

# Faculty Retirement and Mortality: The University of California Voluntary Early Retirement Incentive Programs

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## Abstract

This study examines take-up and long-run mortality effects of the Voluntary Early Retirement Incentive Programs (VERIPs) conducted by the University of California (UC) in the early 1990s. VERIPs induced the retirement of over 20% of tenured and tenure-track faculty at UC. Focusing on the retirement and mortality experiences of tenured faculty over the age of 45 at the time of the first VERIP offer, I find a significant association between receipt of a VERIP offer and subsequent mortality. Each additional year of retirement exposure induced by VERIPs increases cumulative mortality by 1.0%. These effects may reflect the many health-promoting characteristics of the position: the work is cognitively and socially stimulating, requires minimal physical exertion or hazard, and employment protections are nearly inviolate.

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# 1 Introduction

The consequences of retirement for health and mortality are of increasing importance and research interest. As public pensions fall short of funds, raising retirement ages offers one avenue of adjustment. While several recent studies find a protective effect of retirement (see Westerlund et al. (2009), Coe et al. (2012)), the most provocative findings in this area relate to the possibility of negative effects of early retirement, or conversely, positive effects of continued work. Kuhn et al. (2010) examines an early-retirement window in Austria and finds that blue collar workers who take early retirement experience higher mortality as a consequence. Among studies that consider health outcomes, a growing number find evidence of a negative impact of retirement, especially for cognitive health (see Moon et al. (2012) for cardiovascular disease, Rohwedder and Willis (2010), Bonsang et al. (2012) for cognition).

This paper tests for the possibility of the beneficial mortality effects of employment by focusing on the retirement behavior and mortality of tenured university faculty. If health benefits of employment exist, this job is uniquely well-suited to offer them, as it possesses many health-promoting characteristics identified by previous research. Specifically, employment as tenured university faculty entails minimal physical requirements, frequent social interactions, the cognitive stimulation inherent in the work, and strong employment protections. These strong employment protections allow tenured faculty to make work and retirement decisions according to their own benefits, without the threat of age discrimination, layoff or at-will firing. Additionally, the population of tenured faculty is relatively homogenous in their education, access to health care, and previous exposures to health hazards, reducing the role of these (often unobserved) factors in the statistical model.

Tenured faculty at research universities have long been recognized as a special class of worker by retirement policy and researchers. Although mandatory retirement ended in 1984 for all other workers in the United States, universities successfully lobbied for a 10-year delay in the end of mandatory retirement, to January 1, 1994, based on hypothesized declining productivity among older faculty members and the difficulty in dismissing workers with lifetime contracts. Ashenfelter and Card (2002) summarize the effects of the end of mandatory retirement on faculty, finding a discontinuous increase in retirement age after the reform. In the case of the University of California, faculty in this era faced uniquely powerful incentives to give up claims to their lifetime employment contracts. In the early 1990s, UC induced retirement of over 20% of its tenured and tenure-track faculty through a series of generous pension offers, the Voluntary Early Retirement Incentive Programs (VERIPs). Most of the faculty who took VERIPs ended their tenure earlier than would otherwise have

been expected, creating a large pool of early retirees with significant variation in age and pension income. Scholars, for example, Pencavel (2004), have called VERIPs the single largest series of retirement incentives ever offered to faculty, and as such, it represents a promising setting in which to study quasi-experimental variation in retirement behavior and pension wealth, among a population of workers of particular interest for retirement policy.

The evidence presented in this paper lends support to the hypothesis that continued employment can have life-extending benefits, or conversely, that early retirement can have deleterious effects. Among all tenured faculty over age 45 at the time of the first VERIP retirement in 1991, faculty offered VERIPs retired earlier, with the largest shift in cumulative retirement between the ages of 63 and 80. Those offered VERIP exhibit higher mortality rates, beginning around age 68 and extending for the next 10 years, at which point the sample of ineligible faculty deaths becomes too small to estimate the counterfactual. The empirical model estimates that an additional year of retirement contributes 1.0% to the cumulative mortality hazard. Eligibility depended on the sum of the faculty member's age and service credit, so flexible controls for age imply the estimates depend on the comparison of faculty of similar ages but different service credit accrual. Results are robust to dropping those faculty with over 25 years of service credit years of credit (the top 50% of those who received a VERIPs offer) and faculty with fewer than 5 years of service credit. Those with less than 5 years of service represent the bottom 20% of those not receiving a VERIP offer; sample restrictions in the ineligible group quickly reduce the power of the model, as retirement and mortality patterns are unrealized for a greater fraction of these individuals.

These results reflect the early returns from the VERIPs-induced quasi-experiment. Retirement outcomes are just now being finalized, while mortality outcomes have only begun to be realized. In addition to the mortality effects, I also discuss program take-up, particularly the discontinuity in program incentives at age 59 and 60. This portion of the paper extends the previous analysis of VERIPs retirement patterns in Pencavel (2001) to document the eventual retirement outcomes of those not taking VERIPs and those cohorts just too young to be eligible. An appendix expands this discussion in relation to Pencavel (2001).

The paper is organized as follows. Section 2 provides background on the VERIPs offers, data and empirical strategy. Section 3 documents take-up patterns. Section 4 documents the primary results on the long-run retirement and mortality outcomes of UC faculty. Section 5 concludes.

## 2 Empirical Strategy and Data

### 2.1 Background on UC VERIPs

The University of California runs its own defined benefit pension system. The VERIPs program, conceived amid a budget crisis in the early 1990s, enabled the university to use resources from the well-funded pension system to reduce its payroll obligations. The three rounds of VERIPs, with retirements in 1991, 1993 and 1994, coincided with the end of mandatory retirement in 1994, and worked to reduce the initial effects of the uncapped retirement age at UC. VERIPs induced a large shift in the retirement behavior of faculty at UC, and remains a well-known program 20 years after its conclusion. Most of the information on the program is taken from Switkes (2001) and Pencavel (2001).

Within each of the three rounds, VERIP eligibility and incentives followed the same publicly-announced formulas based on the age and years of service at UC for all faculty, except in the last round; concerned about high take-up at the Berkeley flagship campus, the third VERIP tightened eligibility requirements and was reduced in value for Berkeley faculty. The sum of age and years of UC service determined VERIP eligibility, with cutoffs at 80 in the first VERIP, 78 in the second, and 73 (75 for Berkeley) in the third. Faculty needed to be age 50 at the time of retirement. As well, faculty were required to have at least 5 years of service credit if under the age of 62 or 1 year if over age 62; empirically, this constraint does not appear to bind for any otherwise eligible faculty. Faculty who would have been forced to retire through mandatory retirement were permitted to retire through VERIPs.

The VERIPs incentives built on the usual pension formula, and consequently, the VERIPs incentives interacted with the underlying structure of the pension plan. The usual pension formula multiplies an age adjustment, years of service at UC and a highest average salary over a 3-year period (known as Highest Annual Plan Compensation, or HAPC):

$$p_{it} = \bar{y}_{it} f(a_{it}) m_{it}. \quad (1)$$

In this equation,  $p_{it}$  represents the annual pension of individual  $i$  retiring in year  $t$ ,  $\bar{y}_{it}$  is the HAPC,  $a_{it}$  is the age of  $i$  in year  $t$  and  $m_{it}$  is the years of service at UC. The age factor  $f(a)$  rises from 1.09 to 2.41, as follows:  $f(50) = 1.09$ ,  $f(51) = 1.16\%$ ,  $f(52) = 1.22\%$ ,  $f(53) = 1.30\%$ ,  $f(54) = 1.38\%$ ,  $f(55) = 1.50\%$ ,  $f(56) = 1.60\%$ ,  $f(57) = 1.70\%$ ,  $f(58) = 1.80\%$ ,  $f(59) = 1.90\%$ , and  $f(60+) = 2.41\%$ . The VERIPs incentives took the form of an additional 5 years of service credit in the pension formula for all three VERIPs, plus an additional 3 years of

age adjustment (2 years for Berkeley) for the third VERIP. Unused years of age adjustment (i.e. for those reaching age 60 with the age adjustment) could be taken as additional years of service credit. HAPC was increased by 7%, a proportional increase in the pension payment.<sup>1</sup>. Along with an increase in future pension income, retirees received a lump-sum payment of 3 months of income. Broadly, this created three regions of VERIPs incentives: those in the mandatory retirement age group, those who had achieved the maximum age factor at age 60, and those too young for the maximum age factor. For those in the mandatory retirement age group, VERIPs represented a near free lunch. The discontinuous increase in the age adjustment at age 60 was strongly associated with retirement before and during VERIP; as discussed below, VERIP take-up was very low for those below age 60 in the pension formula (i.e. after the age adjustment in the third VERIP).

To illustrate, consider how the VERIPs incentives changed the annual pension offered to a professor who is age 55 with 24 years of service credit at the time of the first VERIPs, appointed at the Los Angeles campus. She will be ineligible for the first VERIP in 1991, as  $55+23=78$  is less than 80. At the time of the second VERIP in 1993, she will be eligible, as her age and service credit now sum to  $57+25=82$ , greater than 78. The second VERIP will offer her a 5 year increase in service credit, increasing her pension offer by  $1.07 \times 1.2 = 1.28$ , or 28%; the 1.07 reflects the 7% increase in pension in all rounds and the 1.2 comes from the 20% increase in service credit. Should she decline this VERIP, she will be eligible for a much more generous VERIP in the third round. She is age 58 in 1994, so the third VERIP will allow her to retire with the age 60 pension factor of 2.41% (a large increase from 1.8% at age 58). She only requires 2 of the 3 years of age adjustment, so her service credit is increased by 6 years, from 26 to 32. The net effect is  $1.07 \times 1.23 \times \frac{2.41-1.8}{1.8} = 1.07 \times 1.23 \times 1.34 = 1.76$ , a 76% increase in the pension that would otherwise have been available in 1994. Of course, she would also receive the lump-sum payment of three months salary, should she retire through either of the last two VERIPs.

Accepting a VERIP offer required faculty to give up their lifetime employment contract, separate from UC for at least a month, reduce their workload at UC to below 50% for at least 5 years, and (as a result of their separation and work restrictions) froze their pension accrual. With no incentive to delay, those who took VERIP also began claiming their pension. VERIP-takers could enroll in the UC annuitant health plan. There was no restriction on other work, and indeed, some share of faculty “retired” through VERIPs and took up tenured positions at other schools; Switkes (2001) says this share was probably small. Re-

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<sup>1</sup>So, for the  $k^{th}$  VERIPs offer  $v_k$  at campus  $c$ ,  $p_{it}(v_k(\lambda_k, \Delta a_{kc}, \Delta m_{kc})) = \lambda_k \bar{y}_{it} f(a_{it} + \Delta a_{kc})(m_{it} + \Delta m_{kc})$ .

tirees could be “recalled” to UC (i.e. rehired) as soon as the academic year after taking VERIP. Limits were set on pay for courses taught while on recall. Departments were technically forbidden from promising to recall VERIP-takers, though it can be assumed that faculty had relatively clear expectations regarding the likelihood of this outcome. In fact, most faculty retained some attachment to UC, and a substantial share are listed as Emeriti on UC department webpages today. Thus, the main effect of VERIP was to reduce the obligations of and rights to employment at UC, as well as to remove both salary and pension incentives to pursue advancement. Beyond freezing age and service credit accrual, VERIPs also removed incentives for promotion and salary increases that would also have increased the value of the pension.

