Excessive Extrapolation and the Allocation of 401(k) Accounts to Company Stock

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ABSTRACT

About a third of the assets in large retirement savings plans are invested in company stock, and about a quarter of the *discretionary* contributions are invested in company stock. From a diversification perspective, this is a dubious strategy. This paper explores the role of excessive extrapolation in employees' company stock holdings. I find that employees of firms that experienced the worst stock performance over the last 10 years allocate 10.37 percent of their *discretionary* contributions to company stock, whereas employees whose firms experienced the best stock performance allocate 39.70 percent. Allocations to company stock, however, do not predict future performance.

ROUGHLY A THIRD OF THE ASSETS in large retirement savings plans are invested in company stock (i.e., stocks issued by the employing firm). In extreme cases, such as Coca-Cola, the allocation to company stock reaches 90 percent of the plan assets. From a diversification perspective, it is even more puzzling that Coca-Cola employees allocate 76 percent of their own *discretionary* contributions to Coca-Cola shares. This strategy seems dubious, and it is in complete contrast to Markowitz (1952) and Sharpe (1964), who predict that people will hold well-diversified portfolios. This paper examines whether excessive extrapolation of past returns could explain at least part of the discretionary allocations to company stock.[1] The empirical analysis utilizes a unique database of SEC filings that describes the variation in investment elections across companies for 1993.

There are at least two reasons why the allocation to company stock is an interesting topic to study. First, the costs of insufficient diversification can be substantial. For example, with the assumption of a constant relative risk aversion of two, Brennan and Torous (1999) find that the certainty equivalent of investing one dollar in a single stock over a 10-year period is only 36 cents! In the case of company stock, the costs of insufficient diversification

[1] There is a widespread belief that employees invest in company stock because they receive a discount, but retirement saving plans do not offer a discount on company stock.

are probably higher, because employees select a stock that is presumably correlated with their human capital, and as a result, they stand to lose both their retirement savings and their jobs if the company fails.

Second, there is a worldwide trend toward investment autonomy. This trend is evident in the migration from defined benefit pension plans to defined contribution savings plans. This trend is also evident in the current debate on social security reform. At one extreme are proposals that would mandate the allocation of assets between stocks and bonds, and possibly other investment categories. At the other extreme are plans that would allow individuals to elect their own asset mixes. One of the advantages of investment autonomy is that it can accommodate differences in individual preferences. Those who are extremely risk averse can select conservative investments, whereas those who prefer more risk can select aggressive investments. It is unclear, however, whether most people can do well as their own money managers (see Benartzi and Thaler (1995, 1999, 2001)). Studying allocations to company stock provides an opportunity to examine whether individuals construct well-diversified portfolios or highly concentrated portfolios.[2]

This paper documents that, under certain circumstances, individuals have a strong tendency to construct portfolios that are highly concentrated in company stock. The tendency for employees to put their own contributions into company stock is stronger when the employer's contributions to a 401(k) plan must be invested in company stock. That is, when the employer's contributions are automatically directed to company stock, employees invest more of their own contributions in company stock. Using questionnaires, I show that this phenomenon is consistent with an endorsement effect: employees interpret the allocation of the employer's contributions as implicit investment advice.

Employees could have a variety of reasons for investing their retirement savings in company stock. This paper focuses on *one* explanation that draws from the seminal work of Tversky and Kahneman (1974) on representativeness. Applying representativeness to company stock, employees might conclude that abnormally high past performance is representative of future performance, even though stock returns are largely unpredictable. In other words, employees might excessively extrapolate past performance.[3]

To test the excessive extrapolation hypothesis as it applies to company stock, I formed five portfolios on the basis of past buy and hold returns and examined the allocation of subsequent *contributions* to company stock.[4] The analysis is based on the allocation of *discretionary* contributions to ensure that the allocation reflects employees' own choices. When portfolios were

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[2] Another interesting question is why employers offer company stock in retirement savings plans, but this question is beyond the scope of this paper.

[3] Huberman (1997) discussed company stock holdings and raised the possibility that the disproportionate allocations might be attributed to a familiarity bias. I explore this explanation in Section II.C.

[4] The unique database that is used in this paper is described in Section I.

formed on the basis of one-year returns, the low-returns portfolio had an average allocation of 21.10 percent to company stock versus 23.70 percent for the high-returns portfolio. As the portfolio formation period increased, so did the difference in allocation. When portfolios were formed on the basis of 10-year returns, the low-returns portfolio had 10.37 percent allocated to company stock versus 39.70 percent for the high-returns portfolio. Thus, the results are consistent with employees extrapolating past returns far into the future. (I also find that allocations to company stock are uncorrelated with subsequent returns, hence, ruling out an information-based explanation.)

