Who Determines When You Retire?
Peer Effects and Retirement*

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1. Introduction

An emerging literature finds that consumers have a difficult time making good financial decisions, particularly when those decisions are complex. For example, Madrian and Shea (2001) find that individuals respond to the complexity inherent in retirement plan choices by simply choosing the default option. Consistent with the idea that consumers find it costly to process financial information or engage in financial transactions, Choi, Laibson and Madrian (2005a) find that many plan participants leave "$100 bills on the sidewalk" by declining matching retirement contributions that can be immediately withdrawn. Similarly, Gustman and Steinmeier (2001) find that retirement plan participants are often unaware of basic plan details. Moreover, the evidence in Choi, Laibson, and Madrian (2005b) implies that education is not always sufficient to improve participants' choices.[1]

We extend this literature by studying the decision about when to retire—one of life's most complex and important financial decisions. Specifically, we test the hypothesis that individuals decide when to retire, at least in part, by observing the retirement decisions of their coworkers.[2] We conduct our analysis using comprehensive, new data on the characteristics and retirement decisions of virtually all non-Federal government employees in the State of Oregon. Our data cover 71,923 retirement-eligible employees at 672 employers over 12 years, providing us with a rich setting in which to test for peer effects. The Oregon Public Employees Retirement System (PERS) is a complex retirement plan, potentially leading individuals to infer their optimal retirement dates from the retirement dates of their coworkers. Interestingly, some of the complexity inherent in the PERS system arises from the presence of significant short-run

[1] Campbell (2006) explores a more general set of financial matters.

[2] Coworker or other peer effects have been shown to play a role in other contexts. For example, Sacerdote (2001) finds that college roommate assignments have an impact on GPA. Duflow and Saez (2002, 2003) find that 401(k) plan participation and the choice of vendor are both influenced by peers. Similarly, Hong, Kubik and Stein (2004) find that stock market participation is higher for social individuals. Manski (1993) which highlights the difficult econometric identification issues that arise in the study of peer effects.

fluctuations in retirement benefits across individuals and through time—variation which we exploit when testing for peer effects.

Understanding how employees decide when to retire—and the role that peers play in this decision—is important because retirement timing decisions may have dramatic impacts on employees, employers, and the economy.[3] Within our sample, figure 1 illustrates that retirements occur in waves. While we can explain a significant fraction of these retirements using demographic characteristics and individual-level data on expected retirement benefits, our main finding is that individual decisions about when to retire are strongly correlated with the retirement timing decisions of their peers, who we define to be retirement-eligible coworkers within the same employer. Moreover, this correlation is economically significant and robust, leading us to conclude that peer effects are an important determinant of individual retirement dates. Given the relative irreversibility of the retirement decision, peer effects have the potential to increase or decrease retiree welfare. For example, mimicking the retirement decisions of coworkers will tend to increase retiree welfare when coworkers face similar retirement incentive or coworkers successfully educate individuals about their own retirement incentives. Alternatively, mimicking the retirement decisions of coworkers will tend to decrease retiree welfare when coworkers fail to recognize when they face different retirement benefits. Our initial attempts to measure the welfare implications of peer effects suggest that welfare costs are likely to be modest.

Our other findings are consistent with prior research. For example, we find that individual retirements respond both to the level of current benefits, as well as a forward-looking measure comparing current and future benefits. They also respond to the short-term retirement

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[3] Stock and Wise (1990), Samwick (1998), Chan and Stevens (2004), Sundaresan and Zapatero (1997), and Farhi and Panageas (2006) provide structure to the retirement decision and implications for rational models of retirement choice. Stanton (2000) describes the embedded stale-price options that are present in some 401(k) retirement plans and the impact that those options have on retirement behaviors. The stale-price options that arise in the PERS plan are a source of exogenous variation that we use to motivate our instrumental variables specifications.

incentives that arise periodically within the PERS retirement system. Where our findings differ from those on the collection of social security benefits are in the lower propensity of PERS members to retire before they are eligible for normal PERS retirement benefits. However, the probability of retiring in the first month of eligibility for normal retirement benefits is over 3 percent for normal employees and 10 percent for police and fire, which are both quite large relative to the unconditional probabilities of 1.47 percent and 1.25 percent, respectively.

2. The Oregon Public Employees Retirement System

Our data come from the Oregon Public Employees Retirement System (hereafter, PERS), the state agency responsible for administering the retirement plans for approximately 95% of the state and local public employees in Oregon. Employers covered by PERS include all state agencies, universities, and school districts; and almost all cities, counties, and other local government units. In 2006, PERS held nearly $56 billion in assets, making it the 22nd largest public or private pension fund in the country. In this section, we outline the plan features that inform our analysis and provide summary statistics for key variables.

2.1. Plan Description and the Calculation of Retirement Benefits

The PERS pension plan combines a traditional defined benefit (DB) plan with a simple defined contribution (DC) plan, and it is funded by contributions from PERS employers and employees.[4] One becomes PERS eligible after a 6-month waiting period. Once eligible, PERS membership is portable to any other PERS employer. Vesting requires either 5 years of service or that the member be at least 50 years old and employed. For non-police and fire employees who became eligible for PERS before August 21, 1981, PERS monthly retirement benefits are the maximum of three benefit formulas, calculated as follows:

[4] For a complete description of the PERS program as it exists today, see the members' handbook at http://www.oregon.gov/PERS/MEM/PERSPLAN/docs/publications/pers_handbook_03_05.pdf.

(1) **Full Formula** = *Final Salary* × *Years of Service* × *Early Retirement Factor* × 0.0167,

(2) **Money Match** = *PERS Account Balance* × *Actuarial Equivalency Factor* × 2,

(3) **Formula + Annuity** = 0.600 × *Full Formula* + 0.500 × *Money Match;*

where *Final Salary* is the higher of employee's average monthly salary in the three calendar years with the highest annual salaries or the employee's average monthly salary over the past 36 months; *Years of Service* is number of months the employee has made contributions into PERS divided by 12; *Early Retirement Factor* reduces retirement benefits below normal retirement levels at the rate of 8% per year; *PERS Account Balance* is the employee's account balance; and *Actuarial Equivalency Factor* is an age-based annuity factor that is set by PERS actuaries. Employees who made their first contribution into PERS after August 21, 1981 are not eligible for Formula + Annuity benefits. Thus, their PERS retirement benefits are the maximum of the Full Formula and Money Match benefits.

General Service employees who made their first contribution to PERS before July 1, 1996 (known as Tier 1 members) are eligible for normal retirement benefits at age 58, while those who made their first contribution on or after July 1, 1996 (Tier 2) are eligible for normal retirement benefits at age 60. All general service members are eligible for normal retirement after 30 years of service and for early retirement at age 55. Thus, *Early Retirement Factor* can be as small as 0.60 for Tier 1 members and 0.76 for Tier 2 members. It is 1.00 for all members at normal retirement. Police and fire employees have more generous terms in two primary dimensions: 1) they become eligible for early retirement benefits at age 50, and they are eligible for full retirement benefits at age 55 or after 25 years of service; and 2) the Full Formula and Formula + Annuity benefits increase slightly.

Employee contributions into their employee retirement account equal 6% of salary. Employees have the option to invest 25%, 50%, 75%, or 100% of these contributions into the "regular account," with the remainder invested in the "variable account." For Tier 1 members, the regular account guarantees a minimum 8% annual return. For Tier 2 members the regular account does not offer a guaranteed minimum return. The variable account reflects the investment performance of the state investment pool, which the Oregon State Treasurer's Office actively manages in a manner that provides substantial exposure to equities.[5] Historically, Tier 1 members benefit frequently from the 8% floor on returns credited to members' accounts while the Tier 2 regular account is only slightly less risky than the variable account. Employee contributions and the returns posted to the regular and variable accounts determine an employee's *PERS Account Balance*, which determines the Money Match benefit as shown above in equation (2).

2.2. Changes to the Calculation of Retirement Benefits

During our sample period, PERS made several changes in the calculation of retirement benefits, creating economically significant incentives (or disincentives) to retire. We focus on changes in actuarial equivalency factors and retirement account balance calculations over time. These changes are tabulated in Figure 2 and described here.

The first major set of changes to the retirement system during our sample period involve the Actuarial Equivalency Factor table, which is used to convert the PERS Account Balance from a lump-sum into an annuity. On January 1, 1997, the Actuarial Equivalency Factor table changed from annual factors to monthly factors. In addition, Actuarial Equivalency Factors were increased for those between the ages of 40 (increased by 6.3%) and 54 (increased by 0.1%), providing the youngest retirement-eligible employees retiring under Money Match with an incentive to postpone retirement beyond January 1, 1997. There was no corresponding incentive

[5] Between 1992 and 2003, the correlation between the annual returns of the state investment pool and the S&P 500 index is 0.922.

for employees retiring under Full Formula. Then, on July 1, 2003, the Actuarial Equivalency Factor tables were updated again, to better reflect current life expectancies, which had increased in the 20 years since the annuity factors were last determined. As a result, Actuarial Equivalency Factors decreased between 1.4% to 17.8%, with decreases ranging between 5.8% and 10.2% for those employees between 58 and 65. These changes, which were announced several years before they went into effect, created strong incentives for employees retiring under Money Match to retire before July 1, 2003, with the strongest incentives for the oldest employees. For example, a potential retiree at age 60 would receive 7.0% less in monthly benefits if they delayed retirement from June 2003 to July 2003.

