

The Retirement Decision: Current Influences on the Timing of Retirement among Older Workers

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Abstract

This paper investigates the influences on retirement behavior among older workers who were surveyed by the Health and Retirement Study (1992-2004). It is found that increases in all categories of wealth (pension, housing equity and other financial wealth) increase the probability of retiring, while good earnings prospects induce continued employment. Retirement plan types have significant impacts: workers covered by defined benefit (DB) plans are more likely to retire, while the defined contribution (DC) plan coverage significantly alters retirement in the opposite direction. Furthermore, the probability and thus timing of retirement for DC plan participants are susceptible to the influence of business cycles through income flow fluctuations that are due to investment performance and interest rate changes. Health insurance (HI), if conditional on employment, strongly defers retirement, while alternative sources of insurance such as retiree HI, spouse's HI, or public HI, encourages labor force exit. The scheduled increases in the full retirement age for Social Security acts to encourage younger cohorts to work longer.

Key words: Retirement, Social Security, Defined Benefit and Defined Contribution Plans, Health Insurance, Business Cycle

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1. Introduction

The factors affecting workers' retirement behavior have attracted much attention among academia and policy makers. This issue deserves particular research and in-depth understanding, given recent developments such as the decline in defined benefit (DB) pension plans and the shift to defined contribution (DC) plans in the past decades, ongoing and proposed Social Security (SS) reforms, and exploding health care costs for retirees as well as for workers.

This paper investigates the determinants of retirement behavior among older workers that were surveyed by the Health and Retirement Study (1992-2004). Our analysis, by including comprehensively both conventional explanatory variables and new measures to reflect recent environmental changes and new insights, revisits issues deemed important in previous studies and makes new contributions to the retirement literature.

It is found that increases in all categories of wealth accumulation (pension, housing equity and other financial wealth) increase the probability of retiring, while good earnings prospects, implying high opportunity cost for retirement, induce continued employment.¹ This is the classic relationship between substitution effect and income effect shown in the case of retirement.

¹ The concepts of "option value" in Stock and Wise (1990) and "peak value" in Coile and Gruber (2000) similarly argue that it is rational for workers to continue employed until certain ages in order to maximize pension wealth accrual.

Retirement plan types have significant impacts on retirement: besides the almost universal Social Security, workers who are additionally entitled to DB plan benefits are more likely to retire than those who are not, while the DC plan coverage significantly alters retirement in the opposite direction. This phenomenon is presumably in part because many DB plans have work disincentives beyond certain ages while DC plans are largely age neutral and in part because DB plans provide more security in retirement income.

There is a concern that the retirement behavior of the DC plan covered workers is sensitive to stock market boom and bust. Our analysis incorporates business cycle effects, as part of the total DC plan effect, by including income flow fluctuations that are due to investment performance and market interest rate cycles. These are risks particular to DC plan participants. We find new evidence to support the above hypothesis, that is, the probability and thus timing of retirement for DC plan participants are susceptible to the influence of business cycles. Workers who have significant income loss (gain) in their DC plans are less (more) likely to retire. This may impose some challenges to employers in work force management. When there are market booms, DC plan participants retire just when companies are in the need to add workers and when there are market busts, DC plan participants stay at work just when companies want to cut the workforce.

As for the impact of health insurance (HI) on the retirement decision, our study reveals that HI, if conditional on employment, strongly discourages retirement, while alternative sources of insurance such as retiree HI, spouse's HI, or public HI, facilitate or may

encourage labor force exit. This finding highlights the importance for employers, in pursuit of strategies for human resource management, to consider retirement incentives inherent in pension plans jointly with the benefits provided by other programs such as health insurance. It should also be noted that benefits modifications for retirees (such as enhancing/eliminating retiree health care coverage) may significantly alter the retirement incentive for current employees.

Various studies have investigated the importance of Social Security benefits as an explanation for early retirements. Our analysis finds that the retirement behavior is significantly linked to such public policies. The ongoing increase in the normal retirement age for Social Security will encourage younger cohorts to work longer.

This paper is organized as follows. The next section reviews briefly the relevant literature. Section 3 describes the data. Section 4 discusses the results from the regression analysis and Section 5 concludes.

2. Literature Review

There is a large literature exploring the potential determinants of retirement among older workers. Many theoretical and empirical insightful research findings have contributed to a deeper understanding of this complex issue. Yet, many debates and questions can be answered by new methods and data. This section highlights briefly the most policy-relevant strands of research and does not intend to make the review comprehensive.

One line of research has investigated the importance of wealth accrual and pension coverage on the timing of retirement. Stock and Wise (1990) and Coile and Gruber (2000) argue that workers have an incentive to remain in continued employment if the pension or Social Security accrual remains attractive. Samwick (1998) also finds that the accrual rate of retirement wealth is a significant determinant of the probability of retirement. He argues that the rapidly growing pension coverage and Social Security entitlements since the 1940s could be the underlying cause of the decline in labor force participation in the early postwar period.