As an additional test of the excessive extrapolation hypothesis, I asked Morningstar.com subscribers to rate the performance of company stock over the last five years and the next five years. Despite the fact that individual stock returns are largely unpredictable, the respondents' ratings were positively correlated ($\rho = 0.52$), which is consistent with the extrapolation hypothesis. The survey provided an opportunity to explore other behavioral explanations such as optimism and overconfidence. I found that only 16.4 percent of the respondents realize that company stock is riskier than the overall stock market. And among those with a high school education or less, a mere 6.5 percent believed that company stock is riskier than the overall stock market.

In the next section, I discuss the database that is used in this paper, and I provide descriptive statistics on company stock holdings in retirement savings plans. In Section II, I explore the role of excessive extrapolation in company stock holdings. Section III summarizes the results.

I. Data

A. Sample Selection

Retirement savings plans that offer employees the choice of investing their own contributions in company stock must file an annual report with the SEC. The annual reports, which are labeled 11-k filings, are the primary source of information in this paper. There are certain filing exemptions, however, the most common one for 401(k)-type plans being the "market test." According to the market test, a retirement savings plan that purchases shares of the company stock on the open market is exempt from filing an annual report. I estimate that roughly a third of the plans buy shares on the open market, and the remaining two-thirds issue shares.[5] Unfortunately, data on plans that buy shares on the market are unavailable, so I only examine plans that issue shares. Consequently, the results reported in this paper may or may not generalize to plans that purchase shares on the open market.

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[5] Similarly, in a private conversation with the author, Marilee Lau, chairperson of the Department of Labor Advisory Council on Employee Welfare and Pension Benefit Plans, estimated that 40 percent of the plans buy shares on the market. More details on the number of plans that are exempt can be obtained from the author upon request.

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Table I

Sample Selection Criteria

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This table describes the sample selection criteria and the remaining number of firms. The sample includes S&P 500 firms that sponsor at least one retirement savings plan with the following features: (a) employees have the option of investing their own contributions in company stock, and (b) company stock shares are issued by the firm rather than bought on the market. When a firm sponsors multiple retirement savings plans, I focus on the largest plan. Plan information is collected from the 1993 annual reports, which are available from the SEC and are known as "11-k" filings.

Selection Criterion	Remaining Firms
S&P 500 firms as of December 1993	500
The firm filed an 11-k with the SEC	219
Non-ESOPs	156
Plan offers common stock (as opposed to preferred)	155
Allocation of plan assets is available	154
Allocation of combined employees'/employers' contributions is available	143
Allocation of employees' contributions is available	136
Number of plan participants is available	135

From a research perspective, there are at least two advantages to 11-k filings relative to other publicly available databases. First, the filings supplement information on the allocation of assets with data on the allocation of contributions. The problem with the allocation of assets is that it does not always reflect employees' choices, because employees forget to rebalance their portfolios (Samuelson and Zeckhauser (1988)). Thus, a positive correlation between past returns and the allocation of subsequent plan *assets* may reflect reluctance to rebalance portfolios rather than excessive extrapolation of past performance. To mitigate this concern, I focus on the allocation of plan *contributions* (i.e., the flows into the plan). None of the other databases, including the *Department of Labor's Form 5500 Tapes*, *IOMA's Quarterly Survey of Company Stock Performance*, *Money Market Directory of Pension Funds*, *Nelson's Directory of Plan Sponsors*, and *Pensions and Investments' Annual Survey of the Top 1,000 Funds* provides information on the allocation of contributions.

The second advantage of 11-k filings is the breakdown of contributions made to the plan into employees' versus employers' contributions. In addition, the notes to the financial statements indicate whether or not the employer's contributions must be taken in the form of company stock. Without this crucial information, it would be impossible to measure the extent to which employees (as opposed to employers) are investing in company stock.

The sample of 11-k filings that is used in this paper is described in Table I. Since the filings are expensive to purchase and have to be coded manually, I focus on a subsample of the population. In particular, I examine the retirement savings plans of the S&P 500 firms, and thus, small firms are not included in the sample. Nonetheless, the S&P 500 sample is representative of firms with company stock holdings, because most company stock holdings

are associated with large companies. The U.S. Department of Labor (1997), for instance, reports that plans with more than 10,000 (1,000) participants account for 64 percent (95 percent) of the nationwide company stock holdings.

Information on the retirement savings plans of the S&P 500 firms was collected for fiscal year 1993. The choice to focus on 1993, as opposed to a more recent year, enables the analysis of subsequent investment performance. One concern is that company stock holdings vary with time; hence, 1993 does not necessarily represent more recent years. To alleviate this concern, I compare the 1993 and 1995 allocations using a subset of the firms. When allocations are measured as a percentage of combined employee/employer contributions, the correlation between the 1993 and 1995 figures is 0.94; when allocations are measured as a percentage of employee contributions, the correlation is 0.90. Thus, the allocation to company stock changes very slowly over time.

