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Essays on Health and Retirement

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ABSTRACT

ESSAYS ON HEALTH AND RETIREMENT

BY

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The essays in this dissertation explore issues related to health and retirement of older Americans, using longitudinal data on older Americans from ten waves of the Health and Retirement Study (1992-2010).

The first essay explores the effect of both subjective and relatively more objective physical and mental health conditions on the probability of exit from full-time employment. Eight health indices (factors) are created from a wide range of health measures by principal component analysis. The effect of these health factors on the time until exit from full-time employment is empirically examined in a proportional hazard model. Single and competing risk specifications are estimated that allow for multiple spells of full-time employment and control for unobserved heterogeneity. The main results suggest that increase in functional limitation factor makes an individual more likely to exit via any route in general and the complete retirement route in particular. For mental health problems, increase in the depression factor increases the likelihood of exit from full-time employment via the complete retirement, part-time work and unemployment routes. While increase in cognitive disorders factor has no significant effect on the likelihood of exit via complete retirement, but increases the likelihood of exit via the disability route. These results have implications for public policies targeted towards retaining older workers within the labor market.

The second essay examines the effect of retirement on post retirement physical and mental health and the extent to which the effects differ across these different health outcomes. The inherent issue of reverse causality between health and retirement that leads to endogeneity is addressed by using multiple sample stratification and instrumental variable estimation strategies. The stratified samples include individuals who are physically and mentally healthy prior to their retirement so that pure effect of retirement on post retirement health may be found. Five different instruments for complete retirement are also used to deal with endogeneity. The sample stratification results unanimously indicate that complete retirement has adverse effect on post retirement physical and mental health. While the instrumental variables approach results are mixed and are based on the choice of instrument for complete retirement.

ESSAYS ON HEALTH AND RETIREMENT

BY

SUBHASREE BASU ROY

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of the Requirements for the Degree

of

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ACCEPTANCE

This dissertation was prepared under the direction of the candidate's Dissertation Committee. It has been approved and accepted by all members of that committee, and it has been accepted in partial fulfillment of the requirements for the degree of Doctor of Philosophy in Economics in the Andrew Young School of Policy Studies of Georgia State University.

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CONTENTS

LIST OF TABLES

LIST OF FIGURES

INTRODUCTION

In the last few decades both developed and developing countries have been experiencing structural aging of their population. According to the United Nations Population Division (Dept. of Economic and Social Affairs), the number of persons aged 65 or older in the world is expected to expand from an estimated 495 million in 2009 to 974 million in 2030. This will result in a world population in which 12 percent will be 65 years of age or older by the year 2030, as compared to 8 percent today. In the USA, the Administration of Aging (Dept. of Health and Human Services) reported that persons 65 years or older numbered 39.6 million in 2009. They represented 12.9 percent of the U.S. population, about one in every eight Americans. This is expected to rise to 72.1 million by 2030 (i.e. 19 percent of the population). The significant reasons for this trend are increases in life expectancy, declines in fertility, and the aging of the "baby boomer" generation.

Population aging affects the size and composition of the labor force and has crucial economic consequences. Gradual "greying" of the working population may lead to changes in aggregate productivity and efficiency in an economy. Such changes are of particular concern for the United States since there is no mandatory retirement age, while the pension and tax system discourage work and create incentives for early retirement[1] (J Gruber & Wise; Jonathan Gruber & Wise, 2005). This means the USA is facing a sharp increase in proportion of older individuals nearing their retirement. This has created budgetary pressure for the government due to a scarcity of funds to support transfer programs to the elderly, such as Social Security. Policy makers have been constantly debating about policies to increase the retirement age. Such a policy may have vital implied benefits- first, to raise the labor force participation rates of older adults (leading to a

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[1] Social security data indicates that retirement age for men declined from 68.5 years to 62.6 years and for women declined from 67.9 to 62.5 years (Gendell, 2001)

lower dependency ratio and a higher experience level); second, to ease fiscal stress by spending less on job training programs and deferring the payments for social security benefits. Whether such policies would benefit individuals and the economy as a whole depends on various factors, such as the effect of health on duration of employment of older workers and also the health effects of retirement. Such policies will be beneficial only if, on one hand, workers reaching old age are in good health and are “fit to work” (thereby contributing to public revenue) and, on the other hand, if retirement has adverse health effects, so that raising the retirement age postpones those unfavorable effects.