A second direction of research looks at the impact of pension types on retirement behavior. Friedberg and Webb (2005) argue that DB plans tend to have age-related work (dis)incentives that first discourage and later encourage retirement, which contribute to early retirement and lead DB covered workers to retire almost two years earlier on average, compared to workers with DC plans. Munnell, Triest, and Jivan (2004) study how pensions affect expected and actual retirement ages. Regarding the actual retirement decision, they find that pension wealth increases the probability of retiring, while the opportunities of pension accruals lower the probability, and that the DB coverage per se raises probability of actual retirement, while DC coverage reduces the probability. Based on survey data about faculty retirement expectations, Flaherty (2006) finds that individuals in DC-only plan situations expect to retire nearly a year later than those in a DB plan, in the context that earlier voluntary enrollments in DB or DC plans by faculty members to some degree reveal their differential preferences.

DB plans provide a steady stream of guaranteed income, while DC plans place participants in considerable exposure to investment risks. The decline in DB plans and the shift to DC plans in the past decades have aroused concern that DC plan covered workers are vulnerable to business cycles or stock market booms and busts. The empirical findings thus far are inconclusive, however. Cheng and French (2000) estimate that about 15 percent of individuals aged 55 and over had an unanticipated wealth increase of \$50,000 or more in constant 1999 dollars between year-ends of 1994 and 1999. However, the labor force participation rates among them increased in this market boom period. The authors believe that the run-up in the stock market was not the primary determinant of employment changes in those years. Among other reasons, the authors conjecture that the changes may well be attributable to the improved employment opportunities and wages in the strong economy and the reduction of work disincentives in the Social Security system. Coile and Levine (2006) focus on aggregate trends in labor supply rather than the wealth effects on individual retirements and find no evidence that stock market changes were the driving force because, first, few households have substantial stock holdings, and second, they must be extremely responsive to market fluctuations to generate the observed aggregate employment reversal in the recession (i.e., an increase in the labor force participation rate for older workers aged 55 to 64 between 2000 and 2002).

By contrast, some other studies find evidence that stock market fluctuations alter retirement behavior. Coronado and Perozek (2003) study the impact of the stock market

boom on retirement decisions, explaining the difference between actual and expected retirement ages among HRS respondents. They find that HRS respondents who held equity prior to the bull market of the 1990s retired, on average, 7 months ahead of their expectations than non-stockholders. The estimate by Hermes and Ghilarducci (2006) on Current Population Survey data shows that the stock market crash since January 2000 caused the labor force participation of older workers aged 55-64 to increase by 2.6 percent and 5.4 percent for men and women, respectively. Their separate estimate on HRS data shows that the probability of retirement for men aged 61-64 with DC plans fell by 10.7 percentage points from 1998 to 2002. However, their results are sensitive to the age ranges selected.²

Another important strand of research is devoted to the effect of health insurance on retirement decisions. Gustman and Steinmeier (1994), based on the modest employer contribution cost to employee HI (\$2,500 per year before age 65), find a small effect of employer-provided health insurance on retirement behavior. Rust and Phelan (1997), explicitly modeling individual risk aversion and a distribution of health care expenditures in a dynamic lifecycle framework, find strong impacts of HI and Medicare on retirement, that is, a significant fraction of “health insurance constrained” individuals “optimally” remain employed to attain HI coverage until they are eligible for Medicare coverage at age 65. Blau and Gileskie (2001) show that the availability of employer-provided retiree health insurance increases the rate of labor exit. Blau and Gileskie (2003) similarly show that the access and restrictions to retiree health insurance and Medicare have a modest

² The magnitude and sign of the interaction term between DC coverage and year 2002 in their nonlinear probit model is conditional on the independent variables. See Ai and Norton (2003) for a discussion.

impact on employment behavior. French and Jones (2004) argue that the value of employer-provided HI not only lies in cost reduction but also uncertainly reduction for employees. Their simulations project that an increase in Medicare eligibility age will significantly delay retirement, if workers have no other source of insurance but that tied to employment. Rust (2005) simulates faculty retirement decisions and shows that an elimination of the retiree health plan (or a substantial reduction of its generosity) as a cost-cutting measure may significantly reduce the incentive for the existing faculty to retire. Mulvey and Nyce (2005) show that, besides DB pension plans, the availability of retiree health insurance boosts the likelihood of early retirement and that linking employer-paid insurance premium to service tenure would mitigate such early exit.

3. The Data

In this analysis, we use the longitudinal, cross-section data from the Health and Retirement Study waves 1992-2004. The HRS dataset is representative of the national population of older workers and retirees and provides detailed information on demographics, health and insurance coverage, income and wealth, and employment or retirement status about Americans over the age of 50.³ The HRS respondents and their spouses are (re)interviewed every two years. We exclude those observations that lack a work-retirement transition. Specifically, the “AHEAD” cohort respondents (born in 1924) and early baby boomers (born in 1948-1953) are dropped because the former were generally already in the retirement phase when surveyed while the latter were added to HRS survey in 2004 and therefore have only one observation. We focus on the retirement

³ Source: <http://hrsonline.isr.umich.edu>. The data and documentation are the Rand version G.

behavior of older workers with private sector and exclude public workers (based on the job with longest tenure). The analysis is focused on the retirement decision for those respondents aged between 50 and 75.

The final data sample consists of the following cohorts: HRS (born in 1931-1941) with survey data 1992-2004, Children of Depression (born in 1924-1930) with survey data 1998-2004, and War Babies (born in 1942-1947) with survey data 1998-2004. Each respondent therefore has up to 7 (years) observations. The implicit assumption is that retirement is reversible – survey respondents may return to work after retirement.

