable in understanding the match decision. We find little evidence that firms provide the employer match in company stock due to cash flow constraints or to increase employee ownership to better align incentives. This is in contrast to the literature that finds these factors to be important determinants of stock option grants to non-executive employees (Core and Guay, 2001). Nor do we find robust evidence that the corporate tax benefit associated with dividends paid on stock in leveraged ESOP plans promotes an employer match in company stock.⁵

Having established the determinants of match policy, we then confirm the findings of prior work concerning the effect of the 401(k) match on participant behavior. Consistent with past research (Benartzi, 2001; Liang and Weisbenner, 2002), we show that employees, on average, invest more of their own contributions in company stock when the employer matches with company stock, resulting in 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 that about two-fifths of this boost in company stock purchases comes from a reduction in contributions to the safest, lowest-return asset in the plan, typically a money market fund.

Using our data on firm characteristics and the effect of the employer match on employees' contributions, we 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 retirement security. We first demonstrate the well-known

⁴ As described further below, an 11-k 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.

⁵ 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.

fact that investors who follow an optimal portfolio allocation strategy are clearly made worse off by being exposed to excessive idiosyncratic risk of the employer stock. We also show, however, that the results differ substantially when we parameterize the simulations to reflect the available evidence that many 401(k) plan participants follow a naïve $1/n$ diversification heuristic (Benartzi and Thaler, 2001; Liang and Weisbenner, 2002), rarely rebalance assets (Samuelson and Zeckhauser, 1988; Ameriks and Zeldes, 2001), and invest more of own contributions in company stock when the match is in company stock (Benartzi, 2001; Liang and Weisbenner, 2002).

These simulations demonstrate the dual effect of matching in company stock—an increase in both the mean account balance and the variance of the distribution. The simulated account balances for “naïve participants” at retirement age indicate that, given the historical equity premium, sufficiently risk-tolerant participants would prefer a plan that offers a company stock match to a plan that offers an unrestricted match. A naïve investor’s preference for a plan at a firm with a company stock match rather than at a firm with an unrestricted choice match reflects two factors. First, firms that match with company stock have lower stock price volatility and lower bankruptcy risk than firms with a choice match. Second, given participant behavior, the effect of a match in company stock is to increase the share of assets held in equities and to reduce the share in lower-yielding and lower-risk fixed-income securities (e.g., money market funds and bonds). The assumed equity premium plays a key role in assessing the preference for a match in company stock. Imposing a four-percentage point reduction in the equity premium, i.e., cutting the historical premium in half, significantly reduces the risk aversion level at which participants would prefer the distribution of outcomes under a company stock match to an unrestricted match.

Although we find that participation in a 401(k) plan at companies that restrict the match to employer stock may lead to a more favorable distribution of outcomes for naïve investors than at choice companies, this finding is *not* meant to suggest that matching with company stock is optimal policy for the firms that do it. Portfolio concentration does not yield a mean-variance efficient portfolio, and even naïve participants would clearly be better off if the match were provided in a diversified equity portfolio. Rather, our results simply suggest that a participant’s distribution of retirement wealth may be improved by a company stock match only if his portfolio otherwise would have had too little invested in stock, either because he followed a $1/n$ investment rule or because he concentrated his investments in a lower-return portfolio. If companies that currently match in company stock would instead match in a diversified equity portfolio, participants would be even better off. However, a firm currently has little incentive to provide such a diversified match, as such a policy does not provide the firm with any of the benefits that accrue from restricting the match to employer stock (e.g., thwarting takeover attempts).

In addition, our results do not indicate that workers would want firms that currently provide an unrestricted match to switch to requiring that employer contributions be in company stock. Indeed, the higher risk of firms that offer an unrestricted match would substantially increase the variance of account balances if these firms were to switch match policy, and only the most risk-tolerant employees would prefer such a change.

Overall, the simulations show that while the restricted employer stock match is clearly sub-optimal, it may still be better than the alternative asset composition under a choice

match, particularly if participants stick with low-yielding default investment options (Choi et al., 2001). The results also show that the desirability of participating in plans that restrict the match versus those that do not depends importantly on the characteristics of the firms that provide the match.

The paper proceeds as follows. In Section 2, we discuss the potential costs and benefits of providing a match in company stock. In Section 3, we provide further details on the data. Section 4 presents our empirical analysis of employer match policy. Section 5 traces the effect of employer match policy on employee investment choices. We provide simulations of 401(k) account balances at retirement under alternative match policies in Section 6. Section 7 concludes and discusses policy implications.

2. The costs and benefits of matching in employer stock

The decision by a firm to provide a match in company stock involves a tradeoff between a number of potential costs and benefits. There are three 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. Rational employees would recognize that a match in company stock substantially increases the concentration of assets and therefore the volatility of their future retirement wealth and, as a result, would value a match in company stock less than a match in cash, which allows them to diversify their portfolio. Second, having a substantial part of one's retirement wealth concentrated in the stock of one's employer may result in a positive correlation between one's future labor earnings, or human capital, and retirement wealth. In other words, when an employer becomes financially distressed, employees risk simultaneously losing their job and suffering a decline in their 401(k) wealth. For both of these reasons, if the company stock match is not fully valued, companies might need to provide a larger match than if it were made in cash or increase other compensation. Third, 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 had provided a match in company stock.⁶

To the extent that these potential costs are important to the firm, one might expect that less risky firms—those with lower stock price volatility or bankruptcy risk—would be more likely to match with company stock because the additional risk imposed on workers is lower. In addition, a firm might not be as concerned about these costs if it also provides other retirement benefits, such as a defined benefit (DB) 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 participants have an additional asset that is largely uncorrelated with company stock performance, because DB plans are prohibited by ERISA to have more than ten percent of plan assets invested in company

⁶ Section 404(c) of ERISA generally relieves employers from liability for fiduciary error when the employer permits participants to exercise control over their retirement plan accounts. If a firm requires the match to be in company stock, however, the safe harbor provisions may no longer apply (Purcell, 2002).

stock. In addition, DB plans, unlike 401(k) plans, are insured by the Pension Benefit Guaranty Corporation (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.⁷ Thus, firms that provide DB plans, as well as firms that have less volatile stock, may feel less constrained in providing the employer match in company stock.

Firms must trade off these costs against several potential benefits from providing the employer match to 401(k) plans in company stock. One potential benefit for all participants is that only the cost basis—not the market value—of company stock is taxed at ordinary income rates at distribution. The net unrealized capital appreciation in company stock qualifies for the capital gains rate, which for many individuals is substantially lower than the ordinary income tax rate that applies to withdrawals of all other assets.⁸ Thus, after-tax retirement wealth will be higher, *ceteris paribus*, for a portfolio invested more heavily in company stock. Another direct benefit is a cost reduction for all firms, because 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. There are also other potential benefits to matching in company stock that likely vary across firms, which we now discuss.

First, 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, perhaps because of asymmetric information (Myers and Majluf, 1984). This argument would predict that firms with less excess cash flow and greater asymmetric information would be more likely to offer a match in company stock, consistent with the use of stock options (Core and Guay, 2001). Low cash flow firms may also be more likely to match in company stock because of less ability to raise funds via debt.

Second, for firms that pay dividends, there is a tax advantage to matching in company stock. Any contribution to a 401(k) plan, whether paid in cash or in company stock, is initially deductible from corporate income taxes. However, by making the contribution in the form of company stock, a dividend paying firm may be able to “double dip” by receiving a future tax deduction for all dividends paid on shares held within the plan *in addition* to the initial deduction for the value of the shares themselves. Specifically, while dividends paid on stock are not usually tax deductible, if firms contribute the employer match in company stock to a leveraged employee stock ownership plan (ESOP), dividends paid on that stock to repay debt may be tax-deductible (Beatty, 1995; Schultz and Francis,

⁷ There is also a statutory limit on the amount of benefits that the PBGC can guarantee. For plans with a 2004 termination date, the maximum guarantee is just under \$45,000 annually for a single life annuity at age 65.

⁸ The special tax treatment for company stock is defined in the net unrealized appreciation (NUA) rule. Under this rule, the distribution of stock must generally be as a lump sum, and must be made in-kind (i.e., in certificate form). If the stock is liquidated and taken in cash, or the stock is rolled into an IRA, then company stock does not receive the special tax treatment. Though the tax savings might be considerable, the distribution will generate an immediate tax bill and could move an individual into a higher tax bracket, and thus may not be a preferred strategy for all individuals.

2002; Iwry, 2003).⁹ Recent business press cites that such tax savings may be significant for some firms (Schultz and Francis, 2002). 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.

Third, a company stock match likely leads to a greater share of the firm being held by employees. As we will later document in Section 4.1, the average percent of total company stock held in the 401(k) plan is almost three times higher for firms that match in company stock relative to those that do not (4.5% and 1.6%, respectively). There are several potential advantages of greater stock holding by employees, including having stock in "friendly hands" to help protect the firm from hostile takeovers (Rauh, 2003). We also test for this motive by examining whether firms that have multiple classes of stock, and thus already have a mechanism to thwart takeovers (DeAngelo and DeAngelo, 1985), are less likely to have a company stock match. Firms may also encourage or mandate holdings of company stock because of the perceived benefits from aligning workers and stakeholders' interests (Jensen and Meckling, 1976; Demsetz and Lehn, 1985; Smith and Watts, 1992). Firms with greater monitoring difficulties, as measured by number of employees (Lazear, 1979, 1983), or greater noise in the operating environment, as measured by idiosyncratic risk (Demsetz and Lehn, 1985), might benefit more from aligning incentives. In addition, firms with a larger value in growth opportunities and intangible assets may benefit more from employee stock ownership due to the asymmetric information between insiders, i.e., employees, and outside shareholders (Holmstrom and Milgrom, 1987). As applied to our question, their model would predict that firms with higher market-to-book ratios would be more likely to offer a match in company stock (Smith and Watts, 1992).