Although VERIPs induced a large change in behavior, like many real-world policies, they were not implemented with program evaluation in mind. The three separate offers that were made to faculty from 1991-1994 were each of increasing generosity. As a result, faculty in their late 50’s who waited for the third VERIP were offered incentives 30% greater than similarly-aged faculty in the first VERIP. Pencavel (2001) compares the fit of probit models of take-up for the various VERIPs, and finds substantially different take-up patterns between them. This is not surprising, considering the populations in the second and third VERIPs were harvested of those most likely to retire. By all accounts, the first VERIP program was unexpected, however, each offer was announced as a “final offer.”<sup>2</sup> Faculty may have (correctly) held expectations of further rounds of VERIPs, particularly during the second round. It is not clear if the programs had important effects on the perception of the financial security of the pension system.

## 2.2 Data

The primary data is drawn from the administrative payroll and pension records of the University of California, as well as several files created at the time of VERIPs.<sup>3</sup> Individuals’ UC employee identification numbers allow linkages across the files. Additionally, population mortality is taken from the Human Mortality Database.

The UC administrative records cover the universe of faculty members active from 1989 to 2012. The payroll records are person-year-appointment level files with annual (October 1)

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<sup>2</sup>The UC Berkeley payroll records show no dip in separation hazard in the year before the first VERIP.

<sup>3</sup>This data was provided by the University of California as a part of the project, “Aging, Work and Retirement among Late-Career Faculty at the University of California,” funded by the Alfred P. Sloan Foundation; Principal Investigators: Sheldon Zedeck, David Card, Marc Goulden, Angelica Stacy and Karie Frasch.

snapshots of the faculty from 1989-2011. Similar files are available for the Berkeley campus back to 1979. The payroll records contain information on pay rate, appointment percent, and appointment details (campus, department, hire date, job codes and titles). Also included are information on gender, birth date, and race/ethnicity. The pension records complement the payroll records. The pension records also contain appointment details and demographics, as well as final salary, marital status, date of retirement, disability and death, re-instatement information and last home address. An internet search on the current employment and mortality of a subset of faculty was conducted; results closely matched the mortality status in the pension records, suggesting the pension records have good coverage of retirement and mortality outcomes. The pension records do not allow us to recover UC-wide retirement patterns that preceded the VERIPs era, as the data contains only those individuals on payroll in 1989 or later.

Information on the VERIPs largely comes from files documenting accepted VERIP offers created around the time of the programs. The VERIPs files contain demographics and appointment details, some information on health plan enrollment, and date of retirement. VERIPs eligibility and year-by-year service credit accrual is not contained in the administrative records or VERIPs files, and must be inferred from age, hire date and completed service credit for those who have retired. In those cases where the faculty member has retired (including VERIP takers), their service credit was imputed as the final service credit less the years since the VERIP offer. In those cases where faculty had not retired, the years since original hire date was used as service credit. The results are unchanged when using original hire date to impute all service credit for all faculty.

### **2.3 Sample Selection and Empirical Model**

The chief empirical challenge in the study of the mortality effects of retirement arises from the joint determination of retirement age and mortality. In particular, those in worse health will have both higher mortality risks and can be expected to retire earlier. If health is a primary motivation for retirement, we expect a negative association between retirement age and mortality—a positive association between retirement duration and subsequent cumulative mortality—to prevail in a sufficiently large sample. Other unobserved predictors of mortality may also influence retirement age, such as wealth, time preference and family situation. VERIPs provides a solution to the problem of the joint determination of mortality and retirement age by introducing variation in retirement age unrelated to mortality. The comparison will then rest on variation in exposure to the VERIPs, so the challenge becomes

addressing the differences between those offered and not offered VERIPs.

Since VERIP eligibility is determined by the sum of age and service credit, the natural comparison is those with just enough age and service credit to receive an offer with those who had smaller sums that left them just ineligible. In light of the sample size and details of the quasi-experiment, I use a pooled instrumental variables (IV) analysis, effectively averaging the outcomes of those tenured faculty offered and not offered VERIPs within the age ranges eligible for the program. VERIPs did not produce the sample size and clean empirical design needed to use regression discontinuity. Partly, this reflects the still-early stages of retirement and mortality among faculty who did not receive a VERIP offer; although, it is not clear that the completion of the retirement and mortality processes will produce a large enough sample at a discontinuity. Particularly problematic is the interaction between the pension incentive and eligibility, as it is not the eligibility threshold alone that mattered in take-up, but also the age adjustment in the pension formula. The analysis of take-up in Section 3 and the Appendix provides details on responses to program incentives.

To make clear how age and service credit interact with program eligibility rules, I plot take-up by age and years of service at UC. The inclusion of younger faculty with each additional VERIP is clear in Figure 1. The figure displays the share of faculty in each age cohort (age in 1991 at time of first offer) who received a VERIP offer. The variation within age occurs due to variation in years of service at UC. The three waves reflect the successive inclusion of younger faculty, as both the eligibility threshold falls and faculty grow older. In the primary analysis, I restrict the sample to tenured faculty between the ages of 46 and 66 at the time of the first VERIP offer in 1991. This excludes the cohorts who were too young to receive a VERIP offer, as well as those old enough to be subject to mandatory retirement.

A sharper discontinuity appears in Figure 2, which displays eligibility by years of service credit. Those with fewer than 18 years of service credit at the time of the first VERIP had only a small chance of receiving a VERIP offer, while virtually all of those above 21 years of credit did receive an offer. Some support appears in the service credit distribution down in the lower levels, reflecting faculty who came to UC later in their lives.

The upper panel of Table 1 describes the eligible and ineligible study population that results from restricting the sample to faculty between the ages of 46 and 66 at the time of the first VERIP retirement in 1991. This is the primary sample used in the analysis. Figure 3 and Figure 4 show the sample sizes by age and years of service at UC, divided into those who ever receive or never receive a VERIP offer. Clearly, those who do not receive offers are younger and have less accumulated service at UC, as these variables determine



eligibility. Common support for the age distributions is reasonable through the mid-50s, above which there are few faculty who are not offered VERIPs. The service distribution has common support over a shorter range, perhaps only from 15 to 20 years of service, reflecting the sharper discontinuity in VERIPs offers. The empirical model will primarily make comparisons of those with different levels of service credit, as the independent effects of age, cohort and selection on age in the initial sample require flexible controls for age and year.

The regression analysis focuses on the effect of retirement duration, predicted by the years since the exogenous arrival of the first receipt of a VERIP offer. Thus, the analysis relies on the comparison of tenured faculty active at UC in 1990 who did and did not receive VERIP offers, with some additional variation provided by the successive inclusion of additional faculty with the roll-out of the three VERIPs. I do not incorporate the pension incentives directly in the current analysis. To do so would require a model of the sample selection process between the rounds of VERIP, including an (assumed) process for (unobserved) expectations regarding future rounds of VERIP; this is left for future work. Retirement is defined as transitioning pension status in the UC pension system, and is an absorbing state in the model.

Formally, I would like to estimate  $M_{is}(RetireLength_{is}) = f(RetireLength_{is}, X_{is}, \mu_i(s), \epsilon_{is})$ , where  $M_{is}$  the mortality hazard of individual  $i$  at age  $s$  as a function of  $RetireLength_{is}$ , length of time since retirement from UC by age  $s$ ,  $X_{is}$ , a vector of observable individual characteristics,  $\mu_i(s)$ , unobservable (to the econometrician) individual mortality risk, and  $\epsilon_{is}$ . The endogeneity problem arises from the correlation between  $\mu_i(s)$  and  $RetireLength_{is}$ , as we have strong evidence that health influences the probability of retirement. To solve this problem, I use VERIP offers to instrument for retirement. The bivariate linear probability model for individual  $i$  observed in periods  $t = 1, 2, \dots, t_{max}$  is:

$$Death_{it} = \beta_0^t + \beta_1 RetireLength_{it} + \sum_j \beta_j^t x_{jit} + \epsilon_{it} \quad (2)$$

$$RetireLength_{it} = \alpha_0^t + \alpha_1 YearsSinceVERIP_{it} + \sum_j \alpha_j^t x_{jit} + \eta_{it}, \quad (3)$$

where  $Death_{it}$  is an indicator for the event occurring by time  $t$ , while  $RetireLength_{it}$  contains time since retirement and  $YearsSinceVERIP_{it}$  time receipt of the first VERIP offer to  $i$ ,  $x_{jit}$  is the  $j^{th}$  observable, time-varying covariate, e.g. polynomial functions of age and gender, as

well as other information in  $X_i$ . In the application, cubics in age and quadratics in age by gender are interacted with year effects; higher-order terms were statistically insignificant and dropped. Superscript coefficients  $t$  are allowed to vary by time. As described, this system can be stacked on  $t$  and estimated by Two-Stage Least Squares, with errors clustered by individual. The coefficient of interest is  $\beta_1$ , the average effect of retirement on mortality in the sample.

### 3 Results on VERIPs Take-up

Before preceding to the analysis of long-run retirement and mortality patterns, this section presents evidence on take-up and the response to program incentives. This analysis reinterprets the evidence reported in Pencavel (2001) on differing take-up patterns across the 3 VERIPs, with some details unrelated to the main hypothesis of this paper contained in the Appendix. Take-up appears to have been quite high for faculty above the age of 60 at the time of the first VERIP retirement in 1991, and very low for those faculty below the age of 53 in 1991, with no strong pattern by years of service at UC for those with less than 25 years of service credit.

The broad patterns in age and years of service at UC among those taking and declining VERIPs offers are reported in the lower panel of Table 1. Not surprisingly, those who took VERIP were older and had more service credit than those who did not. The age gap between takers and non-takers is around 1 standard deviation in the age distribution in all 3 rounds, though the 10th and 90th percentiles reveal significant overlap in the tails of the distribution. The 10th percentile of the take-up age is around 60 in each of the first 2 rounds, and then falls to 57 in the third round. The response on the service credit dimension appears much less predictable than the response on the age dimension. There is also much less overlap in the service credit distributions, as suggested by the sharper discontinuity in service credit in Figure 2. The remainder of the section describes the distribution of take-up by age and service credit in greater detail.

The probability of take-up by age shows several signs of responses to the economic incentives within VERIPs, as well as a role for age effects. Figure 5 displays the probability of retiring through any of the three VERIPs by age at the time of the first VERIP offer in 1991. The two vertical lines highlight two discontinuities in retirement incentives. The dashed line shows faculty over the age of 53, who were eligible for the maximum age adjustment in the pension formula; below this age, take-up was quite low. Take-up rises from 16% to 37% at

this discontinuity, constituting solid evidence of response to the financial incentives. This response is too small to be useful in a regression discontinuity design, given the sample size, but the pattern is robust and replicated in each VERIP (see the Appendix). Retirement continues to rise to 53% over the next 4 older cohorts, an age range over which the maximum financial incentives increase modestly. Ages 58 and above face similar VERIPs offers in the final, most generous round, and there is only a modest increase in take-up over this range.