Retirement is presumably a complex decision-making process. Various economic and demographic factors are expected to jointly influence and facilitate the transition from employment to retirement, and a reversal when applicable. We estimate a probit regression model to identify factors that may help explain the probability of retirement at any age. As retirement behavior is person- or household-specific, demographic characteristics naturally play an important role. In the empirical study, we first control for such factors as age, gender, educational attainment level, marital status, spouse employment status, good or bad health, self-employment, occupation, union membership, and longevity expectation. Particularly interesting are the impacts of the following broader environmental factors: retirement plan coverage, vulnerability of DC plan accounts to business cycle, wealth adequacy, earnings prospect, Social Security rules, and health insurance coverage.

The Appendix describes the construction of all variables used in the regression analysis. Table 1 below summarizes the basic data statistics of HRS respondents who are eventually entered in the regressions. The HRS respondent-level weights are used in the regressions to make the analysis nationally representative. All wealth and income values are in constant 2004 dollars and the unit of measurement is \$10,000.

[Table 1 here]

4. Empirical Results: Explaining the Probability of Retirement

In the probit regression model, the binary dependent variable takes value 0 or 1, indicating that the survey respondent is employed or retired, respectively, if the HRS labor force participation data indicates so. We group partial and full retirements together. A respondent is also classified as retired if he/she is older than 65 but the labor force participation status is missing, if disabled or not in labor force but older than 62, or if disabled, younger than 62 and receiving Social Security Disability Insurance benefits. The variable value of 0 otherwise indicates full- or part-time employment including those unemployed but looking for a full time job.⁴ The regressors are those relevant variables listed above. Table 2 below reports the complete regression results for alternate specifications, i.e., the probit marginal effects for all variables, most of which are statistically significant at 1 or 5 percent level and others at 10 percent. The pseudo R^2 is approximately 0.30 in all regressions, which suggests that our econometric specifications

⁴ The separation of partial employment from partial retirement is directly based on the HRS definition: “If he/she is working part-time and mentions retirement,” the labor force status of the survey respondent “is set to partly retired” and “if there is no mention of retirement,” the status “is set to working part-time”. Source: RAND HRS Data Documentation, Version G, March 2007, p.1035.

fit the data reasonably well. We highlight the key findings in the benchmark Specification 1 that may be more policy relevant.

[Table 2 here]

Retirement Plan Coverage. The recent changes in private pension systems, especially the increasing reliance on DC plans for the provision of retiree benefits, have attracted widespread interest regarding whether the shift is shaking up retirement patterns. DB plans use a predetermined formula to calculate employee benefits based on their salary and number of service years. Regardless of capital market conditions, in a traditional DB plan, retirees receive a steady flow of income benefits for as long as they are alive. DC plan participants, by contrast, bear the investment risk and the longevity risk. The uncertainty of retirement account accumulations and the risk of outliving funds may induce DC plan participants to become more cautious in their work decisions.

We identify the retirement plan coverage based on the implicit or explicit value of wealth, which is attributable to all work histories, not necessarily confined to current job.

Specifically, a person is covered by a DB plan if the present value of his/her future or current DB benefits is greater than zero. Similarly, a positive DC account balance means that there is DC coverage. In the regression, we find that DB pension plan coverage has a significantly positive effect on the retirement hazard. Besides the almost universal coverage by Social Security, workers who are additionally entitled to DB plan benefits are more likely to retire than those who are not, with the probability of retiring at any age being 3.9 percent higher. The impact of DC plan coverage differs, however, in a negative

manner and is also statistically significant. Workers, whose non-S.S. retirement income is mainly DC plan wealth, exhibit a lower labor force exit probability by 3.8 percent.

Wealth Adequacy. The standard life cycle theory postulates that retirement is the wealth decumulation phase in contrast to the wealth creation phase in the working years. Wealth adequacy, among other things, determines whether such a transition is desirable and whether a reasonable lifestyle can be maintained in the retirement years, which are ever-increasing in cost with continued health care cost inflation.

Wealth is defined at the household level, as reported in the HRS. This measure is probably valid because retiring household members may consider the whole family economic situation as the background rather than the wealth held separately under each household member's name. Nevertheless, we adjust the household wealth for household size in an alternative specification. The results are not sensitive to these different wealth measures (see *Robustness Tests* at end of this section).

We include four categories of wealth in the regression without *a priori* imposing a common coefficient on any form of wealth. Social Security and DB plan wealth, both in the form of present discounted value of future benefit payouts, are pooled together given their similar annuity nature. DC wealth includes both DC plan and IRA account balances. Net housing equity refers to the value of primary and secondary houses less mortgages and home loans. Non-housing financial wealth includes all other household financial assets net of debt, excluding housing equity and IRAs. The regression result shows that

all types of wealth help facilitate or perhaps encourage retirement, which is by no means surprising. An improvement in wealth adequacy, for instance, a \$100,000 windfall in the above four categories, would imply higher probability of retiring by approximately 0.8 percent, 0.3 percent, 0.1 percent and 0.2 percent, respectively.