A key objective of this paper is to determine which of these potential costs and benefits appear to be quantitatively important in explaining the cross sectional variation in employer match policy decisions. In the next section, we explain the data that we will use to undertake this analysis.

3. Data and sample characteristics

Our primary data source is collected from 11-k forms. Sponsors of 401(k) plans file an 11-k form with the SEC when the option to invest in company stock is deemed an offering of securities. We collect participant contributions to company stock, money market funds or GICs, and all other funds, the employer's match policy (i.e., whether restricted to company stock), employer contributions to company stock and all other assets, total plan assets, total company stock holdings, and the number of investment options. For the few firms with multiple plans, we collect data for the largest plan.

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. We were able to hand-collect data for 946 companies that offered a match to employee contributions, yielding 3179

⁹ While this benefit is not likely to encourage dividend payments, since most stock is held 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 in order to qualify for this deduction.

Table 1a
 Characteristics of 1998 sample, S&P 1500, and public firms

	1998 sample	S&P 1500	Public firms
Market value (\$ millions)			
Mean	5435	7283	2438
Median	734	1329	192
[10th %–90th %]	[69–9574]	[238–14,211]	[26–3260]
Employees (000s)			
Mean	13.1	19.9	5.4
Median	4.3	6.6	0.5
[10th %–90th %]	[0.5–30.3]	[0.9–45]	[0.02–10.2]
Member of S&P 1500 (%)	51	100	20
Technology sector (%)	15	19	24
Repurchase yield (% mean)	1.76	1.82	1.77

Data are from Compustat. The share repurchase yield is the amount spent to repurchase shares divided by the average of the beginning- and end-of-year market value. Public firms include 7501 U.S. firms.

firm-year observations. Most of the data are in the period 1993 to 1998, with the largest number of firms, 635, in 1998.¹⁰ On average, there are 3.4 observations per firm, with 42% of the firms with 2 observations or less and 58% of the firms with 3 or more observations. 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 1998.¹¹

Information on stock prices and return variance are from the Center for Research in Security Prices (CRSP) database. Other firm financial data, including market-to-book ratios, assets, employees, debt ratings, dividends, cash flow (operating income before depreciation) and details on defined benefit plans are from Compustat.

To characterize our sample, we focus on firms in the sample in 1998, a recent year with the largest number of firms. As shown in Table 1a, about one-half of the sample was a member of the S&P 1500 during 1998.¹² Thus, the typical firm in our sample is smaller, measured by both market value and employees, than the typical S&P 1500 firm, but is larger than the average of all public companies, as available from Compustat. The sample represents a broad cross-section of industries. As noted in the table, 15% of the sample is in the technology sector, somewhat less than the overall market.

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 possibility that the sample could be biased toward firms that do not repurchase stock. While data on plans that exclusively buy

¹⁰ 11-k filings are available on the SEC's EDGAR website starting in 1994. Companies were phased into filing 11-k reports over a three-year period ending in 1996, resulting in a sample size that increases steadily from just under 300 firms in 1993 (the 1994 filing reports plan activity during 1993) to 537 firms in 1996. While reporting plan activity in 1993, some of the 1994 filings report activity over 1992 and 1991 as well. Thus, we have 174 observations in 1992 and 49 observations in 1991.

¹¹ SEC Statement of Position 99-3 allows retirement plans to no longer report annual contributions broken down by fund starting in 1999.

¹² The S&P 1500 consists of the 1500 stocks that comprise the S&P 500 index, the S&P 400 MidCap index, and the S&P 600 SmallCap index.

Table 1b

Aggregate 401(k) plan assets and contributions for 1998 sample, public firms, and all firms

	1998 sample: 635 firms	Public firms	All firms
Total 401(k) assets (\$ billions)	264	698	1377
Total 401(k) assets in company stock (\$ billions)	97	207	207
Employee and employer contributions (\$ billions)	15	49	111
Contributions in company stock (\$ billions)	4.9	NA	NA

Data on 401(k) assets for all firms and public firms are from 1998 5500 filings with the Department of Labor for plans with participants of 100 or more (Table D9 of the 1998 Form 5500 Annual Reports). Public firms are defined as those that had CUSIPs and EINs that could be matched with Compustat. Company stock for public firms and all firms excludes stock indirectly held in trusts and pooled accounts; company stock for public firms assumes that company stock is held only at public firms. Employer contributions constitute 30% of total contributions for the 1998 sample and 31% for all public firms.

shares on the open market for the plan are not available, we document that repurchase activity by firms in our sample does not differ from that at other publicly-traded firms.¹³ Specifically, we find that roughly half of the firms in the sample repurchased stock in 1998 (just evidently not in conjunction with their retirement plan), and as shown in the bottom row of Table 1a, the share repurchase yield (an estimate of the fraction of shares repurchased) for the sample was 1.8%, similar to the yield for the S&P 1500 and all public firms.

We also compare our sample of plans to those at publicly-traded firms and all firms (public and private) as reported on Form 5500 filed with the Department of Labor (DOL).¹⁴ In the aggregate, for our sample of the largest plans at 635 companies in 1998, total plan assets were \$264 billion, representing 38% of plan assets at all publicly-traded companies and 20% of all plans (Table 1b). Total contributions by participants and employers for our sample totaled \$15 billion, about 30% of the \$49 billion for publicly-traded firms and 14% of all firms. In addition, company stock totaled \$97 billion, or 37% of plan assets for our 1998 sample. This is a bit higher than the 30% of 401(k) assets estimated to be held in company stock at all public firms, and likely reflects that not all public companies offer company stock in their 401(k) plan.

4. Empirical analysis of employer match policy

4.1. Summary statistics regarding 401(k) plans and employer match policy

As noted in the first row of Table 2, 39.3% of the 3179 firm-year observations required that the entire employer match be in company stock, comparable to the one-third reported by the Profit Sharing/401(k) Council of America (2002).¹⁵ Such a requirement has

¹³ In the uncommon event that the plan does not allow employees to purchase company stock but does provide the employer match in company stock, it would generally not be deemed an offer of securities, and the plan would not be required to file an 11-k. In our discussion with SEC staff, the onus is on the company to determine whether it needs to file an 11-k.

¹⁴ Publicly-traded companies in the DOL Form 5500 data set were identified by whether they had a CUSIP and matching EINs with those in Compustat.

¹⁵ Firms rarely change their match policy, as only 41 of 946 firms switched from an all company stock match to an unrestricted match or vice versa during the sample period.

Table 2
Relation between match policy and 401(k) asset allocation, full sample

	Mean			Median		
	Match all Co. stock	Match choice	Difference	Match all Co. stock	Match choice	Difference
Full sample 1991–2000 (3179 observations)						
(1) Percent of firm-year observations	39.3	60.7		39.3	60.7	
(2) Percent of employee contributions invested in Co. stock	25.0	15.5	9.5***	19.9	11.3	8.6***
(3) Percent of total contributions invested in Co. stock	45.5	17.0	28.5***	43.8	12.2	31.6***
(4) Percent of total contributions required in Co. stock	28.1	1.8	26.4***	26.8	0.0	26.8***
(5) Percent of total assets invested in company stock	42.4	18.2	24.2***	39.7	11.7	28.0***
(6) Ratio of total employer to total employee contributions	46.0	52.8	−6.8	36.7	39.7	−3.0***
(7) Percent of total firm stock held in 401(k) plan	4.5	1.6	2.9***	2.9	0.8	2.1***
(8) Percent of total firm stock used for 401(k) contributions	0.56	0.20	0.36***	0.36	0.11	0.25***
(9) Number of investment options offered	6.8	8.0	−1.2***	6.0	7.0	−1.0***

***, **, * denote difference is significant at the 1%, 5%, and 10% levels, respectively.

substantial consequences because, for a typical employee who contributes six percent of salary and receives a match of \$0.50 per dollar up to this limit, the match would account for one-third of the total (employee plus employer) contributions. However, match policy has an even larger effect because employees at firms with a match in company stock boost their own voluntary purchases, perhaps because they interpret the employer match as implicit investment advice that company stock is a good investment. Rows 2 through 8 of Table 2 assess the effect of match policy upon the concentration of company stock holdings in 401(k) plans.

In row 2 of Table 2, we show that participants at firms with the employer match in company stock allocated 9.5 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% of their total annual contributions being invested in company stock, compared to 17% at firms with an unrestricted match (row 3). Required company stock purchases account for 28% of total annual contributions, or three-fifths of the observed company stock purchases.¹⁶ Row 5 shows similar patterns in asset holdings, with 42% of plan assets held in company stock at firms with a restricted match, versus 18% at firms with an unrestricted match. Row 6 shows that the size of the employer match

¹⁶ The percent of total contributions required to be in company stock is non-zero for some firms with a choice match because about 10% of these firms also have a small profit sharing plan that when triggered (e.g., company profit targets are met) provides the employee with company stock. In other words, a small fraction of firms that allow choice in their main 401(k) plan may have a small additional plan that occasionally provides additional benefits in the form of company stock.

relative to employee contributions does not differ substantially across firms by match policy.