At the top of the age distribution, somewhat surprisingly, there is no sign of an effect of mandatory retirement in overall take-up. The solid red line in Figure 5 shows the age above which faculty were exposed to mandatory retirement. The finding of no effect of mandatory retirement on overall take-up does not appear in previous reports on VERIPs, which have highlighted high take-up rates among faculty over 65 as evidence that VERIPs was particularly attractive to those subject to mandatory retirement. Despite this sensible association, the pattern within older faculty does not support an important role for mandatory retirement in take-up, at least by the conclusion of the VERIPs. Faculty just too young to be exposed to mandatory retirement show the exact same take-up rates as those who would be forced to retire at age 70: retirement rates are flat between ages 64 and 67, and show no increase at the discontinuity in exposure to mandatory retirement. This is not to say that mandatory retirement did not influence round-by-round take-up; as discussed in the Appendix, take-up in the first VERIP increases from about 50% to 70% at the mandatory retirement age.

There is another puzzle in take-up at the mandatory retirement age. It is not clear why take-up does not rise above 80% for faculty exposed to mandatory retirement. This suggests one of two explanations. First, some faculty so valued the final years of work that they were willing to forgo an increase in pension wealth of some 15-25% (the range of offers to these faculty). Or, second, that some behavioral or frictional element prevented them from making their otherwise-preferred decision (i.e. to retire through VERIPs). This could have been a lack of knowledge of the program, procrastination in filing, or some other force. This evidence, together with the lack of a discontinuity in overall take-up at the mandatory retirement age, leads to the conclusion that VERIPs bought out virtually all of those faculty willing to enter early retirement over the age of 58 or 59 in 1991, about 80% of faculty. The puzzle is why the remaining 20% appear to exhibit such strong inertia, acting as if there are prohibitively high costs of program take-up. I have no satisfactory explanation for this phenomena.

Looking at the distribution of take-up by years of service at UC in Figure 6, there is much

less of a clear association between service credit and take-up, as compared to the patterns in age. Broadly, there are two regions of the service credit distribution. Above 25 or 30 years of service, a very high fraction, approaching 85%, of eligible faculty retired through VERIPs. The fraction approaches the highest take-up rates for any age group, suggesting they are close to their upper limit. Below 25 years of service credit, there is much less, or possibly no association between service credit and take-up. The results are quite noisy, as take-up ranges between 20 and 80%. (One possibility is that married couples with the same service credit and take-up decisions could increase the variance of the take-up rate in this figure. Marital status is contained in the records, but spouses' employment at UC is not.) The long dashed lines on the figure reflect the sample restrictions imposed in the analysis.

In the appendix, I discuss take-up in each of the three VERIP rounds in greater detail.

## 4 Results on Cumulative Retirement and Mortality

### 4.1 Cumulative Retirement and Mortality: Graphical Evidence

Those receiving VERIPs offers retired at younger ages than those who did not receive an offer. Figure 8 plots the (unadjusted) cumulative retirement patterns by age, providing a rough guide to the magnitude of the effect of VERIPs. Beginning in their early 60s, VERIPs-eligible faculty show excess retirement relative to ineligible faculty. This trend continues until the early 80s, the majority of excess retirement occurring between the ages of 65 and 80. The figure should not be interpreted as reflecting the causal effect of a VERIPs offer for two primary reasons. First, cohort and period effects are unaccounted for; those receiving VERIPs offers would be expected to retire earlier, as they are on average older than (i.e. born before) those who did not receive offers. Second, by restricting the sample to those who are active in 1991, those who were older at the time could not retire before their age in 1991. This selection effect works in the opposite direction of the cohort and period effects, though it should be small, as the retirement hazard of both groups is low in the below-65 age range. The empirical model allows for both of these effects without explicitly disentangling them.

Retirement through VERIPs had a strong effect on future work and earnings at UC, despite provisions that allowed faculty to return to work. Figure 7 displays the monthly (October) earnings of faculty offered VERIPs. Earnings take large steps down in the VERIPs years, reaching a level just above zero by 1994. Although some faculty were recalled to partial employment as soon as the year after taking retirement through VERIP, and there were no work restrictions after 5 years had passed, there is no evidence that these avenues had a

significant influence on average future faculty employment at UC. The average earnings of those taking VERIPs remained near zero, suggesting that recall and return to career faculty status were relatively rare.

Similar to the figure for cumulative retirement, Figure 9 plots the cumulative mortality outcomes. The same caveats prevent a direct causal interpretation: cohort/period effects are unaccounted for, and the younger cohorts face some additional mortality risk as they “catch up” to the older cohorts. Setting aside these concerns, a clear pattern of excess mortality appears in the VERIP-eligible cohorts in the ages 65-75. Since mortality outcomes are still being realized for these groups, the divergence occurs in the left tail of the mortality distribution. It is too early to draw conclusions regarding the average or even median mortality experience of these groups.

Since selection on survival in the initial sample works against the finding of excess mortality, cohort and period effects appear to be the most likely confounders. So, how large are these cohort and period effects? Figure 10 and Figure 11 bring in evidence on US population-level mortality matched on age and cohort. Figure 10 plots the cumulative mortality of a sample of population-average individuals of the same age and cohort as the eligible and ineligible faculty in the sample. The first striking characteristic is the extreme longevity of the UC tenured faculty sample: the cumulative mortality curve shows a strong rightward shift, correspond to a longer life; by the end of the 22-year followup, the average member of the population is nearly twice as likely to have died. Second, the early onset of mortality in the population means that the selection on age or “catch-up” mortality in the sample exerts important effects on the progression of mortality, whereas the low mortality risk before age 66 meant this was not noticeable in the sample of UC faculty. To address the “catch-up” mortality problem and better depict the cohort and period trend in mortality, Figure 11 normalizes the mortality of the matched population sample to 0 at age 66. Now, the period and cohort differences in population-level mortality are visible as the difference between the two series. It is quite small, implying that the size of the cohort and period effects are far smaller than the mortality divergence (to the extent that population mortality reflects the effects in this sample).

Period and cohort effects can also be assessed within the sample. Figure 12 repeats Figure 9, focused on the subset of the sample in the 1991 age 50-59 cohorts. Also included on the figure is the mortality of the next 5 younger cohorts, excluding the small fraction of this group that received a VERIPs offer. Restricting the age range reduces the scope for biases resulting from cohort/period effects and selection on survival, though these remain in the

background. This tighter group of cohorts show a divergence in their mortality beginning at age 63 or 64, and extending through the early 70s, at which point the sample size becomes too small for the younger cohorts. Comparing the mortality of those age 50-59 who did not receive a VERIP offer to the mortality of those in age 45-49 age range allows a visual assessment of the cohort and period effects between two groups unaffected by the VERIPs offer (the average age difference between the groups is slightly larger for the two No Offer groups than the age 50-59 groups). As can be seen on the figure, the cohort/period effect does not appear to explain the difference between the groups receiving and not receiving a VERIP offer. It does not suggest a strong trend, and in fact, is in the “wrong” direction (to explain the mortality results) until age 67. This matches what is generally known about the cohort trend in mortality over these years: mortality has been declining at 1-2% per cohort during the 1990s and 2000s. This pace is too slow to explain the differences in mortality between these cohorts only 5 years apart.

Finally, Figure 13 displays cumulative mortality by the take-up response of those eligible for VERIPs. This figure represents the combination of selection into treatment take-up, and the effect of the treatment. It is possible that those who did not take VERIPs were also affected by VERIPs, for example, if their opportunities in their departments were expanded. As expected, those electing to take early retirement show higher mortality, though not until past age 75. This implies that the resulting mortality difference partially depend on the mortality of both those who comply with treatment, and on those who refuse it and remain on the job.

## 4.2 Cumulative Retirement and Mortality: Regression Evidence

The empirical model serves to make a more direct comparison of the groups. It can be thought of as summarizing the average causal effect of retirement on mortality in this population, where the excess retirement approximately occurs in the age ranges depicted in the graphical evidence above. Flexible controls for age and cohort mean that the empirical model draws most of its power from variation in service credit, an issue discussed below.

Receipt of a VERIPs offer robustly predicts additional retirement in the empirical model. The upper panel of Table 2 reports the relationship between receipt of a VERIPs offer and subsequent retirement as the first-stage of the IV model. As the model pools all years, the coefficient on  $YearsSinceVERIP_{it}$  reflects the average increase in retirement over the entire sample period explained by VERIPs (conditional on the age controls). Due to the inclusion of the polynomials in age interacted with year, the excess retirement assigned to VERIP in

the model largely reflects variation in service credit between those offered and not offered VERIPs. On average, each additional year of VERIP eligibility increased actual retirement by about 0.10 years. When the instrument is interacted with year (results not shown), the effect of a VERIP offer is substantially larger in the years immediately following VERIP.

Retirement duration predicts mortality in both the OLS and IV specifications. The OLS specification in Column 1 finds an increase of 1.0% in cumulative mortality for each additional year of retirement. Interestingly, the IV estimate in column 2 is identical to the estimate in Column 1. The IV estimate might have been expected to decrease the magnitude of the effect, if poor health was an important predictor of both earlier retirement and mortality in this population. The lack of a decrease may reflect the relatively homogenous, healthy character of the UC faculty, in which health and retirement may be less closely linked. This estimated effect of retirement on mortality appears quite large. Average mortality in the sample is 5.2% and the mortality rate in retirement is 8.6%.

The model includes controls for age, year and gender, but does not account directly for service credit. This is necessary to provide variation in  $YearsSinceVERIP_{it}$ , as controlling for both age and service credit leaves no first-stage variation in VERIPs offers. The concern with such a strategy is that variation in service credit may predict the longevity of faculty, independent of VERIPs. This would be the case if faculty who come to UC mid-career are longer-lived, or if the large cohorts of initial faculty hires at campuses had short lifespans (and high service credits). Empirically, an association between service credit and lifespan is not detectable, as service credit is not statistically significant when included in the (second-stage) mortality equation. To examine this issue further, Column 3 and 4 impose service-credit sample restrictions. Column 3 restricts to faculty with fewer than 25 years of service credit. The effect increases to 1.6%, with  $p < 0.01$ . This restriction drops half of all faculty who ever received a VERIP offer, but does not compromise the statistical power of the model. Cutting the sample at lower levels of service credit is more problematic, since retirement and mortality outcomes are less frequently realized in these age ranges; what data is there is needed to estimate the model. When dropping the bottom 5 years in Column 4, the F-stat is above 20 and estimated effect is larger in magnitude than the full sample at 1.6%, and just insignificant at a 95% confidence level ( $p = 0.52$ ). Technically, those faculty with fewer than 5 years of service credit were not eligible for VERIPs, although none of these faculty met the eligibility requirements for the sum of age and service credit, either. Dropping more than the bottom 6 years of the service credit distribution compromises the first-stage relationship between VERIPs offers and retirement, lowering the Kleibergen-Paap F-stat

below the rule-of-thumb of 10. A strong relationship between years of service at UC and life expectancy would be difficult to disentangle from VERIP eligibility, however, the evidence does not support such a pattern in the data.