Earnings Prospect or Opportunity Cost. Individuals are compensated when they are working and their labor earnings typically form the major source for consumption and savings. The transition to a full (partial) retirement implies the cessation (reduction) of such earnings, which can be viewed as the opportunity cost for retirees. The higher the earnings prospect, the higher is the opportunity cost. Presumably, the probability of retirement is lower when the marginal gain of working an extra year is large. In our construction, the opportunity cost for a switch to a partial retirement is the full-time earnings last year, while the opportunity cost for a complete labor force exit is the previous full- or part-time earnings, depending on whether he/she was working full or part time last year

The opportunity cost is also adjusted by a growth/depreciation factor estimated on the CPS March surveys 1989-2007 by gender and age. The calculation of growth factors is immune to cohort differences in earnings levels and is aggregated across cohort age-earnings profiles.⁵ For instance, the annual earnings reduction for male workers aged 70 averages 1 percent in real terms.

⁵ The earnings growth/depreciation factors are calculated in several steps: 1) calculate average full-time earnings of workers by age and gender for each cohort (e.g. age-25 workers in CPS1989, age-26 workers in CPS1990, ... and age-44 workers in CPS2007 are considered as one birth cohort); 2) calculate earnings growth rate at each age for each cohort; 3) average growth rates across birth cohorts; 4) use a polynomial of

The regression shows that an earnings prospect of \$100,000, implying significant opportunity cost for retirement, would reduce the probability of retiring by roughly 1.7 percent, other things equal.

Social Security Rules. The U.S. population is aging and fewer workers are projected to contribute to the Social Security system relative to the number of beneficiaries, which is deemed financially unsustainable absent reforms on current payroll contribution rates and benefit payout levels. As one of the measures already being used to improve the S.S. financial solvency, the full (normal) retirement age (FRA) is being gradually increased from 65 to 67. Various studies have conjectured that this move will induce more employment among the older workers.

To capture the impact of Social Security rules on retirement behavior, we include the early retirement benefit reduction factor in percentage terms as a regressor (negative values). This variable is simply the permanent actuarial benefit reduction factor defined by SSA based on birth year if a person claims Social Security earlier than FRA. For instance, it takes value -20 percent if a person born in 1937 with FRA 65 starts claiming S.S. benefit at age 62, -13.3 percent at age 63, -6.7 percent at age 64 and 0 percent at age 65, while a person born in 1938 and a person born in 1960 who start claiming S.S. at age 62 would receive less S.S. benefits by 20.83 percent and 30 percent, respectively, because their FRAs are 65 and 2 months and 67, respectively.

age to fit the observed growth rates; and 5) these fitted and smoother growth rates are the factors used for the adjustment on opportunity cost.

The regression result suggests that a reduction of 10 percentage points in S.S. benefit implies a lower probability of retiring by approximately 1.7 percent. Perhaps the easiest way to interpret this effect is look at the possible retirement decisions between the 1937 and 1943 birth cohorts, for instance. Their FRAs are 65 and 66, respectively. Their respective benefit reductions are 20 percent and 25 percent at the earliest retirement age 62. This 5 percent difference imposed by the 1 year difference in FRA would imply a lower probability of retiring at age 62 for the 1943 cohort by almost 1 percent, *ceteris paribus*. That is, younger cohorts will probably exhibit less early retirement.

Implication of Business Cycle for DC plan participants. Compared to DB plans, DC plan values are vulnerable to business cycles. Though DC participants may have the chance to skim substantial investment returns in a booming capital market, their retirement transition may turn out to be quite bumpy when investment performance is poor. In addition to the possible shrinkage of DC wealth, a DC participant is also faced with market fluctuations of interest rates if she/he were to purchase a life annuity, a necessary product for insurance against longevity risk.

To reflect the effects of business cycle and the timing of annuity purchase, we calculate the annuity payouts that can be generated by the DC wealth at market annuity prices, expressed as a percentage of average earnings over survey years 1992-2004. In the calculation, a joint and survivor life table is used (full benefit to survivor). Interest rates are the going 30-year Treasury bond rates in the survey years. A higher replacement rate

implies better preparation for retirement. To isolate the timing effect, the same duration of annuity payout is used (age 65 to 100) regardless of the respondent's age; otherwise this variable would include the age effect.

This variable has a statistically significant effect on retirement. Specifically, a 10 percent drop in the replacement rate, due to poor investment performance on DC wealth or due to hike in market annuity purchase price, implies a lower probability of retirement in any year by approximately 1 percent.

Health Insurance. For many workers, employer sponsored health insurance is an integral part of the benefits package. Such health insurance coverage may be particularly valuable among the older workers because the probability of falling ill and the risk of suffering catastrophic health care costs generally increase with age. Health care costs and insurance premiums have been on an upward trend in recent decades. Absent employer sponsorship or another source of support, workers upon retirement may face steep increases in health and insurance costs, which is likely to discourage retirement or early retirement. On the other hand, if an employer provides retiree health insurance (RHI), its employees need not be tied to continued employment and thus have more flexibility in retirement timing. Alternatively, a worker covered by a health insurance via his/her spouse's employer also has such flexibility.

Another critical channel of health insurance is through the government-run public insurance and welfare programs. For instance, Medicare, a federal health insurance

program, covers most people age 65 or older and some people younger than 65 with disabilities. Medicaid covers people with limited income or resources for a living. These public programs help support and may actually encourage retirement beyond a certain age (like 65 for the case of Medicare).