Rows 7 and 8 show that, as expected, firms that match in company stock have a significantly higher fraction of their total outstanding shares held inside the 401(k) plan. The amount of company stock held inside the 401(k) plan at company stock match firms averaged 4.5%, exceeding that for choice match firms by 2.9 percentage points. The annual purchase of company stock via employee and employer contributions represented nearly 0.6% of the shares of company stock match firms. Within 401(k) plans of firms with a restricted match, the number of shares held in the plans is comparable to the number of outstanding employee stock options held by non-executives (Core and Guay, 2001; Liang and Weisbenner, 2001). This suggests that when studying stock-based compensation to lower-level employees, incorporating stock received through the pension plan could be important.

The difference in the amount of stock held in 401(k) plans across match policy is of sufficient magnitude to help deter hostile takeover attempts. Shivdasani (1993) finds that the probability of a hostile takeover is significantly lower when a greater share of stock is held by affiliated stockholders (i.e., family trusts, company retirement plans, etc.); differences in ownership of affiliated holders amounted to four percentage points, 3.2% at firms that received a hostile takeover bid compared to 7.3% at firms that were not subject to a bid.

Row 9 shows that firms with a company stock match offer, on average, one fewer investment option to their plan participants. To the extent that participants follow naïve diversification rules (i.e., follow $1/n$ behavior), this would lead to a greater investment of employee contributions in company stock, which would be of potential value to managers interested in boosting the stock held in “friendly hands”.

4.2. Which factors matter? An empirical analysis of match policy

We are interested in determining empirically which potential costs and benefits are most relevant to the firm’s decision about whether to offer their match in company stock or cash. As shown in Appendix Table 1, firms that match in company stock generally have less volatile stock prices and idiosyncratic risk (as measured over the past 24 months) and are considerably more likely to also sponsor a defined benefit plan, have an investment-grade debt rating, and pay dividends. They are also less likely to have multiple classes of stock. To assess the quantitative importance of these factors and other firm characteristics in explaining firm match policy, Table 3 presents coefficient estimates from a regression of match policy upon these firm attributes. The first ten columns report univariate results one at a time (columns 1 to 10). Because many of these firm characteristics are correlated, we then turn to a multivariate analysis (column 11 of Table 3). Standard error calculations in all pooled cross-section regressions allow for heteroskedasticity as well as correlation across observations of the same firm (i.e., firm-level clustering). In columns 1 to 11 we estimate linear probability models to provide easy-to-interpret estimates of the marginal effects of firm characteristics on the choice of match policy. Column 12 reports the marginal effects (evaluated at the sample means) for a probit model.

Table 3
Regression of company stock match on firm characteristics (likelihood company stock match in percentage points)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Defined benefit plan?	22.3*** (3.3)										21.3*** (4.9)	24.7*** (5.5)
Std. dev. of returns		−130.2*** (48.4)									2.7 (69.1)	5.3 (79.9)
Idiosyncratic risk			−125.3*** (48.8)									
Beta			−1.9 (2.7)									
Investment grade debt?				18.1*** (3.6)							11.1** (5.6)	12.7** (6.2)
Cash flow-to-assets					8.6 (14.3)							
Maximum (CF/AS, 0)						33.1* (18.1)					51.4* (31.5)	56.8 (38.0)
Minimum (CF/AS, 0)						−20.2*** (8.0)					−10.8 (74.1)	−10.9 (78.0)
Dividend yield (in %)							3.3*** (1.0)				−1.0 (1.4)	−1.5 (1.7)
Market-to-book ratio								−0.5 (1.4)			0.4 (1.8)	0.7 (2.0)
Log (employees)									1.9* (1.1)		−1.1 (3.0)	−0.9 (3.7)
Multiple classes of stock?										−17.0** (7.0)	−15.0 (11.0)	−19.7 (12.1)
Past 5-year stock return											−0.3 (0.3)	−0.4 (0.5)
S&P 500?											4.9 (6.1)	6.1 (7.0)
Log (assets)											−4.3 (3.0)	−5.3 (3.7)
Dummies for firm age	No	No	No	No	No	No	No	No	No	No	Y, (p=0.09)	Y, (p=0.10)
2-digit industry effects	No	No	No	No	No	No	No	No	No	No	Y, (p=0.00)	Y, (p=0.00)
Model	OLS	OLS	OLS	OLS	OLS	OLS	OLS	OLS	OLS	OLS	OLS	Probit
R ²	0.0708	0.0311	0.0312	0.0521	0.0209	0.0246	0.0359	0.0208	0.0227	0.0261	0.2267	0.1605
# of observations	3179	2679	2679	3179	3098	3098	3170	3141	2993	3179	2089	2089

Regressions include year effects. Marginal effects evaluated at the sample means are reported for the probit model. Standard errors, listed in parentheses, allow for heteroskedasticity and correlation across observations of the same firm over time. ***, **, * denote significance at the 1, 5, and 10% levels, respectively.

The first four columns of Table 3 explore firm characteristics that are relevant to the “cost” of having a match in company stock. As shown in column 1, whether the firm already provides retirement benefits through a defined benefit plan appears to be very important.¹⁷ The estimated effect is positive and large in both the univariate and multivariate specifications, suggesting that firms that have a defined benefit plan are substantially more likely, by 21 to 22 percentage points, to require the match to be in company stock.¹⁸ This is consistent with the hypothesis that providing a DB plan significantly mitigates the risk to employee retirement wealth of having 401(k) plan assets concentrated in company stock.

Columns 2 and 3 show a significant negative relation between stock price volatility (measured over the past 24 months) and the probability of matching in company stock. In a multivariate setting, however, stock price volatility does not have a significant effect, suggesting that this lower volatility is not a major reason that these firms choose to match in company stock (column 11). A more robust finding is that firms with an investment-grade bond rating, as gauged by Standard and Poor’s, are 18 percentage points (11 percentage points in the multivariate setting) more likely to require the match in company stock (columns 4 and 11).

Turning now to the benefits of matching in company stock, we find no direct evidence that cash constraints are an important factor in setting employer match policy (column 5), as there is no direct correlation between cash flow (i.e., operating income before depreciation) and match policy. To explore this relation further, we split the sample into firms by whether cash flow is positive or negative, allowing the coefficient on cash flow to vary across these two types of firms.¹⁹ For the small segment of the sample (3.5%) that has negative cash flow, we find that the probability of a match in company stock increases as cash flow decreases (i.e., the coefficient is negative), possibly suggesting some role for cash constraints for a select minority of firms. However, this correlation is insignificant in the multivariate setting. Moreover, if cash flow is positive, the coefficient estimate is positive, indicating that higher cash flow *increases* the likelihood of a company stock match. *Ceteris paribus*, more profitable firms matching with company stock runs counter

¹⁷ One could envision a scenario in which firms face the choice of offering a 401(k) plan 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 some time and so we are not concerned with potential endogeneity of the DB plan variable.

¹⁸ The multivariate specification also includes dummy variables for whether the firm went public in the 1970s, 1980s, or 1990s (going public prior to the 1970s is the omitted category), and dummy variables for the firm’s two-digit SIC industry classification (the sample spans 66 distinct two-digit industries). The firm age variables are meant to control for differences in pension plan policy that may depend upon a firm’s age or legacy effects (e.g., DB plans were far more common 20 years ago, the accounting and tax treatment of ESOP plans has changed over time), while the industry variables loosely control for differences in worker characteristics across industries that may influence pension plan design. Both the firm age variables and the industry indicator variables are significant, with *p*-values of 0.09 and 0.00, respectively. For example, a firm that went public in the 1990s is 18.8 percentage points less likely to match with company stock than is a firm that went public in the 1970s or earlier, and firms in the telecommunications, utilities, and retail trade industries are more apt to match with company stock.

¹⁹ We also examined excess cash flow (cash flow less capital expenditures) and found qualitatively similar results.

to what we would expect if companies matched with stock because they were cash constrained and so had no other means to provide a match.²⁰

Consistent with Rauh (2003), we find little robust evidence to suggest that the tax-based motivation to match in company stock if dividends are paid is a significant determinant of match policy. In the univariate setting (column 7), coefficient estimates suggest that a one percentage point increase in the dividend yield is associated with a 3.3 percentage point increase in the probability that a firm's match is all company stock (the sample average is 39%). This variable, however, is highly correlated with measures of firm risk and the presence of a DB plan, and thus the estimate becomes less precisely measured and actually flips sign once these other variables are included in the regression.

There is also little evidence that motivations to boost employee ownership guide the match decision. The market-to-book ratio, a proxy for the presence of growth opportunities and intangible assets, is not statistically significant, while the coefficient on $\log(\text{employees})$ is only marginally significant on its own, with the coefficient flipping signs in the multivariate specification. Thus, the desire to align incentives and better monitor employees, as proxied for by these two variables, does not appear to be an important factor in explaining match policy.

Finally, the effect of multiple classes of stock is compelling, decreasing the probability of a match by 17 percentage points (column 10). This result is consistent with the presence of multiple classes of shares and boosting stock in "friendly hands" (i.e., through a company stock match) as being substitutes in preventing unwanted takeover attempts. While the estimated effect of multiple classes of stock is little changed, the coefficient loses significance in the multivariate regression (p -value=0.17). This "friendly hands" effect reinforces the findings of Rauh (2003) that were identified through legislative changes in the takeover environment.

