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The Effects of Retirement on Physical and Mental Health Outcomes

Abstract

While numerous studies have examined how health affects retirement behavior, few have analyzed the impact of retirement on subsequent health outcomes. Using the Health and Retirement Study (1992-2005), this paper estimates the effects of retirement on health status as measured by indicators of physical and mental health. To account for biases due to unobserved selection and endogeneity, panel data methodologies are used, augmented by counterfactual and specification checks to gauge the robustness of the estimates. Results indicate that complete retirement leads to a 5-16 percent increase in difficulties associated with mobility and daily activities, a 5-6 percent increase in illness conditions, and 6-9 percent decline in mental health. Retiring at a later age may lessen or postpone poor health outcomes for older adults, raise well-being, and reduce the utilization of health care services.

1. Introduction

Despite rising life expectancy, the average age at retirement has been declining over the past four decades. Social security data indicate that the retirement age for men declined from 68.5 to 62.6 years, and that for women declined from 67.9 to 62.5 years (Gendell 2001).[1] In a recent study, Gruber and Wise (2005) note that many countries have benefit structures that discourage work by lowering lifetime benefits to people who work longer. There are strong incentives to retire built into the U.S. Social Security system as well as many private pensions (Quadagno and Quinn 1997). With an aging population retiring earlier, Social Security will pay out more in benefits than it collects in payroll taxes by 2018, and these deficits are expected to exhaust the trust fund by 2042. The unfunded liability facing Medicare is six times that of Social Security, and the hospital trust fund will be depleted far sooner than the projected date for Social Security. These trends, and the financial difficulties facing Medicare and Social Security, have prompted policymakers to press for several reforms including an increase in the retirement age.[2]

Whether early retirement is individually or socially optimal depends on how retirement affects subsequent health status, among other things. While numerous studies have examined the effects of changes in health on retirement behavior, research on how retirement impacts health status has been sparse. Using seven longitudinal waves of the Health and Retirement Study (HRS), spanning 1992 through 2005, the objective of this study is to analyze the effects of full retirement on outcomes related to physical and mental health. We are careful in noting that the effect we are analyzing is not that of retirement per se, but rather the change in environment that encompasses retirement, leading an individual to invest more or less in his or her health. While we distinguish voluntary versus involuntary retirement, the behavioral framework suggests that even if retirement is voluntary, individual investments in health may respond to changes in incentives post-retirement. If retirement improves health outcomes, then evaluation of policies that prolong retirement should

account for the effect on health. Results indicate that complete retirement leads to a 5-16 percent increase in difficulties associated with mobility and daily activities, a 5-6 percent increase in illness conditions, and 6-9 percent decline in mental health, over an average post-retirement period of six years. Models indicate that the effects tend to operate through lifestyle changes including declines in physical activity and social interactions. The adverse health effects are mitigated if the individual is married and has social support, continues to engage in physical activity post-retirement, or continues to work part-time upon retirement. Some evidence also suggests that the adverse effects of retirement on health may be larger in the event of involuntary retirement.

2. Relevant Studies

The decision to retire is affected by a number of factors, including the availability of health insurance, Social Security eligibility, financial resources, and spousal interdependence. Several studies have also pointed to health status as a significant determinant. Workers in poor health, who suffer from activity limitations and chronic health conditions, are found to retire earlier than those who are healthy (Belgrave, Haug, and Gómez-Bellengé 1987). Dwyer and Mitchell (1999), using data from the HRS, find that health problems influence retirement behavior more strongly than economic factors. Correcting for the potential endogeneity of self-rated health due to "justification bias," men in poor overall health expect to retire one to two years earlier. Similarly, McGarry (2004) finds that those in poor health are less likely to continue working than someone in good health. Using data from the HRS, she notes that changes in retirement expectations are driven to a much greater degree by changes in health than by changes in income or wealth. Ettner, Frank, and Kessler (1997) also indicate that psychiatric disorders significantly reduce employment among both genders. Several other studies similarly show that poor health motivates early retirement, though the relative impact of health versus economic factors is debated.[3]

In contrast, very few studies have examined the impact in the other direction – that is, how retirement affects subsequent health. This question takes on added relevance given the shifting trends in labor force attachment, aging of the population, and growth in health care expenditures. Szinovacz and Davey (2004) find that depressive symptoms increase for women post-retirement are reinforced by the presence of a spouse with functional limitations. A recent Whitehall II longitudinal study of civil servants by Mein et al. (2003) compared 392 retired individuals with 618 working participants at follow-up to determine if retirement at age 60 is associated with changes in mental and physical health. Their results indicate that mental health deteriorated among those continuing to work, whereas physical functioning deteriorated for both workers and retirees.

A Kaiser Permanente study of members of a health maintenance organization (ages 60-66) compared mental health and other health behaviors of those who retired with those who did not (Midanik et al. 1995). Controlling for age, gender, marital status, and education, retired members were more likely to have lower stress levels and engage in regular exercise. No differences were found between the groups on self-reported mental health status, coping, depression, smoking, and alcohol consumption.

A follow-up study on 6,257 active municipal employees in Finland found an increase in musculoskeletal and cardiovascular diseases among retired men (Tuomi et al. 1991). Östberg and Samuelsson (1994), on the other hand, find positive effects of retirement on health, as measured by blood pressure, musculoskeletal diseases, psychiatric symptoms, and visits to the physician. Salokangas and Joukamaa (1991) find mental health improvements but no clear effect on physical health in a study of Finnish individuals between the ages of 62 and 66 years. Bossé et al. (1987) examine psychological symptoms in a sample of 1,513 older men. Controlling for physical health status, analyses of variance indicate that retirees reported more psychological symptoms than workers. The role of family income (a correlated of retirement) as a determinant of good physical

and mental health is underscored in Ettner (1996). Using data from the National Survey of Families and Households, the Survey of Income and Program Participation, and the National Health Interview Survey, instrumental variables estimates indicate that income is significantly related to several measures of physical health in addition to measures of depressive symptoms.

While these studies highlight important aspects of the interaction between retirement and health, there is no consensus and the studies are also limited in several respects. Many use self-reported evaluation of health and are based on small selected samples, the results of which may not generalize to the overall population. Most of the studies are also based on individuals in other countries, which have substantially different norms, labor markets, and economic incentives embedded in their pension systems relative to the U.S. Several studies employ a simple cross-sectional comparison between workers and retirees and ignore the heterogeneity between the treatment and control. Data limitations also preclude an extensive set of controls, and many do not account for changes in income or assets post-retirement. Most importantly, none of these studies account for biases due to endogeneity.

The present study exploits seven longitudinal waves of a large-scale population survey of older adults in the U.S. Diverse health measures, including self-rated health and objective functional and illness indicators, are used as the dependent outcomes. The HRS data also allow for a rich set of controls, the exclusion of which may have biased other studies. Panel data methodologies and various specification checks are used to overcome unobserved heterogeneity and endogeneity, and disentangle the causal effect of retirement on subsequent health.

3. Analytical Framework

The objective of this study is to assess the extent to which complete retirement impacts health outcomes. This question can be framed within the human capital model for the demand for health (Grossman 1972), which combines the household production model of consumer behavior

with the theory of human capital investment to analyze an individual's demand for health capital. In this paradigm, we find that the effect of retirement on health status is theoretically ambiguous and thus remains an empirical question.[4]

The Grossman paradigm is a convenient abstraction in that it assumes the individual has full control over their health. Thus a standard critique concerns the lack of uncertainty in the production of health capital. However, these mechanisms suggest that the individual does have some degree of control over their health in support of a behavioral framework – for instance, through social interactions, physical activity and exercise, risky behaviors such as smoking and drinking, diet, and preventive health care utilization. While all health outcomes have varying degrees of uncertainty, the indicators used in this study are found to be responsive to health behaviors and lifestyle factors and therefore have a strong deterministic component.[5] Lifestyle behaviors have been shown to be strong indicators of a variety of health outcomes, including heart disease, depression, diabetes, functional limitations, and other chronic disease (for example, see Brach et al. 2004). Injury is more likely in certain populations given the roles of job demands, living conditions, and lifestyle (Chau et al. 2007). Self-management is key in diseases such as diabetes (Tessier and Lassmann-Vague 2007), and lifestyle changes that affect the metabolic syndrome help to prevent illnesses such as heart disease and stroke (Wong 2007). An abundance of literature also points to lifestyle as a large determinant of obesity, which is associated with a host of morbidities (NIDDKD 1996; Rashad 2006).