Retirement is an important labor market phenomenon and a key event in the life of an individual. Retirement constitutes the transition from mid to late adulthood. For many people - especially those who have had long working careers - this passage from the "second phase” (labor force participation) to the "third phase" (retirement) of life may have a dual disposition (i.e. lead to either positive or negative effects). Among several other factors, the health status of an individual may be both a cause and consequence of retirement. An individual may exit from the workforce due to poor health or exiting from workforce could have negative effects on their health. In this dissertation, I explore this retirement-health relationship for older Americans through two separate essays.

In the first essay, I study the effect of physical and mental health on the retirement decisions of older Americans in a duration model with competing risks. This paper adds to the existing literature by exploring the effect of both subjective and relatively more objective physical and mental health conditions on the probability of exit from full-time employment. Exit from full-time employment may occur through five different routes- complete retirement, partial retirement, part-time work, unemployment and disability or not in labor force. Using longitudinal data on older Americans from ten waves of the Health and Retirement Study (HRS)[2] from 1992-2010 and restricted prescription drug use information, eight health indices are created from a wide range of health measures by principal component analysis (PCA). The effect of these health indices on the time until exit from full-time employment is empirically examined in a hazard model. Single (all exit routes lumped together) and competing risk (exits split by five different routes) specifications are estimated that allow for multiple spells of full-time employment and control for unobserved heterogeneity. The main results suggest that among the physical health factors, multiple functional limitations make an individual more likely to exit via the complete retirement route while cancer leads to lower likelihood of exit via complete retirement. For mental health problems, the depression factor increases the likelihood of exit from full-time employment through the complete retirement and unemployment routes. While the cognitive disorders factor has no significant effect on the likelihood of exit via complete retirement, it increases the likelihood of exit via the disability route. Risky lifestyle behavior (smoking, drinking) also increases the likelihood of exit via complete retirement. These results have implications for public policies targeted towards retaining older workers within the labor market. The results point towards the potential for public policy measures aimed at investing on health of older workers to increase the probability of retaining these workers in the work force.

The second essay of my dissertation investigates the health impacts of retirement for older Americans using a long panel (1992-2010) from the HRS. I use a stratified sample of individuals with no pre-retirement health problems and who do not cite health as a reason for retirement in an attempt to address concerns about reverse causality and isolate the effect of

[2] The HRS is a rich source of information on health and labor force participation of older Americans. It is an ongoing longitudinal study, conducted by the Institute for Social Research at the University of Michigan, which began in 1992 and is repeated biennially.
The data can be accessed at http://hrsonline.isr.umich.edu/

retirement on health. I also use multiple instrumental variables (IV) for complete retirement to mitigate the issue of reverse causality. The results indicate that there are statistically significant negative physical and mental health effects due to complete retirement. However the effect on physical health conditions is larger in magnitude than for mental health.

It is reasonable to study the health and retirement relationship in these two separate essays because the first essay follows individuals until they exit from full-time work and examines the effect of pre-retirement health on the probability of exit. The second essay studies the effect of complete retirement on post-retirement health. Hence the two essays focus on the relationship between these variables at different points in time.

I. EFFECT OF HEALTH ON RETIREMENT OF OLDER AMERICANS: A COMPETING RISKS STUDY

1.1 Introduction

Retirement is a vital experience in the life of an individual. Among many other factors (socio-economic and financial), individual health status may have a strong influence on retirement decisions. For the last few decades, population aging has foreshadowed serious policy problems throughout the world, including within the United States. With the rapid rise in population aging in U.S, an increasingly high proportion of individuals are fast approaching their full retirement age (65 years). According to Social Security Administration (Office of Policy), the proportion of people over 65 years of age in 2009 was 12.9 percent as compared to 8 percent in 1950. Over next few decades, as the baby boom generation (born during 1946-1964) enters their elderly years the proportion of individuals over 65 years of age is projected to rise to 20 percent (in 2040).

