1-1-2003

Employee Investment Decisions about Company Stock

James J. Choi
Harvard University, james.choi@yale.edu

David Laibson
Harvard University, dlaibson@harvard.edu

Brigitte C. Madrian
The Wharton School, University of Pennsylvania, BMADRIAN@WHARTON.UPENN.EDU

Andrew Metrick
The Wharton School, University of Pennsylvania

Employee Investment Decisions about Company Stock

Abstract

We study the relationship between past returns on a company's stock and the level of investment in that stock by participants in that firm's 401(k) plan. Several different decision points are of interest: the initial fraction of savings allocated to company stock, the changes in this fraction, and the reallocations of portfolio holdings across different asset classes. We find that high past returns on company stock do induce participants to allocate more of their new contributions to company stock. By contrast, high company stock have the opposite effect on reallocations of portfolio holdings: high returns produce portfolio shifts away from company stock and into other forms of equity. Overall, for company stock decisions, participants in our sample appear to be momentum investors when making contribution decisions, but they are contrarian investors when making trading decisions.

Disciplines

Economics

Comments

The published version of this Working Paper may be found in the 2004 publication: *Pension Design and Structure: New Lessons from Behavioral Finance*.

Pension Design and Structure

New Lessons from Behavioral Finance

EDITED BY

Olivia S. Mitchell and
Stephen P. Utkus

OXFORD
UNIVERSITY PRESS

OXFORD
UNIVERSITY PRESS
Great Clarendon Street, Oxford OX2 6DP
Oxford University Press is a department of the University of Oxford.
It furthers the University's objective of excellence in research, scholarship,
and education by publishing worldwide in
Oxford New York
Auckland Bangkok Buenos Aires Cape Town Chennai
Dar es Salaam Delhi Hong Kong Istanbul Karachi Kolkata
Kuala Lumpur Madrid Melbourne Mexico City Mumbai Nairobi
São Paulo Shanghai Taipei Tokyo Toronto
Oxford is a registered trade mark of Oxford University Press
in the UK and in certain other countries
Published in the United States
by Oxford University Press Inc., New York

British Library Cataloguing in Publication Data
Data available
Library of Congress Cataloging in Publication Data
Data available
ISBN 0-19-927339-1
Typeset by Newgen Imaging Systems (P) Ltd., Chennai, India
Printed in Great Britain
on acid-free paper by
Biddles Ltd., King's Lynn, Norfolk

Chapter 7

Employee Investment Decisions about Company Stock

James J. Choi, David Laibson, Brigitte Madrian, and Andrew Metrick

Recent high-profile cases have illustrated the dangers of employee investment in company stock. These debacles are unlikely to be the last ones, or even the most severe. Companies with more than 50 percent of retirement assets in company stock are common, and fractions over 80 percent continue to prevail at such large companies as Procter & Gamble, Anheuser-Busch, and Pfizer.[1]

The concentration of retirement wealth in company stock is a clear violation of diversification principles. Recently, several studies have quantified the economic costs of this concentration. Muelbroek (2002) uses a Sharpe-ratio approach and finds that the average diversification cost of company stock is about 42 percent of its value. Ramaswamy (2003) uses option-pricing techniques to compute the cost of insuring the extra risk of company stock. For a range of plausible parameter values, he finds that this insurance would be prohibitively expensive.[2]

Despite these high costs, companies continue to offer employee stock in their retirement plans. There are many potential explanations for this behavior, but none are entirely satisfying. For example, employers may believe that stock compensation is inexpensive relative to cash, that there are strong incentive or morale effects, or that friendly employees will aid management in a takeover or other proxy battle. Mitchell and Utkus (2003) review these arguments and find little evidence to support them. The only explanation with any significant empirical support is tax-driven: Dividends paid to certain employee ownership plans are tax-deductible at the corporate level. Liang and Weisbenner (2002) find a significant relationship between company stock fractions of total contributions and dividend payout. Nevertheless, this finding can explain only part of the puzzle, as many firms without any

The authors thank Hewitt Associates for their help in providing the data. They are particularly grateful to Lori Lucas and Jim McGhee at Hewitt. Choi acknowledges financial support from a National Science Foundation Graduate Research Fellowship. Laibson and Madrian acknowledge financial support from the National Institute on Aging (R01-AG-16605 and R29-AG-013020 respectively). Laibson also acknowledges financial support from the MacArthur Foundation.

dividends still have significant employee ownership of company stock in their plans.

Even when employers offer their stock, of course, it does not mean that employees must buy it. While many plans make matched contributions in company stock, and some of these plans restrict employees' rights to sell this stock for some period of time, there is still a significant amount of discretionary contributions to company stock. Benartzi (2001) was the first to investigate this behavior and provided an interesting explanation for it. Using a sample of about half of the S&P 500 companies, he found that discretionary contributions to company stock are positively correlated with the past returns on that stock. He posited that this correlation was due to employees' extrapolation of past returns when forming expectations about future returns. Liang and Weisbenner (2002) confirmed his result for a larger number of companies over a longer time period.