Empirically identifying the causal effect of retirement on health is complicated by two issues. First, an individual's retirement behavior and health status may depend on a common set of unobserved factors (for example, life history and time preference). Second, retirement may be endogenous to health. In addition to retirement affecting health outcomes, the literature has also identified causality in the other direction.

Consider linear specifications of the structural demand function for negative health outcomes (H_{it}) and the labor supply function representing retirement (R_{it}):[6]

(3) $H_{it} = \alpha_1 R_{it} + \alpha_2 I_{it} + \alpha_3 X_{it} + \alpha_4 \mu_i + \varepsilon_{it}$

(4) $R_{it} = \beta_1 H_{it} + \beta_2 E_{it} + \beta_3 X_{it} + \beta_4 \mu_i + \eta_{it}$

Equation (3) is a demand function for health (H_{it}), which is a function of retirement (R_{it}), determinants of health such as health insurance (I_{it}), observable characteristics such as age, gender, race, and education (X_{it}), and unobservable characteristics pertaining to the individual, such as family background, tolerance towards risk, and the rate of time preference (μ_i). Equation (4) postulates labor supply in the form of full retirement (R_{it}). The vector E_{it} represents variables specific to the retirement decision, such as employer-provided health insurance and retiree access to health insurance. The vector μ_i denotes unobserved determinants of retirement that may also influence health. The subscripts refer to the i^{th} individual in time period t.

The parameter of interest is α_1, the structural effect of retirement on negative health outcomes. Ordinary least squares estimation of equation (3) may be biased. This is reflected in equation (5), the quasi-reduced form labor supply function, obtained by substitution of equation (3) into equation (4).

(5) $R_{it} = (\alpha_2\beta_1 / 1\text{-}\alpha_1\beta_1)\, I_{it} + (\beta_2 / 1\text{-}\alpha_1\beta_1) E_{it} + (\alpha_3\beta_1 + \beta_3 / 1\text{-}\alpha_1\beta_1)\, X_{it} +$

$(\alpha_4\beta_1 + \beta_4 / 1\text{-}\alpha_1\beta_1)\, \mu_i + (\beta_1 / 1\text{-}\alpha_1\beta_1)\, \varepsilon_{it} + (1 / 1\text{-}\alpha_1\beta_1)\, \eta_{it}$

$R_{it} = \pi_1 I_i + \pi_2 E_i + \pi_3 X_i + \pi_4 \mu_i + \pi_5 \varepsilon_{it} + \pi_6 \eta_{it}$

If common unmeasured factors (μ_i) determine both health and retirement ($\alpha_4 \neq 0$ and $\beta_4 \neq 0$), then such unmeasured factors are likely to be correlated with retirement ($\pi_4 \neq 0$). The possibility that health influences the decision to retire also leads to correlated errors ($\beta_1 \neq 0$, $\pi_5 \neq 0$).

The estimation strategy exploits the longitudinal panels of the data to control for these biases. The HRS contains a rich set of information on parental history, health insurance, and

indicators for tolerance towards risk and the rate of time preference. Even with the inclusion of these controls, however, the possibility of unobserved selection remains. Since observed health outcomes and labor force behavior for older adults are affected by an accumulation of life-cycle factors, there may be unobserved individual characteristics that may have impacted current health status and the decision to retire. The longitudinal aspect of the data allows for the estimation of individual fixed effects (FE) models that control for all unobserved time-invariant heterogeneity across individuals (μ_i).

Even after identifying off the within-person differences through the fixed effects, reverse causality still remains ($\beta_1 \neq 0$). The sign of β_1 (the reverse effect of health on retirement) is theoretically ambiguous, especially since poor health may force some individuals to withdraw from the labor force and others to work longer to pay medical bills (Anderson and Burkhauser 1985; Dwyer and Mitchell 1999; McGarry 2004). However, with respect to the measures of health employed in this study, conditional on income or wealth, it is generally found (as discussed in Section 2) that poor health drives early retirement. Thus, β_1 is likely to be positive (negative health outcomes may motivate retirement), which implies that the parameter π_3 is also positive. This would impart a positive correlation between retirement (R_{it}) and the structural error term (ε_{it}) in the health demand function. The effect of retirement on adverse health outcomes in the FE models may therefore be overstated.[7]

To account for this bias, the sample is stratified across individuals who had no major illnesses or health problems in the waves prior to retirement. For these individuals, retirement is much more likely to be exogenous to health. Since they are physically and mentally healthy in the waves prior to retirement, their subsequent retirement cannot have been driven by poor health status. Individual FE specifications estimated for the pre-retirement healthy sample will therefore provide the cleanest post-retirement health effects, for the average healthy individual.[8] The

identifying assumption is that for individuals who are mentally and physically healthy at baseline prior to retirement, the *change in health status* among those who retire later serves as a good counterfactual for those who choose to retire earlier. The comparison of the full-sample and the stratified-sample marginal effects will also provide an additional check for whether the endogeneity bias is being alleviated in the hypothesized direction. Further specifications build on these and exploit the longitudinal aspect of the data set to disentangle some of the driving mechanisms by which retirement may impact health outcomes. Information on the reported reasons for retirement also allows an alternative method of identifying individuals whose retirement decisions may be exogenous to their health.

4. Data

The analysis relies on the Health and Retirement Study (HRS), which is conducted by the Institute for Social Research at the University of Michigan. The HRS is an ongoing longitudinal study, which began in 1992 and is repeated biennially.[9] Prior to 1998, the HRS cohort included individuals born between 1931 and 1941, and a separate Study of Assets and Health Dynamics Among the Oldest Old (AHEAD) included individuals born before 1924. Since 1998, AHEAD respondents have been contacted as part of a joint data collection effort with the HRS, and the sample frame was also expanded by including cohorts born between 1924 and 1930 and those born between 1942 and 1947. The present analysis utilizes the first seven waves, spanning 1992 through 2005, and restricts the sample to older adults between the ages of 50 and 75. This yields a maximum sample size of about 77,194 person-wave observations.

The HRS is administered for the specific purpose of studying life-cycle changes in health and economic resources, and includes detailed information on various health outcomes. A series of twelve measures of physical and mental health are constructed from the data. A dichotomous indicator is defined for whether the respondent self-reports that his or her health is poor. Additional

indicators are defined separately for whether the respondent reports that he or she has been diagnosed with the following illnesses: diabetes, heart disease, stroke, high blood pressure, arthritis, and psychological problems. A composite index measuring the number of these illnesses is also defined and ranges from zero to six. Additional composite indices are defined to measure difficulties associated with mobility and activities of daily living (ADL). The mobility index ranges from zero to five and indicates difficulties in walking one block, walking several blocks, walking across a room, climbing one flight of stairs, and climbing several flights of stairs. The ADL difficulties index also ranges from zero to five and indicates difficulties in bathing, eating, getting dressed, getting in or out of bed, and walking across a room. The HRS contains a depression scale, as defined by the Center for Epidemiologic Studies (CES), which ranges from zero to eight. This CESD score measures the sum of adverse mental health symptoms for the past week, including if the respondent felt depressed, felt that everything was an effort, had restless sleep, was not happy, felt lonely, felt sad, could not get going, and did not enjoy life. Studies have confirmed the validity and reliability of the CESD scale as a screening instrument for the identification of major depression in older adults (Irwin, Artin, and Oxman 1999). These measures are chosen since they summarize a broad range of physical and mental health outcomes and have some deterministic component that can be affected in a behavioral framework. Specifically, these measures are correlated with lifestyle factors such as diet, exercise, smoking and drinking, which means that they would be most likely to reflect any causal effect of retirement through behavioral channels.

Dichotomous indicators are defined for complete retirement, if the respondent reports that he is retired and not working, and for partial retirement, if the respondent reports that he is retired but continues to work part-time. Individuals otherwise not in the labor force, including homemakers and the disabled, are excluded from the analysis. Individuals who are partially retired are excluded when estimating the effects of complete retirement on health. Similarly, individuals who are fully

retired are excluded from specifications estimating the effects of partial retirement. Thus, in both analyses the reference category comprises of working individuals in the labor force, and this facilitates the comparison of marginal effects across models.

Health outcomes differ across several observable socio-economic and demographic dimensions. Indicators for gender, race, ethnicity, marital status, and no religious preference are defined and included in the models. Age fixed effects control for any non-parametric declines in health over the life cycle, allowing the retirement indicator to pick up shocks beyond general age-related health deterioration. Real income is calculated for each individual from all available sources including earnings, pension, supplemental security, social security retirement, and other government transfers deflated by the consumer price index.[10]

An individual's health status may also depend on access to care, which in turn is a function of health insurance coverage. The respondent's health insurance status is determined from various questions. A coverage indicator is defined for whether the individual reports being covered by health insurance under any governmental program including Medicare or Medicaid, under his own current or previous employer, under his spouse's current or previous employer, or under any other supplemental insurance.