In Figure 3a, we plot the average change in retirement benefits that a member would receive if she retired now rather than waiting for the next known change in the Actuarial Equivalency Factor tables. We also plot the range of possible changes. In each case, the change in retirement benefits is measured as a monthly return, from the date of the possible retirement to the date of the change. The large positive returns leading up to June 2003, measure the increasing strength of the retirement incentives prior to the change in the Actuarial Equivalency Factor tables on July 1, 2003. The negative returns between January 1992 and December 1996—the period during which Actuarial Equivalency Factor were updated annually, on a member's birthday—measure the disincentive for a member to retire in the months leading up to her birthday.

A second critical change to PERS affected the returns used to calculate PERS account balances. Every April, PERS provides members with a statement that reports retirement contributions and investment returns credited over the prior calendar year along with the members' account balances. Prior to January 1, 2000, the timing of this report reflected the fact that PERS did not finalize annual returns for the regular and variable accounts in year Y until the end of March in year Y+1. Moreover, PERS did not utilize estimated year-to-date returns. Consequently, the PERS Account Balances of members retiring prior to January 1, 2000 were based, at least in part, on stale information about returns.[6] Consider a member who is allocating 100% of his retirement contributions to the regular account and retiring in February 1998, before PERS finalizes either 1997 or 1998 returns. His retirement account balance for 1997 and the first two months of 1998 would be credited with the "finalized" 1996 return of 21.0%.[7] If he waited until PERS finalized the 1997 and 1998 returns, he would have earned lower annual returns of 18.70% in 1997 and 14.10% in 1998, resulting in significantly lower retirement benefits. Effective January 1, 2000, PERS eliminated retirement incentives related to stale returns.

Figure 3b is similar to Figure 1, but plots the average, minimum, and maximum fluctuations in retirement benefits due to stale returns over our sample period. Rather than compare Money Match retirement benefits calculated using both the (known) stale returns to those calculated using (unknown) future finalized returns, we assume that members estimate the future finalized returns for all currently available information. In the case of the individual deciding whether to retire in February 1998, we assume that he estimates the finalized PERS returns for 1997 from the realized stock return data for 1997 and (more noisily) estimates the finalized PERS returns for 1998 from the stock return data for January and February of 1998. When the stale returns are higher than the estimated returns, he has an incentive to retire. When the stale returns are lower than the estimated returns, he has an incentive not to retire. Again, the magnitude of this incentive is measured as a monthly return. In this case, the monthly return is measured between the current month and the month in which PERS finalizes its next set of returns (or eliminates stale returns from the calculation of retirement account balances).

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[6] Stanton (2000) studies the impact of stale price calculations in some 401(k) plans.
[7] When calculating PERS Account Balances, PERS implicitly assumes that all retirement contributions in year Y are made on January 1 of year Y. We follow this rule anytime that we calculate PERS Account Balances.

2.3. Data

Our sample includes PERS members between January 1992 and December 2003.[8] PERS members who made contributions to their PERS retirement accounts before January 1992 enter our sample in January 1992, while new members enter our sample when they begin making contributions to their PERS retirement account. Members exit our sample in the month before they begin collecting retirement benefits, which is typically the last month they are employed, but can be months (or years) after they last worked for a PERS-covered employer. PERS chose to exclude legislators and judges from our data, and we chose to exclude employees of the Oregon University System.[9]

For each member, we have data on birth dates, gender, the earliest year in which a salary from a PERS-covered employee is received, and the date of death for members that die prior to January 2008. We also possess employment spell data. For each member-employer pair in the data, we know when the member begins and ends work; for each member-employer-year, we also know the total salary paid to the member. For each member-year, we know the member's retirement contributions and account balances, as well as the level of his or her allocation to the variable account {0%, 25%, 50%, or 75%}. Finally, we know the year and month in which their first retirement benefit check was mailed. In this paper, we equate the decision to begin collecting retirement benefits with the decision to retire.

In contrast to many retirement studies, which study retirements on an annual basis, our unit of observation is the decision to retire in a given month. Monthly data allow us to exploit monthly variation in the PERS benefits faced by employees. We classify a member as retiring

[8] The beginning of our sample period reflects the first year after PERS adopted its current database structure that it could provide us with all of the variables of interest; the end reflects the fact that PERS transitioned employees to a new retirement plan after 2003.

[9] While the Oregon University System consists of seven universities, PERS employer codes do not distinguish between the different universities. Moreover, faculty members (but not staff) may opt out of PERS and into a 401(a) pension plan similar to the ones offered at many universities.

exactly one month before PERS mails the first benefit check to adjust for the date on which the decision to retire is made. To convert the salary data from annual to monthly, we assume that each member's annual salary is evenly distributed over the months she is employed by a PERS-eligible employer during that year.

2.4. Summary Statistics

Within our sample of Oregon state employees, 71,923 unique individuals are either eligible to retire on January 1992 or become eligible to retire between January 1992 and December 2003. Table 1 panel A provides annual summary statistics for all retirement-eligible employees, regardless of whether they are eligible for early or normal retirement benefits. Between 1992 and 2003, the number of retirement-eligible employees grows from 17,238 to 30,817, the average age of a retirement-eligible employee falls from 58.9 to 58.2, and the average number of years of service remains close to 15. The average (nominal) monthly salary ranges from $2,638 in 1992 to $3,762 in 2003. The average replacement rate, calculated as the monthly retirement benefit the employee would receive upon retirement divided by the employees salary over the prior 12 months, increases from 29% in 1992 to 40% in 1998 and then decreases to 34% in 2003. The fraction of female employees who are eligible for retirement increases from 53% in 1992 to 58% in 2003. The fraction of employees working as police and fire fighters remains close to 10%. Because the Tier 2 employees enter our data in 1996, there are relatively few retirement-eligible Tier 2 employees until 2000, when these members begin to vest. The 99th percentile for salaries is $74,537 in 1992 and $112,000 in 2003.

Table 1 panel B provides annual summary statistics for the 38,888 employees who chose to retire between January 1992 and 2003. Comparing panels A and B, retirees have monthly salaries that are 16-25% higher, replacement rates than are 22-69% higher, and three to four years of additional service relative to their non-retiring peers. Interestingly, the average retirement age falls from 60.5 years at retirement in 1992 to 58.4 years old in 2003. A useful benchmark not reported in Table 1, is that the unconditional probability of retirement in any given month among the individuals represented in panel A is 1.47 percent.

3. Retirement Timing Decisions and the Identification of Peer Effects

In this section, we describe the econometric challenges that arise when attempting to determine whether individual retirement timing decisions are (causally) influenced by the retirement timing decisions of their peers.[10] When predicting retirement dates, the existing literature includes individual measures of current and future retirement benefits, as well as numerous demographic controls. A general specification is given by equation (4):

(4) $\mathbf{y_{ijt} = a + bx_{it} + c\ddot{y}_{-ijt} + e_{ijt}}$,

where

- $\mathbf{y_{ijt}}$ is an indicator variable equal to 1 for individual i at employer j in month t if retirement is chosen, and zero otherwise;
- $\mathbf{X_{it}}$ are characteristics such as individual i's expected retirement benefit if retiring in month t, age in month t, job type, and gender;
- $\mathbf{\ddot{y}_{-ijt}}$ is the proportion of individual i's colleagues choosing to retire at employer j in month t, excluding individual i.

If an individual's retirement date is causally influenced by the retirements of his peers, estimates of c are expected to be positive. However, as detailed in Manski (1993), there are several alternative reasons that we may find positive estimates of c. Using Manski's terminology, the set of potential inferences can be placed into three categories: correlated effects, exogenous effects, and endogenous effects, where endogenous effects refer to true peer effect.

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[10] Our discussion in this section draws heavily on the framework developed by Manski (1993) and the related discussion in Duflo and Saez (2002).