Both of these prior studies rely on firm-level data drawn from SEC filings, which report a firm's average contribution fraction to company stock. Thus, these studies use data for a large number of firms to analyze cross-sectional relationships between firm characteristics and employee discretionary contributions to company stock. Our analysis looks at some similar questions, but our approach is distinct and complementary: We use time-series variation in returns at three large firms' 401(k) plans, from 1992 to 2000, to identify the effect of returns on the company stock choices of 94,191 plan participants. Our objective is to use this time-series variation to better understand the mechanisms by which past returns influence employee investment. Specifically, we attempt to measure the extent of "feedback" investing in company stock, to analyze whether participants are momentum or contrarian investors. Momentum investors trade with a trend, adding to their holdings after high returns; contrarian investors do the opposite. An active finance literature has developed in the past few years to look at the empirical evidence on feedback trading.[3] By focusing on a salient asset class—company stock—we hope to make a contribution to this literature while at the same time providing useful insights for the policy debate on company stock investment.

Description of Our Data

The data used to examine these patterns were provided by Hewitt Associates, a large benefits administration and consulting firm. From Hewitt's roster of clients, we identified three large companies, which we denote here as Alpha, Delta, and Gamma, which offered company stock as an investment option. We obtained detailed data on individual participant in each plan, with two components. The first is panel data on every transaction that occurred in the plans since Hewitt took over the plan administration. These data go from January 4, 1993 to October 20, 1999 for

Alpha; January 31, 1994 to January 26, 2000 for Delta; and April 3, 1996 to March 3, 2000 for Gamma. The second component of the data is cross-sectional, taken at year-end 1998 and 1999, which reports participant data on demographics, hire, and enrollment dates, and balance for all participants with a positive balance or plan activity in 1998 or 1999. We will refer to December 31, 1999 as the "final date." None of these companies are financial services or technology companies.[4]

Table 7-1 summarizes information on participants' demographic statistics who were active in the plans at the final date (a subset of the 94,191 total employees). The average plan balance for these participants was $89,172. The most comparable cross-sectional data to ours is the EBRI/ICI sample of 401(k) plans, which covers about 35 percent of the assets in the 401(k) universe. Holden and VanDerhei (2001) report that average plan balances at the end of 1999 are broken down by plan size, and they find that average plan balances are positively correlated with the number of participants in the plan (this is mainly because larger companies tend to have started plans earlier, thus giving more time for balances to be accumulated). For plans with over 10,000 participants—like all three of our plans—they report an average balance of $73,672, which is quite comparable.

Table 7-2 breaks down the contribution fraction and asset holdings into three non-disjoint asset classes. Company stock contribution fractions were approximately 17 percent at Alpha, 5 percent at Delta, 12 percent at Gamma, and 10 percent as a participant-weighted average across the three companies. The holdings in company stock were similar to the contribution fractions at Gamma, but they were significantly higher at Alpha (32 percent versus 17 percent) and Delta (8 percent versus 5 percent). The disparity at Alpha is partly due to the fact that Alpha made matching contributions in company stock and placed some tenure restrictions on selling these contributions. Like most clients of Hewitt Associates, Delta and Gamma did not match in company stock and placed no restrictions on the holdings of company stock.

TABLE 7-1 Demographic Summary Statistics

Average age	45.0
Average salary ($)	55,830
Average tenure at company (years)	15.8
Average elected contribution rate (%)	8.73
Average plan balance ($)	89,172
Percent who traded in 1999 (%)	39.3
Total companies	3
Total participants (all years)	94,191

Note: Unless otherwise noted, all figures are as of year-end 1999.

Source: Authors' calculations.

TABLE 7-2 Summary Statistics on Equity Holdings

		Company Stock (%)	*Other Equities (%)*	*All Equities (%)*
Company Alpha	Contributions	16.6	51.8	68.4
	Holdings	31.5	39.7	71.2
Company Delta	Contributions	4.5	49.6	54.1
	Holdings	8.1	48.6	56.7
Company Gamma	Contributions	12.0	52.1	64.1
	Holdings	11.4	53.5	64.8
Participant-weighted total	Contributions	9.9	50.8	60.7
	Holdings	17.7	46.0	63.6

Note: Discretionary contributions and year-end balances held that in equities in 1999.

Source: Authors' calculations.

These holdings fractions are somewhat lower than the averages reported by Holden and VanDerwei (2001) using the EBRI/ICI database. They found that, among larger plans (>5,000 participants) with similar investment offerings to our sample companies, the average holding of company stock was 24 percent of the portfolio. Note, however, that many of the plans in this class of the EBRI/ICI sample were similar to company Alpha, in that they matched contributions in company stock and imposed some trading restrictions on these matched contributions. Nevertheless, even Alpha had lower company stock holdings than the average company that matched in company stock.

While the main focus of the chapter is on company stock, it is also useful to know the relationship between past returns and employee allocations to other asset classes. These relationships are not only interesting in themselves, but they are also important for knowing whether changes in company stock investments crowded out other equities. We consider two other asset classes in the chapter: "Total equity" includes all equity holdings, domestic and international, including company stock,[5] and "other equity," which is total equity minus company stock.