In the regression analysis, we include a dummy variable to indicate whether a HRS respondent is covered by health insurance via his/her own employer. This is an employment-based HI coverage. A separate dummy variable reflects whether the respondent has access to HI coverage that is not tied to employment, that is, he/she is eligible to retiree HI coverage by his/her previous or current employer, or he/she is covered by the health plan sponsored by his/her spouse' employer. Another dummy variable is used to indicate whether the respondent is covered by Medicare, Medicaid, VA/CHAMPUS or other government health insurance. It is observed that these types of HI coverage work as substitutes – many workers switch to an HI coverage delinked to employment, in working years as well as upon retirement. As public HI mainly eases life in retirement, the RHI and spouse's HI coverage help bridge the transition from employment to early retirement if a worker is not eligible for Medicare yet.

The regression result shows that health insurance coverage, if conditional on employment, significantly discourages retirement – the probability of retiring in any year being approximately 16.5 percentage points lower. When HI coverage is available through own employer RHI or spouse's HI, the worker is more likely to retire – the probability roughly 7.8 percentage points higher. Government sponsored HI programs have an unsurprisingly

positive effect on retirement – approximately a 16.2 percentage points higher probability of retirement for those under such coverage.

A plausible inference from this finding is that, for an employer to strategically manage human resources, enhancing or eliminating health care coverage for its retirees may have significant impact on current employees' retirement incentive. This finding also highlights the importance of integrating retirement incentives in pension plans with the benefits provided by health insurance.

Demographics. Various demographic variables, which are from the HRS surveys and included in the regression, are found to have an influence on retirement decisions. The probability of retirement naturally increases when workers get older (about 3.1 percent for one year increase in age). Workers who have higher educational attainment, are male, have bad health, or are union members, tend to have higher probabilities of retiring at any age. Self-employed workers and married workers are more likely to work longer. On the other hand, married workers often show some accord in the retirement timing with their spouses – workers have a greater tendency to stop working when their spouses are retired. Life expectancy affects retirement decision – workers who anticipate a good chance of living to advanced ages are more likely to retire later.

Robustness Tests. To check the robustness of our regression results, we test various specifications. Specifically, we allow for possible nonlinear effect of age by including age squared, age cubed (Specification 2 in Table 2), and dummy variables for some

specific ages, adjust wealth for married couples to account for their joint consumption by dividing their household wealth in all categories by square root of 2 (Specification 3), exclude observations on spouses to restrain the regressions on one person in the same household (Specification 4), run an ordered probit model to treat partial and full retirements separately, run a random effects probit model on the panel data,⁶ subtract the self-reported employer and employee contributions from the calculation of DC wealth-earnings replacement rate to further isolate the business cycle impact, and use an additional variable to reflect retirement age flexibility in DB plans (defined as the difference between earliest and full retirement ages, perhaps an indication of early retirement incentives).⁷ These alternate specifications only slightly change the magnitudes of coefficients and maintain the same signs.⁸

5. Conclusions

This paper identifies empirically the critical determinants of retirement behavior of older workers, after carefully controlling for demographic factors. It shows that the likelihood of retirement increases with wealth adequacy and decreases with improved employment opportunities and earnings prospects. More importantly, the findings in this study may suggest that the labor force participation pattern is now undergoing significant transition. Workers under defined contribution plans tend to retire later and their timing of

⁶ Fixed effects probit model is inappropriate because it fails to distinguish the effects of those time-invariant variables. Random effects probit model, however, may yield inconsistent estimates because the assumption that the regressors are independent of error terms does not necessarily hold.

⁷ The testing power of the last two experiments may be weakened by the limited data availability. This analysis uses the self-reported DC plan contributions in the public HRS data. It is also difficult to directly identify whether DB benefit payouts are actuarially favorable for early retirees.

⁸ All results are available from authors upon request.

retirement is sensitive to business cycles. Changes in the Social Security rules such as a hike of normal retirement age will push for a longer work career for the younger cohorts. Exploding health care costs make employer-sponsored health insurance increasingly valuable, which, in the context of the elimination of retiree health insurance by some employers,⁹ may turn out to strongly induce continued employment until the eligibility for Medicare.

Employers, when crafting benefit packages to strategically manage human resources (and policy makers, when designing public policies to improve worker well-being), need to take into account all benefits programs in an integrated manner. To retain older but still productive workers and promote an orderly retirement process, employers may want to carefully tailor their retirement schemes to meet both corporate and employees' needs in a dynamic and competitive labor market.

⁹ Mulvey and Nyce (2005, p.119), for instance, document that the share of medium and large employers that sponsored some retiree health insurance declined from over 80 percent before 1980 to only 40 percent by 2003.