## 5 Conclusion

This paper studies the retirement behavior and mortality of tenured faculty at UC, a particular group of workers who engage in work that fits quite closely with what previous research has characterized as health-promoting: it is cognitively and socially stimulating, there are few physical requirements and virtually no insecurity in continued employment. Many senior faculty have considerable discretion over their involvement in the department, presumably allowing them to engage in more enjoyable, less stressful activities than a typical worker. Perhaps most importantly, very few jobs in the economy have the security of the position of tenured faculty at research universities in the United States. It is possible that tenured professors earn large rents for late-life work that other employers may not tolerate. In so far as the university opposed the end of mandatory retirement, this seems to be their hypothesis.

As of yet, the main mortality outcomes of the VERIPs-induced quasi-experiment are still being realized. While close to 90% of the eligible and ineligible faculty over the age of 45 in 1991 have retired, only around 20% of those eligible for the programs have died, with lower mortality rates in the (generally younger) ineligible group. Between these groups, mortality appears to have approached more rapidly for those offered VERIP than those ineligible. This finding depends on the comparisons of faculty with differing service credit at the time of the VERIPs offer, although it is robust to trimming outlying portions of the sample. It would be useful to have another retirement and mortality source with which to estimate counterfactual mortality. The design of this project suggests an analysis of the end of mandatory retirement on a larger population of tenured faculty.

Could VERIPs have had an effect on non-takers and the untreated? This seems possible. As VERIPs induced the retirement of a large fraction of faculty above the age of 60, the returns to seniority at the university may have risen. VERIPs coincided with the end of mandatory retirement, giving the cohorts of faculty left behind after VERIP new opportunities to define their careers. To the extent that this is the case, ineligible faculty do not represent the counterfactual wherein VERIP is not offered, but rather a counterfactual in which the opportunities on the job expanded. Additional data on faculty outcomes would also be useful here, especially on publications and other measures of research productivity,



and information on department-level eligibility and take-up.

If VERIP did reduce the life expectancy of those offered the program, should this be considered a problem? Not necessarily. Previous research has reported that VERIPs was seen as a success by nearly all stakeholders, particularly faculty offered early retirement. The program was, after all, “voluntary.” We have many examples of people willing to trade health for increased enjoyment of life. Time spent in retirement and leisure is generally valued more highly than time spent employed (at least, for a significant fraction of the population), so it may not be a surprise if faculty are willing to make such a trade-off. On the other hand, it is possible that health effects of retirement were not well-known.

Finally, the broadest implications of this study are for the importance of engagement for the elderly. It is unlikely that the mere fact of employment signifies anything, but rather, that employment composes a bundle of goods, and its rights and obligations may be health-promoting in the best of cases. Uncovering which components of the physical, social and cognitive stimulation provided by employment have the most impact on health, quality-of-life and mortality, is an important step towards replicating these features in other environments. Efforts to combat employment discrimination against the elderly are a more blunt policy instrument recommended by the finding.

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## **Appendix: Mandatory Retirement, Age 60 Kink, and Take-up Patterns**

This appendix extends the Pencavel (2001) analysis of differences in take-up between rounds of VERIP. Pencavel (2001) concludes that changes in expectations regarding future VERIPs, and the harvesting of those with the greatest propensity to retire in the later VERIPs can explain the differences in take-up between VERIPs. Here, I use graphical evidence on the responses to discontinuities in retirement incentives at age 60 and the mandatory retirement threshold to argue that the previous descriptions of VERIPs were, at best, incomplete. Differences in faculty take-up behavior between the rounds do not fit with an important role for the increased expectation of future VERIPs as emphasized by Pencavel, and leave only a modest role for the harvesting of those most likely to retire in the earlier rounds. Instead, I argue that take-up varies by age and VERIP in ways that suggest faculty learned about VERIPs, UC pension incentives, and their outside options over the course of the three rounds. Faculty also appear to exhibit significant inertia.

Examining take-up by round around the discontinuities in pension incentives suggests that the response to the financial incentives in VERIPs increased over time, and that mandatory retirement did shift the timing of retirement through VERIPs. In Figure A.3, take-up shows only a small discontinuity at age 60. The dashed line again denotes the age 60 discontinuity in retirement incentives, and there is virtually no important increase in take-up at either age 59, 60 or 61. Except a bump at age 62, take-up increases nearly linearly over the ages 60-67, and then does show a discontinuous increase at age 68, the age of exposure to mandatory retirement age. The sample size is relatively small here (there are just over 100 faculty age 67, and just under 100 age 68). Despite this, mandatory retirement does appear to influence take-up of the first VERIP, with take-up increasing from below 50% to around 70% between ages 67 and 68. In order to generate the pattern in overall enrollment around the discontinuity in exposure to mandatory retirement, take-up will catch up in the next two rounds among the younger cohorts. This means mandatory retirement had only small effects on the timing of retirement for exposed cohorts, and/or that the sample size is too small to detect these effects. Setting aside sample size issues, the evidence suggests cohorts exposed to mandatory retirement would have retired at the same rates, but perhaps through later VERIPs. In other words, VERIPs was eventually sufficiently generous to buy out all of those faculty predisposed to retire in the age range just below the mandatory retirement cutoff.

The age 60 discontinuity appears much stronger in the second VERIPs, suggesting faculty changed their response to the program over time. Figure A.4 depicts take-up of the second VERIP offer in 1993. Take-up in the second VERIP was near-zero below the age of 59, increases to 10% at 59, and then is relatively flat at 30-40% between age 60 and 69. The small group of faculty above 69 would have been exposed to one last year of mandatory retirement, but do not show a differential take-up response. Comparing take-up in the first two rounds, the most important differences are the low take-up in the early 60s in the first VERIP, and the apparent role of mandatory retirement in take-up in the late 60s in the first VERIP. Besides these two differences, it would be reasonable to summarize take-up as nearly flat at 30-40% above the age 60, particularly in the second VERIP.

The third VERIP again shows a discontinuity in take-up at the maximum age adjustment in the pension system, as well as the highest take-up rates of the 3 VERIPs. The third VERIP entitled retirees to three years of age adjustment (2 at Berkeley), meaning the relevant cutoff for the maximum age adjustment was at age 57 (age 58 for Berkeley). This discontinuity may not be quite as sharp, as unused years of age adjustment could be converted to years of service

adjustment, meaning the incentives are not exactly flat on either side of the discontinuity. Nevertheless, the age adjustment at age 60 remains large and salient. Takeup in the late 50s is particularly striking. Rates of 40-50% correspond to the highest non-mandatory retirement rates in the other rounds of VERIPs. This final round of VERIPs was particularly generous, and it seems fair to conclude that these incentives were quite effective. Despite the harvesting in the earlier rounds of those with the greatest propensity to retire, take-up between age 61 and 70 in the final round of VERIP is the highest of the three rounds, excluding those exposed to mandatory retirement in the first VERIP. The Berkeley faculty were exposed to slightly less generous age adjustment, shifting the distribution to the right by one year. The retirement pattern follows this shift.

## **Discussion of Differences in Take-up Across VERIPs**

In the conclusion, Pencavel (2001) offers two reasons for the differences in take-up across the rounds. First, faculty formed expectations of future VERIPs as the university made multiple “final offers.” And second, the later rounds of VERIPs were harvested of those most inclined to take early retirement. I believe the evidence offers little support for an important role for the first explanation. Pencavel and other authors report the first VERIP offer to be credibly seen as a “final offer,” yet take-up rates are no higher in this round for the population that is not constrained by mandatory retirement. The formation of expectations of future offers should serve only to depress take-up rates in the second and third rounds, particularly differences in take-up induced by differential financial incentives. Some of the only evidence for depressed take rates in the later rounds appears in the under-60 age range in the second VERIP, where take-up is near zero. However, take-up is low below age 60 in all rounds, and this population is at least partially harvested by the first VERIP. In virtually all other age ranges, take-up rises with the VERIPs, particularly at the points where financial incentives are most salient. Thus, the pattern of take-up across VERIPs does not support a diminishing effect of financial incentives, as would be expected if the multiple rounds of VERIPs reduced the credibility of each round as a “final offer.”

Evidence appears stronger for the harvesting of those most inclined to retire in the early rounds, the second reason offered in Pencavel for take-up differences between VERIPs. The clearest evidence for harvesting appears in the flattening of the slope in age after the first round of VERIPs. If there is a natural propensity to retire in the 1991 population of tenured faculty, it will at least partly be associated with age. Since the VERIPs pension adjustment is uniform or declining over the ages 60-69 (excluding those exposed to mandatory retirement),

the increase in take-up in these age ranges reflects some other force, such as health and lifespan. The increases in take-up at the first age of SSA eligibility is also consistent with harvesting, as the age-62 benefit will be most attractive to those in the worst health. Thus, the apparent removal of strong age effects above age 60 in the second and third VERIP fits the harvesting story. (We expect some small slope in take-up below age 60, due to the direct effect of the increasing age factor in the pension system, but there may also be an age effect in the first VERIP below 60.) The effect is, however, rather small. In the first VERIP, average take-up between 60 and 67 rises from 25% to 50% over 8 years, or around a 3% increase in the take-up rate per year of age. In the second VERIP, take-up rises from 30% to 40% over ages 60-69, an increase of 1% per year of age; a similar effect appears in the third VERIP, with take-up rising from 50% at age 60 by about 1% per year of age. If we can naively assign credit to the various effects of financial incentives and the harvesting of the population based on the intercept and slope of the population with uniform or declining financial incentives, we would conclude that the harvesting effect was relatively small compared to the increasing response to financial incentives. Absent the harvesting effect, we would expect a 2% increase in the slope of above-60 take-up in the later rounds. Again, the increasing intercept across rounds is evidence against an important role for expectations of future VERIPs.

What other factors could play roles in take-up across rounds? At least three other plausible causes for differing take-up rates could explain the patterns in take-up: information about the program, inertia, and learning, particularly about (possibly evolving) outside options. I examine each in detail.

Previous authors have highlighted the informational components of the VERIPs campaign (i.e. Switkes (2001), Pencavel (2001)), however, take-up patterns leave significant scope for a lack of awareness of the program. The pattern is especially acute for those exposed to mandatory retirement. Although take-up is highest across all VERIPs and age range in the first VERIP among those exposed to mandatory retirement, it barely rises above 80%. This leaves a significant fraction of older faculty declining what is a very generous pension package, in exchange for a year or two of additional employment. It is not clear why they are doing this. The offer included a three-month lump-sum payment and mortality rates are very low at age 70, so liquidity constraints do not seem a likely story. As well, the lack of a response to the program in the early 60s could be taken as evidence that information was not as disbursed in the first VERIP. Despite these suggestive pieces of evidence, I cannot put too much weight on lack of information about the program as an explanation, given that

earlier authors have found no fault in UC's informational campaign.<sup>4</sup>

The behavior of faculty coincides with the widely observed inertia in pension plan decisions. The evidence for this behavior appears quite strong, although it is less clear why faculty may treat the costs of program take-up as prohibitively high. It is well-known that individuals neglect to make active pension decisions which appear to be quite valuable, and exhibit different behavior under active and passive choice regimes (?). If it can be assumed that information about VERIPs was spread throughout the faculty, then some other source of inertia must explain the take-up patterns, particularly in the mandatory retirement ages. The fraction of faculty exhibiting this behavior is quite large. Consider the effect of these individuals in a model with harvesting: take-up rates in the second and third rounds would be expected to be depressed by the accumulation of inertia in the population, meaning the responses to the incentives in these rounds are correspondingly larger. Thus, inertia can explain the take-up pattern in the mandatory retirement age, but cannot also account for the low take-up response in the early 60s in the first VERIP.