Our focus on the initial contribution fractions to these asset classes, subsequent changes in these contribution fractions, and trades across the classes. Before turning to these analyses, it is useful to examine the empirical frequency of changes and trades. Figure 7-1 plots the likelihood of ever having made a change to contribution fractions, or a trade as a function of tenure in the plan. By 3 years after initial enrollment, almost half percent of participants had made at least one change to their initial contribution fraction, and 47 percent had made a trade.[6] These two groups overlap significantly, so that their union comprises only 58 percent of the full sample. By 6 years after enrollment, these percentages were over 70 percent for either of the two activities separately, and 80 percent for either.

Figure 7-2 plots the frequency of trades per year for all individuals that had at least 3 years' participation as of the final date. Within this whole

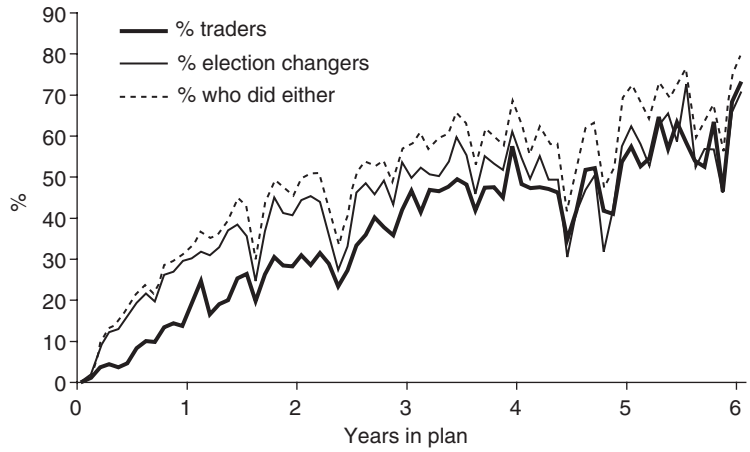

Figure 7-1. Likelihood of trading, changing elections, or doing either at least once, by tenure in plan, 12/31/1992 to 3/6/2000.

Notes: We examine all people for whom we have data since their initial enrollment in the plans. The graph depicts the percent of participants who have made at least one trade, changed their discretionary contribution allocations at least once, or done either, plotted against the number of years we observe them in the plan.

Source: Authors' calculations.

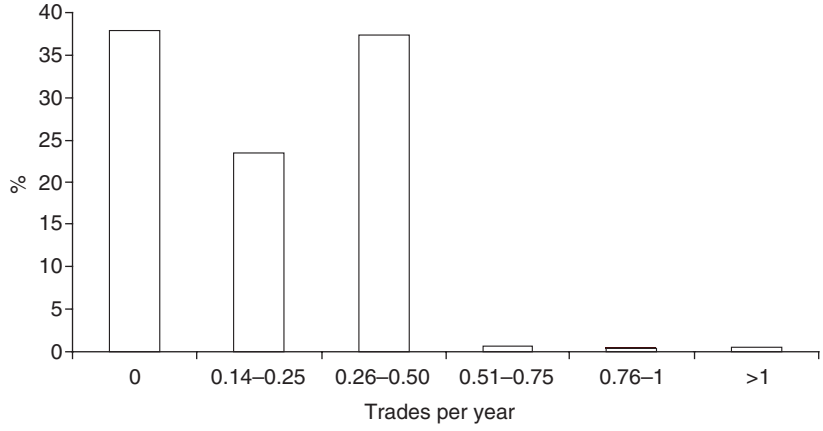

Figure 7-2. Histogram of participant trades per year, 1999 participants.

Notes: We examine all people who are active in the plans as of year-end 1999 and who have been participating for at least three years. We divide the total number of times a participant has traded in our data by the number of years we observe the participant. The graph is a histogram of this ratio.

Source: Authors' calculations.

group, 38 percent never made a trade. The next highest grouping was between 0.26 and 0.50 trades per year, with 37 percent of participants falling into this range. Very few participants made more than half a trade per year. Overall, these trading frequencies are somewhat higher than for the typical firm in the Hewitt universe, most likely because these firms were "early adopters" of the Internet channel for trading and other participant activities (Choi et al., 2002*a*).

Analysis of Initial Contribution Fractions

To investigate the initial contribution fraction, we use a Tobit regression equation of the following form,

$$Y_i = \alpha + \beta X_i + \varepsilon_i, \tag{1}$$

where Y_i is the fraction of company stock (censored below at 0 and above at 1) other equity, or total equity out of the total contribution: X_i is a vector of firm-level and participant-level characteristics that may explain the cross-sectional pattern of flow decisions; and ε_i is a participant-level error term. While we employ panel-data notation to distinguish among participants and initial dates, these regressions used only one observation per participant. The sample included every participant with positive balances or plan activity in 1998 or 1999. For each member of the sample, we included a single observation made on the date he first enrolled in their plan, and all explanatory variables for that participant (X_i) are measured on that same date.

