The Causes and Consequences of

Pension Fund Holdings of Employer Stock

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I. Introduction.

Over the past twenty years, the shift away from defined benefit (DB) and toward defined contribution (DC) plans has simultaneously increased employee control over pension contribution levels and asset allocation and increased their exposure to rate of return risk on pension investments.[1] Greater employee control could improve the pension system by giving workers a greater ability to tailor their pensions to match their own saving preferences and risk tolerance. However, many have questioned whether employees have the financial sophistication to make prudent investment decisions regarding the amount that should be saved or how the assets should be allocated. Also, since some DC plans do not give workers complete control over asset allocation, workers may be subjected to an undesirable mix of assets.

An emerging concern in the management of DC plans is the fact that some plans invest heavily in the stock of the employer. Among 401(k) plans with some employer stock in the portfolio, it is estimated that an average of 38 percent of assets are invested in employer stock (Holden and VanDerhei 2001). There are extreme examples where pension plans have over 90 percent of assets in employer stock (Munnell and Sunden 2002).

Holding a large share of pension assets in a single stock is contrary to the basic principles of diversification and exposes workers to unnecessary risk. A diversified portfolio of assets can provide the same expected rate of return with less risk to the investor as a portfolio concentrated in employer stock. In recognition of this concern, numerous legislative proposals limiting pension holdings of employer stock have emerged. Opponents to such restrictions contend that the benefits of employee ownership stock more than compensate for the risk exposure.

This report examines the causes and consequences of investing pension funds in employer stock using a merger of data from Form 5500 pension filings and stock return data from the Center for Research on Security Prices (CRSP). Section II reviews the existing hypotheses and related empirical evidence on factors that lead pension funds to invest in employer stock. Results from the Capital Asset Pricing Model are employed in section III to derive a measure of the non-diversification costs of holding employer stock. Section IV provides a description of the data used in our study and an empirical analysis of factors influencing pension fund holdings is provided in section V. The effect of employer stock holdings on the risk and return of pension portfolios is examined in section VI along with projections of how legislated limits on employer stock holdings would affect the distribution of returns.

II. Background.

Despite the nondiversification risk of holding employer stock in pension plans, it is quite common. Tabulations of Form 5500 data summarized in Mitchell and Utkus (2002) indicate that 16 percent of DC plan assets in 1998 were in the form of employer stock. Holden and VanDerhei (2001) estimate that 19 percent of assets in 401(k) plans are in employer stock. While an average allocation of 15 to 20 percent to employer stock may not be alarming, some plans hold much heavier concentrations. For example, Mitchell and Utkus (2002) examine the

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[1]Based on statistics from Pension and Welfare Benefits Administration tabulations of Form 5500 data, between 1980 and 1998, DB plan participants fell from 30.1 million to 23.0 million while DC plan participants rose from 17.5 million to 50.3 million.

20 largest DC plans in the United States and find that 6 plans had more than 50 percent of assets in employer stock and one had more than 90 percent of assets in employer stock.

The fact that some plans have a significant share of assets in employer stock has garnered increased media attention over the past few years as some stock prices fell precipitously. In one case, employees had 80 percent of their pension assets in an employer stock that experienced a 92 percent decline in price between 2000 and 2001.[2] Legislators responded to the spate of catastrophic losses in pension plans by proposing new legislation that would regulate pension fund holdings of employer securities and/or mandate that employees be allowed to diversify their employer stock holdings within a certain period of time.[3]

In order to understand why some pension plans invest heavily in employer stock, it is important to first recognize that plans differ in terms of whether the employer or employee makes the choice. As noted in a report by a Working Group on Employer Assets in ERISA Employer-Sponsored Plans, there are essentially three models of investment in employer assets for DC plans -- the participant investment model, directed match model, and the sponsor investment model.

In the participant investment model, the employee chooses among a series of investment options and employer stock can be one of them. The evidence suggests that approximately 30 percent of 401(k) plans offer employer stock as an option.

In the directed match model, the participant chooses how to invest employee contributions, but all or some of the employer contributions are made in the form of employer

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[2]See Farrell (2002).

[3]Purcell (2002) describes bills in the 107th Congress regulating pension plan investments in employer stock. Meulbroek (2002) indicates that there are seventeen different bills being considered by Congress. At present, there

stock. Evidence suggests that approximately 7 percent of 401(k) plans match with employer stock and that the practice is more common in larger plans.

In the plan sponsor model, an investment manager makes the investment decisions for the participants. The sponsor is bound by ERISA fiduciary requirements, but may choose to invest some or all of the contributions in employer securities.

Why do companies and/or their employees ignore basic principles of diversification and invest heavily in employer stock? Mitchell and Utkus (2002) and Sengmuller (2002) provide a good review of possible explanations from both the employer and employee perspective. Some of the explanations for employees preferring stock over a diversified portfolio require an appeal to employees making irrational financial decisions. For example, John Hancock Financial Services (2001), the Vanguard Group (2001), and Benartzi (2001) find evidence that workers rate their employer's stock as less risky than holding an equity mutual fund, whereas other stocks are rated as more risky. Some have argued that this reflects the fact that employees are more familiar with their employer's company and that there is a tendency to be overconfident about companies that a person is familiar with.[4] Meulbroek (2002) cites several studies showing that this bias extends beyond the stock issued by a person's employer to companies located in their own geographic area.

Another reason that employees might choose to invest in employer stock is that they may view the employer's decision to include it as an investment option as an endorsement of the stock. For example, both Benartzi (2001) and Liang and Weisbenner (2002) report that, counter to principles of diversification, when the employer matches employee contributions with

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are two bills pending in the Senate (S. 1919 and S. 1838) and three in the House (H.R. 3677, H.R. 3640, and H.R. 3463).

employer stock, the employee increases their own purchases of employer stock. Bernatzi also uses survey evidence to show that this endorsement effect may apply to other investment alternatives. For example, some people indicate they would increase their own purchases of international stock if the employer matched employee contributions with international stock.

Another reason employees might over-invest in employer stock is that they place too much weight on recent stock performance when making decisions regarding purchases of employer stock [Benartzi (2001) and Sengmuller (2002)]. If employees are particularly cognizant of their employer's stock performance, they may over-purchase shortly after the stock outperforms the market. This could have long lasting effects given that employees rarely reallocate their portfolios or their contributions [Samuelson and Zeckhauser (1988) and Ameriks and Zeldes (2001)]. Moreover, there is some evidence that people are more likely to discount the risk of a stock when they are familiar with the company.

Naive diversification strategies could also lead to over-investment in employer stock. Benartzi and Thaler (2001) find that some investors follow a "1/n strategy" which allocates contributions equally between the n investment options available in the pension plan. Consequently, if employer stock is one of four options, the naive approach would devote one-fourth of contributions to employer stock. Liang and Weisbenner (2002) find evidence that employees illustrate 1/n behavior in choosing how much to invest in employer stock. In some cases, the employer forces the employee to invest in employer stock. For example, employers frequently match employee contributions to 401(k) plans with employer stock. Also, an employee stock ownership plan (ESOP) is required to invest primarily in employer stock. Sengmuller (2002) provides several reasons that employers would prefer that workers invest in

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[4]Meulbroek (2002) lists several studies that document the extent of "home bias" in purchasing stocks.

employer stock instead of a more diversified mix of stocks: (1) stock aligns employee and stock holder interests; (2) stock contributions may have tax advantages over cash contributions; and (3) stock holdings may assist in fighting a hostile takeover attempt or effect leveraged buyouts.

There are several factors that could potentially offset the above employer benefits to mandating that employees invest in employer stock. First, if employees view employer stock as a risky investment and are willing to forego only $.50 of compensation for employer stock with market value of $1, the firm would increase its costs by forcing employer stock on employees unless the tax and productivity effects are sufficient to offset the higher compensation costs. Consequently, *ceteris paribus*, worker or stock characteristics that reduce the employee valuation of a stock relative to its market price should make it less likely that employer stock is included in the pension plan. This should hold true whether the employer or the employee is deciding how much to invest in employer stock.

A second reason that employers may be reluctant to mandate that employees invest in employer stock is that it increases exposure to fiduciary liability. Without mandating investments in employer stock, a company may be eligible for a safe harbor provision offered in section 404(c) of ERISA exempting them from fiduciary liability.[5] If, however, employers mandate investment in employer stock, they lose section 404(c) protection and may be deemed legally liable for employee losses if the employer stock performs poorly.

Since ERISA does provide some special protections to the fiduciary of an ESOP, some legal experts suggest that offering a combination of an ESOP and 401(k) plan (referred to as a KSOP) may be wise if an employer wants to mandate investments in employer stock.[6] If a

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[5]See, for example, Munnell and Sunden (2002).
[6]See, for example, Mariotto (2002).

KSOP is offered, the employer would contribute employer stock to the ESOP portion of the plan and allow the employee to choose between a diversified mix of assets in the 401(k) portion of the plan.

Given the above background on the costs and benefits of pension plan investments in employer stock, several predictions emerge regarding the relationship between worker characteristics, stock risk, and the proclivity to invest in employer stock. For example, investments in employer stock should be lower when the stock is "riskier". As the risk of holding employer stock rises, risk averse workers will discount any compensation in the form of stock and firms could reduce their costs by paying cash instead of stock. Consequently, when the employer stock is riskier, employers will be less likely to pay workers in the form of employer stock. In support of this hypothesis, both Sengmuller (2002) and Purcell (2002) find that the share of assets invested in employer stock is inversely related to the stock's beta coefficient; and Meulbroek (2002) finds that employer stock holdings are inversely related to a measure of the "nondiversification cost" of holding employer stock.[7]

Several recent articles place values on the nondiversification risk associated with pension plan holdings of employer stock. Meulbroek (2002) estimates that $100,000 of employer stock is worth only $42,000 to a person with nondiversified holdings.[8] Ramaswamy (2002) estimates that the premium for an option contract guaranteeing the better of the rate of return on the stock or the rate of return on a well-diversified portfolio would be about $178 per year for each $1,000

[7]Meulbroek's measure of nondiversification risk depends on the stock's beta and the volatility of the stock returns relative to market returns.

[8]This is an average estimate across companies that hold employer stock in their pension plan.

of stock held.[9] Brennan and Torous (1999) estimate that the certainty equivalent of holding one dollar of a typical stock over a 10 year period is only 36 cents. Some researchers contend that holding an employer's stock is even riskier than these estimates suggest since the return on the employer stock is likely to be positively correlated with the worker's wages. At the same time, the extent of discounting by employees is overstated when they hold other financial assets either inside or outside their pension portfolio.