Finally, I would argue that the most important unexplored element in explaining differences in VERIPs take-up across rounds is the role of learning, particularly about outside options. This is the only explanation (besides the spread of information) which can explain an increasing response to financial incentives across the rounds. There are two main components to the outside (or post-VERIPs-retirement) options that early rounds of VERIP may reveal to those eligible later: one is the options for continued employment at UC and the other are professional activities that could be engaged in away from UC. It is not clear which is the more relevant, however, the significant share of faculty eventually recalled to teach at UC (and the availability of information about these options) suggests that previous retirees would have been especially informative about the opportunities at UC. As the VERIPs progressed, departments may have become more willing to accommodate these types of arrangement, creating structures that supported roles for retired faculty. As well, the value of these outside options may have been changing, as the economy improved over the three VERIPs, UC exited the budget crisis, and earlier retirees established contacts outside of UC.

Despite the interesting patterns in take-up, the evidence does support the conclusion in Pencavel (2001) that there does not appear to be a unifying reduced-form model that could describe the responses to VERIP across rounds. This leads me to use a more blunt instrument, looking at the arrival of the first VERIP offer. In future work on this project,

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<sup>4</sup>Speculatively, UC would have had an incentive to target information at those in the ages just below eligibility for mandatory retirement. It is not clear how they could have done this, though.

I plan to incorporate pension accrual accounting to make precise the response to financial incentives in the program, and differences between rounds. However, Pencavel provides an analysis of these issues, and I have already said plenty on the subject of the response to the program.

Table 1: Summary Statistics, UC Tenured Faculty, Ages 46-66 in 1991

Full Sample	Offer	Mean	SD	P10	P90
Age at VERIP 1	0	51.37	4.24	47	57
Age at VERIP 1	1	60.26	3.41	56	65
Service at VERIP 1	0	15.83	7.19	4	24
Service at VERIP 1	1	27.37	4.24	22	33
Female, VERIP 1	0	0.14	0.34		
Female, VERIP 1	1	0.05	0.22		
Take-up of VERIP 1	1	0.21	0.41		
Age at VERIP 2	0	52.02	4.02	48	58
Age at VERIP 2	1	59.57	3.89	55	65
Service at VERIP 2	0	15.02	6.84	5	23
Service at VERIP 2	1	27.05	4.32	22	33
Female, VERIP 2	0	0.15	0.36		
Female, VERIP 2	1	0.05	0.22		
Take-up of VERIP 2	1	0.17	0.38		
Age at VERIP 3	0	52.44	3.65	49	58
Age at VERIP 3	1	58.36	4.60	53	65
Service at VERIP 3	0	13.13	5.99	5	21
Service at VERIP 3	1	25.77	5.04	20	31
Female, VERIP 3	0	0.17	0.38		
Female, VERIP 3	1	0.08	0.27		
Take-up of VERIP 3	1	0.33	0.47		
Offered VERIP	Take-up	Mean	SD	P10	P90
Age at VERIP 1	0	59.62	3.30	55	64
Age at VERIP 1	1	62.72	2.63	59	66
Service at VERIP 1	0	27.20	4.05	22	33
Service at VERIP 1	1	28.06	4.85	22	35
Female, VERIP 1	0	0.05	0.21		
Female, VERIP 1	1	0.06	0.24		
Age at VERIP 2	0	58.96	3.81	54	65
Age at VERIP 2	1	62.52	2.77	60	66
Service at VERIP 2	0	26.83	4.05	22	32
Service at VERIP 2	1	28.15	5.30	21	35
Female, VERIP 2	0	0.05	0.22		
Female, VERIP 2	1	0.07	0.26		
Age at VERIP 3	0	57.01	4.36	52	64
Age at VERIP 3	1	61.06	3.79	57	67
Service at VERIP 3	0	25.21	4.65	20	30
Service at VERIP 3	1	26.88	5.59	20	33
Female, VERIP 3	0	0.08	0.27		
Female, VERIP 3	1	0.07	0.26		

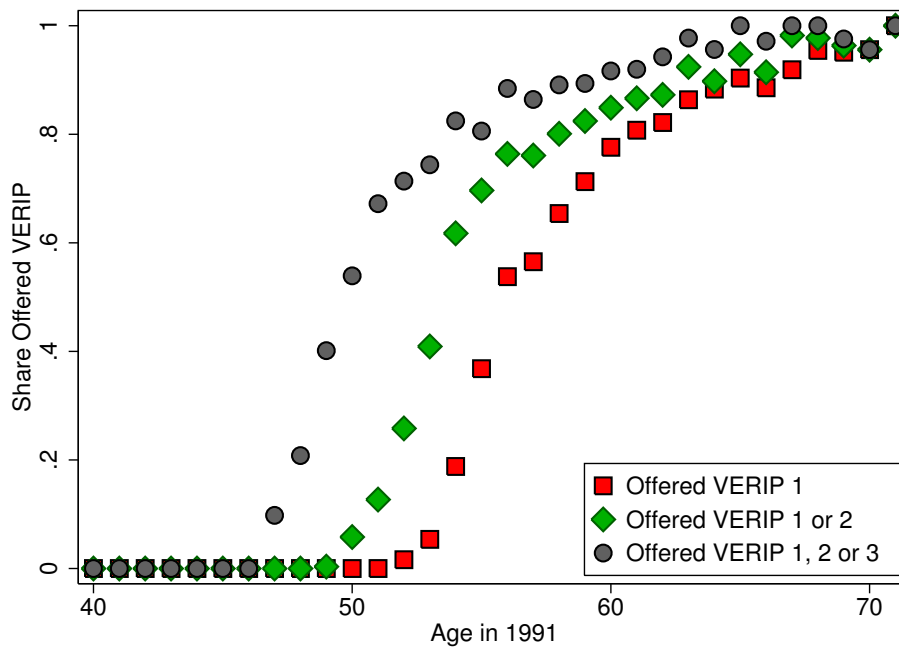


Table 2: Mortality and Length of Retirement

	(1)	(2)	(3)	(4)
	OLS	IV	IV	IV
	All	All	Service<25	Service>5
YearsSinceVERIP		0.13*** (0.014)	0.10*** (0.014)	0.07*** (0.016)
1st Stage F		100.1	55.0	20.1
RetireLength	0.010*** (0.001)	0.010** (0.004)	0.016*** (0.005)	0.016* (0.008)
Individuals	4469	4469	3280	4089
Years Observed	89056	89056	65463	81465

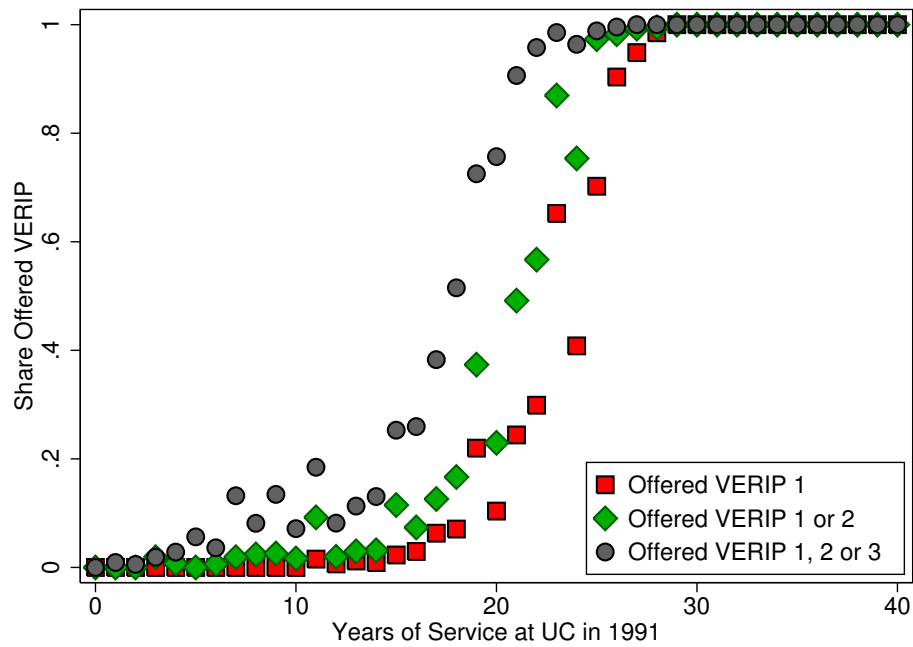
Notes: OLS and IV estimates of the response of cumulative mortality to years spent in retirement. The upper panel reports the first-stage estimates of the effect of offer length (length of time since first VERIP offer) on retirement length. All models include interactions of year effects with polynomials in age and gender. s.e. clustered by faculty member. Significance levels: \*\*\*  $p < 1\%$ , \*\*  $p < 5\%$ , \*  $p < 10\%$ .

Figure 1: Share Receiving VERIPs Offers by Age in 1991



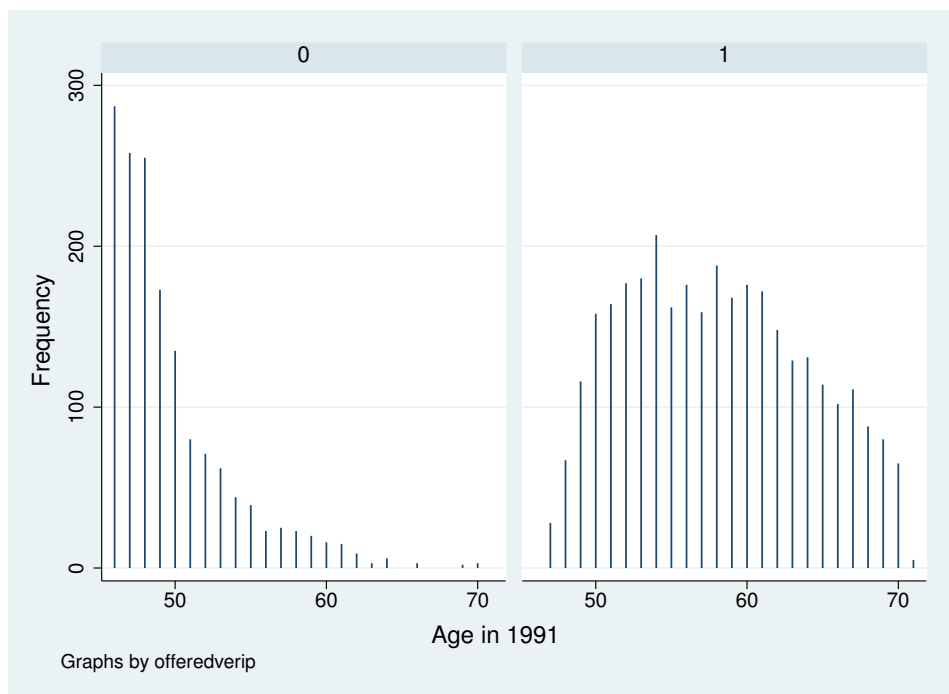
Notes: Share receiving VERIPs offer by age in 1991. Variation within age is due to variation in years of service at UC, and the lowering of the eligibility threshold with each VERIP. The empirical analysis restricts the sample to faculty who are ages 46-66 in 1991.