These demographic changes suggest financing challenges for transfer programs such as the Social Security program. As a result, policymakers may promote policies designed to retain productive older workers in the workforce in order to defer their Social Security payments. The success of such policies depends in part on the ability to identify the key determinants of a worker's decision to retire and the magnitude of their impacts. One obvious factor that plays into a worker's decision to continue working or retire is their health status. Policies that improve the health of workers may encourage them to continue working and defer the start of their Social Security payments.[3] The purpose of this paper is to examine the role of physical and mental

[3] However, such investments might come at an "unanticipated cost" of extending the individual's lifespan, so that the government may end up paying more in social security over all. (Blinder et.al, 1981; (Boskin, Kotlikoff, Puffert,

health conditions in determining the duration of full-time employment for older Americans. In other words, this paper measures the extent to which health influences the decision to retire among older U.S. workers.

There is a literature focused on identifying the causal effect of health on retirement (Anderson & Burkhauser, 1985; Bazzoli, 1985; Bound, 1991; Bound, Schoenbaum, Stinebrickner, & Waidmann, 1998; Disney, Emmerson, & Wakefield, 2006; Dwyer & Mitchell, 1999; Lindeboom & Kerkhofs, 2002). These studies primarily used self-reported subjective measures of health. Such measures of health may be plagued with problems that lead to bias. First, self-reported measures of health are based on subjective judgments and there is no reason to believe that these judgments are comparable across individuals. Second, since poor health may represent a legitimate reason for a person of working age to be outside the labor force, respondents who are not working may cite health problems as a way to rationalize behavior (the "justification hypothesis"). A final issue is that many papers in the literature are forced to rely on relatively short panels due to limitations in data availability at the time of the studies.

This paper adds to the existing literature by using duration analysis on a panel dataset of older Americans (those at least 50 years old and working full-time in 1992) and utilizes a much wider variety of health indices to estimate the impact of health on the duration of full-time employment. Unlike much of the previous literature, the long panel nature of the Health and Retirement Study dataset is exploited here, making it possible to observe more cases of actual retirement than retirement plans (expectations) and the potential to observe multiple spells of employment over a 20-year timeframe[4]. Excluding younger individuals and those initially working less than full-time reduces concern about the justification bias. The issue of subjectivity

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& Shoven, 1987; Coile, Diamond, Gruber, & Jousten, 2002); (Jonathan Gruber & Wise, 2002) explore this area, which is beyond the focus of this paper.

[4] Since each wave is two years apart.

in health outcomes is addressed by constructing eight relatively objective health indices (factors) through principal component analysis (PCA) that are based on a broad range of subjective as well as objective health measures[5]. Unlike previous studies, it is possible to observe how different health measures load in these indices. Besides the health indices created by PCA, changes in physical and mental health between consecutive waves are considered.

The main results for the overall study sample suggest that among physical health factors, an increase in the functional limitations factor increases likelihood of exit from full-time work by 18.88 percent overall, which is largely driven by exits via complete retirement or disability routes. However, the probability of exit for complete retirement is much larger in magnitude. On the other hand, cancer leads to a 7.71 percent decrease in likelihood of exit via complete retirement. Among mental health factors, an increase in cognitive disorders has no significant effect on exit via the complete retirement route but leads to a 1.14 percent increase in likelihood of exit via disability. An increase in depression factor leads to 9.06 percent, 3.04 and 0.90 percent increase in likelihood of exit via complete retirement, part-time work and unemployment routes respectively. An increase in the risky lifestyle behavior factor (smoking, drinking) leads to an increase in likelihood of exit via complete and partial retirement routes.

The rest of this essay is organized as follows: section 1.2 reviews the previous literature and Section 1.3 discusses my theoretical framework. The data is presented in Section 1.4 followed by a discussion of the empirical methodology in Section 1.5. Section 1.6 has a discussion of results followed by conclusion and direction of future research in Section 1.7.

[5] Twenty-eight different health measures have been used in PCA.

1.2 Literature Review

An early paper on this topic, Boskin (1977), does not find any significant effect of health on retirement, but a large effect of Social Security income. Unlike Boskin (1977), Quinn (1977) finds that the presence of a health limitation reduced the probability of labor force participation by 20 percentage points. (Bazzoli, 1985) looks at the determinants of early retirement and the impact of various measures of health. She also addresses the issue of the relative importance of health and economic factors in influencing early retirement. She finds economic factors rather than health factors play the major role in retirement decisions.