3.1. Correlated Effects

Correlated effects arise when the preferences of individuals in a particular peer group are correlated. In our model, correlated effects will arise if the retirement preferences of individuals in a particular employer are correlated (so that the error term, e, in equation 2 is a function of $\ddot{\mathbf{y}}$). For example, individuals with a taste for early retirement could self-select into police and fire careers because those careers offer retirements at younger ages and after fewer years of service. Alternatively, employees within a given employer face similar institutional environments. For example, large employers might provide better information about the retirement plan benefits, resulting in workers who are more sensitive to plan changes. Workers at these firms might be more sensitive to plan changes because they are aware of them. To help rule out correlated effects we carefully control for individual characteristics and retirement incentives. To capture nonlinear impacts of age on retirement, we include a separate fixed effect for each age (measured in years). We also include a separate fixed effect for every month and year in our sample period, and interact each of those fixed effects with a dummy variable that indicates whether the employer is a school district or community college. These interaction terms allow us to control for systematic differences in the retirement patterns of employees on a traditional nine-month school schedule versus those employed on a 12 month basis. In addition, we exploit exogenous variation in retirement incentives that is independent of the potentially idiosyncratic preferences of an employer's employees. One set of exogenous variation comes from the fluctuations in retirement incentives due to stale returns and changes in Actuarial Equivalency Factor tables. Another set of exogenous variation comes from variation in the birth months of coworkers.

3.2. Exogenous Effects

Exogenous effects occur when there is a causal relation between individual choices and the average characteristics of the peer group, even after controlling for individual characteristics.

These effects arise when employees are influenced by the background characteristics of their coworkers rather than their actions. For example, employers may invite PERS to present on-site retirement seminars to their employees. Employees of PERS employers that offer the seminars may make different retirement decisions than those of employers that do not.[11] Exogenous effects can also originate outside of the employer. For example, a local newspaper may educate PERS members about plan changes. Readers of the same paper would retire together even in the absence of peer effects. To help rule out exogenous effects, we include employer-date and county-date control variables.

3.3. Endogenous Effects or Peer Effects

Peer effects are said to occur when there is direct causal impact of peer choices on individual choices. A useful way to think of a true peer effect is to consider measuring the change in behavior that might occur if an employee were to be randomly placed among a new set of peers. The peer effects literature considers two mechanisms that might drive peer effects. First, peer effects may function through individuals' desire to conform to social norms. Second, education of peer group members and subsequent word-of-mouth communication may transmit this education through the peer group. While our priors are that education is likely the more important channel in the retirement decision, we cannot clearly differentiate between the social norms and education mechanisms. This is not necessarily a large concern since welfare implications for the individual, employer, and economy are unlikely to depend on the channel through which the peer effect operates. However, from a policy perspective, this inability to differentiate may limit the prescriptions that can be drawn from our study. For example, if education is the mechanism, poor choices can be improved by better education and there are

[11] If employers randomly make this invitation, any correlation between the employee's retirement and his peers' retirements is driven, in part, by the correlated effects outlined above. However, if the employer chooses to offer the seminars based on the average age of its employees, the correlation is properly called an exogenous effect.

efficiencies in education because even a small sample of educated peers can transmit useful information to their peers. If the mechanism is social norms, education will not have the same impact.

4. Empirical Determinants of Retirement

Our empirical analysis proceeds in three steps. First, we model the individual retirement decision using individual-specific information such as age, gender, job type, projected retirement benefit, and *ex post* mortality measures, as well as exogenous variation in individual retirement incentives based on changes to the PERS retirement system. This step yields a baseline model, allowing us to predict the year and month in which an individual will choose to retire. Second, to test for peer effects in retirement dates, we incorporate into the baseline model the retirement decisions of an individual's coworkers. To help distinguish peer effects from alternative explanations such as unobserved heterogeneity among employers, we include controls that vary at the employer-date level, such as the fraction of non-retirement eligible employees leaving the employer in month *t*. In addition, we exploit two sets of instrumental variables—one set based on the average fluctuations in coworker retirement incentives based on changes to the PERS retirement system and another based on the fraction of coworkers whose birthday occurs in month t. Third, we take steps towards evaluating whether peer-induced retirements have an impact on welfare.

4.1. Why the OLS Model?

Because the dependent variable in equation (4) is binary, it would be natural to estimate a limited dependent variable model using a logistic or probit regression. In fact, the existing retirement literature often uses one of these models. For our research question, however, non-linear models have several limitations. First, fixed effects may be biased in non-linear models.

Second, the logistic model does not permit the use of instrumental variables. It is perhaps for these reasons that the peer effects literature uses ordinary least squares rather than non-linear models (see, for example, Sacerdote, 2001).

All regressions include fixed effects for each of the 34 ages (measured in years) between 46 and 79.[12] Most regressions also include date-by-employer type fixed effects, which means that for each of the 144 months in our sample period (January 1992 through December 2003) we classify employers into education (school districts and community colleges) or not-education to control for unique date effects that may prevail in jobs that are traditionally nine-month jobs. Regressions including time period fixed effects "remove" the average retirement effects due to PERS plan changes and any other time-specific events throughout the sample period. Thus, the coefficients we estimate use within-period, within job category, within age group, cross-sectional variation across employee retirement behavior at PERS employers. The coefficients in Tables 3, 4, and 5 are estimated via OLS and then multiplied by 100, so 100 represents 1 percentage point. Since our main variable of interest fluctuates at the employer-date level, we cluster standard errors at the level of the employer.

4.2. The Retirement Model without Peer Effects

In Table 2, we present four specifications that use individual-level data to predict the retirement of individual *i* in month *t*. Column (1) includes age fixed effects, and dummy variables indicating whether individual *i* is female, active police or fire, belongs to Tier 2 (which offers no guaranteed minimum return in its regular investment account), would receive benefits under Money Match (DC), or would receive benefits under Full Formula (DB).[13] In addition, we include the replacement rate which measures the fraction of her current monthly income that she

[12] Although we limit our sample to ages between 46 and 79, doing so throws out few observations. We only have 4 observations at age 46 and 554 observations at age 79.

[13] The omitted category are the relatively older individuals who would receive benefits under Formula + Annuity.

would receive each month from PERS in retirement.[14]. The predicted sign is positive. Finally, we also include a forward-looking measure that estimates the utility gain from deferring retirement until the optimal retirement time. The "option value of retirement" was introduced into the literature by Stock and Wise (1990), who presented both theoretical and empirical evidence that a worker's propensity to retire is negatively related to the gains from delayed retirement—the more a worker gains from delaying retirement the less likely he should be to retire today. We implement the Stock and Wise (1990) model by calculating the present value of a member's dollar wealth when retiring on the optimal date (including both labor and pension income) and subtracting the present value of a member's dollar wealth when retiring today. [15] When the optimal retirement is today, the difference between these numbers is zero. When the optimal retirement date is in the future, the difference between these numbers is strictly positive, and it measures the present value of the benefit of deferring retirement.[16] The measure that we include in our regressions is divided by individual i's average annual salary over the past 12 months. The predicted sign is negative.

Consistent with theory, the coefficient on the replacement rate is positive and statistically significant at the 1-percent level. The estimated coefficient of 4.791 implies that a one-standard deviation increase in the replacement rate (0.257) increases the probability of retirement by 1.23 percentage points. This effect is economically large; the unconditional probability of retiring in

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[14] Defined as the expected monthly retirement income that individual *i* would receive if she retired in month *t* scaled by her average monthly salary over the past 12 months

[15] Variations of the Stock and Wise measure have been used by Samwick (1998), Chan and Stevens (2004), Chan and Stevens (2006), Coile and Gruber (2007), and others.

[16] Our estimation requires several assumptions. We assume that annual wage growth is 2% and that the annual discount rate is 3%. PERS makes COLA adjustments to the benefit each August that is set at the smaller of Portland's CPI and 2%. Since Portland's CPI was rarely under 2%, we assume the annual adjustments would always be 2%. Consistent with prior research, we assume that members are risk averse and that members value retirement income more than labor income (i.e., members would rather not work). We pick the same parameter values as Samwick (1998). Specifically, we set gamma=0.75 for risk aversion and k=1.5 for the preference for retiring. When k=1.5, members are indifferent between working to earn $3 and retiring to collect $2. Last, we forced members to retire by age 80 because PERS does not calculate the *Actuarial Equivalency Factors* beyond age 80. Given the very small number of members who actually choose to retire beyond age 80, this last assumption does not seem unreasonable.

a given month is only 1.47 percent. Also consistent with theory, the coefficient on the scaled option value of retirement measure is negative and statistically significant. However, it does not appear to be economically significant. The estimated coefficient of -0.005 implies that a one-standard deviation increase (8.206) only decreases the probability of retirement by 0.04 percentage points.

Column (2) introduces a number of additional control variables. The most important of these variables, from our perspective, are the two that isolate the short-run retirement incentives (or disincentives) generated by changes in annuity factors *(AF_delta)* and the use of stale returns in the PERS account balance calculation (*DC_delta*). Each variable measures the change in retirement benefits (as a monthly return) from retiring now relative to waiting for the updated annual returns or annuity factors to take effect. *AF_delta* (Figure 3a) has a mean of 0.7% and a range from -4.3% to 21.1%. *DC_delta* (Figure 3b) has a mean of 1.9% and a range from -33.8% to 28.7%. The predicted signs on both variables are positive since a positive value of *DC_delta* or *AF_delta* implies that retirement benefits will fall if retirement is postponed by one month.