Models of optimal portfolio decisions over the life-cycle imply that workers should move out of risky assets as they approach retirement.[10] Consistent with this prediction, Holden and VanDerhei (2001) show that the share of assets held in employer stock falls with age, particularly after age 50. Also, the fact that many companies allow workers to sell their employer stock holdings after satisfying a minimum age and years of service requirement suggests that employers are responsive to employee preferences to diversify away from stock as they age. In the case of ESOP plans, federal law mandates that workers be allowed to diversify and reduce their holdings of employer stock after they reach age 55 and have 10 years of service. There are no such requirements for non-ESOP plans, however.

Holden and VanDerhei (2001) also report that the fraction of pension assets held in employer stock declines with worker income. This is somewhat surprising given that low income workers are less likely to have significant financial assets outside of their pension that could help offset the lack of diversification in their pension portfolio. The greater holdings of employer stock among low income workers could indicate that lower income (or less educated) workers are less cognizant of the risks associated with holding employer stock or place a greater

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[9]These estimates would underestimate the value of the risk if non-pension forms of employee compensation are positively related to the performance of the company's stock.

value on the "familiarity" of the company they invest in. Consistent with this hypothesis, Benartzi (2001) finds that less educated workers are more inclined to consider employer stock as safer than the overall stock market.

III. Measuring the Cost of Non-Diversification.

A major disadvantage of holding employer stock in a portfolio is that the worker may be forced to hold a portfolio that generates a higher level of risk than necessary for the associated expected rate of return. Meulbroek (2002) uses the capital asset pricing model (CAPM) to construct a measure of how much an investor could improve their expected rate of return without any increase in risk by switching from a single-stock portfolio to a fully-diversified portfolio.[11] For example, by holding a single stock in the portfolio, an investor may be faced with an expected return of .06 and a standard deviation of returns of .03. By allowing the investor to switch to a diversified portfolio, it may be possible to increase the expected return to .08 without any change in the standard deviation of returns. The .02 differential in expected returns is the measure of non-diversification cost. The steps necessary for calculating the non-diversification cost of holding employer stock are outlined below.

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[10] See, for example, the discussion in chapter 6 of Campbell and Viceira (2002).
[11] A description of the CAPM model can be found in Fama (1976).

One result from the CAPM model is that the risk-return tradeoff for mean-variance efficient portfolios can be described as[12]:

$$(1) \quad r_p = r_f + \left[\frac{\sigma_p}{\sigma_m}\right](r_m - r_f)$$

where r_p and σ_p represent the expected return and standard deviation of returns on an mean-variance efficient portfolio p; r_m and σ_m represent the expected return and standard deviation of returns on the market portfolio; and r_f is the rate of return on the risk-free asset.

Another result from the CAPM is that the expected rate of return on security j will reflect the extent of non-diversifiable risk in the market. The equation for the security market line describes this relationship:

$$(2) \quad r_j = r_f + \beta_j(r_m - r_f)$$

where r_j is the expected return on security j, and β_j is the beta coefficient for security j calculated as:

$$(3) \quad \beta_j = \frac{\sigma_{jm}}{\sigma_m^2}$$

where σ_{jm} is the covariance between returns on security j and the market portfolio.

Using these basic results from the CAPM, Meulbroek demonstrates that investing in a single security leads to a risk-return combination that is inefficient. If a mean-variance efficient

[12]A mean-variance efficient portfolio is any portfolio that maximizes the expected rate of return holding the variance of returns constant. One result of the CAPM is that the market portfolio is always a mean-variance efficient portfolio.

portfolio was chosen with the same risk as security j (i.e. σ_j), the security market line in (1) indicates that the investor would realize a return of:

$$(4) \quad r_j^{*} = r_f + \left[\frac{\sigma_j}{\sigma_m}\right](r_m - r_f)$$

By switching from a portfolio consisting entirely of stock j to an efficient portfolio, an investor could increase expected return with no increase in risk by the difference between r_j^{*} and r_j. This is a measure of nondiversification cost (NDC).

$$(5) \quad NDC = r_j^{*} - r_j = \left[\frac{\sigma_j}{\sigma_m} - \beta_j\right](r_m - r_f) = \left[\frac{\sigma_j}{\sigma_m}\right](1 - \rho_{jm})(r_m - r_f)$$

where ρ_{jm} is the correlation between security j's returns and market returns.

From the above, it is clear that nondiversification cost varies with the attributes of the stock. In the extreme, if the returns of the employer stock are perfectly positively correlated with market returns ($\rho_{jm} = 0$), a portfolio consisting entirely of employer stock has the same risk-return characteristics as the market portfolio and NDC is zero. At the other extreme, if employer stock returns are perfectly negatively correlated with market returns, an investment in employer stock is very costly. If a worker holds a stock with perfect negative correlation and volatility that matches that of the market portfolio (i.e. $\sigma_j = \sigma_m$ and $\rho_{jm} = -1$), she would realize an expected return below the risk free rate and still be exposed to risk.

If a worker has the fraction w invested in security j and (1-w) in the market portfolio, the same logic employed above can be used to show that a switch to a mean-variance efficient portfolio would result in the same level of risk but increase the expected return by:

$$(6) \quad NDC = \left[\left(\frac{\mu_p - \mu_m}{\sigma_m} \right) + w(1 - \beta_j) \right] (r_m - r_f)$$

where σ_p is the standard deviation of the portfolio with w invested in security j and (1-w) in the market portfolio.

This measure of nondiversification cost is not perfect for several reasons. First, it relies upon the risk-return relationships drawn from the CAPM which is not without controversy. Fama and French (1992) discuss several empirical facts that have been interpreted as evidence against the CAPM.[13] For example, empirical analysis does not find the implied relationship between a security's returns and its beta. Also, contrary to the CAPM, factors other than beta (such as company size and book-to-market equity) have been found to explain returns. To the extent that the implied relationship between beta and returns is inaccurate, NDC will be measured with error. It is difficult to say whether the NDC is consistently over- or understated without making assumptions about the precise nature of the inaccuracies of the CAPM predictions regarding the relationship between risk and return.

A second problem with this measure of nondiversification cost is the assumption that a worker chooses a portfolio that consists of the employer stock and the market portfolio. A mean-variance efficient investor forced to hold employer stock would adjust the remainder of the

portfolio to contain less than the market share of stocks whose returns are highly positively correlated with the employer stock, and more than the market share of stocks whose returns are negatively correlated with the employer stock. Failing to account for such adjustments would lead to an overstatement of the NDC for investors.

The fact that workers may have financial assets outside of the pension also causes the measure of NDC to be overstated. In the extreme, workers could hedge against the risk exposure created by employer stock holdings by short selling the employer stock outside of the pension.

A final problem with this measure of NDC is that it does not consider the role of uncertainty in labor income. Several papers discussing the nondiversification costs of holding a single security point out that holding the employer's stock aggravates the nondiversification problem because the return on the employer's stock will be positively correlated with labor earnings. If, however, labor income is negatively correlated with employer stock returns, employer stock would serve as a hedge against income uncertainty and make it a good choice for risk diversification.[14] Consequently, NDC would be an under (over-) statement of true nondiversification costs if labor income is positively (negatively) correlated with employer stock returns.

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[13]Some researchers have countered that empirical evidence against the CAPM is flawed because beta is measured inaccurately (see, for example, the discussion in Fama and French 1996).

[14]Campbell and Viceira (2002) consider the issue of income uncertainty and optimal portfolio choice formally and show that, holding the level of risk in an asset constant, as the degree of positive correlation between the risky asset and shocks to labor income increases, workers should shift out of the risky asset since it increases the overall level of consumption uncertainty. If, on the other hand, the risky asset has negative correlation with shocks to labor income, optimal behavior would include more of the risky asset.

While NDC is not a perfect measure of the costs of holding employer stock, if portfolio managers follow any of the CAPM principles in choosing their portfolio, a pension fund should be less inclined to invest in employer stock when NDC is high. Also, the responsiveness to NDC could differ depending upon whether the employer or employee makes asset allocation decisions. Compared to the employee, the employer may be more willing to invest in a employer stock with a high NDC since mandating that everyone participate may lead to greater productivity effects. Individual workers, on the other hand, may view their individual purchases of employer stock as having very little productivity effect.

If a stock has zero NDC, workers may still prefer a market portfolio to a single stock. With zero NDC, the worker has the highest expected return for the risk exposure. Nevertheless, the worker may prefer a different combination of risk and return from the efficient set of possibilities. For example, for a given level of NDC, a higher beta may discourage risk averse workers from holding a employer stock since it represents a higher combination of risk and return.

IV. Data.

Our empirical analysis relies on two data sources. First, Internal Revenue Service (IRS) Form 5500 filings for the years 1990 through 1998 are used to extract information about pension plans. We employ the research data base provided by the Employee Benefits Security Administration that provides a 10 percent sample of pension plans with less than 100 participants

and the universe of all larger plans.[15] Our empirical analysis does not attempt to longitudinally match the pension plans. Second, data from the Center for Research in Security Prices (CRSP) is used to retrieve information on beta, individual stock returns, and returns on the market portfolio.

Table 1 summarizes the effect of sample restrictions on the construction of our data sets. In the Form 5500 data, there are 824,256 pension plan filings between 1990 and 1998. This sample size is reduced substantially by a number of restrictions that are imposed to focus on the issue of employer stock holdings. First, approximately 250,000 plans with less than 100 participants are eliminated from the sample since they do not provide sufficient detail on asset holdings to determine whether employer stock is held. Second, approximately 160,000 DB plans are eliminated. We do not analyze DB plans since federal regulations limit holdings of employer stock to no more than 10 percent of assets in DB plans. Third, approximately 43,000 plans are eliminated because they report no assets at the end of the plan year. Fourth, approximately 16,000 plans are eliminated because some assets are held in a master trust and there is no detail breakdown of the assets in the trust. Later in the paper, we use a special data set available for 1996 where assets in master trusts were spread into detailed asset categories to see if this has a substantive effect on the results. Fifth, approximately 14,000 pension plans for tax-exempt corporations and firms with missing industry codes are deleted.[16] Finally, approximately 8,000 filings are eliminated because they are interim reports, have inconsistent data on asset values, or represent a hybrid of a DB and DC plan. This trims the original 824,256

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[15]The research samples also provide additional editing to correct inaccuracies in the data.