As shown in column (12), the results obtained in column (11) are not model-dependent. The marginal effects of key variables are very similar across the linear probability and probit models.²¹

On balance, the coefficients suggest that firms may be concerned about the risk of company stock in retirement portfolios and/or the risk of being considered a poor

²⁰ This is not to say that cash flow is not an important determinant of whether a firm offers a 401(k) plan or a match at all, but only that it is not an important determinant of the type of match that is provided. Surveys suggest that cash flow constraints are an important determinant of providing 401(k) benefits to employees (see U. S. Department of Labor, 2001a,b), and studies have identified cash flow constraints as an important factor for terminating defined benefit pension plans (see e.g., Petersen, 1992).

²¹ In unreported results, we also find that a logit model yields very similar results. All the conclusions and statistical significance obtained over the full sample 1991–2000 also obtain in the sample period 1993–1998 when 11-k reporting requirements are more uniform. Throughout the regressions, the standard errors are calculated to allow for heteroskedasticity as well as correlation across observations of the same firm (i.e., firm-level clustering). Given that firms very rarely change match policy, this error-structure assumption is appropriate. We also considered alternative error structures. For example, allowing for correlation of observations within a year (beyond the inclusion of year dummies in the regression) instead of across firms yields smaller standard errors (i.e., more significant coefficients), as does assuming an AR(1) process for serial correlation of residuals within firms over time and allowing for correlations within a year. Thus, the error structure assumed in the regressions yielded the largest standard errors on the coefficients (i.e., the smallest t -statistics).

fiduciary, and thus provide the match in company stock only when employees have a fall-back retirement plan or when the firm is less likely to experience financial distress. These considerations appear to be traded off against a desire to place a greater share of stock in friendly hands, with little evidence to support other “benefit” side stories. Lower administrative costs and lower personal tax liabilities for company stock may also be important benefits, though these do not vary across firms. The implications of the lower risk and other sources of retirement income for employee welfare are examined in simulations of retirement wealth by match policy presented later in Section 6.

5. Effects of match policy on employee purchases

In this section, we examine the determinants of employee purchases of assets offered in the 401(k) plan, including 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. These results, along with results of other studies cited below, will be used to guide the parameterization of our simulations of retirement wealth. The results for employee purchases are displayed in Table 4. When the employer match is in company stock, the percent of employees’ own contributions allocated to company stock is seven to eight percentage points higher. 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. This result could also reflect that workers who prefer company stock tend to work for companies that provide their match with company stock. This higher share to company stock comes disproportionately at the expense of the safest asset; employees allocate three percentage points less to the money market/GIC fund when the employer matches in company stock. Thus, about two-fifths of the greater company stock purchases comes from a reduction in contributions to the lowest-return asset.

Also consistent with Benartzi and Thaler (2001) and Liang and Weisbenner (2002), the regressions indicate that $1/n$ is a significant predictor of average firm-wide purchases across all asset classes, where n is the number of investment alternatives. 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. While often significant, the relation between asset returns and contribution decisions is, in general, fairly weak, with the minor exception of past Treasury bill returns. For example, relative to a firm with a stock return of zero, a 50% increase in stock price over the past year is associated with only a 1.2 percentage point increase in the fraction of employee contributions allocated to company stock.²²

²² In a comparable regression, Benartzi (2001, Table 4) estimates a coefficient of 6.0 on past one-year returns, which suggests that a 50% increase in stock price would boost the allocation of employee contributions to company stock by three percentage points (nearly three times the effect we find). To more directly compare results, we estimate our regression focusing on the sample of firms examined by Benartzi (S&P 500 firms in 1993) and, indeed, find a similar coefficient of 5.2. Thus, regressions based on our larger sample indicate that the estimated effect of past returns on allocations to company stock is very time-sensitive.

Table 4

Regression of percent of employee contributions in company stock, money market/GIC, and other options on plan characteristics, past asset returns, and firm characteristics

Variable	Percent of employee contributions in company stock		Percent of employee contributions in money market/GIC		Percent of employee contributions in other options			
					Average per option		Other options in total	
Match required to be in company stock?	8.1*** (1.2)	6.5*** (1.2)	-2.9*** (0.9)	-2.8*** (1.0)	-1.6*** (0.4)	-1.2*** (0.4)	-5.5*** (1.2)	-4.0*** (1.2)
1/# of investment options	79.8*** (8.6)	88.5*** (10.4)	84.6*** (7.5)	69.7*** (9.0)	82.4*** (4.3)	80.7*** (4.8)	-177.0*** (7.5)	-172.6*** (8.2)
Safest option is GIC (rather than money market)?			10.3*** (0.9)	10.7*** (1.0)				
Monthly standard deviation of past stock returns		-32.4*** (12.7)		26.0** (11.7)		5.1 (4.4)		11.9 (13.1)
Own company stock return over past year		2.4*** (0.5)		-0.4 (0.4)		-0.4** (0.2)		-1.9*** (0.6)
Value-weighted market return over past year		4.7 (6.1)		-38.9*** (5.6)		8.8*** (2.5)		32.2*** (5.6)
Treasury bill return over past year		-43.5 (43.5)		142.6*** (50.7)		-61.2*** (25.0)		-100.1** (50.2)
Gov't bond return over past year		-4.4 (3.5)		22.9*** (3.1)		-4.2*** (1.3)		-17.6*** (3.4)
Market-to-book ratio		1.5*** (0.4)		-0.2 (0.3)		-0.4*** (0.2)		-1.1*** (0.4)
Log (assets)		2.6*** (0.3)		0.9*** (0.3)		-0.8*** (0.1)		-3.4*** (0.3)
Constant	3.1** (1.3)	-14.2*** (3.5)	0.8 (1.1)	-6.4* (3.6)	2.0*** (0.6)	9.7*** (1.5)	92.9*** (1.3)	116.4*** (3.9)
R ²	0.1830	0.2929	0.2729	0.3337	0.4766	0.5240	0.3339	0.4709
Number of observations	3133	2629	3133	2629	3117	2616	3117	2616

Coefficient estimates and standard errors (in parentheses) from regressions of the percent of employee contributions allocated to various investment options on pension plan characteristics, past asset returns, and firm characteristics. In the second set of columns, we relate employee contributions in the firm's lowest-return asset (typically a money market fund, or if not offered, a Guaranteed Investment Contract (GIC)) to plan and firm characteristics and past asset returns. Standard error calculations in the pooled cross-section regressions allow for heteroskedasticity as well as correlation across observations of the same firm.

***, **, * denote significance at the 1%, 5%, and 10% levels, respectively.

Past five-year Treasury bill returns are positively correlated with the percent of employee contributions allocated to the money market/GIC fund and negatively related with other investment options.

6. Does it matter? The effect of match policy on retirement wealth

Participants in plans that match with company stock end up with a portfolio that is highly concentrated in employer stock. While this often provides higher expected returns, it also entails substantially more risk. Indeed, recent studies (Poterba, 2003, 2004; Meulbroek, 2002; and Even and Macpherson, 2003b) have clearly shown that forcing individuals to hold an undiversified portfolio imposes significant costs on rational, portfolio-optimizing employees, and that such employees should be willing to pay a substantial premium to avoid this risk.

However, research also finds that when making investments, employees on average invest consistent with naïve $1/n$ diversification strategies, rarely rebalance plan assets, and tend to place more of their own contributions in company stock if the match is provided in company stock. These findings cast doubt on the extent to which the typical 401(k) participant is well characterized as a portfolio optimizer. Thus, in analyzing the effect of match policy on retirement outcomes, it is important to consider its effect on actual, and not just optimal, behavior. Our empirical results also indicate that firms that restrict the match have lower idiosyncratic risk, lower bankruptcy risk, and provide other retirement income through DB plans. Given these complexities, we turn to simulation methods to assess the effect of a restricted match, by comparing the distribution of wealth outcomes under alternative assumptions.

6.1. Simulation methodology

Our simulation approach is similar to that of Poterba et al. (2003), although our model is extended in several dimensions, the most important being the inclusion of employer stock in the portfolio. We assume that an individual begins contributing to a 401(k) plan at age 27 and contributes six 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 three percent of wages each year. The individual's lifetime wage path is taken from Munnell and Sunden (2003).²³

Consistent with our 11-k data, we assume that firms offer seven investment options (the median offering in our sample)—money market, long-term government bond, high-grade long-term corporate bond, a balanced fund (a monthly rebalanced 50/50 mix of

²³ The earnings path is composed of 1.1% average real wage growth, combined with an age-earnings profile of men and women born between 1926 and 1965. Salary at age 50 is set to \$44,000, the median wage earnings for a 50-year old covered by a pension plan in the 2001 SCF. For more details, we refer readers to page 30 of Munnell and Sunden (2003). We are extremely grateful to these authors for providing us with this data.

stocks and bonds), large-cap equities, small-cap equities, and employer stock. Based on our empirical results, we assume initially that participants invest their own contributions using a simple $1/n$ diversification heuristic.²⁴ Except where otherwise noted, we assume that when the company provides an unrestricted match the individual invests the employer match in the same $1/n$ manner as their employee contributions. The assumptions of $1/n$ allocations and seven investment options lead to one-half of annual employee and employer contributions directed toward equities and one-half toward fixed income securities at firms that match in cash. For firms that require a match in company stock, this leads to two-thirds of total (employer plus employee) contributions being directed toward equities and one-third toward fixed income. 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 later relax this assumption. These assumptions closely approximate the actual contribution and account balances that we observe by asset class in actual 401(k) plans. We assume that participants do not rebalance, which is consistent with previous research (Samuelson and Zeckhauser, 1988; Ameriks and Zeldes, 2001), and with many firms' prohibition against diversifying out of the employer match until certain age and service requirements were met.