As *ex post* measures of individual i's health, we introduce one dummy variable that indicates whether individual i dies over the next 12 months and another that indicates whether she dies over the next 48 months. Since we possess information on member deaths through the end of 2007, we are able to define these dummy variables for every retirement-eligible employee in every year of our sample. To the extent that these future deaths are good proxies for relatively poor health today, the predicted signs on both coefficients are positive.

To control for the possibility that individual retirements are constrained by retirement eligibility rules, we introduce dummy variables to indicate whether individual i became eligible for early retirement benefits in month t, in months t-1 through t-11, or prior to month t-11, and to indicate whether individual i became eligible for normal retirement benefits in months t or in months t-1 through t-11. (The omitted category is being eligible for normal retirement for twelve or more months.) Finally, to control for the possibility that members are more likely to retire in their birth month, we introduce a dummy variable that indicates whether month t is individual i's birth month.

Column (3) adds a fixed effect for each date in our sample for school employees and a separate fixed effect for each date for non-school employees to the regression in column (2). We refer to these fixed effects as employer-date fixed effects. These two sets of fixed effects allow us to control for distinctions in seasonal retirements for school employees, commonly on a nine-month schedule, from those for other employees that are one a year-round schedule. Since the two sets of estimated coefficients are similar, we limit our discussion to the estimated coefficients in column (3). The coefficients on both measures of short-run retirement incentives are positive and statistically significant at the 1-percent level. However, the economic magnitudes are quite different. The estimated coefficient of 64.232 on AF_delta and standard deviation of 0.007 imply that a one-standard deviation increase in *AF_delta* increases the probability of retirement by 0.45 percentage points. The corresponding number for *DC_delta* is a much smaller 0.09 percentage points. Since a 1-percentage point increase in *AF_delta* and *DC_delta* has the same expected impact on Money Match retirement benefits, the reduced influence of *DC_delta* likely reflects the facts both that *DC_delta* is a noisier measure than *AF_delta* and that the incentives associated with *DC_delta* received less attention from regulators and the media.

Both *ex post* mortality measures are economically significant predictors of retirement. An individual who dies within the next 12 months is 0.820[17] percentage points more likely to retire today. Individuals are also much more likely to retire in a birth month (0.998 percentage points)

[17] Equal to the sum of .605 and .215, since the variable "dies within 48 months" includes the subset of those members that die within twelve months.

and in the first month that they are eligible for normal PERS retirement benefits (3.021 percentage points).

For robustness, in column (4) we restrict our sample to the subset of members who are active police and fire. The estimated coefficients on the variables of interest are qualitatively similar to those found in the earlier specifications. One interesting difference, however, is that police and fire are even more likely to retire in the first month in which they are eligible for normal PERS retirement benefits (10.243 percentage points versus an unconditional probability of 1.25 percent).

Overall, the findings in Table 2 are consistent with prior research. Individual retirements respond both to the level of current benefits, as well as a forward-looking measure comparing current and future benefits. They also respond to the short-term retirement incentives that arise periodically within the PERS retirement system. Where our findings differ from those on the collection of social security benefits are in the lower propensity of PERS members to retire before they are eligible for normal PERS retirement benefits.

4.3. The Retirement Model with Peer Effects

PERS members may have many peers, each important in a different context. In our tests, we define peers as those people who work for the same employer and are eligible for retirement in the same month.[18] In many cases, this gives relatively fine peer groups. For example, employers include individual school districts (e.g., Jackson County School District #1 and Jackson County School District #10), city employers (e.g., City of Madras and City of Klamath Falls), and fire districts (e.g., Rainier Fire Department and Keizer Fire Department). Many of

[18] If peer effects are driven by social norms (see Section 3), then various social peer groups might be important. This is the idea underlying the analysis in Hong, Kubik, and Stein (2004) which uses survey evidence on whether households interact with their neighbors or attend church to measure peer interaction. On the other hand, if peer effects are driven by word-of-mouth communications, or the information needed to make the decision is employer-related, then employer-based peers are arguably the most important peer group since it is precisely those peers who are informed about the details of PERS.

our employers are quite small and have only a few employees (e.g., the Oregon Hazelnut Commission) while a few are quite large and have thousands of employees (the largest is the Portland School District). In our empirical work, we exclude employers in months where the employer has fewer than two retirement-eligible employees because peer effects are not defined when the PERS member has no retirement-eligible coworkers.

In Table 3, we extend our empirical specification to test for peer effects. Our measure of peer retirements, *Frac_Retire*, is the fraction of a member's retirement-eligible coworkers (excluding herself) that retire from employer j in month t. Our test for peer effects, then, is whether the probability that individual i retires in month t is increasing in *Frac_Retire*. The decision to focus on retirements in month t (instead of, for example, year y), is driven both by the time-varying retirement incentives in the PERS system and our conjecture that peers are a potentially important source of information about these incentives.

In column (1), we add *Frac_Retire* to the specification in column (3) of Table 2. The estimated coefficient is 30.659, which is both statistically significant at the one-percent level and economically significant. Interpreted as a peer effect, a one-standard deviation increase in the fraction of peers retiring (3.36 percent) increases the probability of retirement by 1.03 percentage points, close to doubling the unconditional probability of retirement. Therefore, within our sample, there is a strong correlation between individual retirement decisions and average retirements within the same employer and month, even controlling for individual-level predictors of retirements, age fixed effects, date-by-employer type fixed effects. In fact, the estimated coefficients on the other variables—including individual i’s short-run retirement incentives based on stale returns and changing annuity factors—are almost identical to those estimated in Table 2, suggesting that *Frac_Retire* is essentially uncorrelated with our set of individual-level determinants.

4.3.A. Controls for Correlated and Exogenous Effects

A key question is whether the error term in column (1) is correlated with the peer effects variable due to correlated or exogenous effects. If so, the positive coefficient cannot be interpreted as a peer effect. The remaining specifications in Table 3 attempt to address this concern. In column (1), the fraction of peers retiring in month t is the only variable that varies at the employer-date level. To help rule out correlated or exogenous effects, we introduce three control variables that also vary at the employer-date level.

First, to control for time-series variation in the financial health or quality of the member's workplace (for example, whether the new boss is overbearing), we include turnover of non-retirement eligible employees within the same employer and month. Second, we control for the retirement behavior of PERS members who work for other employers located in the same county. We conjecture that these individuals might retire together because of common economic factors in their county, because they are responding to common information in the local media outlets, or because they and their families face the same local employment opportunities. Third, under the assumption that the former employees of employer *j* are a good control group for the current employees of employer *j*, we control for the fraction of former employees that retire in month t. The estimated coefficient on the turnover of non-retirement eligible employees is positive and statistically significant at conventional levels, however, the estimated coefficients on our peer retirement variable remains essentially unchanged (30.659 versus 30.596), building the evidence that the positive coefficient on *Frac_Retire* reflects peer effects.

4.4.B. Instrumental Variables

We now turn to instrumental variables to explore the robustness of the peer effects interpretation of the positive coefficient estimate on the fraction of current employees retiring. Here, our goal is to isolate variation in the fraction of peers retiring that is being driven by exogenous variation in coworker's retirement incentives—rather than variation due to selection, firm-specific shocks or other unobserved commonality in individual characteristics—and ask whether this variation helps to predict the retirement of member *i* in month *t*. We construct instruments based on the short-term retirement incentives that coworkers face based on stale returns and changing annuity factors, and use these two instruments to predict *Frac_Retire*. The first instrument is the average value of *DC_delta* for all retirement-eligible employees, excluding individual i, who are working at employer j in month t; the second instrument is similar, the average value of *AF_delta* for all retirement eligible employees at employer j, date t, except individual i. The larger these variables, the stronger the short-term retirement incentives faced by an individual's retirement-eligible coworkers. While these same incentives may be correlated with the incentives faced by individual i, we control for i's specific incentives directly in the regressions by including the specific values of these variables for individual i. The coefficients from this IV, reported in column (3), are quite similar to those reported in the earlier OLS specifications. Of particular interest, the coefficient on *Frac_Retire* increases to 40.244 and remains statistically significant at the 1-percent level despite a 5-fold increase in the standard error. The so-called b-day-IV presented in column (4) uses the fraction of co-workers with a birthday in the current month as an instrument to predict the fraction of co-workers retiring. The birth month variable has much to recommend it as an instrumental variable in the sense that birth month has predictive power for *Frac_Retire* and is unlikely to be correlated with unobserved determinants of retirement. Using birth-month as an instrument, the coefficient estimate on *Frac_Retire* falls to 26.929 but remains significant at the 1-percent level and similar in magnitude to the OLS results. Consistent with true peer effects, individual retirements respond to the variation in *Frac_Retire* driven by the various exogenous changes in the PERS retirement system and the propensity of individuals to retire in their birth month.