[16]Tax-exempt and public sector status are determined by the industry code provided on the 5500. There are 8,317 plans that are dropped because of their tax-exempt status; 5,264 dropped because the industry code listed on the 5500 is either missing or invalid; and 226 public sector plans are dropped.

plan filings to 332,711 plans. For future reference, this sample is referred to as the **Form 5500 DC sample**. [17]

For much of our analysis, information on the volatility and the beta of the corresponding employer stock is required. Pension plan information from Form 5500 is merged with returns on the corresponding employer stock from CRSP using identifiers issued by the Committee on Uniform Security Identification Procedures (CUSIP).[18] The data is merged on the basis of the month and year that the form 5500 is file. Since many pension plans are not affiliated with a publicly traded company, approximately 300,000 plan filings are eliminated from the sample because no CUSIP number is provided. Of the firms with a CUSIP, nearly 13,000 cannot be found in the CRSP data and under 100 have missing financial data in CRSP. [19] [20] The end result is that 18,979 pension filings for publicly traded companies can be matched with CRSP data. For future reference, this sample is referred to as the **Form 5500-CRSP DC sample**.

Table 2 describes the company pension holdings of pension plans in the Form 5500 DC sample. Over the 1990-98 time period, only 10.6 percent of plans held some employer stock but 35.3 percent of DC participants were included in plans with some employer stock. The large difference in these statistics reflects the well-established fact that the stock of larger companies is much more likely to be included in the pension plan.

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[17] We do not attempt to match plans longitudinally and thus avoid the potential problems that would be created by omitting plans that cannot be matched over time.

[18] A detailed description of CRSP data is available at http://gsbwww.uchicago.edu/research/crsp/. A description of the CUSIP numbering system is available at http://www.cusip.com/. Since the CUSIP for a corporation may change over time, we use the CRSP data to determine the CUSIP for a corporation during the month and year of the form 5500 filing. The PERMNO of that corporation is then used to access data on prior returns and prices.

[19] The CUSIP number on form 5500 data identifies a security issuer. The CUSIP in CRSP identifies the security issuer and each specific security issued (e.g. a given company may issue several different types of stock or bonds). When a given CUSIP issuer can be matched to several different securities in CRSP, the financial characteristics of the security with the largest market value is chosen to describe the employer stock.

During the 1990s, the percentage of people exposed to employer stock holdings in DC plans declined while the percentage of assets invested in employer stock holdings grew. Between 1990 and 1998, the percentage of DC plans with some employer stock fell from 11.8 to 9.0, and the percentage of DC participants with some employer stock fell from 36.0 to 34.6 percent. Over the same period, the share of all DC assets invested in employer stock rose during the 1990s from 18.7 to 21.1 percent.

Table 3 elaborates on the distribution of stock holdings by pension funds for all plans and plans without ESOP status. Among plans holding some employer stock over the 1990-98 time period, 37 percent of pension plans had more than 80 percent of assets invested in employer stock, and 57 percent of plans had more than 40 percent of assets in employer stock. The concentration of holdings is lower among non-ESOP plans where only 7 percent of plans with some employer stock have more than 80 percent invested in employer stock and 25 percent of plans have more than 40 percent of assets in employer stock. Also, the percentage of non-ESOP plans holding at least 80 percent of assets in employer stock fell by one-half between 1990 and 1998, dropping from 9.0 to 4.5 percent.

Some legislative proposals would place a cap on employer stock holdings. If plans were prohibited from holding more than 20 percent of assets as employer stock in 1998, our estimates suggest that 5.9 percent of DC plans and 22.1 percent of DC participants would be affected if the caps apply to all DC plans. If the 5.4 percent of plans with ESOP status are exempted from the caps, only 2.0 percent of plans and 11.2 percent of non-ESOP participants would be affected.

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[20]The inability to locate some firms in CRSP appears to be the result of either misreported CUSIP numbers in the Form 5500 data, or over the counter stocks that are traded on the NASDAQ and thus not included in the CRSP data.

The Form 5500-CRSP DC sample is used to examine the risk characteristics of employer stock that might be held by pension plans. The measure of volatility used here is the standard deviation of the past year of the company's daily stock returns. The CRSP value-weighted market composite index is used as the proxy for the market portfolio. Table 4 presents several risk and return characteristics of the employer stocks.

The average standard deviation of daily returns for the securities of companies in the Form 5500-CRSP DC sample (.027) is nearly four times that for the market portfolio (.007). The standard deviation of returns ranges from .011 at the 5th percentile to .059 at the 95th percentile.[21]

While greater volatility increases the risk of holding stock, CAPM implies that there is no increase in expected return unless the risk is nondiversifiable. The measure of nondiversifiable risk is captured by the security's beta coefficient. The average beta for companies in the 5500-CRSP DC sample is .754. It ranges from -0.05 at the 5th percentile to 1.82 at the 95th percentile.[22]

In the Form 5500-CRSP DC sample of stocks, NDC has a mean of .27 (median of .20) and ranges from .065 at the 5th percentile to .671 at the 95th percentile. The average NDC of .27 implies that, for the average pension plan holding employer stock, workers would receive a 27 percentage point increase in return with no change in risk by switching from a portfolio consisting entirely of the employer stock to a mean-variance efficient portfolio. The high mean value for NDC is driven primarily by firms with small market capitalization which have a high

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[21]For any security found in the form 5500, the standard deviation of daily returns and beta coefficient are based on the prior year's return data.

degree of diversifiable risk. For firms with market capitalization in the bottom, middle and top one-third, the mean values for NDC are .48, .24, and .13, respectively.

A central hypothesis to be tested in this paper is that pension funds are less likely to be invested in employer stock when the risk of doing so is high. The statistics in the bottom of table 4 support this hypothesis. Apparently, employers and/or their employees are less willing to invest in employer stock when it has high risk or NDC. The volatility and NDC of employer stocks held in at least one of the issuer's pension funds is lower than that of stocks not held. Compared to stocks excluded from pension plans, the NDC is .067 lower and the standard deviation of returns is .007 lower for stocks that are included.[23] The fact that beta is .095 lower for employer stocks that are included in pension plans suggests that workers may be averse to stocks with high risk and return.

While nondiversification cost appears to influence holdings of employer stock, evidence suggests that worker characteristics and plan features also play a role. To simultaneously examine the influence of a wide range of plan, stock, and worker characteristics on the decision to hold employer stock, multivariate analysis is employed. Before turning to the results, some discussion of the other control variables is warranted.

The Form 5500 data indicates the number of participants in the plan. For additional information about the workers that are likely to be covered, we are forced to use industry level data obtained from the 1989 through 1999 March Current Population Surveys. From the CPS, we obtain estimates of 3-digit industry averages of educational attainment, unionism, age, race,

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[22]The beta coefficients are estimated with the past calendar year of daily returns with returns on the CRSP value-weighted representing the market portfolio. The end date for the previous calendar year is chosen to match the beginning of the reported plan year on the form 5500.

[23]Both differences are statistically significant at the .001 level.

and annual labor earnings and merge them to plans based on the industry reported in the Form 5500 data.[24]

There are several pension plan features described in the Form 5500 data that could influence the level of employer stock holdings. Mitchell and Utkus (2002) suggest that when an employer offers both a DB and DC to employees, the employee may be more willing to tolerate the risk of investing in the employer stock since the DB plan provides some insurance. In the 5500 data, we can establish whether an employer offers both a DB and a DC plan, but we cannot determine whether such DB plans cover the same group of workers included in the DC plan.

V. The Determinants of Employer Stock Holdings.

The propensity to invest in employer stock may differ depending on whether the employer or employee makes the asset allocation decisions. Compared to workers, employers may be more inclined to invest in employer stock since there may be positive productivity effects from employee stock ownership. The evidence on productivity effects is mixed, however.[25] Also, employers are more able to realize the tax advantages of employer stock ownership. When each individual worker is allowed to decide whether to invest in employer stock, the

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[24]The worker characteristics were derived from the 1989 to 1999 March Current Population Survey (CPS). The sample is restricted to individuals whose principal job in the prior year was as a wage salary worker at a private-sector employer, which had 100 or employees and offered a pension to its workers. The mean characteristics of these workers were calculated by 3-digit Census industry. Some 3-digit industry codes were combined in order to be consistent with the SIC and NAICS industry codes in the Form 5500 data. The resulting industry-level data set is composed of 181 industries.

[25]For example, while Jones and Kato (1995) find that employee stock ownership can increase worker productivity by 4 to 7 percentage points, Pugh, Oswald and Jahera (2000) find that the productivity effects of employee stock ownership are short-lived.

marginal effect of one person's improved productivity or the tax benefits that accrue to the corporation are likely to be inconsequential since they are split between all the stock holders.

To test for differential attitudes about risk/return tradeoffs, we make use of information in the form 5500 data that indicates whether the pension plan is "participant directed" meaning that it provides for individual accounts and permits a participant to exercise independent control over at least some of the assets in his or her account.

Form 5500 also indicates whether a pension is an ESOP plan. The decision to offer an ESOP is simultaneous to the decision of whether to mandate employer stock holdings. Consequently, we do not control for ESOP status in the multivariate analysis since it would lead to an endogeneity bias. One might argue that ESOPs should be excluded from the analysis since they are required to hold a majority of assets in stock. This, however, would bias our sample by excluding the types of companies that are most willing to force employees to hold a large share of assets in employer stock.

Table 5 presents multivariate analysis of employer stock holdings. Probit models are estimated to determine how various factors influence whether any employer stock is held in the pension plan. The coefficient estimates represent the estimated effect of a one unit change in the relevant explanatory variable on the probability that the pension holds any employer stock.[26] Tobit models are estimated to determine how various factors influence the share of assets held in employer stock. A tobit model is used to properly account for the fact that over one-half of the pension plans have zero percent of assets in employer stock. Ordinary least squares estimates are biased when the dependent variable exhibits truncation at zero. The coefficients presented

[26]The estimated effects are computed for the pension plan with average characteristics.

reflect the effect of a one unit change in the explanatory variable on the expected value of stock holdings.[27]

In the regression sample, 47 percent of pension plans in the 5500-CUSIP DC sample have some assets invested in employer stock. Not surprisingly, this is a much higher fraction of plans with employer stock than found in the 5500 DC sample since the latter sample included plans for firms without a CUSIP. Firms without a CUSIP are either not incorporated and have no stock which can be assigned a CUSIP, or are incorporated but do not have a stock with sufficient trading activity to file for a CUSIP.