We include several firm-level variables in the X_i vector. The main variables of interest are the past returns on company stock and on the overall stock market. Since we seek to separate common shocks (stock market returns) and firm-specific shocks (company stock returns), we include two past return variables. *SP500* is the past return for the S&P 500 in the one year (253 trading days) preceding the enrollment of participant *i*. That is, if participant *i* enrolled on date *t*, then $SP500_i$ is the return from trading date $t - 253$ to trading date $t - 1$. $CSTOCK_i$ is the excess return over the S&P 500 for the company stock of participant *i*. Like *SP500*, it is measured over the preceding 253 trading days. Thus, all participants who enrolled on the same date *t* will have identical *SP500* values; all participants who enrolled on the same date *t* at the same company will have identical *CSTOCK* values. For notational convenience, we drop the *i* subscripts for the remainder of this discussion. Previous research suggests that investment behavior is also influenced by the variance of past returns. Thus, we include two variance measures in *X*. *Std(SP500)* and *Std(CSTOCK)* are the standard deviations of the daily returns on the S&P 500 and company stock over the 253 trading days preceding the enrollment of participant *i*. Finally,

we include a separate fixed effect and trend for each company, and omit a regression constant term.

We also include several participant-level variables as elements of *X*. Consistent with past work, we posit that total equity fractions are related to age, probably in a hump-shaped relationship with equity fractions first increasing and then decreasing later in life. (Consistent relationships across studies have been elusive in the literature, however.[7]) We include *Age* and Age^2 as elements of *X*. In addition, several studies show that overall equity holdings are positively related to salary; including Holden and VanDerhei (2001). For company stock, however, they find little relationship between salary and company stock fractions, with just a hint of slight negative tilt at the highest salary levels. Since we lack data on wealth, we rely on salary as a proxy and include the log of annualized salary for the year of enrollment as an element of *X*.

Company stock contributions may also be related to job tenure. Workers with longer tenure at enrollment could differ from other participants along several dimensions. Since they have been at the company longer, they may have more human capital dedicated to the company, which should induce lower contributions to company stock, other things equal. On the other hand, they may have a greater loyalty to the company and feel more of a duty to invest in company stock. Finally, workers who first participate later in their careers may have waited to do so because they are less financially sophisticated. This lower sophistication may be correlated with poorer diversification and higher contributions to company stock. The relative importance of these different factors is an empirical question, though Holden, VanDerhei, and Quick (2000) report a positive relationship in their study. Accordingly we include a variable, *TENURE*, which is the log of 1 + job tenure (in years), as an element of *X*.

Estimated coefficients are reported in Table 7-3. The dependent variable is the percent of the participant's pay invested in company stock in column 1, other equity in column 2, and total equity in column 3. The results show a strong impact of past returns on the initial contribution fractions to company stock. The coefficients on both *SP500* and *CSTOCK* are positive and significant when the dependent variable is company stock (column 1); conversely, the coefficients on these two variables are negative and significant when the dependent variable is other equity (column 2). These respective coefficients are positive but insignificant for total equity (column 3).

This pattern of results suggests that when company stock returns are high, newly enrolled participants contribute a higher fraction of their flows to company stock and a lower fraction of their flows to other equity; on net, the fraction of flows allocated to all equity (total equity) tends to cancel. Thus, these past returns—both the marketwide (*SP500*) and company-specific (*CSTOCK*)—have mostly a compositional effect on overall equity holdings.

TABLE 7-3 Initial Contribution Allocation, 11/30/1992 to 2/17/2000, as a Function of Asset Returns Prior to Plan Enrollment

	Company Stock	*Other Equities*	*All Equities*
SP500	0.80**	−0.46**	0.04
	(0.07)	(0.06)	(0.07)
CSTOCK	0.45**	−0.14**	0.07
	(0.04)	(0.03)	(0.04)
Std(SP500)	−12.76*	−3.36	−2.21
	(5.16)	(4.10)	(4.79)
Std(CSTOCK)	−12.13**	−2.47	0.39
	(3.55)	(2.91)	(3.41)
Salary	−0.08**	0.16**	0.11**
	(0.01)	(0.01)	(0.01)
Age/100	0.02	0.26	0.24
	(0.50)	(0.41)	(0.48)
$Age^2/1000$	0.04	−0.09	−0.05
	(0.06)	(0.05)	(0.06)
Tenure	0.02*	−0.06**	−0.04**
	(0.01)	(0.01)	(0.01)
Company Trend α	0.02**	0.02**	0.02**
	(0.01)	(0.00)	(0.00)
Company Trend δ	−0.08**	0.17**	0.14**
	(0.01)	(0.01)	(0.01)
Company Trend γ	0.07**	0.06**	0.08**
	(0.02)	(0.02)	(0.02)
$\sigma(\varepsilon)$	0.76**	0.69**	0.80**
	(0.01)	(0.01)	(0.01)

*Significant at the 5% level.
**Significant at the 1% level.