The HRS further contains rich information on other variables that may confound the relationship between retirement and health.[11] All models include dichotomous indicators for year of the interview, to capture unobserved time-varying factors, and indicators for eight census divisions, to capture unobserved differentials in health care and outcomes across the regions. Weighted means for all variables for the full sample and samples stratified across retirement status are presented in Table 1.

Table 1 indicates that about 38 percent of the sample is fully retired, with an additional 12 percent partially retired. The means also indicate that fully retired individuals are in poorer health.

For instance, retirees have 1.7 illnesses compared to one illness for those still working. Similar statistically significant differences are observed for all other indicators of physical and mental health. The figures further show that retirement is correlated with other observed and sometimes unobserved characteristics. For example, retired individuals have completed fewer years of schooling as well as have less educated parents. Fewer retirees are married, have a high income, or have no insurance coverage. They are also more likely to be risk averse and differ somewhat in their financial outlook.[12] Thus there may be "positive selection" on observed characteristics – individuals who are retired are not a random sample. Most notably, retirees are older, with a mean age in the sample of 66, versus the mean age of 58 for individuals who have not yet retired. They are also more likely to differ along characteristics which generally are associated with worse health (less human capital, less parental human capital, less income, non-married, Hispanic or other race, generally more present-oriented, to name a few). The multivariate models account for these differences.

5. Results

Table 2 presents estimation of the baseline specifications (equation 3) for various indicators of health.[13] In addition to basic demographic measures, the extended specification includes health insurance status, parental characteristics, proxies for risk and time preference along with age, year, and census division indicators. Conditional on these covariates, complete retirement has a significant negative impact on health. It raises the probability of poor health by 0.12 percentage points and increases the number of mobility difficulties by 0.66.[14]

Individuals with better health endowment, as proxied by the life-span of the parents, are healthier. Growing up with more educated parents also improves adult health outcomes. Risk-averse individuals are healthier since they may be less likely to engage in risky activities, such as smoking or drinking, or work in riskier occupations, which may adversely affect health (Saffer and

Dave 2005; Barsky et al. 1997). Conditional on age, individuals who are more future-oriented, as proxied by their planning horizon, are also healthier. These individuals may also be less likely to engage in risky health behaviors and may make greater investments in their own health capital (Fuchs 1982). Health insurance has a negative impact on health, likely reflecting adverse selection.

In these models, the magnitudes of the marginal effects are quite large, relative to the sample means. This implies there may still remain considerable selection on unobservable characteristics and reverse causality which may be driving the link between health and retirement. Since the decision to retire and adult health outcomes are generally the result of an accumulation of life-cycle decisions to invest in health and human capital, most of the effects of retirement on health may reflect heterogeneity across individuals. The longitudinal panels of the HRS allow for the estimation of individual FE models that account for this unobserved heterogeneity. The marginal effects of retirement on health remain significant, but decline substantially in magnitude by about 60 percent. This indicates positive selection on unobservables. For instance, these individuals may have made inadequate investments in their own human capital or have dysfunctional family upbringing that may lead to withdrawal from the labor force and worse adult health. This is consistent with the unadjusted differences between retirees and workers (Table 1), which also showed positive selection on observable characteristics.

The second column of Table 2 shows the marginal effects for individual fixed effects models. While controlling for individual fixed effects diminishes the magnitudes, retirement is found to have a significant adverse effect on all proxies of physical and mental health. Results from the second column of Table 2 show, for instance, that complete retirement worsens mobility by 34 percent, leads to a 61.6 percent increase in difficulties associated with activities of daily living (ADL), leads to a 7.9 percent increase in illnesses, and worsens mental health by between 11-14.5 percent, relative to the sample means.

Identifying off the within-individual variation, conditional on age and income, the results are analogous to a pre- and post-retirement difference in health status for each individual relative to others retiring at different ages. However, the possibility remains that retirement itself may be motivated by deteriorating health. This endogeneity would inflate the negative effects of retirement on health. The last row of Table 2 serves as a check and suggests that this is indeed what may be occurring. Restricting the sample to never-smokers and moderate drinkers, retirement is found to raise the probability of cancer (excluding skin cancer) by 24.5 percent. It is implausible that post-retirement lifestyle changes could *cause* such a large increase in cancer, although it needs to be noted that lifestyle factors have the potential to affect certain types of cancer to some degree. [15] If anything, retirement should have minimal or no impact on the probability of contracting cancer for individuals who do not engage in risky activities.

To aid in bypassing endogeneity, the last two columns of Table 2 present estimation of the individual FE models for samples restricted to individuals who were physically and mentally healthy in the waves prior to retirement. Specifically, the sample is limited to those with no mobility difficulties, no illness conditions (diabetes, heart disease, stroke, high blood pressure, arthritis, cancer, or lung disease), and no reported psychological problems pre-retirement. Retirement for these workers should not be motivated by poor health status and represents labor force decisions orthogonal to current or past health. The effect sizes in these models are expected to be smaller, given the positive bias due to endogeneity (see footnote 12).

The third column of Table 2 shows that the negative effects of complete retirement on health are indeed generally much smaller in magnitude, though they remain statistically significant. Retirement causes a 17-22 percent increase in difficulties associated with mobility and daily activities, and a six percent increase in illnesses.[16] It also leads to about a nine percent decline in mental health, as proxied by the CES Depression Scale.[17] In addition, these specifications show

that while retirement negatively impacts health measures, which are most likely to be correlated with lifestyle changes, it has no effect on cancer, where we do not expect to find any large effect.

Prior studies have highlighted important, though not always consistent, differences across gender. To maximize sample size, differential effects by gender were estimated through an interaction term for the specifications in Table 2 (results not reported). For males, retirement generally leads to a larger decline in physical health outcomes as proxied by self-reported health, difficulties in mobility and daily activities, illness conditions, diabetes, heart disease, and stroke. However, with respect to the CES Depression Scale, retirement is found to have a larger negative effect for females. This differential effect may be related to the reasons proposed for the overall larger prevalence of depression and anxiety disorders among women at all stages of life (Nolan-Hoeksema, Larson, and Grayson 1999).

Health Insurance

Withdrawal from the labor force before the age of 65 may be accompanied by a change in health insurance status, which may also be endogenous to health outcomes. The adverse health effects post-retirement may reflect a decline in access to health care if retired individuals lose their employer-sponsored coverage, are ineligible for Medicare if younger than 65 years of age, and opt not to purchase private insurance. Furthermore, those who retire may be more likely to have retirement coverage, and health insurance may also be picking up the propensity to be in poorer health.[18] This adverse selection was apparent in the extended specifications. Simple means also show that retirees are more likely to be insured. To ascertain that the retirement effects are not driven by selective changes into and out of coverage or retiree access to coverage, the sample is constrained to individuals who are consistently insured in all waves. The marginal effects, presented in the last column of Table 2, are not materially affected and remain statistically

significant.[19] Conditional on individual fixed effects, shifts in and out of health insurance related to retirement do not play a major role in the post-retirement decline in health.

Unobserved Health Shocks

While focusing on individuals who were healthy pre-retirement bypasses endogeneity from observed health measures, one concern is that these individuals may nevertheless have experienced a health shock *between* waves that may not be reflected in the diagnosed or reported health outcomes at each wave. Utilizing information on reported changes in health status between waves and reported reasons for retirement allows specification checks for this possibility. The first two columns of Table 3 show individual FE results where the sample is restricted to those who did not report any worsening of health in the wave of retirement (relative to the prior wave) and also did not report any worsening of health in the wave prior to retirement. Thus, for an individual retiring in Wave 4 to make it into the sample, he must not report any health deterioration between Waves 3 and 4, as well as between Waves 2 and 3. Plausibly, for this individual, the retirement decision is orthogonal to any reported health deterioration or shocks between adjacent waves prior to their retirement. Specification 2 employs a more restrictive sample – that is, individuals who did not report any worsening of health between adjacent waves and with no observed ill-health measures prior to their retirement. Although the effect sizes decline slightly in magnitude, the results remain generally robust across all samples and health outcomes. The standard errors also remain relatively stable across samples so as not to significantly alter inferences, despite smaller sample sizes in specification 2.