Both the probability of investing in employer stock and the share of assets invested (i) is greater when the employer offers a DB plan in addition to the DC; (ii) rises until workers reach approximately age 50 and then falls; and (iii) is higher in industries where average labor earnings are greater, where women or Hispanics are a larger share of the workforce, and when unionism is less common.

Of particular interest here is the role that nondiversification cost plays in determining the level of stock holdings. The probit results suggest that increasing the NDC from the 5th to 95th percentile (an increase of .57) leads to a 9.0 percentage point decrease in the probability that any employer stock is included in the pension plan. The tobit results imply that this increase in NDC would lead to a 5.6 percentage point decrease in the percentage of assets invested in employer stock.

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[27]For both the probit and tobit models, the marginal effects for continuous variables are estimated for a pension plan with mean characteristics for all of the explanatory variables. For dummy variables, all the continuous variables are set at the sample mean and the dummy is alternated between 0 and 1 to determine the change in the predicted probability of holding employer stock for the probit and the predicted level of stock holdings for the tobit.

Holding NDC constant, a higher beta reduces pension fund holdings of employer stock. A one unit increase in beta reduces the probability of holding employer stock by 4.5 percentage points and reduces the share of assets invested in employer stock by 2.7 percentage points.

Employee control over asset allocation decisions reduces investment in employer stock. Participant direction of asset allocation reduces the probability of investing in employer stock by 6.1 percentage points and the share of assets in employer stock by 2.6 percentage points. This result is consistent with the hypothesis that employers will place a greater weight on the incentive effects of investing in employer stock than employees since they can mandate investment by all workers. Individual workers cannot force coworkers to purchase the employer stock and are therefore likely to see the productivity effects of their own purchases as small.

The coefficients on the year dummies reveal that the tendency to invest in employer stock grew between 1990 and 1998, even after controlling for nondiversification costs, employee characteristics, and plan characteristics. Holding the control variables constant, the chance that pension assets are invested in employer stock rose by nearly 9.2 percentage points between 1990 and 1998, and the share of assets invested in employer stock rose by 5.8 percentage points.

While virtually any type of DC plan allows investment in employer stock, if an ESOP is chosen, the employer is required by law to invest the majority of assets in employer stock. A KSOP plan allows an ESOP to be combined with a 401(k) plan. By choosing the share of contributions allocated to the ESOP and non-ESOP portions, the sponsor has considerable latitude over the share of assets invested in employer stock. Also, if an employer invests in employer stock through the ESOP portion of the plan, some tax advantages and reduced exposure to fiduciary liability are gained.

Since the choice of ESOP status requires that the majority of assets be invested in employer stock, greater non-diversification cost or stock risk should reduce the likelihood that a given pension plan chooses ESOP status. To investigate this hypothesis, we estimate a probit model of whether a pension plan chooses ESOP or KSOP status as a function of the same control variables that were included in the models of employer stock holding presented in table 5. The participant direction dummy variable is excluded since this is likely to be simultaneously determined with ESOP status.

The results of the probit models of ESOP status are presented in table 6. Many of the factors that influence the share of assets invested in employer stock have the same effect on the probability that ESOP status is elected. For example, non-diversification costs and beta both reduce the chance that a pension has ESOP or KSOP status. Also, pensions with a larger number of participants and those supplemented by a DB plan are more likely to choose ESOP/KSOP status. It is worth noting that while the probability of ESOP status fell during the 1990s, the probability of KSOP status rose.

If ESOP status protects employers from charges that it breached fiduciary liability by investing in employer stock, ESOP managers may be less concerned about investing in high risk stocks. Countering this argument, even with ESOP plans, employees are still sensitive to the risk and return characteristics of the stock and employers should internalize employee preferences because it affects the overall level of compensation that must be offered to compete in the labor market.

To determine whether ESOP status alters the response to the risk features of employer stock, tobit models of employer stock holdings are estimated by ESOP status with the results in table 7. Four groups of pensions are considered: (1) Non-ESOP plans; (2) ESOP plans; (3)

KSOP plans which represent the subset of ESOPs that have a 401(k) feature; and (4) the subset of ESOP plans that do not have a 401(k) option.

A comparison of the estimates reveals that, regardless of ESOP status, higher non-diversification costs and higher betas discourage investment in employer securities. These effects are statistically significant at the .05 level in all plan types except ESOP plans without a 401(k) option. The statistically insignificant effects in ESOP plans might be expected since election of an ESOP without a 401(k) option constrains employers to invest the majority of their funds in employer stock.

Participant direction of plan assets reduces the share of assets invested in employer stock in plans with any ESOP component. This result could reflect the fact that participant direction is a proxy for whether the ESOP provides any investment alternatives beyond employer stock. Alternatively, it might suggest that employees are less willing to invest in employer stock than the employer.

In plans without an ESOP option, participant direction has a positive but statistically insignificant effect on the share of assets held in employer stock. This suggests that in the universe of non-ESOP plans, employees are just as likely as employers to invest in employer stock. Given that the employee is likely to place a lower value on the incentive effects or tax advantages to stock holders of employer stock holdings than is the employer, this result is counter to our expectations. One possible explanation for this result is that without the protection provided by ESOP status, employers are reluctant to mandate that employees hold their stock because it increases their exposure to fiduciary liability.

A concern with the above analysis is that the results are based upon a sample of plans that do not pool their assets in a master trust. When a plan uses a master trust, the form 5500 data

does not require a breakdown of the individual asset holdings. Eliminating such plans could lead to biased estimates if the decision to use a master trust influences employer stock holdings and is correlated with the explanatory variables used in the regression models.

The Employee Benefits Security Administration has provided us with a data set for 1996 in which the assets in master trusts are "spread" to asset categories. Unfortunately, the methods used for allocating the assets require some imputation so there is measurement error in the data. In the 1996 data, 496 plans with master trusts can be added to a sample of 2279 plans. Using the expanded sample, we reestimated models of employer stock holdings to determine whether including plans with master trusts has a substantive effect on results. With the expanded data set, nondiversification costs and beta continue to have significant negative effects on employer stock holdings. Also, firms that offer a DB plan and plans with a larger number of participants increase the share of assets in employer stock. The estimated effects of these variables are smaller in the spread data than in the restricted sample. However, we are not convinced that is because excluding plans with master trusts leads to biased estimates. Rather, it may be explained by the fact that the imputation procedure used to spread the assets in master trusts results in many plans holding a very small share of assets in employer securities. For example, among firms with employer stock, 2.9 percent of plans have less than 1 percent of assets invested in employer stock when plans without master trusts are excluded. When the plans with master trusts are added to the sample, 80.7 percent of plans with some employer stock have less than 1 percent in employer stock.

Overall, the results provide strong confirmation of the hypothesis that regardless of whether employees or employers make the investment allocation decisions, non-diversification costs and risk (captured by beta) reduce investments in employer securities within a given plan

type, and also make it less likely that an ESOP option is chosen. Consequently, both employers and employees exhibit behavior recognizing basic principals regarding portfolio diversification. Nevertheless, significant investments in employer securities expose workers to unnecessary risk. When employers control the asset allocation decisions, one might argue that other benefits of holding employer (e.g. tax advantages, incentive effects, or corporate control) offset the increased risk of holding employer stock. Given that individual employees are unlikely to be motivated by these same benefits, one must appeal to other factors to explain why employees would invest in employer stock when they control asset allocation decisions. For example, evidence that employees tend to underrate the riskiness of their own employer's stock and prefer stocks that are familiar to them could explain the behavior.

VI. The Effect of Employer stock Holdings on Risk and Return.

Given that the average employer stock has greater return volatility than a market portfolio of equities, one might expect that in any given year, pensions with employer stock would have a higher variance in returns. It is conceivable, however, that pension fund managers adjust the other asset holdings to reduce the riskiness of the portfolio as a whole. This could be accomplished by increasing investments in assets with returns that are negatively correlated with employer stock and/or assets with low return volatility.

To investigate the effect of employer stock holdings on risk and return, we must first construct estimates of the rate of return on pension assets from the Form 5500 data. To

accomplish this, we use the approach described in McCarthy and Turner (1989). [28] The annual rate of return is calculated as net income from assets divided by invested assets. The net income from invested assets is defined as the sum of interest, dividends, rents, royalties, net realized gain or loss on sale or exchange of assets, other income, unrealized appreciation or depreciation of assets, and net investment gain from trusts minus unrealized appreciation or depreciation of buildings and depreciable property used in plan operations. Investible assets are defined to reflect assets at the beginning of the year plus additional purchases of assets through the year with the assumption that all purchases are made midyear. [29]

The sample statistics for the rate of return in table 8 indicate that pensions holding employer stock have a higher return and higher variance of returns. Compared to pension plans with no employer stock, the average rate of return is 2.5 percentage points higher and the median is 1.4 percentage points higher. Pension plans with employer stock also experience a wider range of returns. The standard deviation of returns is 10.8 percentage points higher for plans holding some employer stock. Among plans holding some employer stock, the bottom one percent had a rate of return below -50 percent and the top one percent had a rate of return above 112 percent. For plans without employer stock, the bottom one percent had a return below -25 percent and the top one percent had a return above 66%.

While pension plans with employer stock have a higher mean return and variance, it is unclear whether this is an inefficient tradeoff. If, for example, the pension plan could yield the

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[28] Also, following Conte (1994), we make a modest adjustment by omitting the deduction for interest expense from the numerator of the rate of return measure arguing that the change improves measurement of rates of return for ESOPs, without significant impact on rates of return for other types of plan.

[29] To be precise, invested assets are defined as (total assets at beginning of the year + total assets at end of the year- net income from assets - net receivables at beginning of the year - net receivables at end of the year - buildings used in plan operation at beginning of the year - buildings used in plan operation at end of the year)/2

same return with lower risk by switching from employer stock to other equities, the employer stock holdings would be an "inefficient" tradeoff between risk and return. The inefficiency of this tradeoff may, however, be justified by positive incentive effects created by the employer stock holdings.

To motivate the framework for our risk-return regression model, suppose that there are K asset categories and that portfolio i invests the fraction w_{ki} in asset category k. The expected return on the portfolio can be written as:

$$(7)\quad E(r_{pi}) = \sum_{k=1}^{K} w_{ki} r_k$$

where r_k is the expected return on asset category k and r_{pi} is the expected return on the assets in portfolio i.