Figure 2: Share Receiving VERIPs Offers by Years of Service at UC in 1991



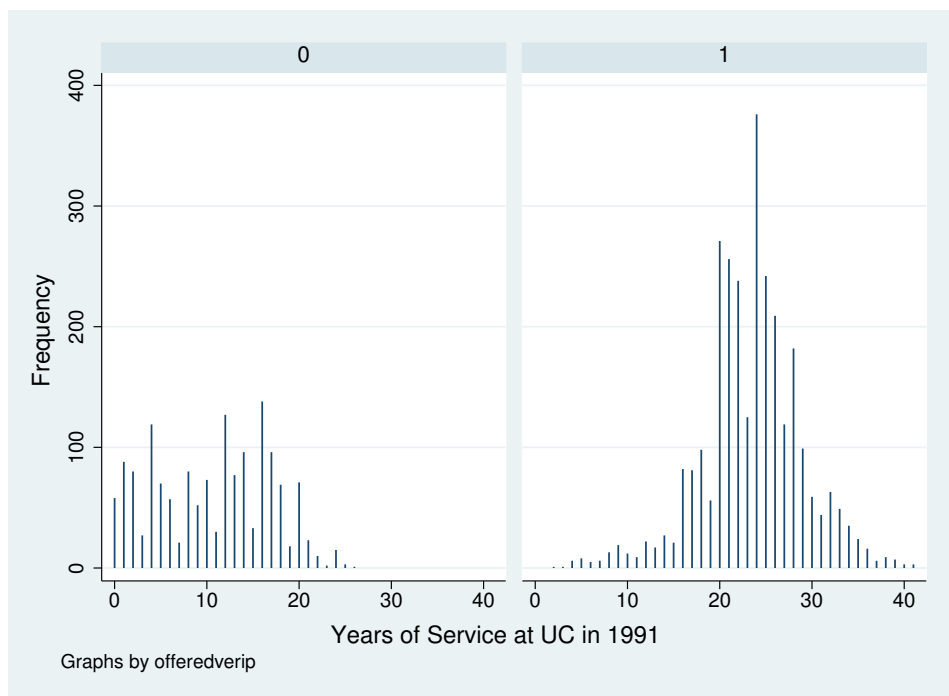
Notes: Share receiving VERIPs offer by years of service at UC in 1991. Variation within service credit is due to variation in age, and the lowering of the eligibility threshold with each VERIP. The empirical analysis reports results for the entire sample, those with fewer than 25 years of service credit in 1991, and those with more than 5.

Figure 3: Total Offers by Age, All VERIPs



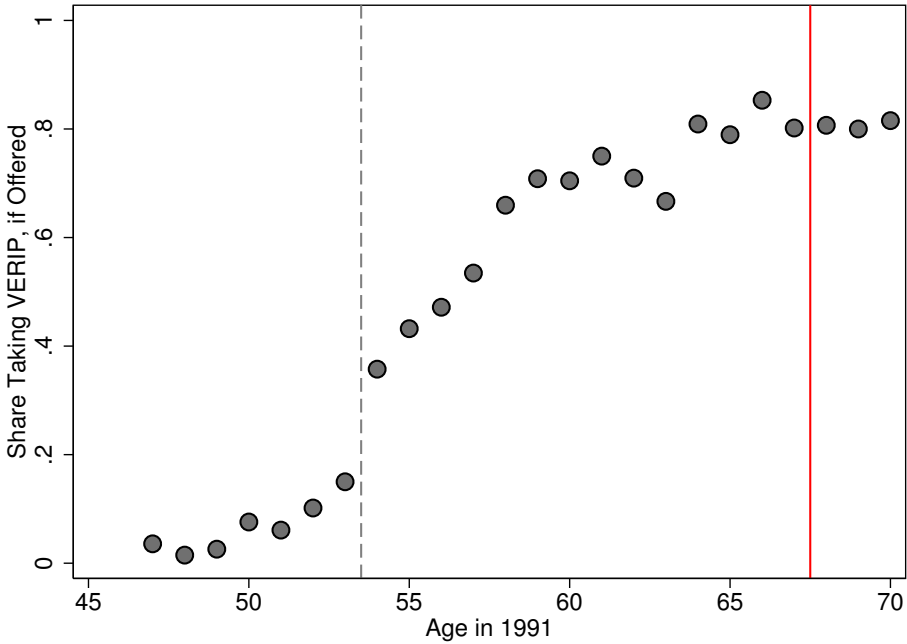
Notes: Total VERIPs offers by age in 1991.

Figure 4: Total Offers by Service at UC, All VERIPs



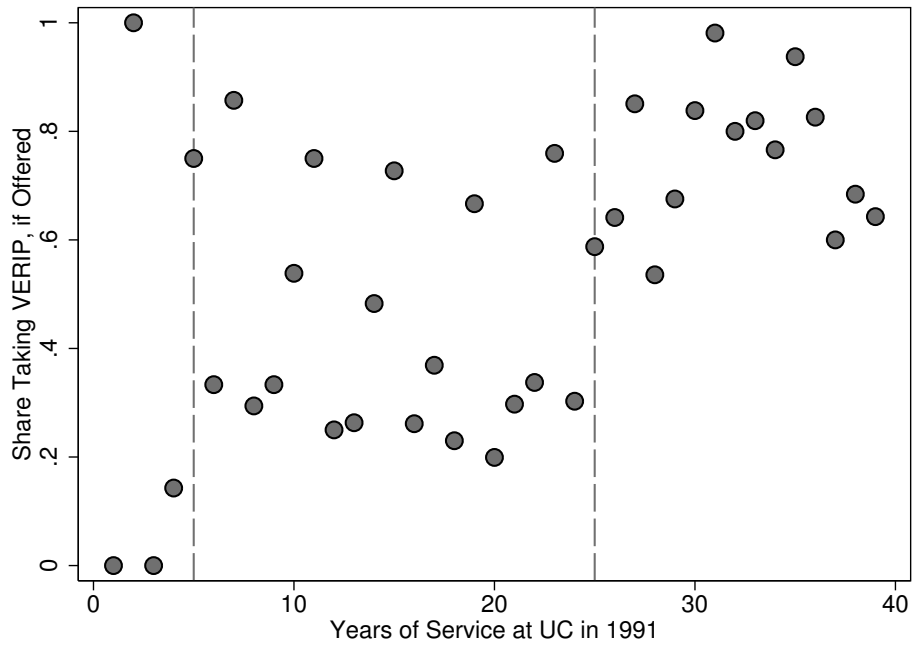
Notes: Total VERIPs offers by years of service at UC in 1991.

Figure 5: Take-up by Age, All VERIPs



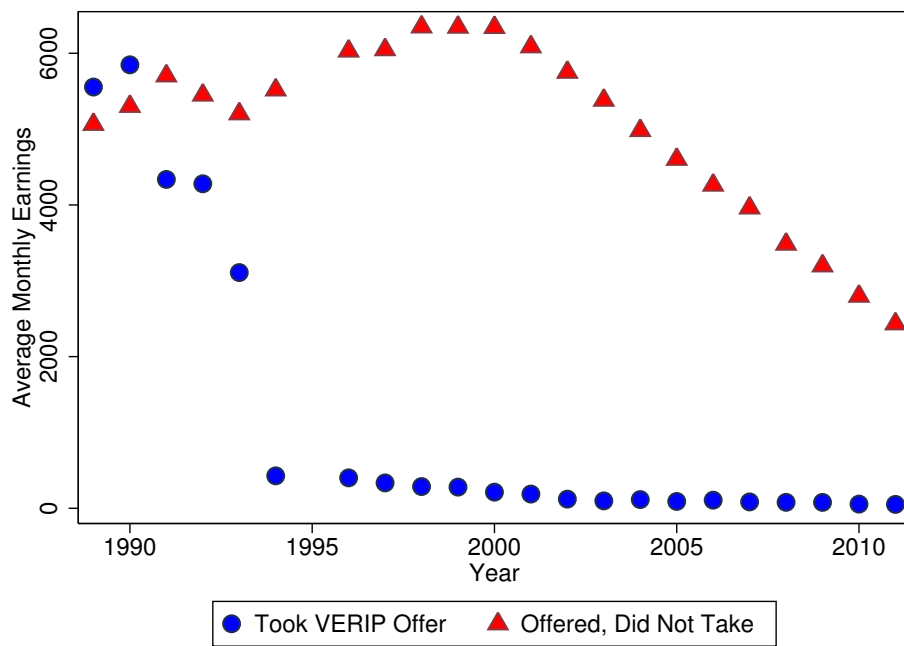
Notes: Take-up of any VERIP offer by age in 1991. The dashed line represents the age above which retirees would receive the maximum pension age-factor in the final round of VERIPs; the solid line represents the age above which faculty were exposed to mandatory retirement. The main regression analysis uses all faculty from ages 46-66 in 1991, thereby dropping those exposed to mandatory retirement.

Figure 6: Take-up by Service, All VERIPs



Notes: Take-up of any VERIP offer by years of service at UC in 1991. The long-dashed lines represent sample restrictions imposed in the regression analysis: those above 25 years of credit are dropped (this is half of those receiving offers); in another test, those with fewer than 5 years of service are dropped (VERIPs required a minimum of 5 years of service to be eligible, although this threshold did not bind for any faculty).

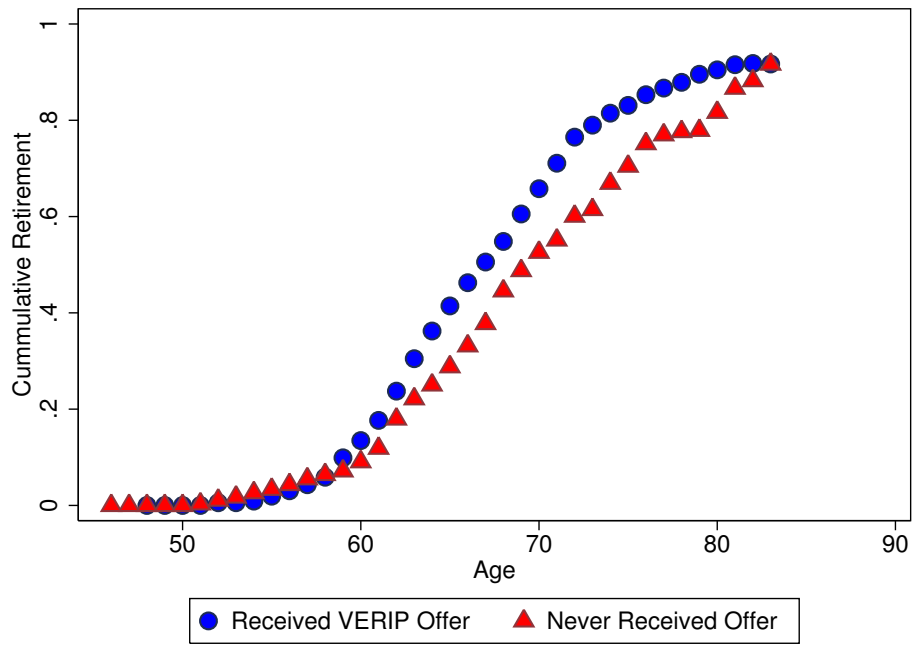
Figure 7: VERIPs and Earnings at UC



Notes: Earnings at UC among those taking and declining VERIP.