Of the S&P 500 firms, 219 filed an 11-k during 1993. When firms report multiple retirement savings plans, I focus on the largest plan. On average, the largest plan covers 87.13 percent of the company-wide plan assets and 88.16 percent of the plan participants. Smaller plans are excluded to minimize data collection costs and to avoid specialized plans such as those in place for foreign subsidiaries. Retirement savings plans that combine ESOPs are also excluded, since it is often difficult to decompose company stock holdings into allocated and unallocated shares. Of the remaining 156 plans, one was eliminated because it offers preferred stock (as opposed to common stock), and another was eliminated because it did not disclose information on asset allocation. The final sample includes 154 plans with information on the allocation of assets and 136 plans with information on the allocation of employees' and employers' contributions. Occasionally, the analysis also requires information on the number of plan participants, which was collected from the *Department of Labor's Form 5500 Tapes*. It is important to note that none of the sample plans offers a discount on company stock.

B. Descriptive Statistics

The sample covers a total of 2.57 million participants, $102 billion in plan assets, and $33 billion in company stock. I estimate that the sample covers two-thirds of the nationwide employee holdings of company stock, based on a grand total of $50 billion in company stock at the end of 1992 (U.S. General Accounting Office (1997)). It is important to highlight the difference between the 64 sample plans that offer stock matches and the remaining 90 plans that offer cash matches. That difference is best illustrated with an example. Suppose an employee contributes $100 a month to the plan and the employer provides an additional contribution of $50. With a stock match, the employer's contribution of $50 is received in the form of employer securities, which cannot be reallocated to other investment options. With a cash match, however, the employee allocates the $50 among the various investment options at his or her discretion.[6]

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[6] Account balances, annual contributions, and the ratio of total participants to active participants, which is a proxy for age, are uncorrelated with the form of the match.

Table II displays descriptive statistics on the allocation to company stock by match type. On average, roughly a third of the plan assets are invested in company stock.[7] Plans with stock matches have 48 percent of the assets in company stock, and plans with cash matches have 25 percent in company stock. Looking at the allocation of combined employee/employer contributions provides similar evidence, though the dispersion across match types slightly increases. Plans with stock matches allocate 50 percent of the combined contributions to company stock, whereas plans with cash matches allocate 21 percent. Weighing the allocations by assets, contributions, or the number of plan participants does not make much of a difference.

The allocation of employees' own contributions, which are virtually always left at the discretion of the employees, reveals an interesting phenomenon. When the match is in cash, employees invest 18 percent of their own contributions in company stock; when the match is in company stock, employees invest more (29 percent) of their own contributions in company stock. It is possible that employees interpret stock matches as an endorsement or as implicit investment advice.

To test the endorsement effect, I conducted several surveys. In the first survey, I used e-mail to contact Morningstar.com subscribers who do not receive a match from their employer, and I asked them to imagine that (a) their employer has decided to offer a match, and (b) the match would have to be invested in an international stock fund. Then I asked the subscribers for their current allocations and whether or not they would change the allocation of their own contributions in response to the match being invested internationally.[8] Unless one's preferred allocation to international stocks is zero, then one should respond to the match by reducing one's own international exposure. This is the only way to keep the combined allocation of the employee and employer's contributions to international stocks constant.

The survey was completed by 38 subscribers.[9] Of the 38 subscribers, 17 (45 percent) indicated that once the match is invested abroad, they would invest *more* of their own money abroad, which is consistent with an endorsement effect. Eleven of the subscribers (29 percent) answered that they would

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[7] The average allocation is consistent with the literature. Clark et al. (1998) use a proprietary database of the consulting firm Watson Wyatt and report that 35 percent of the contributions are allocated to company stock. VanDerhei et al. (1999) analyze a proprietary database of the Employee Benefit Research Institute and find that about 30 to 35 percent of the plan assets are in company stock. The Institute of Management Administration (1998) conducts a quarterly survey of large plans and reports an average allocation of 38 percent of the plan assets to company stock. The U.S. General Accounting Office (1997) provides a lower average (11.3 percent) because it includes small plans, which often do not offer company stock. See Poterba and Wise (1998) for a review of the literature.

[8] A copy of the questionnaire is available from the author upon request.

[9] The sample size is fairly small, because it is difficult to find people who do not receive a match from their employer. Even though I started with a Morningstar sample of 1,095 subscribers, I was able to identify only 220 subscribers who do not receive a match. And out of those 220, only 110 subscribers were willing to receive questionnaires via e-mail. The response rate, however, was relatively high (35 percent).

Table II

Match Type and the Allocation to Company Stock

This table displays the allocation to company stock for two subsamples: (a) plans that allow the employees to direct the employer's match at their own discretion (Match in Cash), and (b) plans that require the match to be invested in company stock (Match in Company Stock).