References

- Ai, Chunrong and Edward C. Norton. 2003. "Interaction Terms in Logit and Probit Models," *Economics Letters*, vol. 80, pp. 123-129.
- Blau, David M. and Donna B. Gilleskie. 2001. "Retiree Health Insurance and the Labor Force Behavior of Older Men in the 1990s," *Review of Economics and Statistics*, vol. 83(1), pp. 64-80.
- Blau, David M. and Donna B. Gilleskie. 2003. "The Role of Retiree Health Insurance in the Employment Behavior of Older Men," NBER Working Paper No. 10100.
- Cheng, Ing-Haw and Eric French. 2000. "The Effect of the Run-Up in the Stock Market on Labor Supply," *Economic Perspectives*, Issue Quarter IV, pp. 48-65.
- Coile, Courtney, C. and Jonathan Gruber. 2000. "Social Security Incentives for Retirement," NBER Working Paper No. 7651.
- Coile, Courtney C. and Phillip B. Levine. 2006. "Bulls, Bears, and Retirement Behavior," *Industrial and Labor Relations Review*, vol. 59(3), pp. 408-429, April.
- Coronado, Julia Lynn and Maria Perozek. 2003. "Wealth Effects and the Consumption of Leisure: Retirement Decisions during the Stock Market Boom of the 1990s," Finance and Economics Discussion Series No. 2003-20, Board of Governors of the Federal Reserve System.
- Flaherty, Colleen. 2006. "The Impact of Pension Plan Type on Expected Retirement Age," Working Paper, Stanford University.
- French, Eric and John Bailey Jones. 2004. "The Effects of Health Insurance and Self-Insurance on Retirement Behavior," Working Paper No. 2004-12, Center for Retirement Research at Boston College.
- Friedberg, Leora and Anthony Webb. 2005. "Retirement and the Evolution of Pension Structure," *Journal of Human Resources*, Spring, Vol. 40 (2), 281-308.
- Gustman, A., and T. Steinmeier. 1994. "Employer-Provided Health Insurance and Retirement Behavior," *Industrial and Labor Relations Review*, 48(1), 124-140.
- Hermes, Sharon and Teresa Ghilarducci. 2006. "The Effect of the Stock Market Crash on Retirement Decisions," Department of Economics Working paper, University of Notre Dame.
- Mulvey, Janemarie and Steven Nyce. 2005. "Strategies to Retain Older Workers," in Robert L. Clark and Olivia S. Mitchell (editors) *Reinventing the Retirement Paradigm*, pp.111-132, Oxford University Press, New York.

Munnell, Alicia H., Robert K. Triest and Natalia A. Jivan. 2004. "How do Pensions Affect Expected and Actual Retirement Ages," Working Papers, Center for Retirement Research at Boston College 2004-27, Center for Retirement Research.

Rust, John and Christopher Phelan. 1997. "How Social Security and Medicare Affect Retirement Behavior in a World of Incomplete Markets," *Econometrica*, 65(4), 781-831.

Rust, John. 2005. "Impact of Retiree Health Plans on Faculty Retirement Decisions," in Robert Clark and Jennifer Ma (editors) *Recruitment, Retention and Retirement: The Three R's of Higher Education in the 21st Century*, pp. 135-169, Edward Elgar Northhampton, Massachusetts.

Samwick, Andrew. 1998. "New Evidence on Pensions, Social Security, and the Timing of Retirement," *Journal of Public Economics*, Vol. 70, 99.207-36.

Stock, James H. and David A. Wise. 1990. "Pensions, the Option Value of Work, and Retirement," *Econometrica*, Vol. 58, No. 5 (September), pp. 1151-1180.

Appendix: Data and Variable Description

The data source is the Health and Retirement Study waves 1992-2004 (Rand version G). The table below describes the construction of all variables used in the regressions. All dollar values are in constant 2004 terms and the unit is \$10,000.

Variable Name	Definition
<i>Binary Dependent Variable</i>	
Retirement	This variable equals to 1 if a respondent is partially or fully retired when the labor force participation data indicates so. He/she is also treated as retired if he/she is older than 65 but the labor force status is missing, if disabled or not in labor force but older than 62, or if disabled, younger than 62 and receiving Social Security Disability Insurance benefit. The observation is dropped if the respondent is not in labor force and younger than 62. The variable is equal to 0 otherwise, including those unemployed but looking for a full time job.
<i>Retirement Plan Coverage</i>	
DB only	(omitted reference: Social Security coverage only) Dummy variable equal to 1 if the respondent is covered by DB plan only (based on DB & DC wealth), 0 otherwise
DC only	Dummy variable equal to 1 if the respondent is covered by DC plan only (based on DB & DC wealth), 0 otherwise
Both DB and DC	Dummy variable equal to 1 if the respondent is covered by both DB and DC plans (based on DB & DC wealth), 0 otherwise
<i>Wealth (\$10,000)</i>	
SS&DB Wealth	Household wealth in Social Security and DB pension plan (present discounted value)
DC Wealth	Household wealth in DC plan and IRAs
Net Housing Equity	Value of primary and secondary houses less mortgages and home loans.
Non-Housing Financial Wealth	Total household assets – all debt – housing equity, excluding IRA
<i>Impact of Business Cycle</i>	
DC Replacement Rate	This variable is the annuity payouts that can be generated by the DC wealth at market annuity prices, expressed as a percentage of average earnings over survey years 1992-2004. It reflects the effects of business cycle and the timing of annuity purchase. A higher replacement rate implies better preparation for retirement. In the annuity calculation, a joint and survivor life table is used (full benefit to survivor). Interest rates are the going 30-year Treasury bond rates in the survey years. To isolate the timing effect, the same duration of annuity payout is used (65-100) regardless of the respondent's age; otherwise this variable would include the age effect.
<i>Social Security Impact</i>	
Early Retirement Benefit Reduction (%, non-positive value)	(partially cohort effect) This is the permanent actuarial benefit reduction factor in percentage if the respondent claims Social Security earlier than full retirement age (FRA) defined by SSA based on birth year. For instance, it takes value -20% if a person born in 1937 starts claiming S.S. benefit at age 62, -13.3% at age 63, -6.7% at age 64 and 0% at age 65, while a person born in 1938 and a person born in 1960 who start claiming S.S. at age 62 would receive less S.S. benefits by 20.83% and 30%, respectively, because their FRAs are 65 and 2 months and 67, respectively. This variable is set to -50% for respondents younger than 62 because they are not eligible for S.S. The regression results are not sensitive to alternative value, say, -100%.