4.4.C. Robustness in the subsample of Police and Fire Employees

Another way to test whether the effect we observe reflects a peer effect is to ask whether it varies with the strength of relationships between coworkers (see, for example, Duflo and Saez (2002)). To answer this question within our sample, we present columns (5) and (6). In column (5) we add a police and fire interaction with the fraction of peers retiring. We find that there is no difference in the strength of the peer effect for police and fire. In column (6) we focus on the subset of employers that combine police officers and/or fire fighters with other types of workers. Our hypothesis is that, within these employers, police and fire workers are more likely to respond to the retirements of police and fire coworkers, while the other workers are more likely to respond to the retirements of non-police and non-fire coworkers. Indeed, in column (6) of Table 3, this is precisely what we find. *Frac_Retire_Same* is defined over the set of police and fire when individual *i* is police or fire and is defined over the non-police and fire employees when individual i is not a police and fire employee. *Frac_Retire_Diff* is defined correspondingly to capture the impact of different employee types. Our estimated coefficient on *Frac_Retire_Same* is 24.367, which is statistically significant at the 1-percent level, while the coefficient on *Frac_Retire_Diff*, is insignificantly different from zero suggesting little spillover between the two groups. We interpret this result to be consistent with information flows efficiently finding the correct peers.

4.5. Peer Effects and Optimal Retirements

Having found evidence consistent with peers influencing retirement dates, a natural question is whether peer effects are helpful or harmful from the perspective of maximizing an individual's retirement benefits. In this section, we take three (small) steps towards answering this question.

4.5.A. Gender, Income and Peer Effects

Motivated by emerging evidence that women and low income individuals' financial literacy and views concerning retirement can be quite different from higher income individuals,[19] we explore the sensitivity in our peer effect variable to gender and income level. Table 4 contains three specifications. In column (1) we find that there appear to be important differences in the sensitivity of women to the determinants of retirement that we study. In particular, we find a significant drop in the peer effect for women relative to men; the estimated interaction term is -6.782 which is statistically significant at the 1 percent level. We also find a substantially lower sensitivity to the future income stream among women as evidenced by the positive .006 estimate on our optimal retirement timing variable (OVOV) and much lower probability of retiring in the first month that women are eligible for retirement. Overall these results suggest that a difference may exist for men and women's retirement decisions. However, the evidence in columns (2) and (3) suggest that this effect may be due to income levels rather than gender.

Column (2) uses low income as the interaction term with the retirement factors. Low income is defined as individual i having income at or below the 25th percentile of all retirement-eligible employees in month t. The results of the low income interaction term are striking. The peer effect variable interaction for low income turns the peer effect from positive to negative for low income workers. In virtually every dimension, low income workers are dramatically less sensitive to the factors that explain higher income worker retirements. In column (3) we estimate the low income interaction among the subsample of female employees and find that the coefficient estimates for higher income females are much more like the results in column (1) after low income interactions are included in the regression. In summary, we interpret this

[19] See, for example, Levy and Seefeldt (2008) and Lusardi and Tufano (2008).

evidence to suggest that low income employees react differently to virtually all of the retirement factors and that income is likely the primary driver of these differences, not gender.

An important question remains in how best to interpret the peer effects in low income employees. Given that we observe lower sensitivity to retirement factors across the board in the low income group, we argue that relevant information, including peer retirements, is less likely to inform choices made by low income employees. Ongoing work will try to better identify whether or not these results have implications for the welfare of low income employees.

4.5.B. More Evidence on Individuals Sensitivity to the "Correct" Peers

In the same spirit as the results on police and fire employee behavior seen in Table 3, Table 5 exploits the fact that the short-run retirement incentives captured by *DC_delta* and *AF_delta* apply most directly to retirement benefits calculated under Money Match. To the extent that individuals primarily mimic peers whose retirement incentives are aligned with their own—a form of peer effect that should move individual's closer to their optimal retirement date—we expect measures of average retirement incentives within each employer and month to strongly predict Money Match retirements, weakly predict Formula + Annuity retirements (since Formula + Annuity benefits are a linear combination of the Money Match and Full Formula benefits), and not predict Full Formula retirements. To test these predictions, we replace *Frac_Retire* with *DC_delta_peers* and *AF_delta_peers*, the variables that average *DC_delta* and *AF_delta* across an individual's coworkers that we used in our IV specifications to predict *Frac_Retire*.[20] Then, we estimate a pooled specification (column (1)) and separate specifications

[20] When we use *DC_delta_peers* and *AF_delta_peers* to instrument for *Frac_Retire*, we are using the cross-employer variation in *Frac_Retire* that can be predicted by *DC_delta_peers* and *AF_delta_peers* to explain individual retirements. This is the appropriate specification when peer retirements are the signal that individuals observe when deciding whether to retire in the same month. When we enter *DC_delta_peers* and *AF_delta_peers* as right hand side variables, on the other hand, we are using the cross-employer variation in the strength of these retirement incentives to explain individual retirements. This is the appropriate specification if stronger retirement incentives generate more discussion of retirement incentives among peers.

for individuals retiring under Money Match, Formula + Annuity, and Full Formula (columns (2), (3), and (4), respectively). In columns, (5) and (6), we separate the Full Formula (i.e. DB) retirees into those choosing to retire with lump sum distributions, where the annuity factor will affect payouts, and those that retire under the normal retirement annuity, where the annuity factor will not affect payouts.

The findings in Table 5 are mixed. In columns (2) and (3), we find that *AF_delta_peers* has a positive and statistically significant impact on Money Match retirements, and a marginally significant effect on Formula + Annuity retirements as predicted since this factor affects these retirees. Where we expected to find *DC_delta_peers* to have an impact in columns (2) and (3) there is no statistically significant relation.[21] In column (4), however, *DC_delta_peers* appear to have a modest impact on Full Formula retirements (DB), even though the incentives captured by those variables have no direct impact on Full Formula benefits. Column (5) shows that this result emanates from the retirees who choose lump sum payouts. These results raise the possibility that at least some individuals are choosing retirement dates in response to incentives they do not actually face.

4.5.C. Variation in Replacement Rates and Peer Effects

The final way that we attempt to quantify the potential helpfulness or harmfulness of peer effects is to compare the dispersion in replacement rates across different employers. To the extent that stronger peer effects lead to less optimal retirements, we expect greater dispersion in the replacement rates of employees working at employers with more retirements. To compare dispersion in replacement rates, we begin by identifying, within each month, the set of employers that have two or more retirements. Next, we calculate the standard deviation in replacement rates within each of these employer-months. Finally, we subtract the average standard deviation

[21] We have recently discovered a data issue that may affect this result.

in replacement rates for those employers whose retirement rates are in the bottom quarter in a given month from the average standard deviation in replacement rates for those employers whose retirement rates are in the top quarter that same month. Figure 4 contains a plot of these differences through time. In 93 of the 144 months in our sample, the difference in the dispersion in replacement rates is positive. The average (median) difference is 0.88 (1.18) percentage points and statistically significantly different from zero at the 1-percent level. By way of comparison, the standard deviation of replacement rates averaged across all employers is close to 24 percent, suggesting that the changes in dispersion we observe are modest.

5. Conclusions and Directions for Future Work

Studying the retirement timing decisions of virtually all state employees in Oregon over 12 years, we find strong evidence that an employee's propensity to retire is positively correlated with his coworkers' decisions to retire. After subjecting this effect to a battery of controls and two different IV strategies, we cautiously conclude that coworkers influence individual retirement decisions. Prior peer effects research has emphasized the social multiplier effect. For example, if a firm can encourage one worker to participate in the 401(k) plan, there might be positive spillovers to other workers through word-of-mouth interactions (see, e.g., Duflo and Saez, 2002 and 2004). In the context of the retirement decision, however, it is unclear whether social multipliers are helpful or harmful. To the extent that peer effects reflect coworkers sharing factual information and then helping individuals correctly apply that information to their own circumstances, peer effects can be expected to benefit individuals via more informed retirement decisions. We view our final set of results as being roughly consistent with this possibility. If, on the other hand, individuals fail to recognize when their circumstances are different, mimicking peers may generate sub-optimal retirement decisions. At a macro level, when peers successfully exploit pension plan mis-pricings, their combined actions could negatively affect the plan's solvency, as was the case in PERS during our sample period. More generally, there could be real effects if lumpy retirements leave state and local governments unable to hire adequate replacement workers in a timely manner. In our opinion, the potential costs and benefits of peer effects in the retirement timing decision merit further analysis.