	Match in Cash	Match in Company Stock	All
Panel A: Company Stock Allocation as a Percentage of Plan Assets			
Number of plans	90	64	154
Mean: equally weighted	25	48	34
Mean: weighted by plan assets	25	50	33
Mean: weighted by the total number of participants	25	47	31
Minimum	1	8	1
Q1	9	31	16
Median	20	47	30
Q3	34	64	51
Maximum	77	90	90
Panel B: Company Stock Allocation as a Percentage of the Combined Employee/Employer Contributions			
Number of plans	84	59	143
Mean: equally weighted	21	50	33
Mean: weighted by combined employee/employer contributions	23	53	32
Mean: weighted by the number of active participants	22	51	30
Minimum	1	19	1
Q1	8	36	15
Median	17	52	32
Q3	29	61	52
Maximum	66	83	83
Panel C: Company Stock Allocation as a Percentage of the Employee Contributions			
Number of plans	78	58	136
Mean: equally weighted	18	29	23
Mean: weighted by employee contributions	21	33	24
Mean: weighted by the number of active participants	21	31	24
Minimum	1	1	1
Q1	7	13	9
Median	15	25	18
Q3	24	42	33
Maximum	65	76	76

not change the allocation of their own contributions. This, of course, would have been a rational response had the subscribers' international allocation been zero to begin with, but only 1 of the 11 subscribers had no international stocks. Interestingly, the least common response was to reduce the international exposure. Ten subscribers selected this response (26 percent).

The Morningstar.com sample is fairly small, so I conducted a similar survey at UCLA, using a larger sample. UCLA provides a nice setting for the experiment because it does not offer an employer match. However, I had to

modify the questionnaire slightly, since UCLA does not offer an international stock fund. In particular, I asked the employees to assume that the match would be invested in a diversified stock fund. Again, the most common response was to increase the allocation to stocks. Of the 124 respondents, 63 (51 percent) indicated that they would increase their own allocation to stocks. Most of the remaining respondents indicated they would not change their own allocation (46 percent), and only a few (3 percent) indicated they would reduce their equity exposure. The results of the UCLA survey confirm those of the Morningstar.com survey, and they are consistent with an endorsement effect.

II. Excessive Extrapolation and Company Stock

The main purpose of this paper is to document that excessive extrapolation of past returns plays a significant role in allocations to company stock. Before turning to the tests and the results, I review the behavioral literature on excessive extrapolation.

A. *Literature Review*

Tversky and Kahneman (1974) in their seminal work on representativeness show that people expect that a sequence of events generated by a random process will resemble the essential characteristics of that process even when the sequence is short. As an illustration of representativeness, Kahneman and Tversky (1972) ask subjects to evaluate the likelihood of various outcomes when tossing a fair coin for heads or tails several times in a row. Consistent with representativeness, they find that people regard the sequence H-T-H-T-T-H to be more likely than the sequence H-H-H-H-T-H.

Griffin and Tversky (1992) provide an extension documenting that people tend to focus on the strength or extremeness of the evidence with insufficient regard for its weight, credence, or predictability. Suppose people observe a sequence of H-H-H-H-T-H, but they do not know whether that sequence was generated by a fair coin or a coin tilted toward heads. The extremeness of the evidence, very much like representativeness, suggests that the coin is tilted toward heads. The small sample size, however, provides very little credibility or predictability. Since people focus on the extremeness of the evidence with insufficient adjustment for predictability, they underestimate the likelihood of the coin being fair, and they overestimate the likelihood of the coin being tilted toward heads. The end result of this judgmental bias is that people believe that the sequence H-H-H-H-T-H is almost guaranteed to be followed by heads. In other words, people see trends and patterns even when the sequence is truly random. This is what is meant by excessive extrapolation.

There is at least some evidence that excessive extrapolation affects investment decisions. Patel, Zeckhauser, and Hendricks (1991), for example, report that purchases of mutual funds are unduly influenced by recent good

Table III
Buy-and-Hold Raw Returns and Subsequent Allocations to Company Stock as a Percentage of Discretionary Contributions

This table displays equally weighted mean allocations to company stock (as a percentage of discretionary contributions) by quintile of past buy-and-hold raw returns. Company stock allocations are measured at the end of 1993. Portfolio 1 (5) includes retirement savings plans with the lowest (highest) past buy-and-hold raw returns. The table also provides the difference between the allocations of the extreme portfolios (i.e., portfolio 5 minus portfolio 1) and t-statistics. $N = 142$.