To estimate retirement wealth, we need to specify processes for asset returns. Monthly returns to the major assets are reported in Ibbotson Associates (2002) from January 1927 through December 2001. The historical annual returns averaged approximately 12% for large-cap equities, 17% for small cap equities, 4% for money market (i.e., Treasury bills), just below 6% for long-term government bonds, and just above 6% for high-grade corporate bonds.

For each of the 420 months of an employee's simulated career, we make a single draw (with replacement) from the historical Ibbotson distributions of monthly returns, treating all asset returns and inflation as a "package". For this same historically drawn month, we record the returns of four "risk factor" portfolios (explained below) that are used to generate an expected return for each company stock in that month. This method retains all within-month, cross-asset correlations for all of our investment options, including employer stock. To compute the expected return for each company in our sample for a given month, we follow the standard approach in the finance literature of implementing a four-factor model, proposed by Carhart (1997).²⁵ Specifically, for each of the firms that had at least 24 months of stock returns over the period 1991–2001 and whose match policy did not change over the sample, we

²⁴ Aggregate evidence of $1/n$ portfolio diversification does not necessarily imply that each individual participant invests $1/n$ in every asset. Thus we also simulate outcomes for participants who would otherwise invest all of their own contributions in only one asset. Participants who otherwise would have invested *only* in a fixed-income security would benefit most from a company stock match because of the equity exposure and diversification gains (albeit very inefficient equity exposure). In contrast, for participants who otherwise would concentrate their investments in a small-cap equity fund, a company stock match is much less desirable due to the addition of idiosyncratic risk with little, if any, incremental return. These results are available in NBER working paper 10419.

²⁵ The four factor returns are taken from http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html.

Table 5
Relation between match policy and stock returns and risk

	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 (market minus risk-free rate) 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***

The average monthly excess return and idiosyncratic risk are calculated from a four-factor (i.e., market, size, book-to-market, and momentum) model proposed by Carhart (1997).

***, **, * denote difference is significant at the 1%, 5%, and 10% levels, respectively.

estimate the following regression of monthly stock returns from CRSP on the four factors.²⁶

$$R_{i,t} - R_{f,t} = \alpha_i + \beta_i^{mkt}(R_{m,t} - R_{f,t}) + \beta_i^{smb}(R_{small,t} - R_{big,t}) + \beta_i^{hml}(R_{high,t} - R_{low,t}) + \beta_i^{umd}(R_{up,t} - R_{down,t}) + \varepsilon_{i,t}$$

In words, the excess stock return (stock return less the risk-free rate) is regressed against the excess market return, the return of small capitalization minus big capitalization stocks (SMB), the return of high book-to-market minus low book-to-market stocks (HML), and the return of stocks that have risen the past eleven months minus those that have fallen (UMD). As shown in Table 5, average raw returns and excess returns computed from the four-factor model do not differ significantly across match policy. With the exception of the size factor, there is no difference in systematic risk across the two groups of firms. The SMB beta is significantly smaller for firms with a company stock match, reflecting that firms that match with company stock tend to be somewhat larger. However, 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.

²⁶ Of the original 946 firms, 41 had a change in match policy, 23 could not be linked with CRSP, and 15 were successfully merged with CRSP but did not have 24 months of returns, resulting in the final sample of 867 firms.

Each firm's estimated coefficients from this four-factor model are then applied to the randomly drawn factor returns in the simulation to generate an expected return for that month of the simulation for each firm. In order to convert each firm-month expected return into a "realized" return, we make a new random draw, this time from each company's error distribution, a normal distribution with variance based on the estimated variance of idiosyncratic risk ($\varepsilon_{i,t}$) of the firm.²⁷ These "realized" rates of return are then applied to existing account balances and new contributions. This process is repeated for each month that the individual is contributing from age 27 through age 61. We save the total account balance at age 62, and repeat this process 100,000 times for each of the 867 firms in our sample.²⁸

6.2. Simulation results: distributions of 401(k) account balances

In the first column of Table 6, we report the distribution of retirement account balances for the 293 companies that require that the match be held in the form of employer stock, where the individual's own contributions are made according to the $1/n$ rule. For each firm, we sort the 100,000 simulated final account balances at age 62 from lowest to highest, and then construct, for each point in the distribution, the median across the firms. Thus, the 1st percentile represents the median of the 1st percentile for the 293 companies, and similarly for the other reported points in the distribution. As can be seen, the distribution of outcomes is highly skewed. While the median account balance is \$494,000, the mean account balance is well over twice that amount, exceeding \$1.2 million. At the 1st percentile of the distribution the individual has only \$108,000 in retirement wealth, while at the 99th percentile, wealth is \$12.5 million.

Whether this wealth distribution is desirable or not depends on the alternative investment strategies available. We begin by demonstrating the well-known result that exposing an individual investor to a high level of idiosyncratic risk is clearly inferior to allowing them to hold a well-diversified portfolio (column 2). Specifically, while the investor in column (2) continues to allocate their non-match portfolio according to a $1/n$ heuristic, we show what would happen if the entire match were placed into a diversified equity fund rather than into employer stock. The diversified equity portfolio is represented by 75% from the S&P 500, and 25% from the small cap equity fund.²⁹

The "% higher wealth" reports the percent of the time that the individual has a higher wealth outcome under the restricted company stock match (col. 1) than under the diversified equity match (col. 2). The company stock match is preferred only 19% of the time, indicating that in the vast majority of cases the individual ends up with more retirement wealth by holding a diversified equity match. A comparison of the full

²⁷ The inclusion of the years 1997 to 2000, when realized stock returns were high, does not materially affect our estimates of expected returns (i.e., excess returns and betas). Estimating excess returns and betas using stock returns over the subsample 1991 to 1996 results in total and idiosyncratic risk that are a bit lower, but the difference in risk across match policy is quite similar to that estimated using the full sample of returns.

²⁸ We found that 100,000 simulations is sufficient for the distribution of account balances to stabilize.

²⁹ The S&P 500 represents approximately 75% of total U.S. market capitalization, small stocks represent less than 10%, while mid-caps represent the remainder. Because historical mid-cap returns are not available, we chose a 75/25 portfolio to illustrate the cost of holding an undiversified portfolio.

Table 6
Distribution of 401(k) plan assets by match policy and firm characteristics

	Base case	Vary match policy for same firms		Vary firm characteristics	Vary match policy and firm characteristics
		Diversified equity match	Naïve diversification		
	Co. stock firm and Co. stock match (1)	Co. stock firm and diversified match (2)	Co. stock firm and choice match (3)	Choice firm and Co. stock match (4)	Choice firm and choice match (5)
% higher wealth with base case	–	19	59	89	70
<i>Account balance at age 62 (\$000s)</i>					
Mean	1240	1042	908	1427	974
1st %	108	128	134	102	131
5th %	151	181	177	140	172
10th %	185	222	209	169	203
25th %	280	333	296	253	285
50th %	494	579	490	462	466
75th %	1036	1079	887	980	880
90th %	2299	2058	1736	2383	1815
95th %	3804	3138	2660	4380	2867
99th %	12,533	7760	7104	15,419	8062
<i>Constant relative risk aversion such that indifferent across firms and/or match policy</i>					
Uncorrelated wealth (\$000s)		Prefer co. stock match if $CRRA < X$	Prefer co. stock match if $CRRA < X$	Prefer co. stock firm if $CRRA > X^*$	Prefer co. stock match if $CRRA < X$
0	–	0.6	1.5	0.6	1.8
250	–	0.7	2.3	0.6	3.0
500	–	0.8	3.0	0.7	4.0
1000	–	0.9	4.4	0.8	6.1

Source: authors' calculations as described in text. * Note that the inequality of the utility comparison is reversed for column (4), signifying that, conditional on a company stock match, more risk-averse individuals prefer the company stock match firms to the choice firms due to their lower idiosyncratic risk.

distribution of outcomes (col. 1 vs. col. 2) illustrates the magnitude of the wealth differentials at each point in the distribution. For instance, at the 1st percentile, the individual ends up with \$20,000, or 16%, less when forced to match in company stock, reflecting the much higher downside risk to portfolio concentration. This is all the more striking considering that, by assumption, contributions made by the employee (which represent 2/3 of total contributions) under these two scenarios are being invested in identical 1/n portfolios. At the median, the difference is \$85,000. While the restricted employer stock match leads to a larger outcome in only the upper 19% of cases, the differences are sufficiently large that a comparison of the *mean* account balance favors the restricted company match.

Recognizing that most investors are risk averse, the bottom panel of Table 6 reports the coefficient of relative risk aversion (CRRA) such that the individual would be indifferent

between the two distributions of wealth at retirement.³⁰ Specifically, we use the isoelastic utility function of the form:

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

The individual is risk neutral when $\gamma=0$ and $\gamma=1$ corresponds to log utility (with higher values of γ indicate greater risk aversion). We search for the value of γ such that the expected utility from the two distributions is the same. With CRRA utility, what matters is the size of the gains and losses relative to total wealth, so we report these results conditional on having varying amounts of additional uncorrelated wealth at retirement, such as Social Security, defined benefit plans, and home equity. To the extent that some of this wealth, such as Social Security wealth, is uncorrelated with 401(k) account balances, it increases a participant's tolerance for risk within the 401(k) plan.³¹ We therefore report risk aversion results for a range of uncorrelated outside wealth.