In attempting to identify the causal effect of health on retirement decisions, the use of subjective measures of health has been a focus of much attention in the literature (Anderson & Burkhauser, 1985; Bazzoli, 1985; Bound, 1991; Bound, et al., 1998; Disney, et al., 2006; Dwyer & Mitchell, 1999; Lindeboom & Kerkhofs, 2002). Such measures of health may be plagued with problems that lead to bias

First, self-reported measures of health are based on subjective judgments (leading to bias) and there is no reason to believe that these judgments are comparable across individuals. The size of the bias present in self-reported health measures is documented in (Benítez - Silva, Buchinsky, Man Chan, Cheidvasser, & Rust, 2004). Second, self-reported health may not be independent of labor market status. Third, since poor health may represent a legitimate reason for a person of working age to be outside the labor force, respondents who are not working may cite health problems as a way to rationalize their behavior ("justification hypothesis"). Fourth, for individuals for whom the financial rewards of continuing in the labor force are low there exists a financial incentive to report poor health as means of obtaining disability benefits. This is often cited as the "disability route" into retirement (Marmot, Banks, Blundell, Lessof, & Nazroo, 2002; Riphahn, 1999). For example, in a study of social security benefit programs in the Netherlands, (Kerkhofs & Lindeboom, 1995) show that recipients of disability insurance systematically overstate their health problems.

A large literature attempts to address this concern about subjective reports of health status. To mitigate response bias, authors have attempted to use arguably more objective measures of health, such as the observed future death of respondents (Anderson & Burkhauser, 1985; Parsons, 1982). (Parsons, 1982) and (Stern, 1989) find those who withdraw from the labor market are likely to cite poor health as the cause even if they are not in poor health, simply because they may be rewarded for doing so through eligibility for transfers. Their findings suggest that the traditional measure of self-reported health is endogenous due to "justification hypothesis." In other words, people who intend to keep working will downplay their health problems while ones who dislike work and wish to exit from the labor force will exaggerate their health problems. (Dwyer & Mitchell, 1999) implement an instrumental variable approach to deal with endogeneity using the first four waves of HRS. The authors used parental health and mortality, respondent's age, number of children, and BMI as instruments for self-assessed health. They do not find evidence to support the justification hypothesis. This could be because in the first four waves the HRS sample is still relatively young and does not yet consist of a majority of retired individuals.

(Bound, et al., 1998) examined the relationship between health and alternative labor force transitions like retirement, job change, and application for disability insurance. Their analysis not only considers health status, but also declines in health and its effect on the work behavior of individuals. According to the authors, retirement is often a last resort. Prior to such an outcome, workers may resort to increased effort, putting in more time, requesting a reduction in performance standards, or changing jobs in order to accommodate their physical limitations.

Using the first few waves of the HRS, (McGarry, 2004) models the labor market behavior and retirement probabilities of older workers prior to their eligibility for early retirement benefits and Social Security. She finds that changes in retirement expectations are driven more by health than economic variables. The effect of subjective measures of health is strong even when objective measures are included. (Miah & Virginia, 2007) also use HRS data to determine how chronic illness affects asset accumulation and retirement. They find that the vast majority of the chronically ill population does not report their general health to be poor nor do they report functional limitations in activities of daily living. Nevertheless, their results indicate that chronic illness leads these people to accumulate fewer assets during their working years and consequently retire later.

While most studies in the existing literature use a fixed effect approach on panel data from different countries to investigate the effect of health on retirement,(Meghir & Whitehouse, 1997); (Christensen & Kallestrup ‐ Lamb, 2012; Siddiqui, 1997) use duration models to study effect of poor health on labor force transitions for UK, British and Danish panel surveys respectively. In sum, these findings strongly suggest that poor health is a determinant of retirement or exit from the work force.

1.3 Theoretical Framework

Given that the health status of individuals is not observable and difficult to measure objectively, it is difficult to disentangle the effect of health on retirement. To provide a theoretical ground for the empirical investigation, I use the static lifecycle retirement model first developed by Fields and Mitchell (1984). The model assumes individuals solve the following utility maximization problem:

$$\text{Max } U(C, RET, Z) \tag{1.1}$$

$$\text{s.t. } C = PVY + W_0 \tag{1.2}$$

where, U is a concave function increasing in the present value of lifetime consumption, C, and leisure in the retirement period, RET. The variable Z is an age-specific taste shifter that would include health (a large component of Z would be health). Consumption, C, is just equal to the present discounted value of income over the remaining life of the worker (PVY is discounted by the time preference and probability of survival). While W_0 is the wealth gathered at the time of taking the retirement decision. PVY includes the discounted sum earnings after taxes over the lifetime and pension contributions (PVE) and net income from pensions and social security income (PVP):

$$PVY = PVE + PVP \tag{1.3}$$

An individual's optimal retirement age is a function of PVE, PVP, and Z which is assumed to mainly consist of own health, spouse's health, marital status, and spouse's earnings, offers of retirement incentives, and changes in net worth or permanent income.