Quintiles Formed on the Basis of Buy-and-Hold Raw Returns for:	Quintile of Buy-and-Hold Returns					Observed Difference $(5 - 1)$	T-Statistic
	(Low) 1	2	3	4	5 (High)		
Prior year	21.10%	23.16%	27.85%	25.99%	23.70%	2.60%	0.60
Prior 2 years	22.61	22.43	25.18	28.74	22.96	0.35	0.06
Prior 3 years	14.14	25.45	26.21	28.84	27.78	13.64	3.33
Prior 4 years	11.74	22.20	28.18	31.10	30.23	18.49	4.64
Prior 5 years	12.64	18.68	26.27	34.66	31.21	18.57	4.33
Prior 6 years	11.99	18.72	29.33	33.45	29.96	17.97	4.63
Prior 7 years	11.36	18.98	24.11	34.79	33.70	22.34	5.87
Prior 8 years	11.46	20.69	24.22	32.96	33.63	22.17	5.70
Prior 9 years	11.08	20.76	20.52	34.04	36.68	25.60	6.49
Prior 10 years	10.37	19.68	21.56	31.51	39.70	29.33	8.39

performance, even though performance shows no persistence. What makes our setting particularly interesting is that excessive extrapolation is very costly in the case of company stock holdings. It is costly in the sense that employees, who are likely to be risk averse, construct highly concentrated portfolios.

B. Archival Evidence

The excessive extrapolation hypothesis states that past returns on company stock are positively correlated with subsequent allocations to company stock, versus a null of no correlation. To test the excessive extrapolation hypothesis, I split the sample of SEC filings into quintiles based on buy-and-hold raw returns prior to 1993. The formation period varies from 1 year (1992) to 10 years (1983 to 1992). Then I calculate the (equally weighted) mean allocations to company stock as a percentage of discretionary contributions by quintile. To avoid overlapping returns and investment choices, allocation percentages are based on discretionary contributions for 1993. The results of this analysis are reported in Table III.

When portfolios are formed on the basis of 1-year returns, the relation between past returns and subsequent allocations to company stock is mixed. The allocation difference between firms with the best stock performance (Quintile 5) and those with the worst stock performance (Quintile 1) is only 2.60

percent, and it is not statistically significant ($t = 0.60$). As the formation period lengthens, however, the relation becomes stronger. When portfolios are formed on the basis of 3-year returns, the allocation difference is 13.64 percent, and it is highly significant ($t = 3.33$). For formation periods of 5 and 10 years, the allocation difference increases to 18.57 percent ($t = 4.33$) and 29.33 percent ($t = 8.39$), respectively. These results indicate that employees look for a long track record before they invest in company stock, which is consistent with the excessive extrapolation hypothesis.

To control for various firm characteristics, I supplement the portfolio analysis with cross-sectional regressions. The dependent variable is the allocation to company stock as a percentage of discretionary contributions for fiscal year 1993. The independent variables include the logarithm of one plus the raw buy-and-hold returns prior to December 31, 1993, match type indicator (cash = 0, stock = 1), monthly Beta from January 1989 to December 1993, the monthly standard deviation of returns from January 1989 to December 1993, the logarithm of the market value of the firm as of December 1993, and the logarithm of the book-to-market ratio at the end of fiscal year 1993. On average, the regressions include 140 observations.

The results in Table IV are very similar to the univariate portfolio analysis described earlier.[10] Specifically, there is a positive correlation between past returns and subsequent allocations to company stock, and that correlation gets stronger as the return-accumulation period lengthens. When returns are measured over five years or longer, the coefficient on past returns is around 12, and the t-statistic is above four.[11] The adjusted R-squares also increase with the accumulation period, from 12 percent for 1-year returns to 33 percent for 10-year returns. Another observation that is consistent with my earlier results is that the allocation of *discretionary* contributions to company stock is about seven percentage points higher when the match is already in company stock as opposed to cash ($1.98 < t < 2.54$).

With respect to the various firm characteristics that are included in the regression, it appears that employees prefer to invest in relatively large firms, although the coefficient on size varies with the return-accumulation period. In particular, it gets smaller and less significant as the return-accumulation period lengthens. The reason for this phenomenon is the positive correlation between firm size and past returns, since current firm size is equal to the market value 10 years earlier plus the 10-year returns. Interestingly, employees do not pay much attention to the standard deviation of returns, even

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[10] Since allocation percentages are limited to the 0 to 100 range, I considered censored regressions instead of traditional OLS regressions. However, none of the observations in the sample is censored (i.e., all values are above 0 and below 100 percent). Therefore, I report OLS regressions.

[11] I also ran the regressions with the allocation to company stock measured as a percentage of equities (i.e., company stock plus stock funds). This specification controls for risk tolerance to the extent that the allocation to equities captures risk tolerance and the allocation to company stock represents the forecasted performance of company stock relative to other stocks. The results are similar to those reported in Table IV.