Variable Name	Definition
<i>Earnings Prospect (\$10,000)</i>	
Earnings or Opportunity Cost	<p>This variable reflects the earnings if the respondent chooses to work or opportunity cost if she chooses to retire.</p> <p>For a full-time worker, this variable equals earnings (wage/salary income + bonuses/overtime pay/commissions/tips + 2nd job or military reserve earnings, professional practice or trade income). The opportunity cost for a switch to a partial retirement is the full-time earnings last year, while the opportunity cost for a full retirement is the previous full- or part-time earnings, whichever applicable.</p> <p>In the construction of opportunity costs, previous earnings are adjusted by a growth/depreciation factor, which is calculated on CPS March surveys 1989-2007 by gender and age.</p>
<i>Health Insurance Coverage</i>	
HI conditional on R's employment	Dummy variable equal to 1 if the respondent is covered by health insurance via his/her own employer, 0 otherwise.
HI unconditional on R's employment	Dummy variable equal to 1 if the respondent is covered by retiree health insurance via his/her own employer, or by his/her spouse's HI or retiree HI, 0 otherwise.
HI via public program	Dummy variable equal to 1 if the respondent is covered by Medicare, Medicaid, VA/CHAMPUS or other government health insurance, 0 otherwise.
<i>Demographics</i>	
Age	Actual age
Male	Dummy variable equal to 1 if the respondent is male, 0 otherwise.
Bad Health	Dummy variable equal to 1 if self-reported health status is fair or poor, 0 otherwise (good, very good, and excellent).
Current Job Physically Challenging	Dummy variable equal to 1 if current job requires lots of physical effort, lifting heavy loads, or stooping/kneeling/crouching), 0 otherwise. The value for retirees is determined by their previous job.
Union Member	Dummy variable equal to 1 if the respondent is covered by labor union, 0 otherwise. The value for retirees is determined by their previous job.
Married	Dummy variable equal to 1 if the respondent is married, 0 otherwise.
Spouse Retired	Dummy variable equal to 1 if the respondent's spouse is retired, 0 otherwise.
Self Employed	Dummy variable equal to 1 if the respondent is self employed, 0 otherwise.
High School Diploma or GED	Dummy variable equal to 1 if the respondent has high school or GED degree, 0 otherwise.
Some College Education	Dummy variable equal to 1 if the respondent has some college education (degree less than a BA), 0 otherwise.
College Degree and above	Dummy variable equal to 1 if the respondent has a BA degree or greater, 0 otherwise.
	<i>The omitted category is education less than high school.</i>
Longevity Expectation	Self-reported subjective probability (0 – 100%) of living to age 75+.
Source: Authors' constructions based on Health and Retirement Study 1992-2004 survey data.	

Table 1 Summary Data Statistics

Variable	Median	Mean	Std. Dev.	Min	Max
Retired	0	0.23	0.42	0	1
Age	59	58.42	4.19	50	74
Male	0	0.46	0.50	0	1
Married	1	0.75	0.43	0	1
Spouse retired	0	0.22	0.41	0	1
Self-Employed	0	0.13	0.34	0	1
Bad health	0	0.13	0.34	0	1
Current job physically challenging	0	0.23	0.42	0	1
Union member	0	0.22	0.41	0	1
High school degree or GED	0	0.38	0.49	0	1
Some college education	0	0.23	0.42	0	1
College degree and above	0	0.24	0.43	0	1
Probability of living to age 75+ (%)	75	67.77	26.84	0	100
S.S. early retirement benefits reduction (- %)	-50	-39.30	17.98	-50	0
DB coverage only	0	0.17	0.37	0	1
DC coverage only	0	0.30	0.46	0	1
Both DB and DC coverage	0	0.35	0.48	0	1
Health insurance, conditional on employment	1	0.62	0.49	0	1
Health insurance, unconditional on employment	1	0.58	0.49	0	1
Health insurance, public	0	0.10	0.29	0	1
Social Security Wealth (PDV)	16.04	17.02	7.46	0	69.1
Defined Benefit pension wealth (PDV)	14.34	24.30	34.76	0	1510.1
S.S. + DB Wealth (PDV)	21.67	29.15	29.40	0	1546.2
Defined Contribution plan wealth	1.51	8.15	23.40	0	2265.8
Net housing equity	8.36	12.36	30.47	-655.3	2390.1
Non-housing financial wealth	1.90	10.20	42.96	-91.9	3675.5
Total household wealth	42.66	59.86	78.57	-634.1	4791.7
Earnings prospect or Opportunity cost	3.27	4.25	5.67	0	419.8
Total household income	6.14	8.33	11.70	0	781.0
DC wealth-earnings replacement rate (%)	2.91	16.03	43.69	0	398.4

Note: 1. Wealth and income variables are in constant 2004 terms and the unit is \$10,000.