Notes: The dependent variable in column 1 is the percent of the participant's first payroll contribution that went to company stock, the dependent variable in column 2 is the percent of the participant's first payroll contribution that went to other equities, and the dependent variable in column 3 is the percent of the participant's first payroll contribution that went to all equities. Coefficients shown are for tobit regressions censored at 0 and 1. *SP500* is the cumulative return on the S&P 500 for the 253 trading days prior to the participant's enrollment in the plan. *CSTOCK* is the cumulative return in excess of the S&P 500 on company stock for the 253 trading days prior to participant enrollment. *Std(SP500)* and *Std(CSTOCK)* are the standard deviations of the S&P 500 and company stock returns, respectively, over the 253 trading days prior to the participant's enrollment. *Salary* is the log of annual salary in the year of enrollment (in 1999 CPI-deflated dollars), *Age* is the participant's age at the time of enrollment, Age^2 is the square of *Age*, and *Tenure* is the log of one plus the years between the participant's original hire date and plan enrollment date. *Company Trend x* is the years between December 31, 1980 and the participant's enrollment if the participant is in Company *x*, and zero otherwise. $\sigma(\varepsilon)$ is the standard deviation of the latent variable's residual. Coefficients on fixed-effect company dummies and a constant are not shown. Standard errors are reported in parentheses below the point estimates.

Source: Authors' calculations.

For the other independent variables, we find results consistent with previous studies. The coefficients on *age* and age^2 (column 3), while not significant, are consistent with a hump-shaped relationship between the total equity fraction and age. The relationship between salary and total equity is positive and significant, while the relationship between salary and company stock fraction is negative and significant.

One possible criticism of these results is that the standard errors may be understated. If firm-specific shocks induce correlated behavior across participants enrolling around the same time, then the assumption of cross-sectionally independent residuals would be violated, and the standard errors would be biased downward. For example, if firms changed their communication strategies to new participants, then these new strategies could induce correlated behavior. In this case, it would appear that we have more independent observations than we really do.

A comment is in order regarding this possibility. First, the regression specification controls for firm-specific differences in average behavior (with fixed effects) and for firm-specific changes in this average behavior over time (with trend variables for each firm). To also control for firm-specific shocks would require a specification of the correlation structure induced by such shocks, and this requires imposing more structure on the model which may not be appropriate. Instead, we perform a simple robustness check by assuming an extreme case: perfect correlation for all participants who enroll on the same day. To do this, we compute the average percentage allocated to each asset class by all participants who enrolled on each day. We then perform a separate time-series regression of these averages for each firm on the firm-specific independent variables used in equation (1). Furthermore, we allow for error correlation across days by computing Newey–West (1987) robust standard errors. Even in this extreme case, the evidence confirms that past returns affect contribution allocations.

The strongest evidence is for the company stock fraction, where two of the three firms show a positive and significant impact of past company stock returns on the company stock fraction, and one of the companies shows a positive and significant impact of past S&P 500 returns.[8] For other equity, the results are consistent with participant-level evidence in Table 7-3: Coefficients on company stock are negative and significant for two firms, and the coefficients on S&P 500 are negative (but insignificant) for all three firms. For total equity, these results again appear to cancel, with no strong pattern to the coefficient signs. Thus, it appears that past returns have mainly a compositional effect within total equity as for the individual-level results in Table 7-3, with high past returns leading to higher fractions allocated to company stock and lower fractions allocated to other equity.

Analysis of Changes in Contribution Fractions

After examining snapshots of flows and the impact of past returns on these snapshots, we now turn to an examination of the determinants of the changes in these flows. To explore how past returns affect changes to flow fractions, we shift attention away from returns preceding enrollment to focus on returns preceding specific changes.

Table 7-4 summarizes the results of Logit regressions for the probability that a participant boosts his company stock fraction (column 1), other equity fraction (column 2), and total equity fraction (column 3). The dependent variable is an indicator variable equal to one if the fraction is increased and zero otherwise. Explanatory variables are as before except that *SP500* and *CSTOCK* represent for the year immediately preceding the contribution fraction change. The sample includes every change made by any participant who was active in the plans at year-ends 1998 or 1999.[9]

The results demonstrate more evidence of the powerful impact of past returns on participant behavior. As in the previous section, that the coefficient on *CSTOCK* is again positive and significant for the company stock regressions (column 1). In this case, however, the coefficient is also positive (and nearly significant) for other equities, so it appears that company stock does not crowd out other equities when contributions are changed. The net effect of *CSTOCK* on total equity is positive and significant (column 3). Another contrast with Table 7-3 is that the coefficient on *SP500* is negative and significant for company stock (column 1) and is positive and significant for the total equity fraction. In this case, high returns on the marketwide component of company stock returns induce a shift away from company stock and towards other equity, with a new effect of shifts towards equity and away from other assets (column 3). Overall, participants act like momentum investors for total equity.

As in the previous section, there may be concern that the standard errors in Table 7-4 could be understated, due to firm-specific shocks. To check robustness, we again collapse all participant observations on each trading day down to a single observation for each firm. To do this, we construct a new dependent variable, Y_{mnt}, for each asset class m (company stock, other equity, or total equity) at each firm n on every trading date t. Y_{mnt} is a fraction, where the numerator is the number of participants in firm n who increased their flow fraction to asset m on date t, minus the number of participants in firm n who made an allocation change to any fund on date t but did not increase their flow fraction to asset m. The denominator is all participants at firm n who made any allocation change on date t. We then estimate separate time series regressions for each firm, to determine whether the qualitative results from Table 7-4 also hold here. The answer is yes: several coefficients are significant and have the same sign as their analogues in Table 7-4.[10] These significant coefficients are negative for one firm on *SP500* and positive for two firms for *CSTOCK* in the company stock