Table IV

Cross-sectional Regressions of Allocation to Company Stock as a Percentage of Discretionary Contributions on Past Returns

This table includes cross-sectional OLS regressions (*t*-statistics in parentheses). The dependent variable is the allocation to company stock as a percentage of the discretionary contributions for fiscal year 1993. The independent variables include the logarithm of one plus the raw buy-and-hold returns prior to December 31, 1993, match type indicator (cash = 0, stock = 1), Beta (calculated from January 1989 to December 1993), the monthly standard deviation of returns from January 1989 to December 1993, the logarithm of the market value of the firm as of December 1993, and the logarithm of the book-to-market ratio at the end of fiscal year 1993 (i.e., all fiscal years ending in calendar year 1993). On average, the regressions include 140 observations.

Returns Calculated Over	Adj-R^2	$\ln(1 + Ret)$	Match Type Indicator	Beta	$\sigma(Ret)$	$\ln(MV)$	$\ln(BV/MV)$
Prior year	0.12	6.01	6.61	−3.99	−32.43	4.56	−2.62
		(0.89)	(1.98)	(−1.06)	(−0.36)	(2.76)	(−0.92)
Prior 2 years	0.15	10.60	7.01	−7.31	−30.08	4.29	−2.03
		(2.24)	(2.18)	(−1.81)	(−0.35)	(2.65)	(−0.72)
Prior 3 years	0.18	13.81	7.77	−7.15	58.99	4.18	−0.56
		(3.19)	(2.47)	(−1.91)	(0.67)	(2.64)	(−0.20)
Prior 4 years	0.21	13.13	6.99	−6.42	98.40	3.54	−0.09
		(3.76)	(2.26)	(−1.79)	(1.10)	(2.24)	(−0.03)
Prior 5 years	0.23	12.28	6.48	−6.57	92.87	3.45	−0.71
		(4.19)	(2.12)	(−1.85)	(1.07)	(2.21)	(−0.26)
Prior 10 years	0.33	12.58	7.23	−8.48	127.43	2.82	0.55
		(6.20)	(2.54)	(−2.55)	(1.59)	(1.92)	(0.21)

though they invest in a single security. This raises the possibility that employees do not really understand the risk profile of a single security and company stock in particular. Consistent with this conjecture, John Hancock Financial Services (1999) reports that a majority of employees feel their own company stock is safer than a diversified portfolio.

The portfolio analysis and the regression analysis indicate that employees buy company stock after it has gone up. An interesting question to ask is: how does company stock perform subsequently? To answer this question, I form quintiles based on the allocation of discretionary contributions to company stock as of year-end 1993.[12] Next, I calculate equally weighted buy-and-hold raw returns by quintile (without rebalancing). Over the one-year following the portfolio formation period, employees who allocate the most to company stock (i.e., portfolio 5) earn 6.77 percent *less* than do those who allocate the least (see Table V). The results are similar for the two- and

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[12] It is plausible that the allocation of discretionary contributions is not representative of what employees would have chosen in the absence of stock matches. To address this concern, I repeated the analysis using retirement savings plans that offer cash matches only. The results, which are very similar, can be obtained from the author upon request.

Table V
Allocation to Company Stock as a Percentage of Discretionary Contributions and Subsequent Buy-and-Hold Raw Returns (1994 to 1997)

This table displays equally weighted mean buy-and-hold raw returns by company stock holdings, and it is based on 142 firms. There is no rebalancing. Portfolio 1 (5) includes retirement savings plans with the lowest (highest) allocation of discretionary contributions to company stock as of December 1993. The table also provides the difference between the returns on the extreme portfolios (i.e., portfolio 5 minus portfolio 1), and the threshold for significant difference at 10 percent and 5 percent. Statistical inferences are based on the following bootstrapping procedure. First, I construct two portfolios with 28 observations each by randomly drawing observations (with replacement) from the 11-k sample of 142 plans. Next, I calculate the mean difference in returns between the two portfolios. Then, this process is repeated 10,000 times to obtain the distribution of differences in means and determine the threshold for statistical significance at 10 percent and 5 percent (one-tailed test). For instance, the mean difference in one-year returns has to exceed 7.12 percent to be statistically significant at 10 percent.

| | Allocation to Company Stock | | | | | Observed Difference $(5-1)$ | Threshold for Significant Difference at $\alpha = 10\%$ | Threshold for Significant Difference at $\alpha = 5\%$ |
	(Low) 1	2	3	4	5 (High)			
Allocation to company stock as a percentage of discretionary contributions	4.59%	12.19%	19.34%	31.85%	53.90%	49.41%		
One-year returns	6.64	6.55	1.27	−1.03	0.13	−6.77	7.12	9.22
Two-year returns	43.69	40.78	38.24	43.33	31.92	−11.77	14.75	17.65
Three-year returns	59.29	70.28	68.64	79.66	56.25	−3.04	21.99	26.48
Four-year returns	101.08	114.55	109.89	149.92	103.14	2.06	36.15	46.37

three-year returns, though they are slightly different for the four-year returns. Over a period of four years, employees who allocate the most to company stock earn 2.06 percent more than do those who allocate the least, although the difference is not statistically significant.[13] These results indicate that employees are unable to predict the future performance of company stock. Hence, an information-based explanation for company stock holdings seems unlikely to hold.