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Table 1: Oregon PERS Employee and Retiree Characteristics 1992-2003

For the employees that are eligible to retire (panel A) and those that do retire (panel B), we report the average monthly salary over the prior 12 months, replacement rate (defined as the monthly benefit if retiring today divided by the average monthly salary)current salary, years of service within PERS, age, percentage of members who are female, percentage of members who are police and fire fighters, percentage of members classified as Tier 2 (Tier 1 is the complement), and the percentage of members who allocate a positive fraction of their employee contributions into the variable account (the remainder invest 100% in the regular account).

Panel A: Characteristics of Employees Eligible to Retire

Year	Number	Final Salary	Replace. Rate	Years of Service	Age	Female	Police & Fire	Tier 2	Var > 0%
1992	17,238	$2,638	29%	15.4	58.9	53.1%	9.1%	0.0%	22.7%
1993	18,019	$2,743	31%	15.5	58.9	54.1%	9.1%	0.0%	25.8%
1994	18,285	$2,858	30%	15.6	58.8	54.4%	9.5%	0.0%	28.5%
1995	17,981	$2,840	36%	15.2	58.6	55.0%	9.5%	0.0%	30.2%
1996	19,561	$2,958	33%	15.5	58.6	55.3%	9.6%	2.8%	30.8%
1997	21,612	$3,079	38%	15.6	58.4	55.1%	11.1%	5.6%	34.0%
1998	23,213	$3,211	40%	15.5	58.2	55.3%	11.2%	8.9%	35.0%
1999	23,294	$3,304	39%	14.8	58.1	56.0%	11.7%	13.5%	35.1%
2000	23,542	$3,366	38%	14.5	58.1	56.6%	12.1%	17.7%	38.2%
2001	27,010	$3,515	37%	14.8	58.2	57.0%	11.5%	20.4%	39.4%
2002	30,179	$3,676	36%	15.0	58.2	57.6%	10.9%	22.9%	34.9%
2003	30,817	$3,762	34%	14.8	58.2	58.1%	10.5%	26.1%	25.6%

Panel B: Characteristics of Employees Choosing to Retire

Year	Number	Final Salary	Replace. Rate	Years of Service	Age	Female	Police & Fire	Tier 2	Var > 0%
1992	2,075	$3,261	39%	19.7	60.5	46.7%	9.7%	0.0%	24.2%
1993	2,332	$3,396	41%	19.7	60.4	48.9%	8.4%	0.0%	25.8%
1994	3,388	$3,552	42%	20.6	60.0	51.0%	9.5%	0.0%	29.8%
1995	1,795	$3,305	45%	18.8	60.3	53.3%	6.1%	0.0%	30.1%
1996	2,231	$3,580	45%	19.8	59.9	51.9%	8.1%	0.2%	31.6%
1997	2,677	$3,759	51%	20.3	59.7	53.3%	10.6%	0.5%	35.7%
1998	4,394	$3,898	58%	21.2	59.1	53.3%	8.4%	1.0%	34.7%
1999	4,265	$4,074	59%	20.8	58.6	53.6%	9.9%	1.6%	34.0%
2000	2,044	$4,115	56%	19.3	58.6	53.2%	10.8%	5.0%	39.6%
2001	2,853	$4,349	58%	20.7	58.7	55.0%	9.6%	4.6%	38.6%
2002	4,492	$4,614	61%	21.8	58.6	54.9%	9.5%	4.6%	30.1%
2003	6,342	$4,545	57%	21.3	58.4	56.7%	9.3%	4.8%	21.9%

Table 2: Linear Probability Model Predicting Individual Retirements, 1992-2003

Estimation is via OLS. Sample is restricted to those employers with two or more employees eligible to retire in year t. Employee ages range from 46 to 79. Standard errors that cluster on employer are reported in []. Coefficients are multiplied by 100, so that 100.0 represents 1 percentage point.

Dependent Variable:	*1 if employee i retires on date t, 0 otherwise*			
Sample:	**All members**	**All members**	**All members**	**PF only**
Estimation:	**OLS**	**OLS**	**OLS**	**OLS**
	(1)	**(2)**	**(3)**	**(4)**
Expected monthly retirement income if member retires scaled by lagged salary (t)	4.791 ***	4.370 ***	4.290 ***	3.311 ***
	[0.135]	[0.123]	[0.118]	[0.175]
PV expected additional retirement benefits if member retires at optimal date t*, scaled by lagged salary (t	-0.005 ***	-0.015 ***	-0.006 ***	-0.010 *
	[0.001]	[0.001]	[0.001]	[0.005]
Measure of short-run retirement incentives due to stale returns (t) **[DC_delta]**		4.775 ***	4.696 ***	3.022 **
		[0.494]	[0.478]	[1.194]
Measure of short-run retirement incentives due to changing annuity factors (t) **[AF_delta]**		100.323 ***	64.232 ***	69.911 ***
		[3.841]	[3.173]	[9.678]
PERS Tier Two?	0.116 ***	0.213 ***	0.090 **	0.266 ***
	[0.033]	[0.036]	[0.038]	[0.101]
Female?	0.041	0.049 *	0.004	0.039
	[0.026]	[0.026]	[0.025]	[0.045]
Police or Fire Fighter?	-0.131	-0.350 ***	-0.253 ***	
	[0.096]	[0.078]	[0.077]	
Retiring member would receive DB benefits? (t)	-0.333 ***	-0.476 ***	-0.399 ***	-0.378 ***
	[0.061]	[0.058]	[0.057]	[0.123]
Retiring member would receive DC benefits? (t)	-0.460 ***	-0.360 ***	-0.361 ***	-0.462 ***
	[0.069]	[0.052]	[0.054]	[0.122]
1st month eligible for early retirement? (t)		-0.370	-0.350	-2.175 **
		[0.286]	[0.280]	[0.868]
1st year eligible for early retirement? (t)		-1.447 ***	-1.462 ***	-2.716 ***
		[0.204]	[0.200]	[0.742]
Otherwise eligible for early retirement? (t)		-0.525 ***	-0.559 ***	-1.436 ***
		[0.082]	[0.080]	[0.243]
1st month eligible for normal retirement? (t)		3.070 ***	3.021 ***	10.243 ***
		[0.472]	[0.446]	[2.680]
1st year eligible for normal retirement? (t)		0.259 ***	0.250 ***	0.955 **
		[0.081]	[0.077]	[0.392]
Member birthday occurs this month? (t)		0.962 ***	0.998 ***	0.693 ***
		[0.100]	[0.097]	[0.208]
Member dies over the next twelve months? (t)		0.610 ***	0.605 ***	0.103
		[0.180]	[0.179]	[0.756]
Member dies over the next 48 months? (t)		0.210 ***	0.215 ***	0.511 **
		[0.060]	[0.058]	[0.248]
Separate fixed effect for each age (in years)?	Yes	Yes	Yes	Yes
Date-by-employer type FE?	---	---	Yes	Yes
N	2645422	2645422	2645422	286971
R-Squared	0.0134	0.0189	0.0594	0.0474

Table 3 – Linear Probability Model Testing for Peer Effects in the Choice of Retirement Dates, 1992-2003

Estimation in columns (1), (2), (5), and (6) is via OLS. Estimation in columns (3) and (4) is via IV. The instruments in column (3) are the average values of *DC_delta* and *AF_delta* for your coworkers in month t. The instrument in column (4) is the fraction of coworkers whose birthday occurs in month t. In columns (1) through (5), the sample is restricted to those employers with two or more employees eligible to retire in year t. In column (6), the sample is restricted to police and fire that work at an employer with two or more retirement-eligible police and fire and two or more retirement-eligible non-police and non-fire. Employee ages range from 45 to 79. Standard errors that cluster on employer are reported in [ ].