The variance of expected returns on portfolio i can be written as:

$$(8)\quad Var(r_{pi}) = \sum_{k=1}^{K} w_{ki}^2 Var(r_{ki}) + 2 \sum_{k=1}^{K} \sum_{j \neq k} w_{ki} w_{ji} cov(r_{ki}, r_{ji})$$

With the above relationship between returns, the variance of returns, and asset shares in mind, the following multivariate regression model of returns is estimated:

$$(9)\quad r_{it} = X_{it} \beta + \varepsilon_{it}$$

where r_{it} is the annual rate of return earned by pension plan i during filing year t ; X_{it} is a vector of explanatory variables containing the share of assets invested in various categories and year dummies; β is a vector of parameters to be estimated reflecting the expected return on assets; and ε_{it} is a residual that is assumed to be normally distributed with zero mean and variance given by:

(10) $\sigma^2_{it} = Z_{it}\gamma$

where Z_{it} is a vector of explanatory variables including the squared asset shares and year dummies; and γ is a vector of coefficients to be estimated. The γ coefficients reveal the effect of a particular asset class or year on cross-sectional variance of returns; the β coefficients indicate the effect on the mean level of returns. To make the variance equation easier to interpret, only the squared share of each asset category is included. Interaction terms between the various asset shares representing covariance terms are excluded. The model is estimated with maximum likelihood methods.

The asset categories included in the risk-return model are collapsed into 4 categories: (1) bonds (2) employer stock; (3) non-employer stock; and (4) other assets.[30] The risk-return model is estimated with the share of assets in government bonds and the year dummy for 1990 excluded from the returns and variance equations. Consequently, government bonds are the reference asset category and 1990 is the reference year in both the return and variance of returns equations. The coefficients on the asset shares reveal how a particular asset category affects returns or variance relative to government bonds.

The estimated coefficients from the risk-return model are presented in table 9. The estimates imply that the ranking of asset categories in terms of their effect on the pension

[30]To be precise, bonds includes: non-interest bearing cash, interest bearing cash, certificates of deposit, U.S. government debt, corporate debt, loans secured by mortgages, loans to participants, and other loans. The other assets category includes receivables, common trusts, pooled trusts, 103-12 investments, assets with registered investment companies, funds held in insurance company general accounts, partnerships/joint ventures, real estate, and employer property, buildings and other property used in plan operation.

portfolio return (starting with the highest first) is employer stock, non-employer stock, other assets, and bonds. A chi-squared test rejects the hypothesis that the returns on company and non-employer stock are equal. The coefficients for the variance equation suggest that employer stock increases the variance of returns more than non-employer stock and both types of stock increase variance more than bonds or other assets. A chi-squared test rejects the hypothesis that company and non-employer stock have identical effects on the variance of returns.

The risk/return regression implies that, compared to other non-employer stock, employer stock holdings generate a higher yield and increase the variance of returns across plans. In the reference year, both the predicted rate of return and the cross-sectional standard deviation of returns are 21 percent higher if the portfolio contains 100% employer stock instead of 100% non-employer stock[31]

The bottom half of table 9 presents estimates for non-ESOP plans alone. The implied effects of employer stock holdings on risk and return are quite similar to those found for all plans combined. Relative to the other asset categories, employer stock holdings are associated with both the highest return and the highest risk.

Nearly 70 percent of the pension plans in our sample have some assets invested in pooled arrangements where it is impossible to determine whether the assets are invested in stocks, bonds, or otherwise.[32] Since investment income for each of the pooled categories is reported separately, we can compute a rate of return for assets held outside of these various pooled

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[31]In the reference year (1990), the predicted rates of return and standard deviation for a portfolio with 100% stock are 10.9% and .41, respectively. For a portfolio with 100% non-employer stock, the corresponding values are 9.0% and .34.

[32]The different types of pooled arrangements include pooled separate accounts, common collective trusts, and 103-12 investment entities, and registered investment companies.

investment arrangements.[33] If the rate of return on non-pooled assets is substituted for the rate of return on all assets in the regression equation, the results change very little in terms of the effect of employer stock, stock, and bonds on both the level and variance of returns.[34]

A shortcoming of the regression approach employed above is that it relies heavily on the normality assumption for the distribution of returns. Inter-quantile regressions avoid this problem and provide a means to examine the effect of asset allocation on differences between percentile points in the rate of return distribution. A 75/25 inter-quantile regression of returns, for example, reveals how asset allocation affects the difference between the 75th and 25th percentile of the return distribution.

Inter-quantile regression results for the 75/25, 90/10 and 95/5 are presented in table 10.[35] All three inter-quantile regressions reveal that the share of assets in employer stock has the largest effect on inter-quantile differences in pension portfolio returns; non-employer stock has the second largest effect; bonds have the smallest effect. As an illustration of the size of these differences, for a portfolio comprised entirely of bonds, the estimated 75/25 difference (i.e. the difference between the return at the 75th and 25th percentile) is 6.3 percentage points; the 90/10 is 15.3 percentage points; and the 95/5 is 24.2 percentage points. This contrasts sharply with the predictions for a portfolio comprised entirely of employer stock where the 75/25 difference is 38.2 percentage points; the 90/10 is 83.9 percentage points; and the 95/5 is 123.7 percentage points.

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[33]The rate of return on assets is calculated as net investment income divided by assets. To calculate the rate of return on assets held outside of the pooled arrangements, we subtract income from pooled arrangements from the numerator and assets included in the pooled investment arrangements from the denominator.

[34]The estimated effect of stock, employer stock, and bonds on the level and variance of the rate of return is also insensitive to exclusion of the 16 percent of plans whose filing is not on a calendar year basis.

[35]Standard errors for the coefficient estimates are estimated with 500 bootstrap samples.

The bottom panel of table 10 presents results for non-ESOP plans only. The conclusion that employer stock increases the range of returns more than any other asset category remains in the non-ESOP subsample.

As another approach to understanding the effect of employer stock holdings on risk and return, several simulations are employed. For every pension plan that holds employer stock, we estimate the return that would have prevailed if the employer stock portion of the portfolio was replaced by a diversified stock portfolio represented by the CRSP value weighted index over the same period. To perform the simulation, we estimate annual returns for the employer stock and the CRSP value weighted index for the twelve months corresponding to the pension plan reporting period.[36] The simulated return for pension portfolio i ending in period t is calculated as

$$(11)\ r_{it}^{*} = r_{it} + w_{it}^{s}(r_{t}^{m} - r_{it}^{s})$$

where subscripts i and t indicate pension portfolio i in period t (a month-year combination); r^{*} is the simulated return; r is the actual return; w^{s} is the fraction of assets invested in employer stock; r^{m} is the rate of return on the market portfolio; and r^{s} is the rate of return on the employer stock. For the simulation, the fraction of assets invested in employer stock is calculated as the average between the fractions reported at the beginning and the end of the plan year.

The distribution of actual and simulated returns is presented in table 11. The first two columns show the distribution for all pension plans, regardless of whether employer stock is held

in the portfolio. The third and fourth columns provide the distribution of actual and simulated returns for plans that have some employer stock in the portfolio.

For plans that hold some employer stock at either the beginning or end of the plan year, replacing the stock with the CRSP value weighted portfolio would lead to a small reduction (.30 percentage points) in the annual rate of return, but a large reduction (13.1 percentage points) in the standard deviation of returns. Whereas the first percentile of returns for plans with some employer stock is -49.6 percent, it would be -12.1 percent if the market portfolio replaced employer stock. At the 99th percentile, returns would be reduced from 112.1 percent to 53.7 if the market portfolio replaced employer stock. Examination of the overall distribution reveals that replacement of employer stock with the market portfolio has its largest effects in the extreme tails of the distribution. The differences at the 25^{th}, 50^{th}, and 75^{th} percentiles are less than .3 percentage points.

One way to limit the risk exposure is to place a limit on the fraction of assets held in employer stock. For example, ERISA limits a defined benefit plan to holding no more than 10 percent of plan assets in employer stock. A recent senate proposal (S. 1838) would limit an individual participant's holdings of employer stock to no more than 20 percent of any participant's assets in 401(k) plans.

To investigate the impact of caps on employer stock holdings, returns are simulated for the case where employer stock holdings are capped at 10, 25, or 50 percent of assets invested in employer stock. Our simulations assume that these caps apply at the plan level, not the

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[36] Since 16 percent of the pension plans in our sample have filing periods that differ from the calendar year, annual returns for employer stock and the CRSP value weighted index are estimated for the 12 months prior to the ending month and year of the filing period.

participant level.[37] As expected, these caps lead to a distribution of returns that lies somewhere between the actual distribution and what would be achieved with a total prohibition on employer stock holdings. Caps at 10, 25, or 50 percent have a negligible effect (less than .3 percentage points) on the mean return for portfolios holding some employer stock. Nevertheless, a cap as high as 50 percent has a fairly substantial effect on the distribution of returns. The standard deviation of returns would be reduced from .277 to .195 with a 50% cap, to .161 with a 25% cap, and to .148 with a 10% cap.

Instead of using the market portfolio of stocks, we also simulated returns for portfolios that replace employer stock with 5 year government bonds. These results are reported in the bottom half of table 11. Replacing employer stock with government bonds reduces both the mean and standard deviation of returns more than replacement with the market portfolio. Replacing employer stock with government bonds reduces the mean rate of return from 14.8 to 9.5 percent and the standard deviation of returns from .277 to .117. As expected, replacing employer stock with government bonds instead of the market portfolio of stocks leads to a greater reduction in both the mean and standard deviation of returns.

Table 12 presents results for the sub-sample of non-ESOP pension plans. Given that the non-ESOP plans generally have a smaller share of assets in employer stock than ESOP plans, it is not surprising that replacement of employer stock with either a market portfolio of stocks or bonds has a smaller effect on the distribution of returns. Nevertheless, the effect of limiting employer stock holdings remains substantial even in the non-ESOP sample of plans. Replacing employer stock with the market portfolio of stocks would reduce the standard deviation of

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[37]Proposed legislation would limit holdings at the participant (not plan) level. If employees are allowed to choose how much to invest in employer stock, a 10 percent cap could cause the share of assets invested in employer stock to

returns from .177 to .111. A 10 percent cap on employer stock holdings would reduce the standard deviation of returns to .112. Even a 50 percent cap would reduce the standard deviation of returns to .138. The reduced risk associated with the caps on employer stock holdings comes at a price. If employer stock is entirely replaced by the market portfolio, the mean return on non-ESOP plans would be reduced by .7 percentage points. A 50 percent cap would reduce the mean return by only .3 percentage points.