TABLE 7-4 Probability of Increasing Contribution Fraction, 12/31/1992 to 3/3/2000, as a Function of Asset Returns Prior to the Election Change

	Company Stock	*Other Equities*	*All Equities*
SP500	−2.09**	2.85**	1.02**
	(0.10)	(0.08)	(0.08)
CSTOCK	0.59**	0.06	0.23**
	(0.04)	(0.03)	(0.03)
Std(SP500)	−148.70**	39.67**	−47.97**
	(5.45)	(4.58)	(4.60)
Std(CSTOCK)	1.62	−5.40	16.49**
	(3.97)	(3.42)	(3.40)
Salary	−0.14*	0.02	−0.09**
	(0.02)	(0.02)	(0.02)
Total Balances	−0.14**	−0.08**	−0.13**
	(0.01)	(0.01)	(0.01)
Age /100	2.66**	3.73**	4.18**
	(0.69)	(0.58)	(0.58)
$Age^2/1000$	−0.23**	−0.47**	−0.40**
	(0.08)	(0.07)	(0.07)
Tenure	−0.01	0.04**	0.18**
	(0.01)	(0.01)	(0.01)
Company Trend α	0.40**	−0.36**	−0.20**
	(0.01)	(0.01)	(0.01)
Company Trend δ	0.02	−0.10**	−0.02**
	(0.01)	(0.01)	(0.01)
Company Trend γ	0.22**	−0.00	−0.23**
	(0.01)	(0.01)	(0.01)

* Significant at the 5% level.
** Significant at the 1% level.

Notes: This table presents the results of a binary logit regression of the probability a participant increases the fraction of his or her contribution to company stock (column 1), other equities (column 2), and all equities (column 3), conditional on making a change to his or her contribution allocations. *SP500* is the cumulative return on the S&P 500 for the 253 trading days prior to the participant's first contribution after an election change. *CSTOCK* is the cumulative return in excess of the S&P 500 on company stock for the 253 trading days prior to the post-change contribution. *Std(SP500)* and *Std(CSTOCK)* are the standard deviations of the S&P 500 and company stock returns, respectively, over the 253 trading days prior to the post-change contribution. *Salary* is the log of annual salary in the year of the post-change contribution, and *Total Balances* is the log of total balances in the plan in the calendar month prior to the change, both in 1999 CPI-deflated dollars. *Age* is the participant's age at the time of the post-change contribution, Age^2 is the square of *Age*, and *Tenure* is the log of one plus the years between the participant's original hire date and the post-change contribution. *Company Trend x* is the years between December 31, 1980 and the participant's post-change contribution if the participant is in company *x*, and zero otherwise. Coefficients on fixed-effect company dummies and a constant are not shown. Standard errors are reported in parentheses below the point estimates.

Source: Authors' calculations.

regressions; positive for two firms on *SP500* and negative for one firm on *CSTOCK* in the other equity regressions; and positive for one firm on *SP500* in the total equity regressions. Meanwhile, no coefficients are significant with the opposite sign from their analogues in Table 7-4.

Analysis of Trading Behavior

The previous sections analyzed the determinants of contribution fractions–investment flows—to company stock and other equity. Many researchers focus on flows because these data allow for the cleanest test of the impact of past returns on investment decisions. By contrast, studies of asset holdings and past returns suffer from an obvious problem: High returns through price appreciation on any given asset will tend to increase the fraction of that asset in overall holdings, even if investors take no action. Nevertheless, it is asset *holdings*, not *flows*, that drive the long-run distribution of wealth. In an extreme scenario, one could imagine that all participants rebalance their holdings on a regular basis, so that differences in flows cause only minor long-run differences in their portfolio allocations.

For example, consider a participant who wanted to have 5 percent of his overall holdings in company stock. Suppose further that this participant allocated 20 percent to company stock at initial enrollment, because the participant had not yet decided to limit company stock to 5 percent of his or her overall portfolio. In later years, he or she could change the contribution fraction in company stock to 5 percent, but would still need to rebalance the participants' holdings periodically, to ensure that the 5 percent fraction was maintained. It may be the case that it is found to be simpler to rebalance his or her holdings periodically to 5 percent and ignore the flow component in the short run. If so, even though contribution fractions might appear to be influenced by returns prior to enrollment, we would not notice any long-run impact of these fractions on portfolio diversification.

To examine this possibility, we look at the rebalancing decision ("trades") with the same methods used to study changes in the flow fraction. We take every trade initiated by employees who have positive balances or plan activity in 1998 or 1999, and then we estimate a separate Logit regression for each asset class, where the dependent variable takes on a value of one if the trade increased holdings in that asset class and zero otherwise.[11]

Results appear in Table 7-5, and the key evidence appears in column 1. Here we see that returns one year prior to the trade on both components of company stock returns (*CSTOCK* and *SP500*) induce participants to trade *out* of company stock, but only for SP500 is there a significant effect. For both components, high returns induce participants to substitute away from company stock and towards other equities, with positive and significant coefficients on both components in column 2. These results are consistent with "profit-taking" behavior found in other studies where investors tended