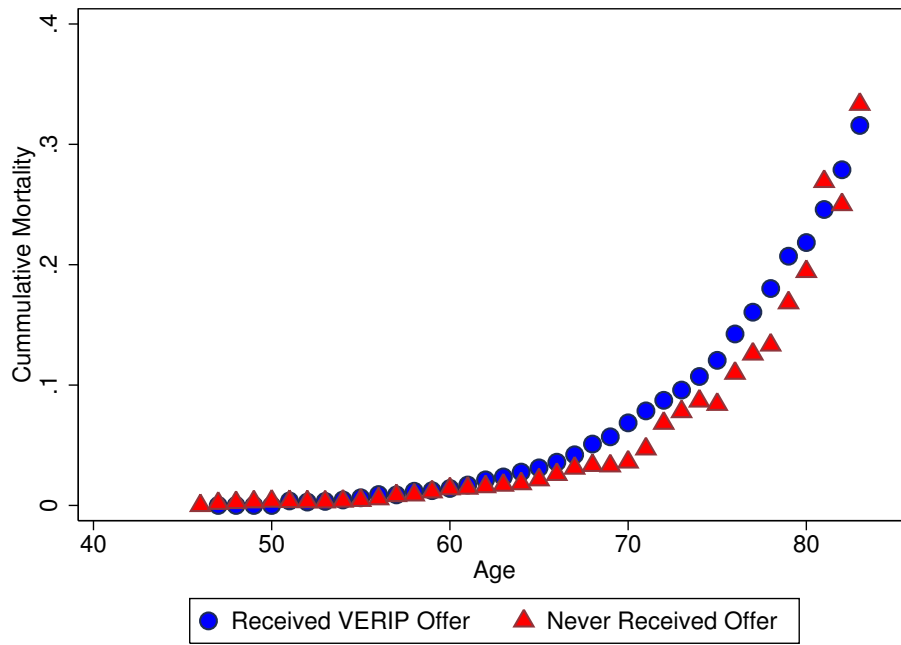


Figure 8: Cumulative Retirement by Age



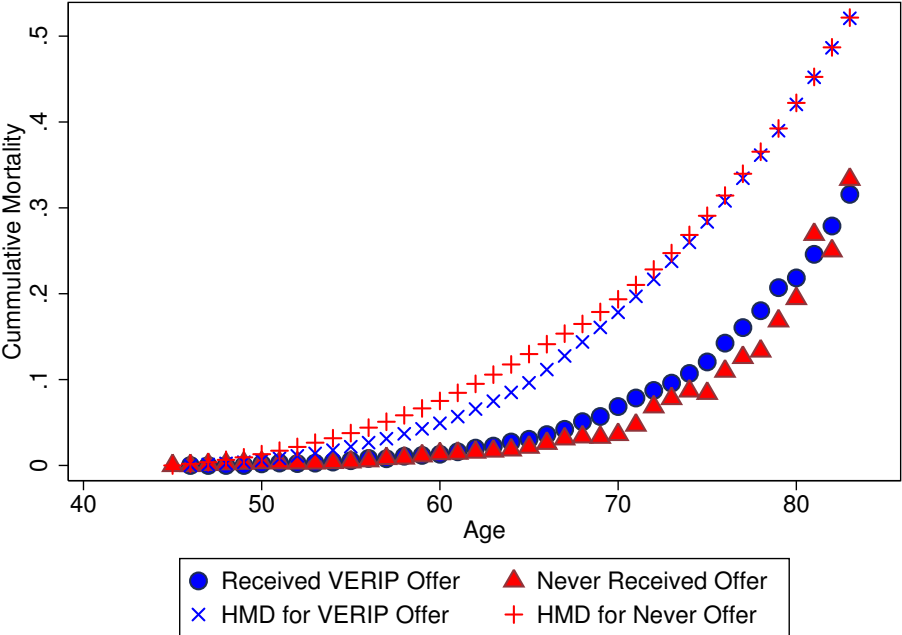
Notes: Cumulative retirement of the VERIP eligible and ineligible faculty between the ages of 46 and 66 at the time of the first VERIP offer in 1991. Figure plots raw (unadjusted) data.

Figure 9: Cumulative Mortality and VERIPs Eligibility



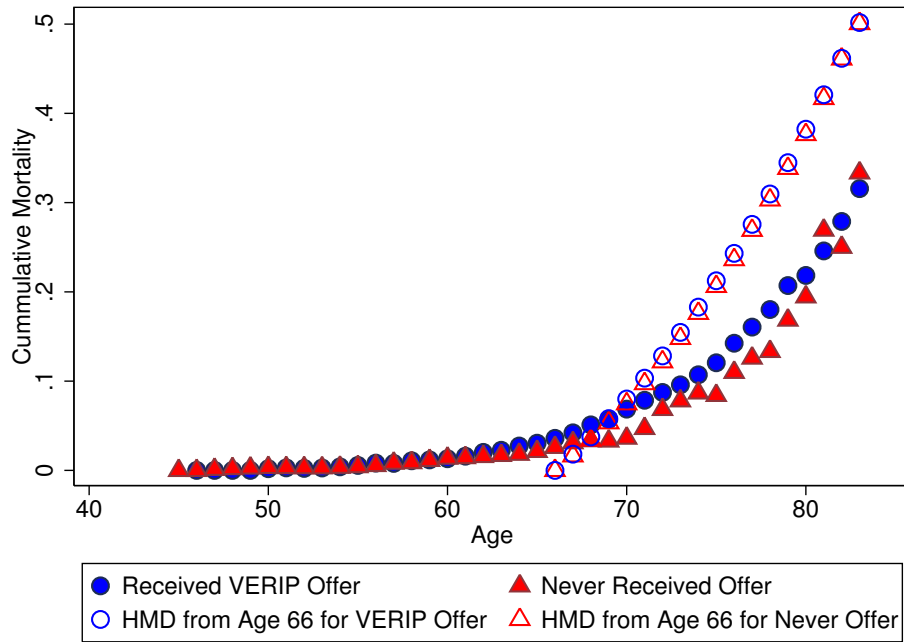
Notes: Cumulative mortality of the VERIP eligible and ineligible faculty between the ages of 46 and 66 at the time of the first VERIP offer in 1991. Figure plots raw (unadjusted) data.

Figure 10: Cumulative Mortality of UC Faculty vs Matched US Population



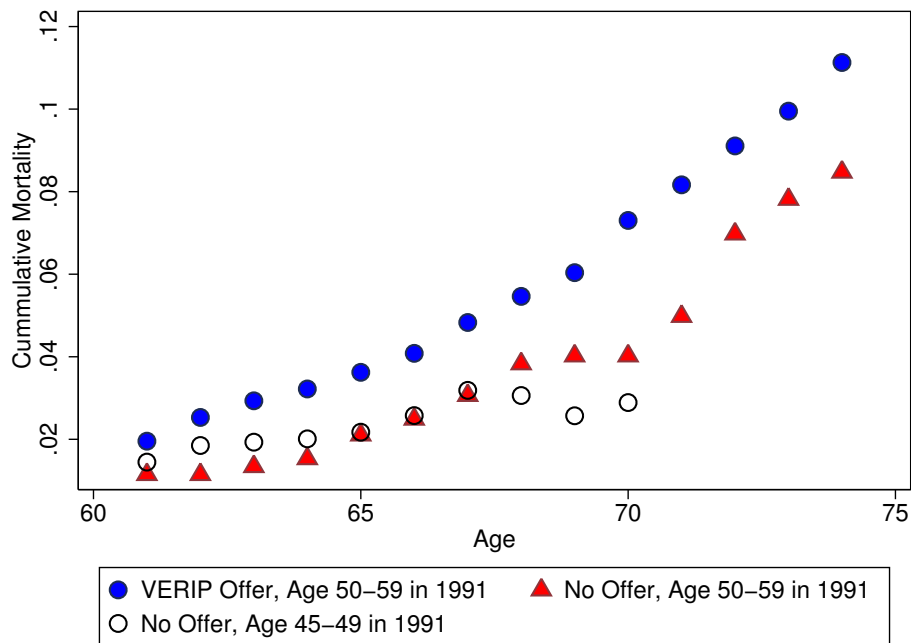
Notes: Cumulative and matched (age-cohort) US population-level mortality of the VERIP eligible and ineligible faculty between the ages of 46 and 66 at the time of the first VERIP offer in 1991. Population mortality taken from the Human Mortality Database (HMD). Matched US-population mortality for younger ineligible exceeds the older ineligible due to the additional mortality risk in the ages 46-66; for faculty, mortality is near zero in these age ranges, so no such effect appears.

Figure 11: Cumulative Mortality and US Cohort Effect From Age 66



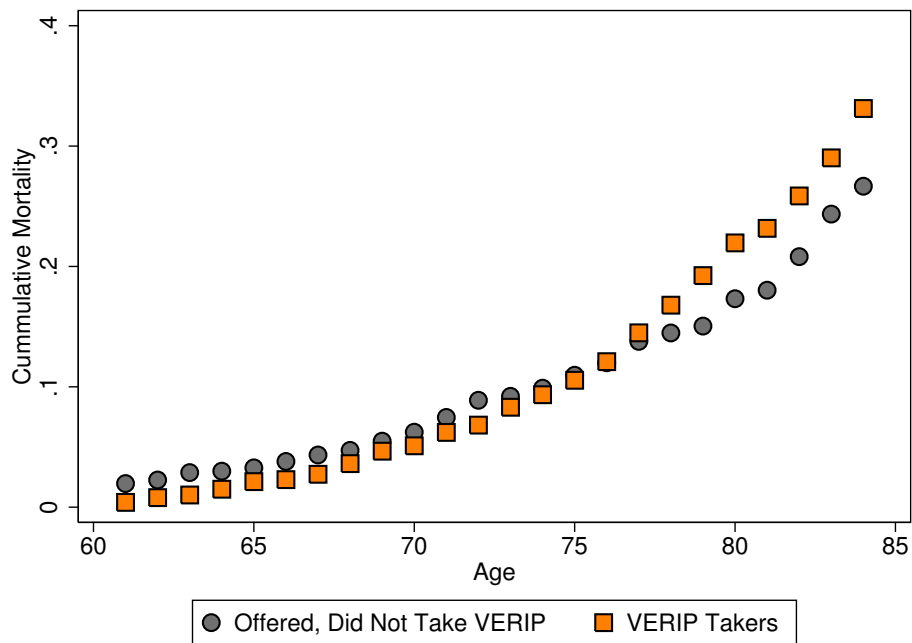
Notes: Cumulative and matched (age-cohort) US population-level mortality of the VERIP eligible and ineligible faculty between the ages of 46 and 66 at the time of the first VERIP offer in 1991. Population mortality taken from the Human Mortality Database (HMD). To correct the previous figure for the cumulated mortality risk of the younger ineligible cohorts, this figure normalizes mortality to zero at age 66. The population-level period and cohort effects are the distance between the hollow triangles and circles.