In summary, the evidence suggests that past returns on company stock have a substantial effect on subsequent investment decisions, even though employees are unable to predict the future performance of company stock. Employees of firms with the best 10-year returns have 39.70 percent of their discretionary contributions invested in company stock, whereas those in firms with the worst 10-year returns have 10.37 percent invested in company stock. These results suggest that employees buy company stock after it has already gone up, which is consistent with the excessive extrapolation hypothesis.

C. Company Stock Survey: Additional Evidence on Excessive Extrapolation

To further explore the excessive extrapolation hypothesis, I conducted a survey asking plan participants to rate the past and future performance of company stock. The specific questions are as follows:

How would you rate the return on the stock of your employing firm over the LAST five years versus the return of the overall stock market?

What is your best estimate of the future return on the stock of your employing firm over the NEXT five years versus the return of the overall stock market?

The response scale ranges from "much higher" to "much lower."[14] The null hypothesis assumes no correlation between past and future ratings, whereas the excessive extrapolation hypothesis predicts a positive correlation.

The survey provides an opportunity to explore a wide range of additional explanations, some of which are difficult to test with company-wide data. Since the main focus of this paper is to explore the role of excessive extrapolation in allocations to company stock, I describe the other explanations very briefly. There is ample evidence that people tend to be optimistic (Weinstein (1980)) and overconfident (Odean (1999) and Barber and Odean (2000)). In the case of company stock, optimism and overconfidence might affect the perception of risk, so the survey includes the following question about the likelihood of company stock experiencing a loss:

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[13] The results are robust to several risk adjustments, including those in Fama and French (1993) and Carhart (1997). Details on the risk-adjusted returns are available from the author upon request.

[14] The questionnaire is available from the author upon request.

> In your opinion, is the stock of your employing firm more likely or less likely than the overall stock market to lose half of its value over the NEXT five years?

The response scale ranges from "far less likely" to "far more likely." To the extent that employees are overconfident, they might believe that company stock is safer than a diversified portfolio. The questionnaire also includes proxies for familiarity (Huberman, 1997), loyalty (based on the Organizational Commitment Questionnaire of Mowday, Steers, and Porter (1979)), and peer pressure.

The survey was conducted on the web site of Morningstar.com during September 1999. The survey was completed by 1,095 Morningstar.com subscribers. The respondents are predominately white males; 90 percent of them completed a two-year college or received a higher degree; the average age is 45 years; the average income is $95,462; and about a third invest their discretionary contributions in company stock. Because the sample is not necessarily representative of the population of 401(k) participants, the results have to be interpreted cautiously.

To test the excessive extrapolation hypothesis, I calculated the correlation between the subjective ratings of past returns and future returns. This correlation is 0.52, and it is significant at the 0.01 level (not reported in a table). Thus, the survey respondents believe that past returns are likely to persist. Since individual stock returns are largely unpredictable, it seems that employees excessively extrapolate past performance. I supplement the Pearson correlation with Tobit regressions in which the dependent variable is the percentage of discretionary contributions that are allocated to company stock and the main independent variable is past returns. The results are consistent with excessive extrapolation, as indicated by a significantly positive coefficient on the past return variable. The remaining variables of interest—familiarity, loyalty, and peer pressure—are insignificant.[15]

The survey also suggests that people are optimistic and/or overconfident about the future prospects of company stock. Only 16.4 percent of the respondents believe that company stock is riskier than the overall stock market, as indicated by the likelihood of losing half its value over the next five years.[16] Furthermore, a mere 6.5 percent of those who did not attend college consider company stock to be riskier than the overall stock market. Naturally, it is difficult to determine whether these subjective assessments of risk are based on proprietary information or judgmental biases. Since it is hard to imagine that 93.5 percent of the firms are safer (or no riskier) than the overall stock market, however, I personally believe that individuals do not fully understand the risk of company stock.

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[15] The complete Tobit results are available from the author upon request.

[16] John Hancock Financial Services (1999) conducted a similar survey, in which plan participants were asked to rate the risk of company stock and a stock fund. Using their data, I find that 18 percent of the people realize that company stock is riskier than a stock fund.

In summary, the archival and experimental evidence is consistent with the notion that employees excessively extrapolate past returns on company stock. The experimental evidence also documents that employees are optimistic and overconfident about the future prospects of company stock. In particular, only 16.4 percent of the respondents believe that company stock is riskier than the overall stock market. Unfortunately, as a result of excessive extrapolation, optimism, and overconfidence, employees could incur substantial costs as they construct highly concentrated portfolios.