In the HRS, reasons for retirement are probed at the time that the individual first reports retirement, though there are various gaps and inconsistencies across waves. Four indicators are found to be consistent across waves with minimal missing observations. These include the following reasons for retirement: 1) Poor health, 2) Wanted to do other things, 3) Wanted to spend

more time with family, and 4) Did not like work. Columns 3-7 of Table 4 present results where this information is exploited.[20]

Specification 3 is restricted to the sample that excludes all individuals who reported that poor health was an important reason in their retirement decision. Across the four health indicators, complete retirement is found to have a significant and adverse impact. Specification 4 excludes all individuals who cite poor health as a retirement reason, and further restricts the sample to individuals who were healthy (with respect to the observed indicators) in the waves prior to retirement. Thus, this sample also addresses the concern of unobserved health shocks between waves. To the extent that the individuals are healthy prior to retirement, and also do not attribute their retirement to health reasons, retirement would be exogenous to health status for this group. The results are not materially affected, though there is an increase in the standard errors due to reduced sample size. The effect sizes in models 3 and 4 are slightly smaller in magnitude, yet this may be consistent with potential "justification bias" that has been suggested in the literature. There is concern that subjective reports of health are biased by individuals using poor health as a justification for early retirement (Bound 1991; McGarry 2004). In this case, these restricted samples would be excluding individuals who truly retired due to health reasons as well as those who may have retired for other reasons but are using their health as a justification.

Models 5-7 look at the group of individuals who are healthy in the waves prior to retirement, alternately stratifying by other (non-health related) reasons. Model 5 focuses on those who retired "to do other things." Models 6 and 7 focus on those who retired "to spend more time with family" and those who retired because they "did not like work," respectively. The coefficient magnitudes are robust across most of these specifications, and also similar to the earlier models. Reduced sample sizes inflate the standard errors, although the inferences are generally not affected. It is

perhaps not surprising that for those who did not like work, the results for the CESD scale are no longer significant.

Specification Checks

If these estimated effects are due to causal behavioral changes prompted by retirement, the effects should be spread out over time and not concentrated in the first wave post-retirement. If a substantial health effect is observed in the first post-retirement observation, then this would suggest that unobserved health shocks are motivating retirement or there are anticipation effects.[21] Specification 1 in Table 4 estimates the individual FE models for the full sample that does not adjust for endogeneity. As expected, there are large significantly negative effects of retirement on health even in the first post-retirement wave. This suggests that the effect cannot plausibly be causal, reflecting endogenous selection and possible anticipation effects. Specification 2 re-estimates the FE model for the preferred conservative sample of individuals who are healthy in the waves prior to retirement. None of the first post-retirement wave effects are significant, and most of the effect of retirement on health is being realized in the latter periods. (The effect sizes for depression are imprecisely measured due to inflated standard errors.) Specification 3 restricts the analysis to only the first wave after retirement. The effect sizes continue to be insignificant and small in magnitude. These results are validating, in that they do not show any large immediate effects that might cast doubt on a causal interpretation.

As an additional specification check, a pseudo-retirement indicator is constructed to gauge whether the preferred models are bypassing the endogeneity bias. It is defined such that an individual who retired in wave 5 is falsely assigned retirement in a prior wave (wave 3 in this case), and so on. Specifications 4 and 5 of Table 4 present the marginal effects of pseudo-retirement on poor health outcomes for the extended and preferred specifications.[22] Pseudo-retirement should have no causal adverse effect on health outcomes, since it is not inherently reflecting any real

change in status. In the extended models, however, the indicator has a strong, significantly negative effect on all measures of health. This suggests that the effects are biased upwards (in magnitude) due to endogeneity. Pseudo-retirement is picking up systematic variations across individuals and other concurrent shifts related to aging, health, and labor force behavior. If the preferred specifications are successful in removing the endogeneity, then the marginal effect of pseudo-retirement should decline to zero and become insignificant. The fifth column reassuringly confirms this to be the case.

Models based on instrumental variables are also estimated, though these results should be interpreted with caution due to the inherent difficulties of identifying valid instruments. The sample was limited to those who reported that they expected to retire at the same time as their spouse, and further limited to those who reported that they were not concerned about inadequate retirement income. For these individuals, the spouse's retirement status (complete, partial, or non-retired) is a significant predictor for own-retirement status. The instruments are also orthogonal to own health, conditional on own retirement and wealth, and they "pass" the overidentification test. Results from these models indicate marginal effects somewhere between the full sample individual FE and the pre-retirement healthy sample individual FE models. The standard errors are larger, making the estimate imprecise for illness conditions. Models are also estimated separately for those individuals who retired at age 62. Retirement at age 62 is likely to have a larger exogenous component (relative to other ages), since the spike is related to social security and other pension eligibility. The marginal effects tend to be similar to those based on the individual FE models for the pre-retirement healthy sample. These results are presented in the last two columns of Table 4.[23]

Stratifications

Table 5 estimates the preferred individual FE models for the pre-retirement healthy sample, stratified across additional dimensions.[24] These stratifications shed light on some of the possible mechanisms for the post-retirement decline in health.

One hypothesis concerns the post-retirement reduction in social interactions and support that were formed through and at work. Since studies have linked social interactions to better health, the transition from work to full retirement may lead to deteriorating mental and physical health through this channel. In this case, the negative effects of retirement should be larger for individuals without a spouse or a partner. Social support from a spouse may help to buffer shocks and offset some of the diminished external social interactions. The first two rows of Table 5 confirm this direction of effect. Complete retirement generally leads to worse health for single relative to married individuals. The difference is especially large for mental health, which is consistent with prior studies that show social interactions to have a significant effect on depression (Cohen 2004).

For many individuals, work-related activities may constitute the primary form of exercise and physical activity. If retirement leads to a decline in the frequency or intensity of physical activity, then health may deteriorate. The prevalence of engagement in physical activity post-retirement is similar for those individuals with physically demanding work relative to others. The decline in physical activity post-retirement is therefore steeper for individuals who had physically demanding jobs prior to retirement. Ceteris paribus, retirement would be expected to have a larger adverse health effect for these workers. The next two rows stratify the sample across individuals who report that their job required a great deal of physical effort almost all of the time. Retirement is found to deteriorate physical health more for these individuals relative to those in non-laborious work.[25] Similarly, retirement should cause the largest declines in health among those who do not participate in vigorous physical activity post-retirement, to substitute for the drop in work-related physical activity. The next two samples, stratified across individuals who participate and do not

participate in physical exercise after retirement, show that the marginal effects are indeed substantially larger for those who do not remain physically active. Summary measures show that for individuals who do not engage in physical activity, there is a slight increase in weight and the probability of being overweight. This is consistent with the transition from work to full retirement leading to negative lifestyle factors that worsen health.

In standard models of labor supply, it is assumed that leisure is utility-enhancing, and thus work is utility-diminishing. In this case, retirement would be expected to yield benefits due to the increase in leisure time, ceteris paribus. To the extent that this effect offsets some of the negative health effects, retirement would be expected to have a smaller adverse effect on health for those individuals who found work especially distasteful or stressful. The next two models are stratified across individuals who report that their work involved a great deal of stress almost all of the time. For these individuals, retirement is presumably stress-reducing, and consequently their decline in physical and mental health is also expectedly smaller.

An additional stratification based on whether the retirement decision was voluntary or involuntary is shown next.[26] Among those who report that their retirement was "forced," we further exclude from the analysis individuals reporting health as a retirement reason. Conditions leading to forced retirement include job displacements, employer policy towards older workers, care obligations, and other personal reasons. Standard errors are inflated due to smaller sample sizes; however, there is some evidence that the adverse effects of retirement on health are larger in the event of forced retirement and smaller in the event of voluntary retirement.

Where the negative health effects of full retirement are mediated by other positive factors, the magnitudes are found to be smaller. An additional robustness check is permitted by individuals who are partially retired – that is, those who continue to do some part-time work after retiring from their jobs. Complete retirement has adverse health effects, consistent with an increase in the

relative net price of health investment, a decline in social interactions and a decline in work-related physical activity. If this is a causal relationship, then partial retirement would be expected to have little or no adverse health effects since the incentive to avoid work loss from illness still exists, which raises the marginal benefit of investing in health. Part-time work may also impart positive effects through social support and physical activity. The final two rows of Table 5 confirm this pattern. Partial retirement generally has a much smaller negative effect on health outcomes, relative to full retirement. It is found to significantly increase the number of illness conditions by 0.055 [4.2%] and difficulties in daily activities by 0.016 [10%], compared with 0.083 [6.4%] and 0.027 [17%] for complete retirement. For other measures of physical and mental health, partial retirement has no significant adverse effects.[27]

6. Conclusion

While unadjusted differences document a strong negative effect of complete retirement on health, the aim of this study was to examine how much of this association is consistent with a causal mechanism and how much of it is being driven by non-random selection and endogeneity. Estimates suggest that indeed most of the observed difference (80-90 percent) is due to such confounding. However, a sizable residual effect remains that is consistent with a behavioral framework. Results from the preferred specifications indicate that complete retirement leads to a 5-16 percent increase in difficulties associated with mobility and daily activities, a 5-6 percent increase in illness conditions, and a 6-9 percent decline in mental health. These are average cumulative effects realized over a period of about six years post-retirement.