Poterba (2003) reports simulations in which company stock is inferior to a market portfolio at *all* levels of risk aversion. This result arises because his company stock was modeled in a CAPM framework with $\beta=1$. Thus, the addition of idiosyncratic risk simply generates a company stock return distribution that is a mean preserving spread of overall equity market returns. By definition, any risk-averse individual will prefer the distribution with the same mean but a lower variance.

In contrast, our model of stock returns is considerably richer, due to the use of the multi-factor model with company-specific betas that are empirically estimated and applied to historical data. In general, the expected returns for each company's stock differs from the S&P 500, and are higher on average. In addition, the company specific betas, in general, are not equal to one. Thus, the distribution of company stock outcomes can have higher means, as well as much higher variances, than the market portfolio. For reasonable levels of risk aversion, however, the higher return on company stock is swamped by the higher idiosyncratic risk. Even with additional uncorrelated wealth of \$1 million, an individual exhibiting log utility ($\gamma=1$) would prefer the diversified equity match to a company stock match.

Given the empirical evidence that many investors do not hold optimal portfolios, it is also interesting to compare the wealth distribution from a restricted match to the wealth distribution associated with an empirically motivated parameterization of how individuals, on average, actually invest the match in the absence of restrictions. Thus, in column (3) we

³⁰ We recognize, of course, that if individual investors were choosing optimal portfolios based on this specification of lifetime utility, they would not follow a $1/n$ strategy, fail to rebalance, and so forth. Our use of this utility function is simply meant to provide a stylized representation of the fact that risk-averse consumers care about the entire distribution of outcomes, and place particularly heavy weight on "bad" outcomes.

³¹ Using the Health and Retirement Study (HRS), Poterba et al. (2003) estimate the wealth holdings of households with a male at retirement age (i.e., between 63 and 67). Annuitized wealth is \$240,800 for the median household with less than a high school education and \$375,500 for those with at least a college degree. Total household wealth excluding DC plan accounts ranges from \$362,300 for the median household with less than a high school education to \$1,102,400 for households with at least a college degree. This suggests that for utility comparisons, a reasonable range of uncorrelated wealth is \$250,000 or \$500,000.

report the distribution of wealth for the same set of firms, but under the assumption that individuals allocate their match according to the same $1/n$ rule that they use to allocate their own contributions. By comparing column (1) with column (3), we learn how match policy restrictions would affect the outcome for naïve investors, holding firm stock return characteristics constant, and find that the results differ markedly from the diversified equity match in column (2). For this set of firms, the company stock match beats the $1/n$ allocation 59% of the time, with both the mean and the median delivering higher wealth. The “indifference risk aversion” level is substantially higher as well. With \$250,000 of uncorrelated outside wealth, an individual with $\gamma < 2.3$ would prefer the company stock match. This rises as high as 4.4 with \$1 million in outside wealth.

Up until this point, we have been focusing on the comparison of outcomes within the set of firms that, in reality, provide the match in company stock. However, as our empirical work demonstrates, it is not random which firms choose to restrict their match. A comparison of column (1) with column (4) illustrates the importance of these firm characteristics by comparing a “restricted match policy” of the 293 firms that actually match in company stock to the sample of 574 firms that actually allow choice. Note that column (4) is a counterfactual exercise, because it assumes that these 574 choice companies force a match in company stock. By holding match policy constant, but varying firm characteristics, this comparison illustrates the important role of firm characteristics, as 89% of the time, an individual would be better off in the set of restricted match companies. Clearly, if an employee were forced to work at a company where the match was in employer stock, he or she is generally better off doing so at a company with the risk characteristics of those companies that, in reality, do force such a match. In other words, companies are at least partially sorting on the basis of just how bad a company stock match is—those firms that allow choice are particularly wise to do so. Note that the direction of the risk aversion comparison is, in this case, reversed—given the higher idiosyncratic risk of the choice companies, any individual with risk aversion greater than 0.6–0.8 would prefer the firms that match in company stock.

In the final column of Table 6, we now make the “real world” comparison between a restricted match at the restricted match companies to an unrestricted, choice match at the choice companies, assuming naïve diversification. A comparison of columns (1) and (5) now captures both the difference in firm return characteristics *and* the difference in the firm’s match policy. The results suggest that, given a choice between working for a firm with a restricted match and working for a firm with a choice match, and accounting for the differences in firm characteristics, an individual would end up with a larger account balance 70% of the time with the company stock match firm. Both the mean and median differences in account balances are substantial. With \$250,000 in outside wealth, it requires a risk aversion level of 3 or greater for the choice match at the choice firms to be the preferred distribution. With \$1 million of uncorrelated wealth, the CRRA below which the individual prefers the company stock match is 6.1. With no uncorrelated wealth, individuals with a risk aversion coefficient below 1.8 prefer the company stock match. The outperformance of the retirement portfolio at company stock match firms reflects two factors. First, more contributions are directed toward higher-yielding assets when the match is provided in company stock, which implies that less is invested in lower-yielding assets. Second, company stock match firms have lower risk, which, for an equal share in

company stock, reduces the likelihood that the portfolio balance at these firms will fall below the balance at unrestricted match firms.

6.3. Robustness checks

The results from Table 6 made several simplifying assumptions, including no differential administrative costs associated with alternative match policies, no indirect effects of match policy on an employee's own contributions, no risk of bankruptcy, and a large historical equity premium. In this section, we relax a number of these assumptions in order to examine the robustness of our findings. The dominance of a diversified equity match over an employer stock match is, as expected, robust across all assumptions. As such, we limit our attention here to the "naïve diversification" scenarios.

In the first set of three columns in Table 7, we examine sensitivity to adding differential administrative costs and indirect effects of an employer match on a participant's own portfolio allocation. To consider fund management expenses, we assume zero costs for company stock, and set management expenses of other assets according to the costs at corporate plans reported in a confidential industry study. Given the assumed asset composition of total contributions (i.e., employee and employer), these assumed fees translate into a \$0.21 reduction per \$100 of contributions for company stock match firms compared to a \$0.31 reduction for choice match firms, a difference of ten basis points.³²

This scenario also incorporates the indirect effects of a company stock match policy that were discussed in Sections 4 and 5. Specifically, we recognize that own voluntary purchases of company stock are higher when the match is in company stock, and that firms that match in company stock typically offer one fewer alternative investment choice in their plan. Since we only observe how participants invest given the match policy of their firm, but not under the counterfactual, an implicit assumption underlying the utility comparisons for this scenario is that employees in a firm with a company stock match would invest their contributions differently if they switched to an unrestricted match firm, and vice versa. These indirect effects lead to greater purchases of company stock in company stock match firms, boosting the annual share of employee contributions invested in company stock from 14% to 24%, and the share of total contributions invested in company stock from 42% to 49%.³³

³² Samwick and Skinner (2004) assume expenses of 42, 71, and 92 basis points for money market, bond, and equity funds, respectively, based on Investment Company Institute (ICI) data for funds outside of 401(k) plans. Using these higher expenses would increase the advantage of company stock relative to these alternative assets, roughly doubling the difference in total fees across match policy.

³³ Under this scenario, it is assumed that participants at a firm that matches with company stock boost their own allocations to company stock by seven percentage points (14.3% to 21.3%). Two-fifths of this boost comes from a reduction in contributions to the money market fund, with the remaining evenly distributed across the other five options. Because the company stock match plan offers one fewer option, employee contributions to company stock increase by an additional 2.4 percentage points (i.e., $16.7 - 14.3 = 2.4$). Rather than eliminate one of the six non-company stock assets, we reduce employee contributions to these six assets by approximately 0.4 percentage points each, i.e., $(16.7 - 14.3)/6$. Thus, the share of total employer plus employee contributions allocated to company stock is 49.1% after incorporating both indirect effects. This leads to a portfolio allocation for both contributions and account balances that closely match those of actual 401(k) plans.

Table 7
Distribution of 401(k) plan assets by match policy, considering counterfactual scenarios

	Add administrative costs and indirect effects			Also add bankruptcy			Also add lower equity premium (lowered by 0.325% per month)		
	Choice firm	Co. stock firm	Co. stock firm	Choice firm	Co. stock firm	Co. stock firm	Choice firm	Co. stock firm	Co. stock firm
	Choice match	Co. stock match	Choice match	Choice match	Co. stock match	Choice match	Choice match	Co. stock match	Choice match
% higher wealth	30	70		33	67		56	44	
% higher wealth		62	38		52	48		41	59

Account balance at age 62 (\$000s)

Mean	905	1278	840	877	1236	826	401	514	382
1st %	124	96	127	123	94	127	100	73	102
5th %	162	137	166	159	135	166	121	95	124
10th %	190	171	197	188	168	195	136	112	140
25th %	266	260	276	263	248	272	173	149	177
50th %	432	466	455	427	445	440	244	234	248
75th %	810	1,031	821	794	1,014	817	387	458	393
90th %	1660	2352	1588	1596	2285	1588	683	940	672
95th %	2658	3971	2437	2562	3842	2412	1023	1493	948
99th %	7491	3600	6445	7171	12,869	6418	2608	4615	2287

Constant relative risk aversion such that indifferent across firms and/or match policy, additional uncorrelated wealth (\$000s)

	Co. stock firm vs. choice firm	Co. stock firm (choice vs. co. stock)	Co. stock firm vs. choice firm	Co. stock firm (choice vs. co. stock)	Co. stock firm vs. choice firm	Co. stock firm (choice vs. co. stock)
0	1.9	1.6	1.7	1.5	1.2	1.1
250	3.2	2.6	2.8	2.2	2.0	1.8
500	4.4	3.4	3.7	2.9	2.8	2.5
1000	6.7	5.1	5.6	4.3	4.3	3.7

Source: authors' calculations as described in text.