Figure 12: Cumulative Mortality, Selected Cohorts



Notes: Cumulative mortality of the VERIP eligible and ineligible faculty between the ages of 50 and 59 at the time of the first VERIP offer in 1991, with mortality of the ineligible in the ages 45-49.

Figure 13: Cumulative Mortality and VERIPs Take-up



Notes: Cumulative mortality of the VERIP eligible and ineligible faculty between the ages of 46 and 66 at the time of the first VERIP offer in 1991. Figure plots raw (unadjusted) data. VERIP-takers are older than those declining their VERIPs offers.

## Appendix Figures

Figure A.1: Take-up by Eligibility Score (Age + Service) in 1991

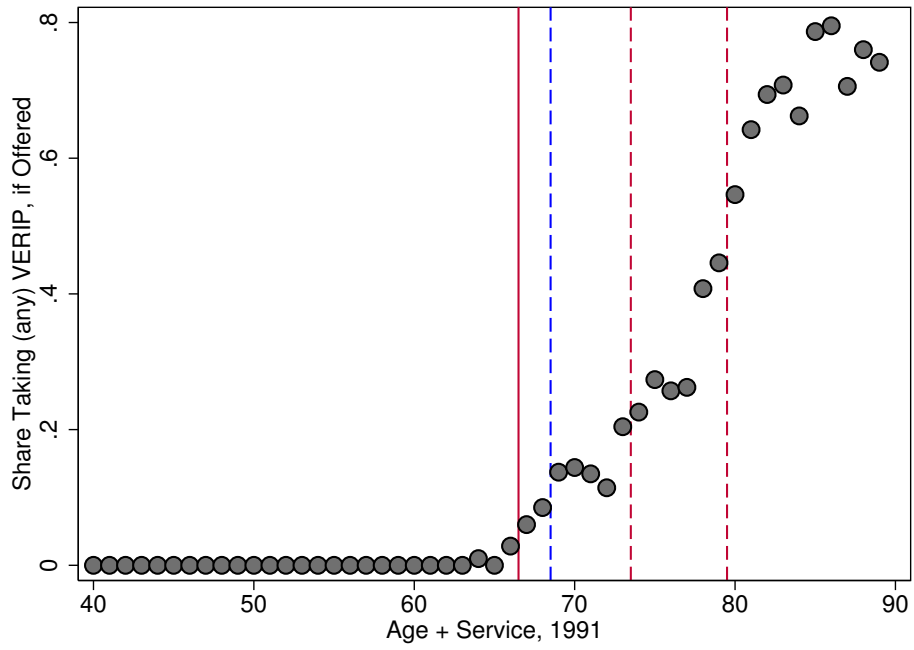




Figure A.2: Average Retirement by Eligibility Score (Age + Service) in 1991

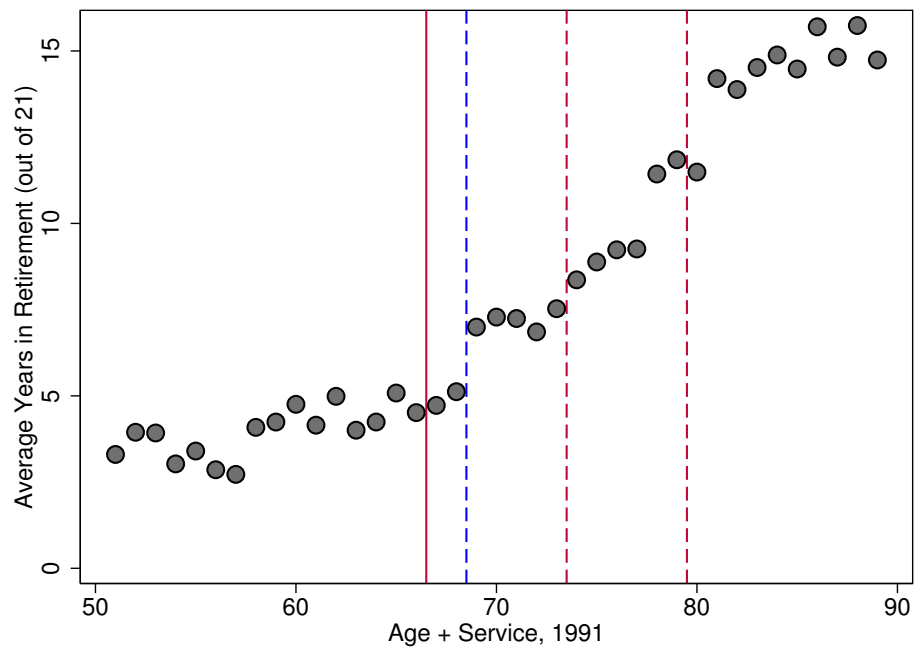


Figure A.3: Take-up by Age, VERIP 1

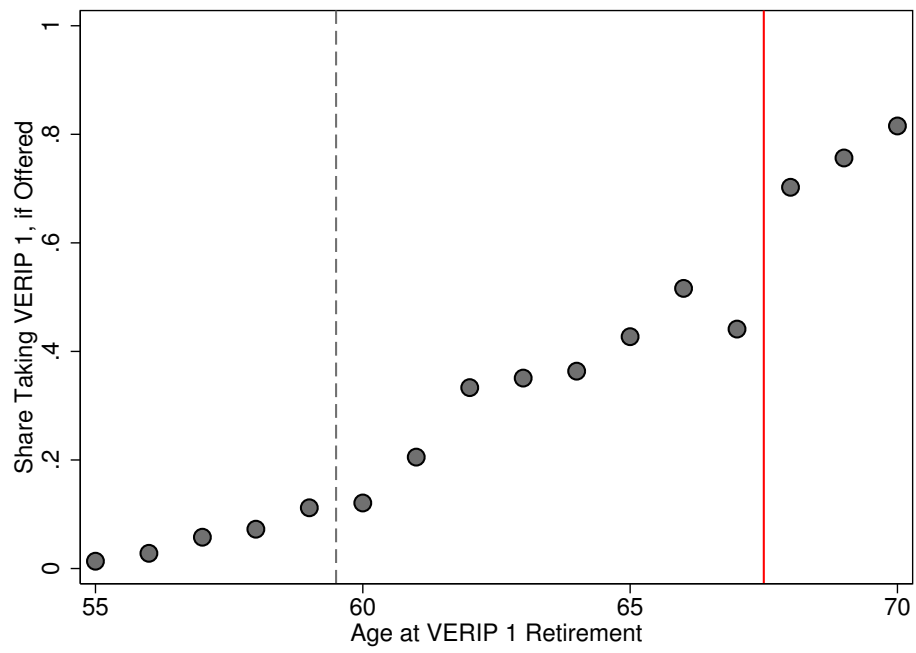


Figure A.4: Take-up by Age, VERIP 2

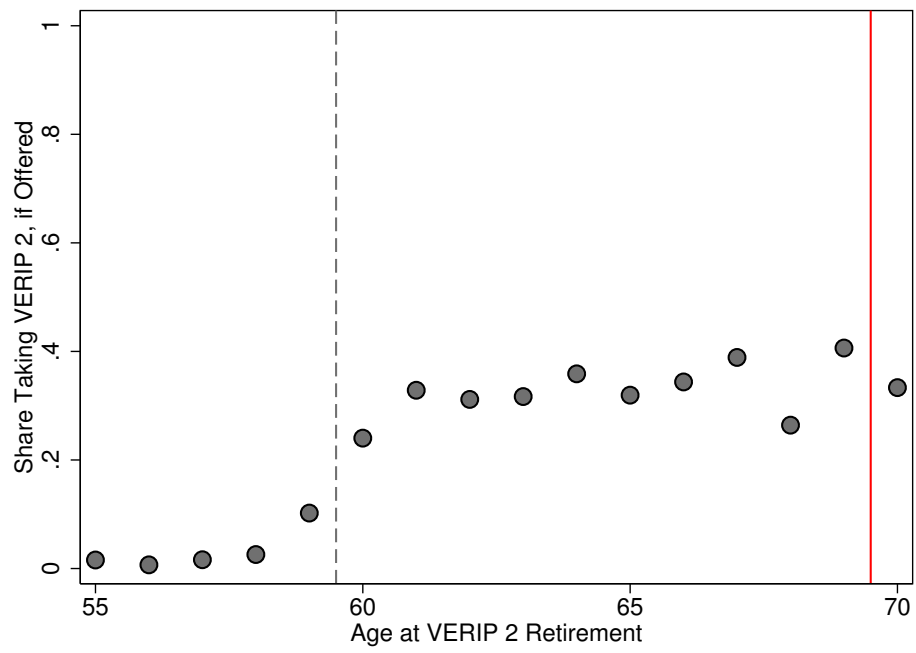


Figure A.5: Take-up by Age, VERIP 3

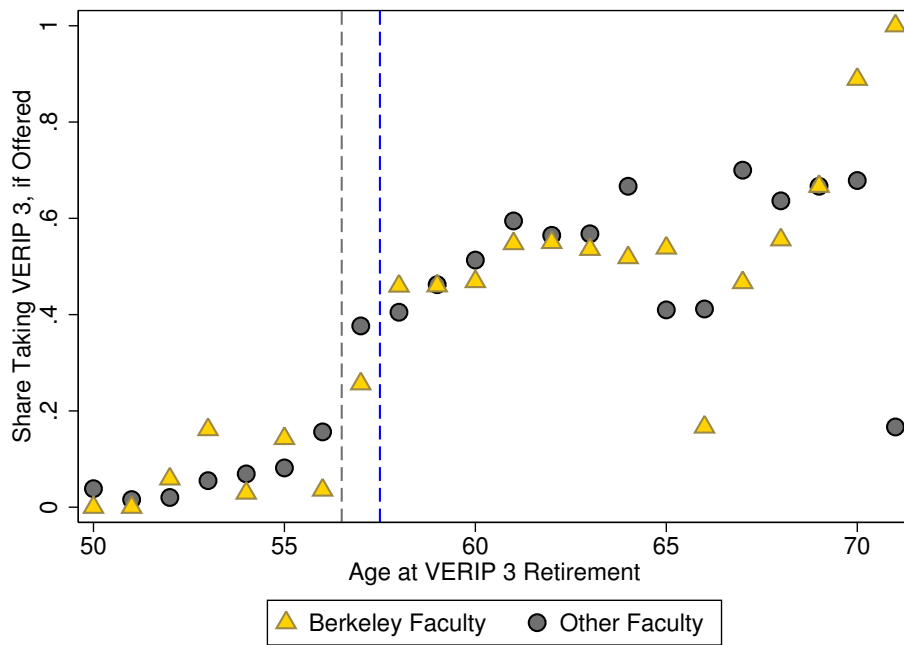


Figure A.6: Mortality by Eligibility Score (Age + Service at UC) in 1991