Additional checks indicate that the effects tend to operate through lifestyle changes including declines in physical activity and social interactions. Future research should focus on these lifestyle shifts and other channels by which retirement impacts health. The adverse health effects are mitigated if the individual is married and has social support, continues to engage in physical

activity post-retirement, or continues to work part-time upon retirement. There is also some evidence that the adverse health effects are larger in the event of involuntary retirement. In this case, programs that help older workers forced into retirement find alternative employment opportunities may be health-promoting. On the other hand, voluntary withdrawal from the labor force also has some negative health impact that is consistent with changes in health behaviors and lifestyle post-retirement. This does not necessarily suggest that individuals who retire early or voluntarily are irrational or that they have not considered the full implications of retirement, including the change in environment or incentives. Indeed, the behavioral framework presupposes some rationality.[28] However, if retirement decisions are "forced" or voluntary retirement is rationally based on market constraints (delayed retirement credit in Social Security or private pensions, incentives in defined-benefit plans, labor market inflexibility regarding hours or work opportunities), then there may be room for altering these market constraints so as to improve the health of older adults, ceteris paribus.

With the financial difficulties facing Social Security and Medicare compounded by an aging population retiring earlier, policymakers have pressed for higher retirement ages.[29] For employer and private pension plans, 60 remains a popular age for benefits eligibility. Furthermore, the Social Security system as well as many private pension plans contains incentives that may discourage work for certain individuals.[30]

The negative effects of retirement on subsequent health status found in this study have held up to various specification and robustness checks, and yet should nevertheless be interpreted with caution due to the striking nature of the results. The estimates have policy implications, however, and should be considered in any policy evaluation that aims at shifting the retirement age. In the presence of negative health effects, policies that aim to increase the retirement age may be desirable. A higher retirement age, by postponing or reducing poor health outcomes, will also

consequently reduce the utilization of health services by older adults conditional on life expectancy, which may have implications for the projected increases in Medicare expenditures. Ceteris paribus, retiring at a later age would lessen or postpone poor health outcomes, raising well-being and reducing the utilization of health care services, particularly acute care. Thus, policies that raise the retirement age, while improving the financial liability of Social Security, may also curb the long-term growth in Medicare expenditures, even if the Medicare eligibility age remains unchanged.

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Table 1
Weighted Sample Means [1]

Variable	All	Retired	Non-Retired
Retirement			
Complete Retirement	0.379 (0.485)	1.000 (0.000)	0.000 (0.000)
Partial Retirement	0.115*** (0.319)	–	–
Health Outcomes			
Good Health	0.489*** (0.500)	0.369 (0.483)	0.566 (0.496)
Poor Health	0.059*** (0.235)	0.116 (0.320)	0.022 (0.146)
Mobility Difficulties	0.700*** (1.195)	1.144 (1.484)	0.443 (0.894)
Activities of Daily Living (ADL) Difficulties	0.160*** (0.603)	0.314 (0.849)	0.063 (0.335)
Illness Conditions	1.308*** (1.168)	1.721 (1.269)	1.057 (1.024)
Diabetes	0.126*** (0.332)	0.175 (0.380)	0.096 (0.294)
Heart Disease	0.166*** (0.372)	0.253 (0.435)	0.111 (0.314)
Stroke	0.043*** (0.203)	0.078 (0.269)	0.021 (0.143)
High Blood Pressure	0.420*** (0.494)	0.511 (0.500)	0.364 (0.481)
Arthritis	0.447*** (0.497)	0.564 (0.496)	0.380 (0.485)
Psychological Problems	0.108*** (0.310)	0.143 (0.350)	0.086 (0.281)
Center for Epidemiologic Studies Depression (CESD) Scale	1.244*** (1.799)	1.541 (1.984)	1.056 (1.643)
Cancer	0.091*** (0.288)	0.129 (0.336)	0.067 (0.250)
Sociodemographic			
Age	61.437*** (7.083)	66.169 (6.378)	58.365 (5.621)
Male	0.510*** (0.500)	0.476 (0.499)	0.535 (0.499)
Black	0.095*** (0.293)	0.104 (0.305)	0.089 (0.285)
Other Race	0.036*** (0.187)	0.031 (0.175)	0.039 (0.194)
Hispanic	0.058*** (0.234)	0.050 (0.218)	0.063 (0.243)
Education	12.779*** (2.972)	12.186 (3.042)	13.181 (2.833)

Married	0.695***	0.659	0.718
	(0.460)	(0.474)	(0.450)
No Religious Preference	0.069***	0.060	0.075
	(0.253)	(0.238)	(0.263)
Income	16.884***	9.931	21.303
	(24.867)	(13.665)	(28.996)
Health Insurance	0.935***	0.968	0.914
	(0.246)	(0.176)	(0.280)
Mother's Age	75.349***	75.678	75.165
	(13.661)	(14.730)	(12.892)
Father's Age	71.310***	71.106	71.428
	(14.013)	(14.381)	(13.759)
Mother's Education	0.727***	0.668	0.769
	(0.445)	(0.471)	(0.422)
Father's Education	0.644***	0.584	0.684
	(0.479)	(0.493)	(0.465)
Native Born	0.918***	0.929	0.911
	(0.275)	(0.256)	(0.285)
Risk Averse	0.634***	0.666	0.618
	(0.482)	(0.472)	(0.486)
Planning Horizon 5-10 Years	0.295***	0.272	0.309
	(0.456)	(0.445)	(0.462)
Planning Horizon More than 10 Years	0.104	0.101	0.105
	(0.305)	(0.302)	(0.307)
Physical Activity / Stress			
Vigorous Physical Activity	0.399***	0.360	0.421
	(0.490)	(0.480)	(0.494)
Physical Work	0.353**	0.362	0.346
	(0.478)	(0.481)	(0.476)
Stressful Work	0.543***	0.559	0.531
	(0.498)	(0.496)	(0.499)
Observations	77,194	31,411	44,799

1 Data are for individuals ages 50 to 75 from waves 1 to 7 of the Health and Retirement Study (HRS). Standard deviations are in parentheses. Number of observations listed represents the maximum number. For some variables, the actual sample size is slightly less due to missing information. Retired and Non-Retired samples exclude individuals who are partially retired. Asterisks denote that the difference between the Retired and Non-Retired samples is statistically significant as follows: *** significant at the one-percent level ** significant at the five-percent level * significant at the ten-percent level.

Table 2
Models of Health Outcomes on the Full Sample: The Role of Completed Retirement [1]

Dependent Variable	Specification			
	1	2	3	4
	Extended	Individual Fixed Effects	Individual Fixed Effects Healthy Pre-Retirement	Individual Fixed Effects Healthy Pre-Retirement Consistently Insured in All Waves
Poor Health	0.1163*** (0.0041) [1.971]	0.0494*** (0.0035) [0.837]	0.0267*** (0.0066) [0.453]	0.0252*** (0.0059) [0.427]
Mobility Difficulties	0.6593*** (0.0202) [0.942]	0.2380*** (0.0152) [0.340]	0.1563*** (0.0295) [0.223]	0.1617*** (0.0273) [0.231]
Activities of Daily Living (ADL) Difficulties	0.2643*** (0.0105) [1.652]	0.0985*** (0.0088) [0.616]	0.0268** (0.0112) [0.168]	0.0237** (0.0116) [0.148]
Illness Conditions	0.4972*** (0.0198) [0.380]	0.1030*** (0.0101) [0.079]	0.0834*** (0.0263) [0.064]	0.0699*** (0.0267) [0.053]
Diabetes	0.0657*** (0.0058) [0.521]	0.0126*** (0.0035) [0.100]	0.0126* (0.0173) [0.100]	0.0142** (0.0058) [0.113]
Heart Disease	0.0987*** (0.0064) [0.595]	0.0268*** (0.0039) [0.161]	0.0148* (0.0081) [0.089]	0.0084 (0.0084) [0.051]
Stroke	0.0428*** (0.0036) [0.995]	0.0173*** (0.0026) [0.402]	0.0075** (0.0038) [0.174]	0.0052 (0.0035) [0.121]
High Blood Pressure	0.0910*** (0.0084) [0.217]	0.0112** (0.0045) [0.027]	0.0087 (0.0125) [0.021]	0.0089 (0.0125) [0.021]
Arthritis	0.1170*** (0.0084) [0.262]	0.0234*** (0.0050) [0.052]	0.0385*** (0.0147) [0.086]	0.0289* (0.0157) [0.065]
Psychological Problems	0.0824*** (0.0054) [0.763]	0.0123*** (0.0030) [0.114]	0.0003 (0.0056) [0.003]	0.0031 (0.0055) [0.023]
Depression (CESD) Scale	0.4832*** (0.0267) [0.388]	0.1810*** (0.0236) [0.145]	0.1145* (0.0616) [0.092]	0.1367** (0.0626) [0.110]
Cancer [2]	0.0145* (0.0088) [0.193]	0.0184*** (0.0060) [0.245]	0.0001 (0.0083) [0.001]	0.0081 (0.0094) [0.106]