The simulation results suggest that replacing employer stock with a diversified portfolio of stocks would have only a modest effect on average returns, but could substantially reduce the variance of returns across plans. Replacing employer stock with bonds would have a larger effect on both the mean and variance of returns. It is important to point out that these results are conditioned upon stock and bond market performance in the 1990s when stock market performance was quite strong. If data from the recent stock market down turn were used as the basis for the simulation, replacing employer stock with bonds would likely have resulted in a much smaller reduction (and perhaps an increase) in mean returns.

VII. Summary and Conclusions.

This report finds that slightly over 10 percent of DC plans hold some employer stock, but slightly more than one-third of DC participants have some employer stock in their pension fund. Overall, about one-fifth of all DC assets are invested in employer stock.

While employer stock holdings in the aggregate represent only about one-third of DC assets, the concentration of assets held in employer stock varies substantially across pension

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drop below 10 percent.

plans. The first objective of this study was to determine whether the decision to hold employer stock is influenced by the nondiversification cost and risk of the company, the characteristics of the workforce, or whether the asset allocation decisions are made by the employer or the employee.

Our empirical evidence reveals that the investment behavior of pension funds is consistent with predictions generated by models of optimal portfolio management. We estimate a measure of the nondiversification cost of holding a particular stock as the increase in the expected rate of return that an investor would realize with no change in risk by switching from a portfolio consisting entirely of that stock to an mean-variance efficient portfolio. Our evidence shows that pension funds are less likely to hold a employer stock when the nondiversification cost of doing so is high. Also, holding nondiversification costs constant, pension funds tend to avoid high risk stocks with high returns. While the negative correlation between the level of stock holdings and nondiversification costs suggests that basic principals of optimal portfolio management play a role in pension fund choices, other factors must play a role in explaining why pension funds hold employer stock. When employers make the investment decisions, employer stock holdings could be explained by appeals to productivity, tax, or anti-takeover effects. Since individual employees are unlikely to be motivated by the factors that might motivate employers, it is more difficult to provide an economic rationale for employee investments in employer stock. Consequently, an explanation for employee behavior may rest upon an observed tendency for people to underestimate the risk of stocks they are familiar with, or an inclination to perceive the employer's decision to offer employer stock as an investment option as an endorsement of its quality as an investment vehicle.

The fact that high nondiversification cost and a high beta reduce pension fund holdings of employer stock may dampen the negative consequences of employer stock holdings on risk and return. Moreover, pension fund managers may also be able to reduce the risks of concentrated holdings of employer stock by adjusting the remainder of the portfolio. Our evidence suggests, however, that investor behavior does not eliminate the added risk of holding employer stock. Relative to other stock holdings, a concentration of employer stock increases both risk and return. Compared to a portfolio with 100% non-employer stock, a portfolio with 100% employer stock is estimated to have a 21 percent higher average rate of return and a 21 percent higher standard deviation of returns.

Legislative proposals to place a limit on employer stock holdings could have a substantial effect on pension fund returns. The answer depends critically upon what assets would replace the employer stock. Using simulation methods, we estimate the effects of capping employer stock holdings and replacing the stock with either the CRSP value weighted index, or five-year government bonds. If employer stock holdings are capped at 10 percent of total assets and replaced by the CRSP value weighted index, there would be a negligible effect on the rate of return earned on pension funds (less than one-half a percentage point) but cut the standard deviation of returns in half. Even a 50 percent cap on employer stock holdings would reduce the standard deviation of returns by approximately 40 percent. If ESOP plans are exempted, a 10 percent cap would reduce the mean return by 0.6 percentage points and the standard deviation of returns by 6.4 percentage points; a 50 percent cap would reduce the mean return by 0.3 percentage points and the standard deviation of returns by 3.8 percentage points. If, on the other hand, employer stock holdings were replaced by 5 year government bonds, a 10 percent cap on employer stock holdings would reduce the average rate of return by 4.3 percentage points

and reduce the standard deviation of returns by 15.7 percentage points. Consequently, the effect of legislative caps on the distribution of returns will depend critically on how pensions would adjust their asset allocation in response to the cap. It is also worth noting that these simulations are based upon stock performance during the 1990s when stocks performed very well. The effects of exchanging employer stock for other assets may differ for a period when the market is in decline. For example, it is likely that replacing employer stock with bonds during the recent stock market downturn may have simultaneously increased pension returns and reduce the variance of returns.

The desirability of legislated limits on employer stock holdings is debatable. On the one hand, it is apparent that such legislation would lead to a fairly substantial reduction in the risk of pension holdings in exchange for a modest reduction in return. At the same time, employer stock holdings could enhance firm productivity and legislative limits could damage firm productivity and employee compensation. Moreover, there are alternative means to reduce the employee risk exposure to employer stock holdings. In the extreme, employees could sell their employer stock short, although this would defeat the desired incentive effects of holding employer stock. Alternatively, firms or workers could reduce risk exposure by investing more heavily in securities that have low (or negative) correlation with their employer's security. An obvious difficulty with these solutions to the problem of risk exposure to employer stock holdings is that some employees will lack the requisite financial knowledge for making such adjustments and yet others will lack the necessary non-pension, non-housing wealth that could be used to help neutralize the concentration of employer stock in their pension funds.

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Table 1: Sample Sizes and Deletions for Data Sets

	Sample Size	Deletions
Sample Size for Form 5500 Sample	824,256	
Less than 100 Participants		253,521
Defined Benefit Plans		157,406
Asset Total at End of Year Equals Zero		43,013
Master Trust Assets Greater than Zero		15,728
Public Sector, tax-exempt, or Missing Industry Code		13,801
Interim reports		5,263
Sum of Asset Parts Not Within 2% of Reported Asset Total		1,402
Individual Asset Value Exceeds Reported Total of Assets		849
Defined Benefit Plan with Benefits Partly Based on Balance		562
Total Deletions		491,545
Sample Size in Form 5500 DC Data Set	332,711	
No CUSIP in Form 5500		300,313
Among CUSIP firms, no match in CRSP		13,351
Missing data for calcuation of NDC		68
Total Deletions		313,732
Form 5500/CRSP Sample Size	18,979	

Table 2: Employer Stock Holdings

Percent of plans with Employer Stock

Year	Unweighted	Weighted by number of participants	Sample Size
1990	11.8%	36.0%	28,676
1991	11.6%	37.0%	29,424
1992	11.3%	36.6%	32,566
1993	11.3%	36.1%	35,410
1994	10.9%	35.7%	35,529
1995	10.5%	34.6%	38,416
1996	10.2%	33.5%	41,697
1997	9.7%	34.8%	43,947
1998	9.0%	34.6%	47,046
1990-1998	10.6%	35.3%	332,711

Share of Assets in Employer Stock among Plans with Employer Stock

Year	Unweighted	Weighted by Assets	Sample Size
1990	54.9%	43.4%	3,392
1991	55.1%	45.1%	3,408
1992	55.1%	46.9%	3,693
1993	55.6%	45.0%	3,989
1994	54.9%	45.6%	3,880
1995	54.1%	45.3%	4,046
1996	52.9%	44.5%	4,247
1997	51.5%	45.9%	4,239
1998	49.8%	45.1%	4,239
1990-1998	53.7%	45.3%	35,133

Share of Assets in Employer Stock among all Plans

Year	Unweighted	Weighted by Assets	Sample Size
1990	6.5%	18.7%	28,676
1991	6.4%	20.6%	29,424
1992	6.3%	21.6%	32,566
1993	6.3%	21.2%	35,410
1994	6.0%	20.9%	35,529
1995	5.7%	20.9%	38,416
1996	5.4%	20.6%	41,697
1997	5.0%	22.2%	43,947
1998	4.5%	21.4%	47,046
1990-1998	5.7%	21.1%	332,711

Table 3: Distribution of Employer Stock Share by ESOP Status

All Plans

		Share for Plans with Employer Stock				
Year	No Stock	<20%	20% to 39%	40% to 59%	60% to 79%	80% to 100%
1990	88.2%	28.5%	12.6%	9.6%	10.5%	38.7%
1991	88.4%	28.1%	13.4%	9.9%	9.8%	38.8%
1992	88.7%	27.8%	13.5%	10.2%	9.7%	38.9%
1993	88.7%	26.3%	14.2%	10.7%	9.9%	38.9%
1994	89.1%	27.2%	14.3%	10.6%	9.5%	38.4%
1995	89.5%	28.6%	13.9%	10.4%	9.6%	37.5%
1996	89.8%	29.9%	14.3%	10.2%	9.0%	36.5%
1997	90.4%	31.4%	14.3%	10.2%	8.9%	35.2%
1998	91.0%	34.5%	14.0%	9.2%	7.8%	34.5%
1990-1998	89.4%	29.3%	13.9%	10.1%	9.4%	37.4%

Non-ESOP Plans

		Share for Plans with Employer Stock				
Year	No Stock	<20%	20% to 39%	40% to 59%	60% to 79%	80% to 100%
1990	93.6%	53.1%	19.7%	11.2%	7.0%	9.0%
1991	93.6%	51.2%	20.0%	12.4%	7.6%	8.8%
1992	93.9%	51.2%	21.8%	12.1%	6.7%	8.1%
1993	94.0%	49.4%	22.9%	13.2%	7.0%	7.5%
1994	94.2%	50.9%	23.3%	12.6%	6.6%	6.6%
1995	94.4%	53.7%	22.2%	12.2%	6.3%	5.6%
1996	94.4%	55.1%	22.7%	10.9%	5.7%	5.7%
1997	94.5%	55.5%	21.0%	11.6%	6.0%	5.8%
1998	94.9%	60.8%	20.7%	9.7%	4.3%	4.5%
1990-1998	94.2%	53.7%	21.6%	11.7%	6.3%	6.7%