2. Source: Authors' calculations based on Health and Retirement Study 1992-2004 survey data.

Table 2 Probit Regression Results – Marginal Effects on Retirement Decision
Binary Dependent Variable: 1 = retired, 0 = not retired

Independent Variable	Specification 1		Specification 2		Specification 3		Specification 4	
	dF/dx	z	dF/dx	z	dF/dx	z	dF/dx	z
DB Coverage Only	0.03904	3.95***	0.03896	3.98***	0.03624	3.66***	0.03910	3.33***
Both DB & DC Coverage	-0.02702	-2.96***	-0.02624	-2.91***	-0.02931	-3.20***	-0.02498	-2.28**
DC Coverage Only	-0.03828	-4.85***	-0.03689	-4.73***	-0.03873	-4.91***	-0.04398	-4.43***
S.S.+DB Wealth (PDV)	0.00078	4.49***	0.00077	4.46***	0.00111	4.88***	0.00096	4.44***
DC Wealth	0.00030	1.69*	0.00031	1.77*	0.00033	1.37	0.00055	1.95**
Net Housing Equity	0.00014	1.98**	0.00013	1.91*	0.00022	2.34**	0.00030	2.26**
Non-Housing Financial Wealth	0.00020	2.37**	0.00019	2.37**	0.00018	1.79*	0.00008	0.82
Earnings Prospect or Opportunity Cost	-0.00168	-1.95*	-0.00166	-1.95*	-0.00168	-1.89*	-0.00131	-1.46
DC Wealth-Earnings Replacement Rate (%)	0.00088	11.43***	0.00086	11.33***	0.00089	11.68***	0.00093	8.53***
S.S. Early Retirement Benefit Reduction (-%)	0.00172	7.98***	0.00383	10.64***	0.00173	8.00***	0.00174	6.67***
Health Insurance, conditional on Employment	-0.16498	-24.98***	-0.16250	-24.91***	-0.16478	-24.95***	-0.17839	-20.27***
Health Insurance, unconditional on Employment	0.07767	14.28***	0.07498	13.96***	0.07681	14.11***	0.08302	12.22***
Health Insurance, Public	0.16199	16.55***	0.18215	17.78***	0.16267	16.60***	0.17673	14.56***
Age	0.03056	24.79***	-0.17294	-0.38	0.03059	24.82***	0.02858	19.16***
Age Squared	--	--	0.00555	0.71	--	--	--	--
Age Cubed	--	--	-0.00004	-1.00	--	--	--	--
High School Degree or GED	0.02643	3.53***	0.02669	3.62***	0.02591	3.46***	0.02469	2.67***
Some College	0.02349	2.74***	0.02371	2.80***	0.02297	2.68***	0.02031	1.95*
College and Above	0.02966	3.21***	0.02986	3.28***	0.02947	3.19***	0.02560	2.30**
Male	0.03955	6.66***	0.03843	6.56***	0.03975	6.71***	0.04186	5.82***
Bad Health	0.09899	12.42***	0.09648	12.23***	0.09935	12.46***	0.10055	10.67***
Current Job Physically Challenging	-0.01904	-3.24***	-0.01908	-3.30***	-0.01916	-3.26***	-0.03133	-4.41***
Union Member	0.01631	2.39**	0.01615	2.40**	0.01568	2.3**	0.01881	2.25**
Married	-0.06307	-8.98***	-0.06166	-8.89***	-0.05082	-7.07***	-0.05269	-6.39***
Spouse Retired	0.16377	22.69***	0.16108	22.59***	0.16413	22.71***	0.15875	16.00***
Self-Employed	-0.05886	-7.05***	-0.05826	-7.11***	-0.05936	-7.12***	-0.05608	-5.40***
Probability of Living to age 75+	-0.00025	-2.64***	-0.00025	-2.62***	-0.00025	-2.59***	-0.00039	-3.41***

	<u>Specification 1</u>	<u>Specification 2</u>	<u>Specification 3</u>	<u>Specification 4</u>
No. of Obs.	31634	31634	31634	21124
obs. P	0.22	0.22	0.22	0.21
pred. P (at x-bar)	0.15	0.15	0.15	0.15
Wald Chi2	5391.7	5393.5	5402.3	3423.4
Prob > chi2	0.00	0.00	0.00	0.00
Log pseudo likelihood	-11682.1	-11651.0	-11676.7	-7742.4
Pseudo R2	0.2995	0.3014	0.2998	0.2933

Note:

1. Wealth and income variables are in constant 2004 terms and the unit is \$10,000.
2. Specification 2 allows for non-linear effect of age; Specification 3 adjusts wealth by dividing household wealth by square root of 2 for married couples; and Specification 4 drops observations on spouses and adjusts household wealth for married couples as in Specification 3.
3. The HRS respondent-level weights are used in the probit regressions.
4. *, **, and *** denote significance at the 0.10, 0.05, and 0.01 level, respectively.
5. Source: Authors' regression results based on Health and Retirement Study 1992-2004 survey data.