In the first set of three columns, we report the results for 1) choice firms with a choice match, 2) firms with a restricted match in company stock, and 3) the counterfactual world in which the company stock match firms provide an unrestricted match. A comparison of the first two scenarios provides information about the difference in retirement wealth from working for the two different types of firms, and it accounts for differences in firm characteristics as well as match policy. From this, we see that the outcomes under the restricted match are higher 70% of the time, and that individuals with risk aversion less than 3.2 would prefer the company match if they had \$250,000 in uncorrelated wealth. As such, these results are quite similar to the base case comparison of columns (1) and (5) of Table 6.

A comparison of the second column with the third column in Table 7 provides different information; namely, whether conditional on working at a company stock match firm, a naïve investor would be better off with the company stock match or an unrestricted match. This comparison shows that, holding firm characteristics constant, the restricted match in employer stock is preferred 62% of the time. The indifference risk aversion level is also somewhat lower indicating that the desirability of a company stock match relative to a choice match discussed above in part reflects the differences in risk across the two types of firms.

An important omission from our simulations thus far is the possibility of the bankruptcy of the firm and the associated loss in value of company stock holdings in the 401(k) account, such as that experienced by 401(k) participants at companies like Enron and Worldcom. To address this, we allow firms to go bankrupt which zeroes out the value of company stock in the 401(k) plan. In order to further capture the risk that arises from the correlation between human capital (i.e., earnings) and financial capital (i.e., 401(k) wealth), we also assume that when a firm goes bankrupt, the employee experiences a six-month period of unemployment, during which he has no additional earnings, and therefore no additional contributions to the 401(k) plan. We introduce a bankruptcy probability by designating each firm as being included in one of three groups—those with investment-grade bonds, speculative-grade bonds, and non-rated bonds—and applying the expected default probability for that group to the firm.³⁴ The expected default probabilities used for each group represent the median rate for that group during 1997 and 1998, as estimated by KMV Corporation, a group that implements a method that measures the likelihood that the market value of a firm's assets falls short of its liabilities. The expected default probabilities for the year ahead are 0.15% for investment-grade firms, 1.93% for speculative-grade firms, and 1.61% for firms with no bond rating. Across the 867 firms, the average expected bankruptcy rate is 1.1% per year, roughly in line with realized bond default rates that averaged about 1.3% per year from 1981 to 2000 according to Standard and Poor's, and the aggregate business failure rate from 1990 to 1997 reported by Dun and Bradstreet.³⁵ These rates imply that a firm has a 32% chance of failure over the 35-year investment horizon.

³⁴ Bond ratings are from Standard and Poor's and available in Compustat. A rating of BBB- or better is classified as investment grade. For firms that changed bond rating over the period, we used their average rating.

³⁵ See Standard and Poor's (2001) and Dun & Bradstreet, Table B-96 in the *Economic Report of the President, 2002*.

We implement this bankruptcy procedure by calculating a return cut-off that corresponds to the monthly equivalent of the 0.15%, 1.93%, or 1.61% annual bankruptcy probability of each group. When the random return draw for a particular company is lower than the bankruptcy return cutoff for that firm, we set the company stock account balance to zero. Variation in bankruptcy rates across firms therefore depends both on which default group the firm is in and the firm's stock price volatility, as firms with greater volatility are more likely to hit the bankruptcy return cutoff. For our sample, the expected annual default probability averages 0.59% for company stock match firms, and 1.41 for choice match firms, substantially higher both because there are fewer investment-grade firms in the choice match group and because these firms have higher idiosyncratic risk.

The middle scenario of [Table 7](#) (columns 4, 5 and 6) shows that bankruptcy risk, even with reduced contributions, only slightly reduces the mean and median account balances, with the balances for the company stock match plan still exceeding the choice match plan balance two-thirds of the time. It is still the case that sufficiently risk-tolerant individuals (CRRA of 2.8 with \$250,000 of uncorrelated wealth) would prefer the company stock match. This comparison, of course, assumes that they continue to follow a naïve diversification strategy in the absence of a forced match—it of course continues to be true that the individual would do even better if the match were instead invested in a diversified equity portfolio. The influence of bankruptcy is somewhat larger when we hold firm characteristics constant and vary the match policy. For example, the “% higher wealth” drops from 62% without bankruptcy to only 52% with it.

On net, the bankruptcy effect is not as large as one might have expected. This limited effect can be explained by two factors. First, the firms that match with company stock have a substantially lower risk of bankruptcy, as reflected in their greater likelihood of being rated investment grade and lower stock price volatility. Thus, while employees at company stock match firms have more of their account subject to bankruptcy risk (i.e., invested in company stock), bankruptcy happens less frequently. Second, bankruptcy, which reduces company stock holdings to zero, is related to the realization of a very bad outcome, which, in the absence of the forced bankruptcy, would already have reduced company stock holdings substantially. In our previous simulations, it was possible to have monthly return realizations at the bottom tail of the distribution as low as -100% ; our implementation of bankruptcy effectively treats monthly return realizations beyond -65% to -70% as if they were -100% . Thus, the marginal effect of this “imposed” bankruptcy is not that large because the stock would have performed poorly anyway (i.e., whereas a -80% return wipes out four-fifths of the account balance in the first scenario in [Table 7](#), it would lead to bankruptcy in the middle scenario and thus wipe out the entire company stock balance).

Of course, there are at least two direct effects of bankruptcy. We focus on the reduction in utility that comes with lower retirement wealth. A second effect, which we do not measure, is the direct loss in utility at the time of the unemployment spell itself due to the loss of one's job. Of course, this loss exists irrespective of the company's match policy. Indeed, given that the probability of bankruptcy is higher for the set of

choice firms, accounting for this effect would simply make the restricted match companies look even more appealing to a prospective employee. An open question is whether, for psychological reasons, there is an additional loss in utility that arises from watching one's 401(k) balance decline at the same time one loses a job, even after controlling for the loss in retirement wealth. To the extent that such factors are important, our estimates understate the negative utility consequences of bankruptcy on match policy.

Another concern is that we draw from the distribution of historical returns in which there was a sizeable equity premium, and that this premium may be lower going forward than it has been in the past (Blanchard, 1993; Campbell, 2001; Diamond, 2001; Fama and French, 2002). 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 eight percentage points to approximately four percentage points for our simulations.³⁶

This four-percentage point cut, which we layer on top of a possibility of bankruptcy, dramatically reduces expected retirement account balances, more so for company stock match firms due to the larger share of holdings in equity. The median balance for the company stock match firms is \$234,000 (versus \$445,000 before the halving of the equity premium), just about equal to the median balance for the choice match firms. Thus, the company stock match exceeds the choice match only 44% of the time. The mean balance for the company stock match firm still exceeds that for the choice match firm. When additional uncorrelated wealth of \$250,000 is assumed, the reduction of the equity premium reduces the CRRA at which participants are indifferent to match policy from 2.8 to 2.0. This simulation underscores that a lower equity premium is a greater source of risk to a match in company stock than firm bankruptcy.

7. Conclusion and policy implications

In deciding whether to offer an employer matching contribution in company stock in their 401(k) plans, plan sponsors must trade off a number of costs and benefits. We find that firms are more likely to restrict the match to company stock if firm risk is low and employees are also covered by a defined benefit plan. This is consistent with firms considering the effect of match policy on participant retirement security, either because of concerns over fiduciary liability under ERISA or because employees at these firms more fully value company stock because of the lower firm-specific risk. Unlike stock option grants to non-executives, the firm's decision to match in company stock does not appear to be correlated with cash flow or with measures of the benefits

³⁶ The equity premium reduction of 32.5 basis points per month is applied to all equity instruments. We have not altered the return on the money market or bond investments, although in general equilibrium one might expect these returns to change if the equity premium is reduced. Nor have we altered the variance of the various asset classes.

of aligning incentives of employees and owners. We do not find robust evidence that the potential tax deduction for firms paying dividends to shares held in the 401(k) plan is an important determinant of a company stock match. However, we do find evidence that a company stock match is more likely if the firm does not have multiple classes of stock, which is an alternative mechanism to reduce hostile takeover attempts.

We use simulation methods to assess the effect of match policy on the distribution of participant account balances at retirement, incorporating both behavioral responses to match policy by participants and the characteristics of the firms offering the plan. While restrictions on choice reduce welfare for portfolio-optimizing individuals, our results suggest that for sufficiently risk-tolerant individuals who behave in a manner consistent with the data, participating in a 401(k) plan at a company that restricts the match is often preferable to participating in a plan at a company with an unrestricted match. This result is attributable to several factors. First, the firms that match in company stock have lower bankruptcy risk and stock price volatility. Second, the match in company stock increases the equity exposure of participants, often by reducing the share of assets held in lower-return fixed-income securities. Lower administrative costs for company stock holdings also contribute to the desirability of a company stock match. However, a lower equity premium reduces the preference for a company stock match. Of course, our finding that individuals would be even better off if companies provided a match in a diversified equity portfolio suggests that policies to encourage a match with a diversified equity portfolio would be welfare enhancing relative to the current hands-off policy.