1 Standard errors are robust clustered at the individual level and reported in parentheses. Semi-elasticity of health outcome with respect to retirement, evaluated at the sample mean, is reported in brackets. Sample is limited to individuals ages 50 to 75. Significance is defined as follows: *** significant at the one-percent level ** significant at the five-percent level * significant at the ten-percent level. Each cell represents the marginal effect of Complete Retirement on the given health outcome from a separate regression. Sample sizes range from 53,551 to 75,752 (specifications 1 & 2) and from 4,951 to 5,289 (specifications 3 & 4). Each specification includes the same covariates listed in Appendix 2.

2 Sample is limited to never-smokers and moderate drinkers.

Table 3
Exploring Unobserved Heterogeneity in a Model of Health: Health Shocks and Preferences

	Specification						
	1	2	3	4	5	6	7
	Individual Fixed Effects	Individual Fixed Effects	Individual Fixed Effects	Individual Fixed Effects	Individual Fixed Effects	Individual Fixed Effects	Individual Fixed Effects
	_	Healthy Pre-Retirement	_	Healthy Pre-Retirement	Healthy Pre-Retirement	Healthy Pre-Retirement	Healthy Pre-Retirement
Dependent Variable	Did not report worsening of health	Did not report worsening of health	Health not a reason for retirement	Health not a reason for retirement	Retired: To do other things	Retired: To spend more time with family	Retired: Did not like work
Mobility Difficulties	0.1196*** (0.0178) [0.171]	0.0970*** (0.0224) [0.139]	0.0683*** (0.0143) [0.098]	0.0804*** (0.0212) [0.115]	0.1143*** (0.0316) [0.163]	0.0924*** (0.0280) [0.132]	0.1159** (0.0481) [0.166]
Activities of Daily Living (ADL) Difficulties	0.0523*** (0.0094) [0.332]	0.0170* (0.0098) [0.106]	0.0279*** (0.0069) [0.174]	0.0074 (0.0070) [0.046]	0.0332*** (0.0117) [0.208]	0.0156 (0.0137) [0.098]	0.0102 (0.0133) [0.064]
Illness Conditions	0.0650*** (0.0113) [0.050]	0.0692*** (0.0231) [0.057]	0.0446*** (0.0105) [0.034]	0.0488** (0.0230) [0.037]	0.0835*** (0.0286) [0.064]	0.0745*** (0.0274) [0.057]	0.1881*** (0.0437) [0.144]
Depression (CESD) Scale	0.0693** (0.0318) [0.056]	0.0759 (0.0546) [0.064]	0.0487** (0.0242) [0.039]	0.0432 (0.0550) [0.035]	0.0477 (0.0629) [0.038]	0.0334 (0.0685) [0.028]	-0.0216 (0.1213) [-0.017]

See notes to Table 2. Sample sizes range from 4,519 to 5,289 (specifications 1-5) and 970 to 3,193 (specifications 6-7). Significance is defined as follows: *** significant at the one-percent level ** significant at the five-percent level * significant at the ten-percent level.

Table 4
Specification Checks

Dependent Variable		Specification						
		Timing [1]			Pseudo-Retirement [2]		Alternate Identification Methods	
		1	2	3	4	5	6	7
		Individual Fixed Effects Full Sample Decomposition: Timing of Retirement Effect	Individual Fixed Effects Healthy Pre-Retirement Decomposition: Timing of Retirement Effect	Individual Fixed Effects Healthy Pre-Retirement Restricting Effect to first Post-Retirement Wave	Extended –	Individual Fixed Effects Healthy Pre-Retirement	Instrumental Variables [3]	Individual Fixed Effects Retired at Age 62 [4]
Mobility Difficulties	Post-Retirement Wave 1	0.1878*** (0.0225)	0.0312 (0.0397)	0.0326 (0.0398)	0.0858*** (0.0213)	-0.0061 (0.0239)	0.2299* (0.1357) F = 112.15*** Hansen J = 2.62	0.2005*** (0.0447)
	Post-Retirement Waves 2+	0.2168*** (0.0275)	0.0938** (0.0406)	–				
Activities of Daily Living (ADL) Difficulties	Post-Retirement Wave 1	0.0987*** (0.0130)	0.0084 (0.0172)	0.0029 (0.0130)	0.0257*** (0.0084)	0.0076 (0.0051)	0.1055* (0.0616) F = 112.15*** Hansen J = 0.55	0.0885*** (0.0239)
	Post-Retirement Waves 2+	0.1331*** (0.0159)	0.0407** (0.0208)	–				
Illness Conditions	Post-Retirement Wave 1	0.1124*** (0.0149)	-0.0321 (0.0344)	0.0300 (0.0472)	0.1251*** (0.0236)	-0.0043 (0.0119)	0.2472 (0.1545) F = 112.15*** Hansen J = 0.38	0.1030*** (0.0290)
	Post-Retirement Waves 2+	0.1256*** (0.0198)	0.1801*** (0.0477)	–				
Depression (CESD) Scale	Post-Retirement Wave 1	0.1475*** (0.0365)	0.0566 (0.0807)	0.0323 (0.1228)	0.1841*** (0.0368)	-0.0028 (0.1056)	0.3589* (0.2163) F = 122.14*** Hansen J = 0.38	0.1120 (0.0724)
	Post-Retirement Waves 2+	0.1416*** (0.0440)	0.0620 (0.0822)	–				

Notes: The extended specification includes covariates listed in Appendix 2. The individual fixed effects specification also includes Married, Income, and fixed effects for Age, Year, and Census Division, and is limited to individuals who had no mobility difficulties, no illness conditions, and no psychological problems in the wave prior to retirement. Standard errors are robust clustered at the individual level and reported in parentheses. Significance is defined as follows: *** significant at the one-percent level ** significant at the five-percent level * significant at the ten-percent level.

1 See text and notes to Table 2.

2 Each cell represents the marginal effect of Pseudo-Retired indicator on the given health outcome from a separate regression. The sample is further limited to non-retired individuals.

3 Each cell represents the marginal effect of Retired on the given health outcome from a separate IV regression. The excluded instruments are indicators for whether the spouse is completely or partially retired. The sample is limited to married individuals who reported that they plan on retiring at the same time as

their spouse and they are not concerned about inadequate retirement income. Standard errors are reported in parentheses. The joint F-statistic on the excluded instruments is reported. Hansen J is the Chi-squared statistic on the test of overidentifying restrictions.

4 Each cell represents the marginal effect of Retired on the given health outcome from a separate regression. The sample is limited to individuals who retired at age 62. Standard errors are reported in parentheses.