Dependent Variable: ***1 if employee i retires on date t, 0 otherwise***

Sample:	All members	All members	All members	All members	All members	PF only
Estimation:	OLS	OLS	Benefit IV	B-day IV	OLS	OLS
	(1)	(2)	(3)	(4)	(5)	(6)
Fraction of current employees retiring (t)	30.659 ***	30.596 ***	40.244 ***	26.929 ***	30.664 ***	
[Frac_Retire]	[2.14]	[2.142]	[10.810]	[7.963]	[2.233]	
Frac_retire * Job Police Fire Dummy					-0.750	
					[6.773]	
Fraction of eligible employees with same PF status						24.367 ***
as the member retiring (t) **[Frac_Retire_Same]**						[4.415]
Fraction of eligible employees with different PF status						3.492
than the member retiring (t) **[Frac_Retire_Diff]**						[2.694]
Fraction of eligible employees at other employers		-0.062	-0.027	-0.076	-0.051	4.565
within same county retiring (t)		[2.749]	[2.356]	[2.900]	[2.739]	[6.445]
Fraction of non-retirement eligible employees		1.506 ***	1.331 ***	1.572 ***	1.504 ***	-1.678 **
who leave employer (t)		[0.510]	[0.485]	[0.553]	[0.510]	[0.743]
Fraction of former employees retiring (t)		0.349	0.313	0.363	0.348	-0.130
		[0.277]	[0.239]	[0.293]	[0.278]	[1.141]
Expected monthly retirement income if member retires	4.233 ***	4.235 ***	4.217 ***	4.242 ***	4.235 ***	3.109 ***
scaled by lagged salary (t)	[0.116]	[0.116]	[0.118]	[0.118]	[0.116]	[0.196]
PV expected additional retirement benefits if member	-0.006 ***	-0.006 ***	-0.006 ***	-0.006 ***	-0.006 ***	-0.011 **
retires at optimal date t*, scaled by lagged salary (t)	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.005]
Measure of short-run retirement incentives	4.673 ***	4.676 ***	4.668 ***	4.679 ***	4.676 ***	2.880 **
due to stale returns (t) **[DC_delta]**	[0.464]	[0.464]	[0.459]	[0.465]	[0.464]	[1.150]
Measure of short-run retirement incentives	63.366 ***	63.353 ***	63.082 ***	63.456 ***	63.329 ***	68.339 ***
due to changing annuity factors (t) **[AF_delta]**	[3.081]	[3.080]	[3.083]	[3.115]	[3.046]	[9.771]
Individual controls from Table 3?	Yes	Yes	Yes	Yes	Yes	Yes
Separate fixed effect for each age (in years)?	Yes	Yes	Yes	Yes	Yes	Yes
Date-by-employer type FE?	Yes	Yes	Yes	Yes	Yes	Yes
N	2,645,422	2,645,422	2,645,406	2,645,406	2,645,422	273,479
R-Squared	0.0627	0.0627	0.0624	0.0626	0.0627	0.0533

Table 4. Testing for Peer Effects among Women and Lower Income Employees, 1992-2003
Estimation is via OLS. Sample is restricted to those employers with two or more employees eligible to retire in year t. Specification extends specification (1) in Table 3 by adding 6 interaction terms. Column (1) interacts variables with dummy variable indicating member is female; columns (2) and (3) interact variables with dummy variable indicating members lagged annual income is in the bottom 25 percent within that year-month. Employee ages range from 46 to 79. Standard errors that cluster on employer are reported in []. Coefficients are multiplied by 100, so that 1.000 represents 1 percentage point. Column (3) includes only female members in the sample.

Dependent Variable:			
Sample:	**All members**	**All members**	**Female only**
Estimation:	**OLS**	**OLS**	**OLS**
Interaction	**Female**	**Low Income**	**Low Income**
	(1)	**(2)**	**(3)**
Fraction of current employees retiring (t)	34.392 ***	44.924 ***	46.732 ***
[Frac_Retire]	[2.206]	[2.425]	[2.849]
[Frac_Retire] x Interaction	-6.782 ***	-52.512 ***	-48.317 ***
	[1.796]	[2.155]	[2.248]
Expected monthly retirement income if member retire:	4.238 ***	4.282 ***	4.426 ***
scaled by lagged salary (t) **[Replacement]**	[0.151]	[0.125]	[0.138]
[Replacement] x Interaction	-0.033	-1.245 ***	-1.477 ***
	[0.145]	[0.159]	[0.162]
PV expected additional retirement benefits if member	-0.011 ***	-0.009 ***	-0.007 **
retires at optimal date t*, scaled by lagged salary (t)	[0.002]	[0.003]	[0.003]
[OVOV] x Interaction	0.006 ***	0.007 ***	0.003
	[0.002]	[0.002]	[0.003]
1st month eligible for normal retirement? (t)	0.232 ***	0.263 ***	0.087
	[0.072]	[0.076]	[0.072]
[1st month] x Interaction	-1.724 **	-2.907 ***	-1.728 ***
	[0.814]	[0.535]	[0.403]
Measure of short-run retirement incentives	5.063 ***	4.299 ***	4.206 ***
due to stale returns (t) **[DC_delta]**	[0.554]	[0.447]	[0.580]
[DC_delta] x Interaction	-0.908	-0.381	-0.217
	[0.579]	[0.637]	[0.728]
Measure of short-run retirement incentives	56.076 ***	74.006 ***	80.914 ***
due to changing annuity factors (t) **[AF_delta]**	[3.934]	[3.340]	[4.353]
[AF_delta] x Interaction	13.152 ***	-29.784 ***	-18.939 ***
	[4.226]	[5.704]	[7.145]
Separate fixed effect for each age (in years)?	Yes	Yes	Yes
Date-by-employer type FE?	---	Yes	Yes
N	2,645,422	2,645,422	1,482,818
R-Squared	0.0628	0.0676	0.0705

Table 5. Peer effects in retires under different retirement plan design, 1992-2003

In this table we use the variables *DC_delta_peers* and *AF_delta_peers* which represent the average values of the *DC_delta* and *AF_delta* variables for people at individual i's employer. The sample is then restricted in the columns to employees with retirement benefits that put them in each of the categories DC, FPAM (formula plus annuity method), or DB. Estimation is via OLS in all columns. Sample is restricted to those employers with two or more employees eligible to retire in year t. Employee ages range from 45 to 79. Standard errors that cluster on employer are reported in [].

Dependent Variable:	***1 if employee i retires on date t, 0 otherwise***					
Estimation:	**OLS**	**OLS**	**OLS**	**OLS**	**OLS**	**OLS**
Retirement Benefit Calculation(s):	**ALL**	**DC**	**FPAM**	**DB**	**DB (lump sum)**	**DB (annuity)**
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
DC_delta averaged across coworkers	-0.0126	0.0094	-0.0254	-0.0523 **	-0.0486 *	-0.0037
[DC_delta_peers]	[0.019]	[0.025]	[0.047]	[0.025]	[0.025]	[0.010]
AF_delta averaged across coworkers	0.3383 **	0.5487 **	0.7587 *	0.0691	0.0819	-0.0129
[AF_delta_peers]	[0.134]	[0.218]	[0.410]	[0.130]	[0.118]	[0.050]
Measure of short-run retirement incentives	0.0476 ***	0.0905 ***	0.0812			
due to stale returns (t) **[DC_delta]**	[0.005]	[0.008]	[0.053]			
Measure of short-run retirement incentives	0.6332 ***	0.2699 ***	-0.1264			
due to changing annuity factors (t) **[AF_delta]**	[0.031]	[0.047]	[0.122]			
Expected monthly retirement income if member	0.0429 ***	0.0410 ***	0.0582 ***	0.0524 ***	0.0504 ***	0.0020 ***
retires scaled by lagged salary (t)	[0.001]	[0.001]	[0.004]	[0.005]	[0.005]	[0.001]
PV expected additional retirement benefits if member	-0.0001 ***	-0.0001 ***	-0.0003 **	0.0000	0.0000	0.0000
retires at optimal date t*, scaled by lagged salary (t)	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Separate fixed effect for each age (in years)?	Yes	Yes	Yes	Yes	Yes	Yes
Date-by-employer type FE?	Yes	Yes	Yes	Yes	Yes	Yes
N	2,645,406	1,614,182	305,001	726,223	726,223	726,223
R-Squared	0.0594	0.0702	0.083	0.0169	0.0157	0.0028

Figure 1: Percentage of Retirement-Eligible Employees Retiring by Month, 1992-2003