Indeed, while a company stock match offers some benefits, such as more stock in friendly hands for management, lower transaction costs, and favorable tax treatment, it is not clear that these benefits are sufficient to outweigh cost of non-diversification for portfolio-optimizing employees. This raises the question of why this outcome could persist if moving from a company stock match to a broadly diversified equity portfolio match represents a potential Pareto improvement. One likely explanation, which is supported by survey evidence from Vanguard (2002), is that many employees substantially underestimate the risk of undiversified company stock holdings. If employees view their company's stock as safer than a diversified portfolio of stocks, this likely alters the perceived cost–benefit tradeoff.

Disentangling the alternative hypotheses for firms' choice of match policy is important for guiding public policy. Our evidence that cash flow constraints are not important suggests that policy prescriptions to prohibit a match in company stock would be unlikely to lead to a less generous employer match, which might have been the case if these firms had no other means to contribute to the plan. However, our evidence consistent with a firm matching in company stock to deter a takeover attempt by increasing the shares held in "friendly hands" suggests that a cap on company stock may make offering an employer match less desirable for the firm. The lack of evidence supporting the traditional equity incentive view suggests that a prohibition on a match in company stock is unlikely to lead firms to increase equity-based compensation to employees through other means, such as by granting more stock options.

Appendix A

Appendix Table 1

Summary statistics of firm characteristics by match policy, full sample

Variable (in %)	Mean			Median		
	Match all Co. stock	Match choice	Difference	Match all Co. stock	Match choice	Difference
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
Investment grade debt?	48.9	30.2	18.8***	0.0	0.0	0.0
Cash flow/assets	12.6	12.2	0.4	12.5	12.3	0.3
Is cash flow/assets < 0?	3.5	3.5	-0.1	0.0	0.0	0.0
Cash flow/assets (if > 0)	14.0	13.0	1.0	12.9	12.5	0.4
Cash flow/assets (if < 0)	-26.7	-11.0	-15.7	-8.8	-6.6	-2.2
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***
Market-to-book ratio	1.68	1.73	-0.06	1.30	1.33	-0.03
Total employees (000s)	18.0	13.0	5.0	5.0	4.0	1.0**
Multiple classes of stock?	3.0	6.5	-3.5**	0.0	0.0	0.0
Past 5-year stock return	137.4	177.0	-39.5*	95.0	92.8	2.6
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***

***, **, * denote difference is significant at the 1%, 5%, and 10% levels, respectively.

References

- Agnew, Julie, Balduzzi, Pierluigi, Sunden, Annika, 2003. Portfolio choice and trading in a large 401(k) plan. *American Economic Review* 93 (1), 193–215.
- Ameriks, John, Zeldes, Stephen, 2001. How do household portfolio shares vary with age? Working paper. Columbia University. December.
- Beatty, Anne, 1995. The cash flow and informational effects of employee stock ownership plans. *Journal of Financial Economics* 38, 211–240.
- Benartzi, Shlomo, 2001. Excessive extrapolation and the allocation of 401(k) accounts to company stock. *Journal of Finance* 56, 1747–1764.
- Benartzi, Shlomo, Thaler, Richard H., 2001. Naïve diversification strategies in retirement savings plans. *American Economic Review* 91-1, 79–98.
- Blanchard, O.J., 1993. Movements in the equity premium. *Brookings Papers on Economic Activity* 2, 75–138.
- Campbell, John, 2001. Forecasting US equity returns in the 21st century. In: Social Security Advisory Board, John (Ed.), *Estimating the Real Rate of Return on Stocks over the Long Term*, August, 3–10.
- Carhart, Mark M., 1997. On persistence in mutual fund performance. *Journal of Finance* 52, 57–82.
- Choi, James, Laibson, David, Madrian, Brigitte, Metrick, Andrew, 2001. For better or for worse: default effects and 401(k) savings behavior. NBER Working Paper, vol. 8651. December.
- Core, John E., Guay, Wayne R., 2001. Stock option plans for non-executive employees. *Journal of Financial Economics* 61, 253–287.
- Profit Sharing/401(k) Council of America, 2002. 44th Annual Survey of Profit Sharing and 401(k) Plans.

- Council of Economic Advisors, 2002. Economic Report of the President. United States Government Printing Office, Washington, DC.
- DeAngelo, H., DeAngelo, L., 1985. Managerial ownership of voting rights: a study of public corporations with dual classes of common stock. *Journal of Financial Economics* 14, 33–69.
- Demsetz, Harold, Lehn, Kenneth, 1985. The structure of corporate ownership: causes and consequences. *Journal of Political Economy* 93 (6), 1155–1177.
- Diamond, Peter, 2001. What stock market returns to expect for the future: an update. In: Social Security Advisory Board, Peter (Ed.), *Estimating the Real Rate of Return on Stocks over the Long Term*, August, 11–16.
- Even, William, Macpherson, David, 2003a. The distributional consequences of the shift to defined contribution plans. Working paper. Miami University. July.
- Even, William, Macpherson, David, 2003b. The causes and consequences of company stock holdings in pension funds. Working paper. Miami University. November.
- Fama, Eugene, French, Kenneth, 2002. The equity premium. *Journal of Finance* 62, 637–659.
- Holmstrom, Bengt, Milgrom, Paul, 1987. Aggregation and linearity in the provision of intertemporal incentives. *Econometrica* 55, 303–328.
- Ibbotson Associates, 2002. S&P (Stocks, Bonds, Bills, and Inflation) 2002 Yearbook: Market Results for 1926–2001. Ibbotson Associates, Chicago, IL.
- Iwry, Mark, 2003. Promoting 401(k) security. *Tax Policy Issues and Options*, Urban-Brookings Tax Policy Center, September, vol. 7.
- Jensen, Michael C., Meckling, William H., 1976. Theory of the firm: managerial behavior, agency costs and ownership structure. *Journal of Financial Economics* 3 (4), 305–360.
- Lazear, Edward P., 1979. Why is there mandatory retirement? *Journal of Political Economy* 87 (6), 1261–1284 (December).
- Lazear, Edward P., 1983. Pensions as severance pay. In: Bodie, Zvi, Shoven, John B., Wise, David A. (Eds.), *Financial Aspects of the United States Pension System*. University of Chicago Press, Chicago, pp. 57–85.
- Liang, Nellie, Weisbenner, Scott, 2001. Who benefits from a bull market? An analysis of employee stock option grants and stock prices. Federal Reserve Board working paper 2001-57.
- Liang, Nellie, Weisbenner, Scott, 2002. Investor behavior and the purchase of company stock in 401(k) plans—the importance of plan design. NBER Working Paper, vol. 9131.
- Meulbroek, Lisa, 2002. Company stock in pension plans: how costly is it? Working paper. Harvard University.
- Mitchell, Olivia S., Utkus, Stephen, 2004. Lessons from behavioral finance for retirement plan design. In: Mitchell, Olivia S., Utkus, Stephen (Eds.), *Pension Design and Structure: New Lessons from Behavioral Finance*. Oxford University Press, Oxford, UK, pp. 3–41.
- Munnell, Alicia H., Sunden, Annika, 2003. *Coming Up Short: the Challenge of 401(k) Plans*. Brookings Institution Press, Washington, D.C.
- Myers, Stewart, Majluf, Nicholas, 1984. Corporate financing and investment decisions when firms have information that investors do not have. *Journal of Financial Economics* 13 (2), 182–221.
- Petersen, M.A., 1992. Pension reversions and worker-stockholder wealth transfers. *Quarterly Journal of Economics* 35, 1035–1056.
- Poterba, James, 2003. Employer stock and 401(k) plans. *American Economic Review* 93 (2), 398–404.
- Poterba, James, 2004. Portfolio risk and self-directed retirement savings programmes. *Economic Journal* 114, C26–C51.
- Poterba, James, Rauh, Joshua, Venti, Steven, Wise, David, 2003. Utility Evaluation of Risk in Retirement Saving Accounts. NBER working paper, vol. 9892.
- Purcell, Patrick, 2002. Employer stock in retirement plans: investment risk and retirement security. CRS Report for Congress. June.
- Rauh, Joshua, 2003. Own company stock in defined contribution pension plans: a takeover defense? Working paper. MIT.
- Samuelson, William, Zeckhauser, Richard, 1988. Status quo bias in decision making. *Journal of Risk and Uncertainty* 1, 7–59.
- Samwick, Andrew, Skinner, Jonathan, 2004. How will 401(k) pension plans affect retirement income? *American Economic Review* 94 (1), 329–343.

- Schultz, Ellen E., Francis, Theo, 2002. Hot tax break: 401(k)s—why firms stuff plans with stock. *Wall Street Journal*. January.
- Shivdasani, Anil, 1993. Board composition, ownership structure, and hostile takeovers. *Journal of Accounting and Economics* 16, 167–198.
- Smith, Clifford W., Watts, Ross, 1992. The investment opportunity set and corporate financing, dividend and compensation policies. *Journal of Financial Economics* 32 (3), 262–292.
- Standard Poor's, 2001. Ratings Performance 2000: Default, Transition, Recovery, and Spreads, January.
- United States Department of Labor, Employee Benefits Security Administration, 2001a. Report of the Working Group on Increasing Pension Coverage, Participation and Benefits, Nov. 13.
- United States Department of Labor, Pension and Welfare Benefits Administration, 2001. Private pension plan bulletin. Abstract of 1998 Form 5500 Annual Reports. Winter.
- VanderHei, Jack, 2002. The role of company stock in 401(k) plans. *Risk Management and Insurance Review* 5 (1), 1–20.
- Vanguard, 2002. Vanguard Participant Monitor: Expecting Lower Market Returns in the Near Term. January.