Table 5
Stratified Samples [1]

Specification	Dependent Variable			
	Mobility Difficulties	ADL Difficulties	Illness Conditions	Depression Scale
Unmarried	0.1737***	0.0349**	0.0865*	0.2215*
	(0.0728)	(0.0137)	(0.0450)	(0.1281)
Married	0.1487**	0.0160	0.0865***	0.0903
	(0.0262)	(0.0115)	(0.0277)	(0.0621)
Job required Physical Effort	0.2121***	0.0509***	0.1571***	0.1225
	(0.0493)	(0.0187)	(0.0413)	(0.1039)
Job did not require Physical Effort	0.1303***	0.0192	0.0553*	0.1621**
	(0.0321)	(0.0134)	(0.0316)	(0.0695)
Non-Participation in Vigorous Physical Activity Post-Retirement	0.2627***	0.0522***	0.0862**	0.2349***
	(0.0441)	(0.0191)	(0.0368)	(0.0831)
Participation in Vigorous Physical Activity Post-Retirement	0.0530*	0.0048	0.0847**	-0.0362
	(0.0292)	(0.0079)	(0.0301)	(0.0718)
Job was Non-Stressful	0.1706***	0.0392***	0.1054***	0.1726**
	(0.0404)	(0.0133)	(0.0349)	(0.0863)
Job was Stressful	0.1503***	0.0267	0.0843**	0.1477*
	(0.0369)	(0.0165)	(0.0347)	(0.0833)
Retirement was Involuntary (Excluding health as a reason)	0.1845***	0.0169	0.1079*	0.1440
	(0.0599)	(0.0233)	(0.0618)	(0.1380)
Retirement was Voluntary	0.0504**	0.0025	0.0330	0.0454
	(0.0244)	(0.0094)	(0.0267)	(0.0631)
Complete Retirement (Reproduced from Table 3)	0.1563***	0.0268**	0.0834***	0.1145*
	(0.0295)	(0.0112)	(0.0263)	(0.0616)
Partial Retirement [2]	0.0022	0.0159*	0.0549*	-0.0803
	(0.0288)	(0.0085)	(0.0310)	(0.0718)

1 Each cell represents the marginal effect of Retired on the given health outcome from a separate regression. All specifications include Married (except in samples stratified by Married), Income, and fixed effects for age, year, census division and the individual. Standard errors are robust clustered at the individual level and reported in parentheses. Sample is limited to individuals ages 50 to 75, who had no mobility difficulties, no illness conditions, and no psychological problems in the wave prior to retirement. Significance is defined as follows: *** significant at the one-percent level ** significant at the five-percent level * significant at the ten-percent level.
2 Sample excludes individuals who are completely retired.

Appendix 1
Variable Definitions [1]

Variable	Definition
Complete Retirement	Dichotomous indicator for whether respondent is fully retired
Partial Retirement	Dichotomous indicator for whether respondent is partially retired
Good Health	Dichotomous indicator for whether respondent reported health as being excellent or very good
Poor Health	Dichotomous indicator for whether respondent reported health as poor
Mobility Difficulties	Index for mobility problems ranging from 0 to 5, indicating the respondent reporting any difficulty in walking 1 block, walking several blocks, walking across a room, climbing 1 flight of stairs, and climbing several flights of stairs
Activities of Daily Living (ADL) Difficulties	Index for problems in Activities of Daily Living (ADL) ranging from 0 to 5, indicating the respondent reporting any difficulty in bathing, eating, getting dressed, getting in/out of bed, and walking across a room
Illness Conditions	Index of respondent's diagnosed conditions, ranging from 0 to 6, indicating high blood pressure, diabetes, heart problems, stroke, psychiatric problems, and arthritis
Diabetes	Dichotomous indicator for whether respondent has ever been told by doctor that he or she has diabetes
Heart Disease	Dichotomous indicator for whether respondent has ever been told by doctor that he or she had a heart attack, coronary heart disease, angina, congestive heart failure, or other heart problems
Stroke	Dichotomous indicator for whether respondent has ever been told by doctor that he or she had a stroke
High Blood Pressure	Dichotomous indicator for whether respondent has ever been told by doctor that he or she has high blood pressure
Arthritis	Dichotomous indicator for whether respondent has ever been told by doctor that he or she has arthritis or rheumatism
Psychological Problems	Dichotomous indicator for whether respondent has ever been told by doctor that he or she had emotional, nervous, or psychiatric problems
Center for Epidemiologic Studies Depression (CESD) Scale	Index of mental health for respondent, ranging from 0 to 8, indicating the negative mental health symptoms for last week (depressed, everything an effort, restless sleep, not happy, lonely, sad, could not get going, and did not enjoy life)
Cancer	Dichotomous indicator for whether respondent has ever been told by doctor that he or she has had cancer or a malignant tumor of any kind, except skin cancer
Age	Age of respondent
Male	Dichotomous indicator for whether respondent is male
Black	Dichotomous indicator for whether respondent is black but not Hispanic
Other Race	Dichotomous indicator for whether respondent's race

	is other than white, black, or Hispanic
Hispanic	Dichotomous indicator for whether respondent is Hispanic
Education	Years of education completed
Married	Dichotomous indicator for whether respondent is married
No Religious Preference	Dichotomous indicator for whether respondent has no religious preference
Income	Total individual income from all sources, measured in thousands of 1982-1984 dollars
Health Insurance	Dichotomous indicator for whether respondent has any type of health insurance coverage
Mother's Age	Age of mother, or age at death
Father's Age	Age of father, or age at death
Mother's Education	Dichotomous indicator for whether respondent's mother has attended 8 or more years of school
Father's Education	Dichotomous indicator for whether respondent's father has attended 8 or more years of school
Native Born	Dichotomous indicator for whether respondent was born in the United States
Risk Averse	Dichotomous indicator for whether respondent is very risk averse
Planning Horizon 5-10 Years	Dichotomous indicator for whether respondent's relevant financial planning horizon is 5-10 years
Planning Horizon More than 10 Years	Dichotomous indicator for whether respondent's relevant financial planning horizon is greater than 10 years
New England	Dichotomous indicator for whether respondent resides in the New England region
Mid Atlantic	Dichotomous indicator for whether respondent resides in the Mid Atlantic region
East North Central	Dichotomous indicator for whether respondent resides in the East North Central region
West North Central	Dichotomous indicator for whether respondent resides in the West North Central region
South Atlantic	Dichotomous indicator for whether respondent resides in the South Atlantic region
East South Central	Dichotomous indicator for whether respondent resides in the East South Central region
West South Central	Dichotomous indicator for whether respondent resides in the West South Central region
Mountain	Dichotomous indicator for whether respondent resides in the Mountain region
Pacific	Dichotomous indicator for whether respondent resides in the Pacific region
Vigorous Physical Activity	Dichotomous variable that equals 1 if respondent is physically active 3 or more days a week
Physical Work	Dichotomous indicator for whether the respondent's job required a lot of physical effort most or all of the time
Stressful Work	Dichotomous indicator for whether the respondent's job involved much stress most or all of the time
Year	Year of interview

Appendix 2
Models of Health Outcomes on the Full Sample: The Roles of Explanatory Variables

Dependent Variable	Poor Health		Mobility Difficulties	
Specification	Extended	Individual Fixed Effects	Extended	Individual Fixed Effects
Complete Retirement	0.1163*** (0.0041) [1.971]	0.0494*** (0.0035) [0.837]	0.6593*** (0.0202) [0.942]	0.2380*** (0.0152) [0.340]
Male	0.0152*** (0.0029)	_	-0.1981*** (0.0161)	_
Black	0.0052 (0.0049)	_	0.0431* (0.0249)	_
Other Race	0.0236*** (0.0088)	_	0.0593 (0.0402)	_
Hispanic	-0.0145** (0.0068)	_	-0.0956*** (0.0340)	_
Education	-0.0102*** (0.0006)	_	-0.0494*** (0.0031)	_
Married	-0.0306*** (0.0034)	0.0019 (0.0049)	-0.1790*** (0.0183)	0.0152 (0.0221)
No Religious Preference	0.0193*** (0.0071)	_	0.0321 (0.0345)	_
Income	-0.0001*** (0.00003)	-0.00001 (0.00002)	-0.0012*** (0.0003)	0.00001 (0.0001)
Health Insurance	0.0137*** (0.0045)	_	0.1136*** (0.0211)	_
Mother's Age	-0.0003*** (0.0001)	_	-0.0031*** (0.0006)	_
Father's Age	-0.0001 (0.0001)	_	-0.0024*** (0.0006)	_
Mother's Education	-0.0068 (0.0044)	_	-0.0011 (0.0231)	_
Father's Education	-0.0125*** (0.0040)	_	-0.1076*** (0.0214)	_
Native Born	0.0016 (0.0054)	_	0.1347*** (0.0278)	_
Risk Averse	-0.0051* (0.0029)	_	-0.0132 (0.0161)	_
Planning Horizon 5-10 Years	-0.0168*** (0.0030)	_	-0.1133*** (0.0171)	_
Planning Horizon More than 10 Years	-0.0149*** (0.0045)	_	-0.1474*** (0.0248)	_
Age Fixed Effects	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes
Census Division Fixed Effects	Yes	Yes	Yes	Yes
Individual Fixed Effects	No	Yes	No	Yes
Observations	53,551	75,727	53,400	72,905

Standard errors are robust clustered at the individual level and reported in parentheses. Semi-elasticity of health outcome with respect to retirement, evaluated at the sample mean, is reported in brackets. Sample is limited to individuals ages 50 to 75. Significance is defined as follows: *** significant at the one-percent level ** significant at the five-percent level * significant at the ten-percent level.