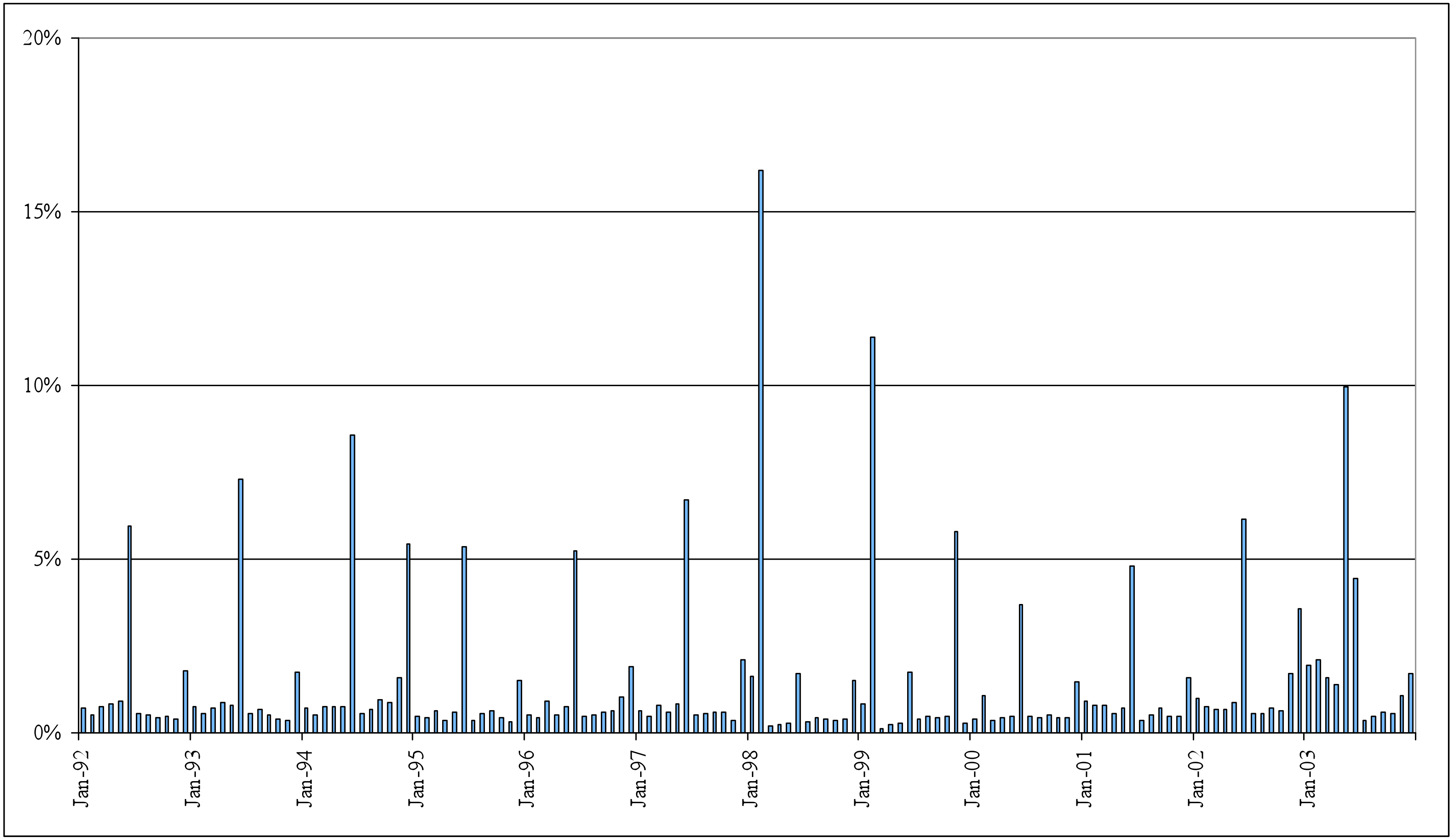

Figure 2: History of Retirement Plan Changes and Impact on Incentives to Retire

Jan-92, Jul-92, Jan-93, Jul-93, Jan-94, Jul-94, Jan-95, Jul-95, Jan-96, Jul-96, Jan-97, Jul-97, Jan-98, Jul-98, Jan-99, Jul-99, Jan-00, Jul-00, Jan-01, Jul-01, Jan-02, Jul-02, Jan-03, Jul-03, Dec-03

Exogenous Variation in Annuity Factors	Implications for Annuitized DC Benefits	Implications for Annuitized DB Benefits
From the beginning of our sample period through 12-31-96, annuity factor updated once per year, in same month as member's birthday	Incentive to retire decreases in months immediately prior to member's birthday	None
On 01-01-97, new AFs adopted; AFs in same month as member's birthday increased modestly for those aged 40 to 54; AF now updated monthly	Incentive for younger members to postpone retirement until after 01-01-97 Eliminates incentive to try to retire in same month as member's birthday	None
Effective 07-01-03, significantly lower AFs adopted	Strong incentive to retire prior to 07-01-2003	None

Exogenous Variation in DC Account Balance	Implications for Annuitized DC Benefits	Implications for Annuitized DB Benefits
From the beginning of our sample period through 12-31-1999, regular and variable account balances were calculated using **"last known rate" (LKR)**	When LKR exceeds expected return based on most recent financial return data, incentive to retire When LKR falls below expected return based on most recent financial return data, incentive not to retire	None
Effective 01-01-00, calculate regular and variable account balances using actual YTD returns	Eliminates retirement incentives based on stale returns	None

Figure 3a: Annuity Factor -- Average Impact 1992-2003

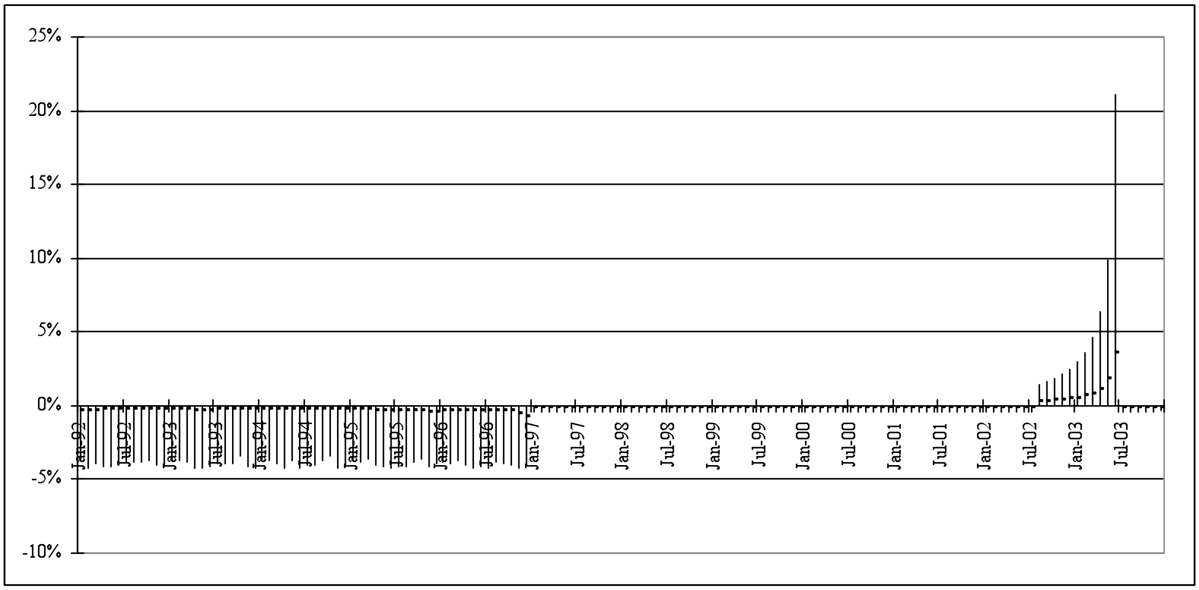

Figure 3b: Stale Returns -- Average Impact 1992-2003

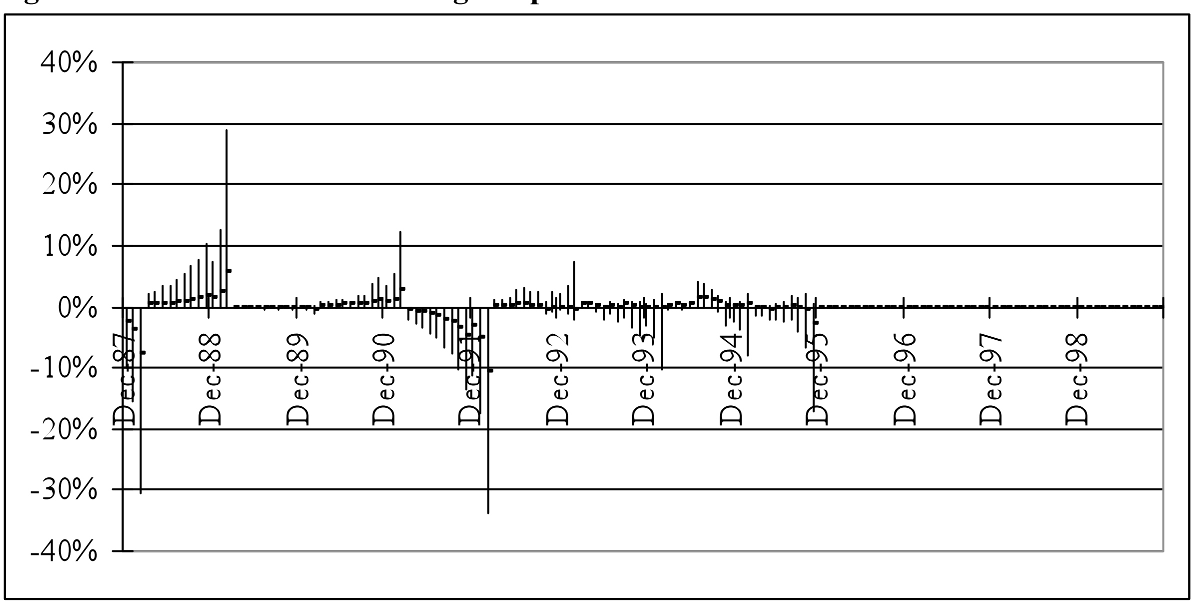

Figure 4: Difference in Standard Deviations of Replacement Rates for Employers with High vs. Low Retirements, 1992-2003