D. Do All Investors Exhibit the Same Behavior?

The evidence in this paper suggests that employees' behavior is consistent with the excessive extrapolation hypothesis. However, if all investors exhibit the same degree of extrapolation, then it is puzzling that employees allocate more to company stock than other investors do. Merck employees, for instance, have 70 percent invested in company stock, whereas Merck's market capitalization suggests that, on average, investors have roughly 1 percent of their portfolios in Merck. One way to address this issue is to investigate whether familiarity magnifies the degree of extrapolation, which in turn could make employees extrapolate more than others. Before I turn to the data, I provide a brief review of the literature on familiarity as it relates to investments.

Heath and Tversky (1991) find that people prefer betting on their own judgment over an equally likely chance event when they consider themselves familiar with the matter, but not vice versa. Heath and Tversky even find that people are willing to pay a significant premium to bet on their judgments. Consistent with a familiarity bias, Huberman (1997) reports that people tend to invest a relatively large portion of their portfolios in their local phone company. Huberman also suggests that familiarity bias could have an important role in allocations to company stock within 401(k) plans. Familiarity can affect employees' behavior in various ways. In this section, however, I only focus on the interaction between familiarity and extrapolation.

To explore the interaction between familiarity and extrapolation, I use data from the Morningstar.com survey, which asked the participants to rate the past performance of company stock, predict its future performance, and indicate the degree of familiarity with the employing firm. I find that those who are "very familiar" with their employing firm indicated a somewhat higher correlation between past and future performance ($\rho = 0.55$) than those who are "moderately" familiar ($\rho = 0.39$). As a more formal test, I run a regression of future performance on past performance and the interaction between past performance and familiarity. The interaction term is significantly positive ($p < 0.01$), which suggests that extrapolative behavior is magnified by familiarity. To the extent that employees are more familiar with company stock than other investors, they are likely to exhibit a higher degree of extrapolation.

Familiarity might also explain why employees are overconfident about the likelihood of company stock experiencing a loss, since overconfidence increases with familiarity (Heath and Tversky (1991)). Consistent with Heath and Tversky's results, John Hancock Financial Services (1999) find a negative correlation between familiarity and the perceived risk of an investment. In particular, John Hancock Financial Services show that people are more familiar with company stock than they are with a stock fund and that company stock is perceived as safer than a stock fund. Using their data, I also find a positive correlation between the degree to which an employee is familiar with company stock and the perceived safety of company stock.[17]

III. Summary and Conclusions

Employees invest a nontrivial portion of their *discretionary* funds in company stock. On diversification grounds, this seems a dubious strategy, especially given the likely correlation between company stock and human capital. This paper explored the role of excessive extrapolation in discretionary allocations to company stock. The results indicate that allocations to company stock are correlated with past returns but not with future returns, which is consistent with the excessive extrapolation hypothesis.

The survey I conducted on Morningstar.com provided additional evidence in support of the excessive extrapolation hypothesis. In particular, individuals rated the past and future performance of company stock, and the correlation between the ratings was significant. The survey also provided evidence that is consistent with optimism and overconfidence. Only 16.4 percent of the respondents believe that company stock is riskier than the overall stock market. The documented misconceptions about the risk of company stock raise difficult questions about the effectiveness and objectivity of the educational materials plan participants receive.

Unfortunately, the costs of insufficient diversification are often substantial. The calculations of Brennan and Torous (1999) suggest that (at least some) employees are better off holding cash than a portfolio that is concentrated in company stock. Legislators who recognized this problem have attempted to reduce company stock holdings, but recent regulations in this area are unlikely to affect company stock holdings because they cover less than one percent of the plans (Anand, 1996).

Excessive extrapolation is a general phenomenon that might apply to investments other than company stock. For instance, the substantial flows into the stock market over the last decade might be explained by excessive extrapolation of the outstanding market performance. There is at least some anecdotal evidence that current expectations are too high. Benartzi, Kahneman, and Thaler (1999), for example, asks visitors to the Morningstar.com

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[17] Another factor that might increase employees' overconfidence in company stock is the illusion of knowledge. Oskamp (1965) documents that information tends to increase psychologists' confidence in their clinical decisions, though accuracy does not go up.

web site to assess the likelihood of stocks outperforming bonds over the next 20 years. A third of the respondents believe that the likelihood is 100 percent. In other words, they think that the stock market is *guaranteed* to outperform the bond market. Extrapolative behavior that results in the construction of highly concentrated portfolios raises major concerns about investment autonomy in defined contribution savings plans and privatized social security systems. Clearly, more research is needed on the costs and benefits of investment autonomy.

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