Appendix 3
Sample Attrition

	Specification		
	1	2	3
Dependent Variable	Individual Fixed Effects Healthy Pre-Retirement Sample Attrition: Balanced panel Waves 1-7	Individual Fixed Effects Healthy Pre-Retirement Sample Attrition: Excluding all Passive Attritors	Individual Fixed Effects Healthy Pre-Retirement Sample Attrition: Inverse Probability Weighting
Mobility Difficulties	0.1539*** (0.0309) [0.220]	0.1292*** (0.0251 [0.185]	0.1192*** (0.0290) [0.170]
Activities of Daily Living (ADL) Difficulties	0.0333*** (0.0106) [0.208]	0.0216** (0.0088) [0.135]	0.0168 (0.0115) [0.106]
Illness Conditions	0.0809*** (0.0271) [0.062]	0.0728*** (0.0238) [0.056]	0.0510* (0.0268) [0.039]
Depression (CESD) Scale	0.1141** (0.0587) [0.092]	0.0930* (0.0548) [0.075]	0.1434** (0.0634) [0.116]

See notes to Table 2. IPWs are predicted using baseline characteristics (gender, race, ethnicity, education, parental education, religion, and native-born) along with other time-varying factors (age indicators, wave indicators, census division indicators), lagged covariates (income, marital status, and health insurance), and health status in the prior wave. Significance is defined as follows: *** significant at the one-percent level ** significant at the five-percent level * significant at the ten-percent level.

[1] Recent data suggest a slight upturn in the trend towards early retirement. However, it is not clear whether this reflects a structural reversal or cyclical factors.

[2] As of 2002, the retirement age for full social security eligibility was raised to 67 for those born in 1960 or later. (There is a gradual increase in the retirement age from 65 to 67 for those born between 1937 and 1960. Those born in 1938 fully retire at 65 and 2 months; those born in 1955 retire at 66 and 2 months, and so on.)

[3] See, for example, Anderson and Burkhauser (1985), Bazzoli (1985), and Rice, Roberts, and Jones (2006).

[4] More detail on this can be found in Dave, Rashad, and Spasojevic (2006).

[5] In fact, it would be implausible (and we exploit this as a specification check) to find that retirement has significant effects on health shocks that are independent of individual behaviors.

[6] The health outcomes function is based on the demand for health model in Grossman (1972). The retirement function is based on the standard labor supply model (for example, see Borjas, 2004). Intercepts are suppressed for convenience.

[7] It can be shown that the bias due to structural endogeneity is equal to $E[\Sigma (R_{it} - \check{R}) (\varepsilon_{it}) / \Sigma (R_{it} - \check{R})^2]$, which is positive if R_{it} and ε_{it} are positively correlated.

[8] This is equivalent to a differenced specification with individual fixed effects. Thus, the pre-post difference in health status is compared across individuals retiring at different ages, conditional on the sample being healthy in all waves prior to retirement.

[9] Blacks, Hispanics, and Florida residents are oversampled. Sampling weights are provided to adjust for unequal probabilities of sample selection.

[10] Models were also estimated with alternate measures, including net household assets and net household income. The results are not materially affected. Since these measures are missing for a larger proportion of the sample, reported specifications control for income from all sources instead.

[11] Details on these variables are provided in Appendix 1.

[12] Questions on tolerance towards risk are asked only once to each individual, and thus these variables do not vary over time in the data set. See Barsky et al. (1997) for a detailed analysis of the risk preference module in the HRS.

[13] Standard errors in all models are corrected for autocorrelation at the individual level using STATA's cluster option. Appendix 2 presents results for all RHS variables for self-rated poor health and mobility difficulties. Due to the large

sample sizes, we estimate linear probability models rather than logit or probit ones in cases where the outcome variable is dichotomous.

[14] As seen in Appendix 2, the effects of other factors are consistent with prior studies. Blacks and other races are of significantly poor health relative to whites. Prior studies document that education makes individuals more efficient in producing health, and hence educated individuals have better health outcomes (Grossman and Kaestner 1997). Married individuals are also healthier, as are non-religious individuals. The marginal effect of income indicates that health is a normal good. One of the channels by which retirement may affect health is through income (Ettner 1996). Models which exclude income (not reported) yield marginal effects of retirement on poor health outcomes that are only slightly larger in magnitude. This indicates that the decline in income upon retirement is not the main driver of the decline in health.

[15] This counterfactual test is not a perfect one. Evidence has been put forth suggesting that some types of cancer are affected by lifestyle, stressing good nutrition and physical activity in cancer prevention (Calle et al. 2003). However, if large negative effects of retirement on cancer are found for non-risk engaging individuals, then the specifications may still be reflecting endogeneity bias.

[16] The semi-elasticities represent the effect for the average individual in the HRS sample, for transition from work to full retirement. Assessing the effects for a one-standard deviation change in the probability of retirement yields magnitudes which are about one-half those reported in the text. It should be noted that these effects are strictly applicable only to the pre-retirement healthy group of individuals due to non-random sorting of pre-retirement healthy and unhealthy individuals. As expected, the pre-retirement healthy group differs along observable characteristics from those excluded in this analysis. The average individual in this sample is more likely to be a married, non-black, male who is more future-oriented and has about a half-year more schooling, 16 percent more income, and more educated parents, relative to the excluded individuals. To the extent that retirement may magnify some of the channels for those who are unhealthy prior to retirement, the decline in health post-retirement may be larger. In this respect, these effects may be interpreted as lower-bound estimates.

[17] Since the typical individual in the HRS is observed for three post-retirement waves, these are cumulative effects being realized over six years subsequent to retirement, on average.

[18] We thank an anonymous referee for highlighting this point.

[19] Models are also estimated, explicitly controlling for health insurance status, history of coverage (number of prior waves respondent was insured), and whether the respondent has access to retiree coverage through their employer or their spouse's employer. There are no significant differences in the results.

[20] We thank two anonymous referees for this suggestion.

[21] We thank an anonymous reviewer for this suggestion.

[22] For this analysis, the sample is limited to non-retired individuals. If retired individuals are included in the sample, the pseudo-indicator may still pick up subsequent negative health effects of actual retirement.

[23] In the HRS, the primary mode in retirement age is 62, followed by 60 and 65. Examining only those individuals who retired at age 65 yields similar effects though they are imprecisely estimated due to reduced sample sizes. In order to gauge the timing of moving into a sick state, hazard models of poor health against retirement were also implemented. For both the full and preferred samples, there is positive duration dependence and retirement is found to increase the hazard of subsequent poor health. Results are available upon request.

[24] Results are presented for the composite measures of physical and mental health. Estimates for the separate illness conditions (such as diabetes, high blood pressure, and heart disease) follow the same pattern.

[25] Since the specification is limited to individuals who were physically and mentally healthy pre-retirement, controlling for age and individual fixed effects, it is unlikely that the post-retirement worsening in health is significantly related to their work.

[26] While mandatory retirement was widespread in the U.S. in the 1960s and 1970s, it was abolished in 1986 and no longer in practice due to anti age-discrimination laws (some exceptions remain for state and local police, firefighters federal law enforcement and corrections officers, air traffic controllers, and commercial airline pilots). Since the HRS begins in 1992, this does not permit the use of compulsory retirement rules for broad segments of the population as exogenous shocks to retirement.

[27] While selective attrition is a concern for all longitudinal datasets, it can be especially relevant in our analysis of health outcomes due to death-related attrition. In the HRS, the average mortality rate between waves is 2.3 percent, consistent with the Social Security Administration life table mortality rates (Kapteyn et al. 2006). Appendix 3 reports three different approaches to inform on potential bias due to this attrition. The results are highly similar across the three specifications, and estimates remain robust.

[28] An alternative explanation involves hyperbolic discounting and time-inconsistent preferences. When the individual is working, the investment return from staying healthy in the form of higher income and productivity provides a commitment device to continue investing in health. Indeed, about 30 percent of Americans report no regular physical activity outside of work. The individual may retire, knowing that he will have more free time and thinking that he will continue to stay active and invest in a healthy lifestyle. However, upon retirement, a retiree with hyperbolic discounting may keep postponing such investments (for example, joining a gym, eating healthy, staying active, or quitting smoking) which in turn may adversely impact health.

[29] Alan Greenspan headed up the 1983 bipartisan commission that raised the Social Security payroll tax and enacted an increase in the retirement eligibility age. He continued thereafter to press for further increases in the retirement age, given the improving feasibility of work at older ages.

[30] See Quadagno and Quinn (1997) and Mitchell (1992), for instance. It should be noted that Social Security's delayed retirement credit has been increasing on a phased basis for individuals born after 1928. While the initial credit rate of 4 percent may have been less than actuarially fair, the applicable credit rate for prospective retirees born after 1942 is 8 percent. This would seem in fact to be actuarially fair.