TABLE 7-5 Probability of Trading into Asset Class, 1/4/1993 to 3/6/2000, as a Function of Asset Returns Prior to Trade

	Company Stock	*Other Equities*	*All Equities*
SP500	−2.18**	2.31**	0.09
	(0.06)	(0.05)	(0.05)
CSTOCK	−0.01	0.31**	0.07**
	(0.02)	(0.02)	(0.02)
Std(SP500)	−159.70**	71.28**	−62.22**
	(4.24)	(3.86)	(3.71)
Std(CSTOCK)	−36.62**	−20.47**	−26.88**
	(2.33)	(2.26)	(2.14)
Salary	0.04**	0.08**	0.02
	(0.01)	(0.01)	(0.01)
Total Balances	−0.07**	−0.02**	−0.03**
	(0.01)	(0.00)	(0.00)
Age/100	4.47**	−2.83**	1.24**
	(0.56)	(0.50)	(0.48)
$Age^2/1000$	−0.52**	0.26**	−0.09
	(0.06)	(0.05)	(0.05)
Tenure	0.07**	−0.05**	0.03**
	(0.01)	(0.01)	(0.01)
Company Trend α	0.50**	−0.26**	0.15**
	(0.01)	(0.01)	(0.01)
Company Trend δ	0.10**	−0.12**	0.05**
	(0.01)	(0.01)	(0.01)
Company Trend γ	0.56**	−0.26**	0.05**
	(0.02)	(0.01)	(0.01)

* Significant at the 5% level.
** Significant at the 1% level.

Notes: This table presents the results of a binary logit regression of the probability a participant makes a trade increasing his or her holdings in company stock (column 1), other equities (column 2), or all equities (column 3), conditional on the participant trading. *SP500* is the cumulative return on the S&P 500 for the 253 trading days prior to the trade. *CSTOCK* is the cumulative returns in excess of the S&P 500 on company stock for the 253 trading days prior to the trade. *Std(SP500)* and *Std(CSTOCK)* are the standard deviations of the S&P 500 and company stock returns, respectively, over the 253 trading days prior to the trade. *Salary* is the log of annual salary in the year of the trade, and *Total Balances* is the log of total balances in the plan on the day of the trade, both in 1999 CPI-deflated dollars. *Age* is the participant's age at the time of the post-change contribution, Age^2 is the square of *Age*, and *Tenure* is the log of one plus the years between the participant's original hire date and the trade date. *Company Trend x* is the years between December 31, 1980 and the participant's trade if the participant is in company *x*, and zero otherwise. Coefficients on fixed-effect company dummies and a constant are not shown. Standard errors are reported in parentheses below the point estimates.

Source: Authors' calculations.

to sell "winner" stocks and hold "loser" stocks (Odean, 1998; Grinblatt and Keloharju, 2001). Somewhat paradoxically, the net effect on total equity is positive and significant for the *CSTOCK* component, perhaps because rising prices on company stock induce participants to feel wealthier and less risk-averse.

We next perform an analogous analysis at the firm level, using the same approach described in previous sections. The dependent variable here is the number of participants who increased their holdings of the respective asset class on day *t*, minus the number of participants who made any trade but did not increase their holdings of the respective asset class on day *t*, all divided by the number of participants who made any trade on day *t*. We estimate separate regressions for each asset class for each firm. Even in this extreme case, this evidence indicates that past returns affect contribution allocations. Consistent with the results of Table 7-5, we find that the coefficient on *SP500* is negative and significant for one firm, and it is negative but insignificant for the other two. For other equity, the coefficients on *SP500* are positive and significant for all three firms. Overall, then, it appears that participants act as contrarians in their trades for company stock.

Conclusions

Our analysis has studied the decisions of almost 100,000 individual 401(k) participants, seeking a better understanding of the determinants of employee discretionary investment in company stock. We study three companies, which include many participants, though the sample is still small relative to the universe of 401(k) participants, and it includes a relatively low level of company stock holdings. The great detail in the data, however, allows for an analysis at several different stages in the 401(k) process, and our main conclusion is that past returns matter at every stage. Thus, high returns on company stock for the year prior to enrollment induce participants to make higher initial contributions to company stock. Furthermore, high returns over any one-year period induce participants to increase these contribution fractions. High returns on company stock have the opposite effect on trading decisions: High past returns induce participants to reallocate their portfolios away from company stock and toward other equities. Thus, participants are momentum investors when making decisions about investment flows, but they appear to be contrarian investors when making trading decisions.

Our results allow us to build on the important work of Benartzi (2001), who found a positive relationship between past returns on company stock and current contributions to company stock, with the strongest results for past 10-year return, and weaker results for shorter horizons. We can explain that result as the combination of several forces. First, when participants join, they are influenced by the past returns, including the past one-year return. Some participants never alter their initial contribution

fractions, and so while specific past years may seem influential at any point in time, the influence of the most recent year will be limited. Second, some participants do make change, but these changes are infrequent, and fewer than 40 percent make changes in any given year. These changes are influenced by prior returns, but the influence of the most recent year tends to be limited. Taken together, initial contributions and contribution changes are both influenced by one-year returns, but these years are spread out over a long period. Consequently, if we seek to understand the relationship between current contributions and past returns, the longer period appears better at the company level.