Table 4: Sample Statistics for Matched Form 5500/CRSP Data Set

	All		
Measure	Mean	5th Percentile	95th Percentile
Standard Deviation of Stock Return	0.027	0.011	0.059
Standard Deviation for Market Return	0.007	0.005	0.010
Beta	0.754	-0.050	1.82
NDC	0.266	0.065	.671
	Stocks not held in issuing company's pension(s)		
	Mean	5th Percentile	95th Percentile
Standard Deviation of Stock Return	0.031	0.012	0.065
Standard Deviation for Market Return	0.007	0.005	0.010
Beta	0.803	-0.097	2.02
NDC	0.301	0.074	0.749
	Stocks held in issuing company's pension(s)		
	Mean	5th Percentile	95th Percentile
Standard Deviation of Stock Return	0.024	0.010	0.052
Standard Deviation for Market Return	0.007	0.005	0.010
Beta	0.708	-.019	1.64
NDC	0.234	0.059	.591

Table 5: Determinants of Presence of Employer Stock and Employer Stock Share

	Probit		Tobit	
Variable	Marginal	t-stat	Marginal	t-stat
Nondiversification cost	-0.1636	-9.45	-0.1087	-11.20
Beta	-0.0454	-8.15	-0.0265	-8.61
Participant Directed	-0.0613	-7.81	-0.1255	-29.94
Number of active participants	0.0065	15.09	0.0017	14.02
Company also offers DB plan	0.0834	9.73	0.0521	11.27
Age:				
25 to 34	-0.2640	-1.70	-0.1423	-1.71
35 to 44	-0.0504	-0.34	-0.1491	-1.88
45 to 49	0.7361	2.81	0.4219	3.03
50 to 54	-0.3032	-0.85	-0.3286	-1.70
55 to 64	-1.6797	-7.00	-1.0163	-7.82
65 to 99	0.6671	1.00	0.3500	0.97
Race/Ethnic Status:				
Black	-0.0009	-0.69	0.0006	0.94
Other Race	-0.0195	-6.79	-0.0096	-6.10
Hispanic	0.0121	5.97	0.0052	4.72
Female	0.0028	6.04	0.0022	8.57
Education:				
High School Graduate	-0.0002	-0.11	-0.0007	-0.66
Some College	0.0089	7.51	0.0051	8.00
College Graduate	-0.0040	-2.00	-0.0036	-3.37
Graduate Degree	-0.0018	-0.71	-0.0037	-2.71
Union Member	-0.0015	-2.96	-0.0008	-3.02
Real Wage/Salary Income/10000	0.0093	7.15	0.0078	10.90
Year:				
1991	0.0256	1.54	0.0244	2.73
1992	0.0354	2.15	0.0367	4.15
1993	0.0811	4.97	0.0685	7.81
1994	0.0979	5.98	0.0780	8.87
1995	0.0812	5.01	0.0673	7.72
1996	0.0982	5.99	0.0815	9.23
1997	0.0990	5.96	0.0783	8.78
1998	0.0949	5.56	0.0654	7.13
N	18,979		18,979	

Note: The dependent variable for the probit model is whether the plan has any assets in employer stock. The dependent variable for the tobit model is the share of plan assets in employer stock. The marginal effects represent the effect of a 1 unit change for continuous independent variables and a discrete change for dummy independent variables, evaluated at sample means.

Table 6: Determinants of ESOP and KSOP Status

	ESOP Probit		KSOP Probit	
Variable	Marginal	t-stat	Marginal	t-stat
Nondiversification cost	-0.050	-3.60	-0.049	-4.93
Beta	-0.038	-8.27	-0.007	-2.61
Number of active participants	0.003	14.97	0.001	13.64
Other DB plan	0.045	6.55	0.038	9.23
Age				
25 to 34	0.026	0.21	-0.105	-1.36
35 to 44	-0.824	-6.90	-0.140	-1.93
45 to 49	0.725	3.47	0.171	1.37
50 to 54	-0.831	-2.86	0.055	0.31
55 to 64	-0.127	-0.65	-0.292	-2.48
65 to 99	-2.251	-3.94	-0.454	-1.33
Racial/Ethnic Status:				
Black	0.006	5.55	-0.0003	-0.42
Other Race	-0.015	-6.16	-0.003	-2.28
Hispanic	0.007	4.04	0.004	3.27
Female	0.002	6.50	0.000	0.97
Education:				
High School Graduate	0.000	0.25	0.004	3.52
Some College	0.005	4.98	0.004	6.54
College Graduate	-0.006	-3.98	0.002	1.80
Graduate Degree	-0.005	-2.07	0.005	3.56
Union Member	-0.003	-7.03	-0.001	-3.67
Real Wage/Salary Income/10000	0.012	11.23	0.001	0.87
Year:				
1991	0.006	0.44	0.001	0.17
1992	-0.001	-0.10	0.006	0.76
1993	0.005	0.41	0.007	0.86
1994	0.003	0.25	0.014	1.76
1995	-0.008	-0.64	0.007	0.91
1996	-0.012	-0.94	0.012	1.49
1997	-0.036	-2.90	0.007	0.86
1998	-0.043	-3.35	-0.004	-0.58
N	18,979		18,979	
Percent ESOP	21.6%		7.1%	

Note: The dependent variable for the ESOP probit model is whether the plan is an ESOP plan. The dependent variable for the KSOP probit model is whether the plan is a KSOP plan. The marginal effects represent the effect of a 1 unit change for continuous independent variables and a discrete change for dummy independent variables, evaluated at sample means.

Table 7: Determinants of Employer Stock Share by ESOP Status based on Tobit Models

	Non-ESOP		ESOP		KSOP		ESOP w/o KSOP	
Variable	Marginal	t-stat	Marginal	t-stat	Marginal	t-stat	Marginal	t-stat
Nondiversification cost	-0.102	-14.07	1-0.060	-2.08	-0.137	-2.55	-0.019	-1.42
Beta	-0.012	-5.47	-0.020	-2.34	-0.044	-2.90	-0.005	-1.22
Participant Directed	0.004	1.40	-0.259	-19.67	-0.176	-9.34	-0.111	-6.71
Number of active participants	0.001	9.70	0.001	2.50	0.001	2.42	0.000	1.55
Other DB plan	0.042	12.73	-0.005	-0.36	-0.033	-1.41	0.004	0.69
Age								
25 to 34	-0.165	-2.70	0.115	0.49	-0.164	-0.41	0.066	0.58
35 to 44	-0.065	-1.16	0.377	1.57	-0.177	-0.44	0.258	2.17
45 to 49	0.060	0.59	0.846	2.21	0.259	0.37	0.380	2.09
50 to 54	-0.240	-1.72	1.243	2.22	3.876	3.91	0.199	0.74
55 to 64	-0.632	-6.83	-2.008	-5.25	-3.340	-4.96	-0.765	-4.06
65 to 99	0.274	1.08	4.146	3.63	4.102	2.31	2.102	3.54
Racial/Ethnic Status:								
Black	0.000	0.63	-0.005	-2.39	-0.014	-3.83	-0.001	-1.42
Other Race	-0.008	-7.58	0.017	3.64	0.016	2.24	0.008	3.20
Hispanic	0.006	7.98	-0.014	-3.98	-0.019	-2.76	-0.005	-2.72
Female	0.001	6.24	0.002	2.64	0.007	5.53	0.000	-0.55
Education:								
High School Graduate	0.002	2.13	-0.010	-3.23	-0.006	-0.91	-0.003	-1.84
Some College	0.005	10.21	-0.003	-1.84	-0.006	-1.94	0.000	-0.16
College Graduate	0.000	-0.20	-0.008	-2.25	-0.004	-0.56	-0.002	-1.16
Graduate Degree	0.001	1.28	-0.025	-5.49	-0.024	-3.18	-0.007	-2.95
Union Member	0.000	0.10	0.000	-0.43	0.002	1.66	0.000	-1.12
Real Wage/Salary Income/10000	0.004	7.81	0.005	2.42	0.008	2.14	0.000	0.38
Year:								
1991	0.005	0.70	0.053	2.31	0.030	0.80	0.024	2.14
1992	0.002	0.26	0.097	4.23	0.113	3.10	0.034	2.93
1993	0.019	2.99	0.128	5.68	0.151	4.07	0.046	4.08
1994	0.021	3.34	0.133	5.87	0.139	3.78	0.052	4.52
1995	0.009	1.39	0.135	5.97	0.148	4.02	0.049	4.30
1996	0.016	2.48	0.152	6.62	0.173	4.68	0.056	4.82
1997	0.011	1.70	0.161	6.85	0.181	4.89	0.060	4.85
1998	-0.001	-0.16	0.158	6.45	0.166	4.26	0.058	4.55
Intercept	-0.307	-6.2	0.725	3.65	0.555	1.42	0.226	2.35
N	14,889		4,090		1,355		2,735	
Average % in Employer Stock	11.1%		60.6%		41.7%		69.9%	

Note: The dependent variable is the share of plan assets in employer stock The marginal effects represent the effect of a 1 unit change for continuous independent variables and a discrete change for dummy independent variables, evaluated at sample means.

Table 8: Sample Statistics for Rates of Return

	All Plans		
Measure	With Employer Stock	No Employer Stock	All
Mean	14.8%	12.3%	13.5%
Standard Deviation	27.7%	16.9%	22.8%
Percentiles of distribution			
1	-49.6%	-25.1%	1-40.6%
5	-18.3%	-2.3%	-11.0%
10	-7.6%	0.9%	-2.0%
25	3.4%	6.2%	5.2%
50	12.3%	10.9%	11.5%
75	22.0%	17.2%	19.0%
90	37.8%	23.2%	29.2%
95	55.6%	27.9%	42.5%
99	112.1%	65.6%	93.6%
Sample Size	8,841	9,540	18,381
	Non-ESOP Plans		
	With Employer Stock	No Employer Stock	All
Mean	13.6%	11.9%	12.6%
Standard Deviation	17.6%	10.2%	13.7%
Percentiles of distribution			
1	-23.9%	-7.9%	-16.3%
5	-6.9%	-0.3%	-2.6%
10	-1.6%	1.9%	0.7%
25	5.2%	6.5%	6.1%
50	12.3%	10.9%	11.4%
75	19.7%	16.8%	17.8%
90	29.3%	22.2%	24.4%
95	37.5%	25.5%	30.1%
99	68.3%	39.7%	54.3%
Sample Size	5,741	8,615	14,356