The most interesting and policy-relevant findings pertain to the relationship between asset holdings and past returns. Absent frequent rebalancing, high returns on assets will tend to increase the portfolio allocation to these assets. This makes it difficult to directly test for a relationship between asset holdings and past returns on these assets. The best we can do is to try to infer these relationships by looking at different decisions made by investors. Since most previous studies have used cross-sectional snapshots of holdings and contribution fractions, they have logically focused on the latter as the cleanest source of data. These studies find—as do we—that high past returns on company stock tend to increase contribution fractions to company stock. Nevertheless, the time-series data used here show that trading decisions may work to mitigate some of this effect. Since high past returns induce participants to substitute out of company stock, the strong relationship between past returns and contributions is less dangerous for asset allocation than it might appear.

Notes

[1] The original source for these percentages is Schultz and Francis (2002), reported by Mitchell and Utkus (2003).

[2] For example, he notes that "a 25-year-old employee who wanted to buy an insurance policy on company stock that he cannot reallocate until he is 50 years old" would have to pay $739 per $1000 of value.

[3] For a discussion of this literature, see Goetzmann and Massa (2002).

[4] Several other recent papers have used participant-level panel data to explore different aspects of 401(k) investment behavior, but none of these papers have focused on company stock. See Agnew, Balduzzi, and Sunden (2003), Ameriks and Zeldes (2001), Choi et al. (2002*a, b*).

[5] Omitting international funds from the definitions of other equity and total equity does not qualitatively alter the results of the paper. For balanced funds, we include the fraction of that fund targeted to equities.

[6] These figures omit trades and allocation changes that were initiated by the plan administrators.

[7] Ameriks and Zeldes (2001) survey this literature and discuss new evidence from a survey of TIAA-CREF participants.

[8] Complete results are not presented here but are available from the authors on request.

[9] We omit changes made at Gamma in November 1996 and April 1998 because numerous funds were shut down in those months, so allocation changes then may have been due to the plan administration automatically shifting contributions away from the closed funds.

[10] Complete results are not presented here but are available from the authors on request.

[11] We omit trades that were initiated by plan administrators.

References

Agnew, Julie, Pietro Balduzzi, and Annika Sunden. 2003. "Portfolio Choice, Trading, and Returns in a Large 401(k) Plan." *American Economic Review* L (93): 193–205.

Ameriks, John and Steve Zeldes. 2001. "How do Household Portfolios Vary with Age." Columbia University Working Paper. New York.

Benartzi, Shlomo. 2001. "Excessive Extrapolation and the Allocation of Company Stock to Retirement Accounts." *Journal of Finance* 56(5): 1747–1764.

Choi, James J, David Laibson, and Andrew Metrick. 2002*a*. "How Does the Internet Affect Trading? Evidence from Investor Behavior in 401(k) Plans," *Journal of Financial Economics* 64(3): 397–421.

Choi, James J., David Laibson, Brigitte Madrian, and Andrew Metrick. 2002*b*. "Defined Contribution Pensions: Plan Rules, Participant Choices, and the Path of Least Resistance." In *Tax Policy and the Economy*, ed. James Poterba. Cambridge: MIT Press: 67–113.

Goetzmann, William N. and Massimo Massa. 2002. "Daily Momentum and Contrarian Behavior of Index Fund Investors." *Journal of Financial and Quantitative Analysis* 37(3): 375–389.

Grinblatt, Mark, and Matti Keloharju. 2001. "What Makes Investors Trade?" *Journal of Finance* 56(2): 589–616.

Holden, Sarah and Jack VanDerhei. 2001. "401(k) Plan Asset Allocation, Account Balances, and Loan Activity in 1999." *Investment Company Institute Perspective* 7(1).

Holden, Sarah, Jack VanDerhei, and Carol Quick. 2000. "401(k) Plan Asset Allocation, Account Balances, and Loan Activity in 1998." *Investment Company Institute Perspective* 6(1): 1–24.

Liang, Nellie and Scott Weisbenner. 2002. "Investor Behavior and the Purchase of Company Stock in 401(k) Plans—The Importance of Plan Design." University of Illinois Working Paper. Champaign.

Mitchell, Olivia S. and Stephen P. Utkus. 2003. "The Role of Company Stock in Defined Contribution Plans." In *The Pension Challenge: Risk Transfers and Retirement Income Security*, eds. Olivia S. Mitchell and Kent Smetters. Oxford: Oxford University Press: 33–70.

Muelbroek, Lisa. 2002. "Company Stock in Pension Plans: How Costly Is It?" Harvard Business School Working Paper 02-058.

Odean, Terrance. 1998. "Are Investors Reluctant to Realize Their Losses?" *Journal of Finance* 53(5): 1775–1798.

Ramaswamy, Krishna. 2003. "Company Stock and Pension Plan Diversification." In *The Pension Challenge: Risk Transfers and Retirement Income Security*, eds. Olivia S. Mitchell and Kent Smetters. Oxford: Oxford University Press: 71–88.

Schultz, Ellen E. and Theo Francis. 2002. "Companies' Hot Tax Break: 401(k)s." *Wall Street Journal*. January 31: C1.