Table 9: Rate of Return Models

	All Plans			
	Returns		Heteroskedasticity	
	Coefficient	t-stat	Coefficient	t-stat
Intercept	0.0259	6.55	0.0081	21.82
Employer Stock	0.0834	12.41	0.1576	47.19
Non-Employer Stock	0.0644	7.60	0.1052	28.22
Other assets	0.0217	6.06	-0.0020	-8.96
Year:				
1991	0.1112	23.05	0.0125	13.08
1992	0.0405	11.91	-0.0017	-4.10
1993	0.0404	12.97	-0.0036	-9.78
1994	-0.0191	-6.13	-0.0034	-9.21
1995	0.1329	35.91	0.0028	5.28
1996	0.0889	25.27	0.0008	1.79
1997	0.1254	37.25	-0.0012	-3.03
1998	0.0881	25.13	-0.0002	-0.55
Sample Size	18,381		18,381	
p-value for Test for Equality of Stock and Employer Stock Coefficients	0.040		0.000	

	Non-ESOP Plans			
	Returns		Heteroskedasticity	
	Coefficient	t-stat	Coefficient	t-stat
Intercept	0.0314	10.39	0.0048	18.30
Employer Stock	0.0824	11.24	0.1213	31.96
Non-Employer Stock	0.0682	9.39	0.0555	20.08
Other assets	0.0231	9.31	-0.0001	-0.70
Year:				
1991	0.0892	28.32	-0.0001	-0.17
1992	0.0307	12.02	-0.0034	-12.98
1993	0.0342	12.97	-0.0027	-10.34
1994	-0.0255	-9.41	-0.0022	1-8.14
1995	0.1275	37.93	0.0037	8.31
1996	0.0804	27.73	-0.0005	-1.68
1997	0.1159	39.36	-0.0005	-1.57
1998	0.0848	27.08	0.0008	2.19
Sample Size	14,356		14,356	
p-value of Test for Equality of Stock and Employer Stock Coefficients	0.130		0.000	

Note: The dependent variable is the rate of return for the plan's assets. The returns equation shows the effect on a change in the asset year or year on the mean return . The heteroskedacity equation shows the effect of the squared asset share or year on the variance of returns. The reference group is the share of plan assets in government bonds or its square.

Table 10: Interquantile Models

	All Plans					
	75/25		90/10		95/5	
Intercept	0.063	13.45	0.153	14.24	0.242	11.30
Employer Stock	0.319	39.11	0.686	39.46	0.995	40.65
NonEmployer Stock	0.171	17.75	0.469	21.73	0.758	15.91
Other assets	0.015	4.98	0.009	1.64	0.014	2.06
Year:						
1991	0.006	1.11	-0.012	-0.97	-0.0551	-2.12
1992	-0.051	-12.79	-0.101	-9.44	-0.158	-6.95
1993	-0.036	-8.61	-0.080	-7.49	-0.131	-6.06
1994	-0.043	-10.82	-0.087	-8.47	-0.145	-6.86
1995	0.003	0.57	-0.012	-1.08	-0.062	-2.85
1996	-0.040	-9.19	-0.079	-7.36	-0.129	-5.96
1997	-0.015	-3.32	-0.030	-2.34	-0.064	-2.91
1998	0.014	2.68	0.016	1.25	-0.009	-0.41
Sample Size	18,381		18,381		18,381	
p-value for F-test for equality of stock and employer stock coefficients	0.000		0.000		0.000	
	Non-ESOP Plans					
	75/25		90/10		95/5	
Intercept	0.065	15.60	0.124	18.69	0.166	14.64
Employer Stock	0.248	24.26	0.512	26.50	0.765	24.60
NonEmployer Stock	0.103	11.73	0.257	11.69	0.459	13.77
Other assets	0.005	1.69	0.008	1.97	0.028	4.44
Year:						
1991	0.009	2.15	0.012	1.45	-0.004	-0.27
1992	-0.043	-13.31	-0.068	-9.73	-0.092	-7.63
1993	-0.027	-7.28	-0.036	-5.46	-0.060	-5.06
1994	-0.030	-8.93	-0.049	-7.09	-0.060	-4.85
1995	0.014	3.61	0.026	3.55	0.006	0.56
1996	-0.031	-8.37	-0.041	-5.78	-0.053	-4.29
1997	-0.011	-2.96	0.002	0.24	0.000	-0.05
1998	0.014	3.29	0.032	3.81	0.039	2.93
Sample Size	14,356		14,356		14,356	
p-value for F-test for equality of stock and employer stock coefficients	0.000		0.000		0.000	

Note: The dependent variables are the difference in return on plan assets between the 75th and 25th, 90th and 10th, and 95th and 5th percentiles. The quantile regressions standard errors are based on 500 bootstrap replications.

Table 11: Actual and Simulated Returns for All Plans

Simulations Using Stock Index Return

	All Plans		With Employer Stock		With Restrictions on Employer Stock		
	Actual	Simulated	Actual	Simulated	10%	25%	50%
Percentile:							
1	-40.6%	-18.4%	-49.6%	-12.1%	-13.0%	-17.7%	1-27.7%
5	-11.0%	-3.1%	-18.3%	-4.2%	-4.6%	-5.6%	-8.3%
10	-2.0%	0.1%	-7.5%	-0.8%	-0.8%	-1.2%	-2.0%
25	5.2%	6.3%	3.4%	6.7%	6.6%	5.9%	4.9%
50	11.5%	12.0%	12.3%	13.7%	13.6%	13.6%	13.2%
75	19.0%	19.3%	22.0%	21.4%	21.4%	21.4%	21.3%
90	29.2%	26.6%	37.8%	30.1%	29.9%	30.9%	31.9%
95	42.5%	33.3%	55.6%	33.9%	34.7%	37.9%	43.9%
99	93.6%	59.0%	112.1%	53.7%	56.5%	62.2%	80.2%
Mean	13.5%	13.4%	14.8%	14.5%	14.6%	14.7%	14.7%
Standard Deviation	22.8%	15.8%	27.7%	14.6%	14.8%	16.1%	19.5%

Simulations Using 5 Year Treasury Bond Return

	All Plans		With Employer Stock		With Restrictions on Employer Stock		
	Actual	Simulated	Actual	Simulated	10%	25%	50%
Percentile:							
1	-40.6%	-18.8%	-49.6%	-14.0%	-12.7%	-15.6%	1-28.0%
5	-11.0%	-1.5%	-18.3%	-0.6%	-1.3%	-4.7%	-9.4%
10	-2.0%	1.7%	-7.5%	2.5%	1.5%	-0.5%	-2.6%
25	5.2%	5.9%	3.4%	5.6%	5.3%	4.8%	4.5%
50	11.5%	8.9%	12.3%	7.6%	9.2%	10.2%	10.2%
75	19.0%	14.9%	22.0%	12.4%	14.1%	16.3%	16.8%
90	29.2%	21.2%	37.8%	18.1%	19.9%	22.9%	26.6%
95	42.5%	25.9%	55.6%	22.3%	24.3%	28.3%	37.5%
99	93.6%	55.8%	112.1%	45.6%	47.2%	56.3%	76.5%
Mean	13.5%	10.9%	14.8%	9.5%	10.5%	11.3%	11.9%
Standard Deviation	22.8%	14.6%	27.7%	11.7%	12.0%	13.8%	18.1%
Percent Affected by Restriction					78.8%	60.2%	41.6%
Sample Size	18,381		8,841		8,841	8,841	8,841

Note: The actual return is the return on the plan's assets. The simulated return is the return that would have occurred if the return on the employer stock share of plan assets was replaced with either the overall market or 5-year Treasury bond return. The simulated returns for the employer stock with restrictions scenarios were calculated by replacing the employer stock return with the market or bond return for the share of plan assets that exceeded the restriction.

Table 12: Actual and Simulated Returns for Non-ESOP Plans

Simulations Using Stock Index Return

	All Plans		With Employer Stock		With Restrictions on Employer Stock		
	Actual	Simulated	Actual	Simulated	10%	25%	50%
Percentile:							
1	-16.3%	-9.8%	-23.9%	-11.6%	-11.7%	-13.2%	1-17.3%
5	-2.6%	-1.3%	-6.9%	-2.4%	-2.8%	-3.5%	-3.3%
10	0.7%	1.1%	-1.6%	0.2%	0.1%	0.1%	0.1%
25	6.1%	6.5%	5.2%	6.5%	6.5%	6.1%	6.0%
50	11.4%	11.6%	12.3%	12.9%	12.7%	12.9%	12.9%
75	17.8%	17.8%	19.7%	19.4%	19.5%	19.4%	19.4%
90	24.4%	23.4%	29.3%	25.1%	25.8%	26.1%	25.8%
95	30.1%	27.0%	37.5%	29.2%	29.3%	31.3%	31.8%
99	54.3%	38.3%	68.3%	37.9%	39.3%	46.3%	57.3%
Mean	12.6%	12.3%	13.6%	12.9%	13.0%	13.1%	13.3%
Standard Deviation	13.7%	10.6%	17.6%	11.2%	11.2%	12.1%	13.8%

Simulations Using 5 Year Treasury Bond Return

	All Plans		With Employer Stock		With Restrictions on Employer Stock		
	Actual	Simulated	Actual	Simulated	10%	25%	50%
Percentile:							
1	-16.3%	-10.7%	-23.9%	-13.9%	-12.1%	-13.3%	-17.5%
5	-2.6%	-0.5%	-6.9%	-1.0%	-1.3%	-2.4%	-3.4%
10	0.7%	1.9%	-1.6%	1.9%	1.5%	0.7%	0.7%
25	6.1%	6.1%	5.2%	5.7%	5.8%	5.5%	5.6%
50	11.4%	10.1%	12.3%	9.1%	10.2%	10.9%	10.4%
75	17.8%	15.5%	19.7%	13.8%	15.2%	16.3%	15.6%
90	24.4%	21.0%	29.3%	18.8%	20.4%	21.9%	21.9%
95	30.1%	24.5%	37.5%	22.0%	23.6%	26.3%	28.2%
99	54.3%	36.7%	68.3%	33.9%	35.7%	39.9%	53.6%
Mean	12.6%	11.0%	13.6%	9.8%	10.7%	11.2%	11.3%
Standard Deviation	13.7%	9.8%	17.6%	9.2%	9.4%	10.6%	12.6%
Percent Affected by Restriction					68.3%	42.8%	19.8%
Sample Size	14,356		5,741		5,741	5,741	5,741

Note: The actual return is the return on the plan's assets. The simulated return is the return that would have occurred if the return on the employer stock share of plan assets was replaced with either the overall market or 5-year Treasury bond return. The simulated returns for the employer stock with restrictions scenarios were calculated by replacing the employer stock return with the market or bond return for the share of plan assets that exceeded the restriction.