Health status is likely to impact the optimal retirement age in many ways. Poor health may lower productivity and hence reduce earnings. Health can also influence preferences through an effect on the utility of consumption and leisure. For example, poor health can make work more difficult and less rewarding, hence reducing the probability of working full-time. Poor health can also increase the demand for leisure (non-work time) to care for one's health. In both of these cases, the relative utility of leisure increases and would be predicted to result in retirement. On the other hand, poor health can increase the marginal utility of consumption relative to leisure (higher health care costs leads to need for higher income), which may lead to deferring retirement. Therefore, the effect of poor health on labor force participation is theoretically uncertain and creates a justification for empirical examination.

1.4 Data

The analysis presented in this paper exploits a long panel of data for Americans (1992-2010) from the Health and Retirement Study (HRS) conducted by the Institute for Social Research at the University of Michigan.[6] The HRS is an ongoing longitudinal survey, which began in 1992, and is conducted in biennial waves. Prior to 1998, the main HRS cohort included individuals born between 1931 and 1941, and another distinct cohort, the Study of Assets and Health Dynamics among the Oldest Old (AHEAD), included individuals born before 1924. Since 1998, the data for theses two cohorts is collected jointly, and the sample frame has been expanded to include cohorts born between 1924 and 1930 and those born between 1942 and 1947. The HRS is administered for the specific purpose of studying life-cycle changes in health and economic resources, and includes detailed information on various subjective and objective health outcomes.

In this paper, I focus on a sample of older individuals who were at least 50 years of age who were working full-time in 1992. The sample consists of 4,128 individuals having multiple records that generate 15,442 person-wave observations.

1.4.1 Employment Spells

I consider two types of employment spells in my analysis. I start by focusing on initial employment spells by following the 4,128 individuals in my sample starting in wave 1 (1992)

[6] "The HRS (Health and Retirement Study) is sponsored by the National Institute on Aging (grant number NIA U01AG009740) and is conducted by the University of Michigan. More information is available at: http://hrsonline.isr.umich.edu/

over the subsequent waves until their first observed exit from full-time employment occurs (initial exit model).[7] At the end of each two year wave of the HRS, an individual who was working full-time in the previous wave could either continue working (and thus be treated as a right censored observation for that wave) or exit full-time work via one five different routes: complete retirement, partial retirement, part-time work, unemployment and disability. The exit routes are defined using the labor force participation variable.[8] Individuals leave full-time employment through one of the five exit routes mentioned above or leave the survey via attrition or for some other reason, such as death. Those that remain in full-time employment or that exit the survey are treated as right censored employment spells[9]. Overall, 3.4 percent of the sample remains continuously full-time employed across all of the waves we observe.

[7] Since I am focusing here on initial employment spells, any subsequent transitions back to full-time work are ignored. This implies I am considering retirement to be an absorbing state.

[8] In the HRS, individuals who report working 35 or more hours per week are considered full-time and those working less are considered part-time. This includes the hours and weeks worked in both the main and second job. The key HRS variable of interest here is the labor force participation variable (LFPV). If the respondent reports working full-time then their LFPV is set to that status. If he/she is working part-time and also reports retirement LFPV is set to partly retired. If there is no such reporting of retirement, then the variable is set to working part-time. If the respondent is neither working nor looking for work but there is reporting of retirement, then his LFPV is set to retired (completely retired). If retirement is not mentioned and a disabled employment status is given, then it is set to disabled. Otherwise, it is set to "not in the labor force." If the respondent is not working but is looking for a full-time work, labor force participation is set to unemployed. If he/she is looking for a part-time job and mentions retirement, then it is set to partly retired. Finally, individuals looking for a part-time job and not reporting retirement, have LFPV set to unemployed.

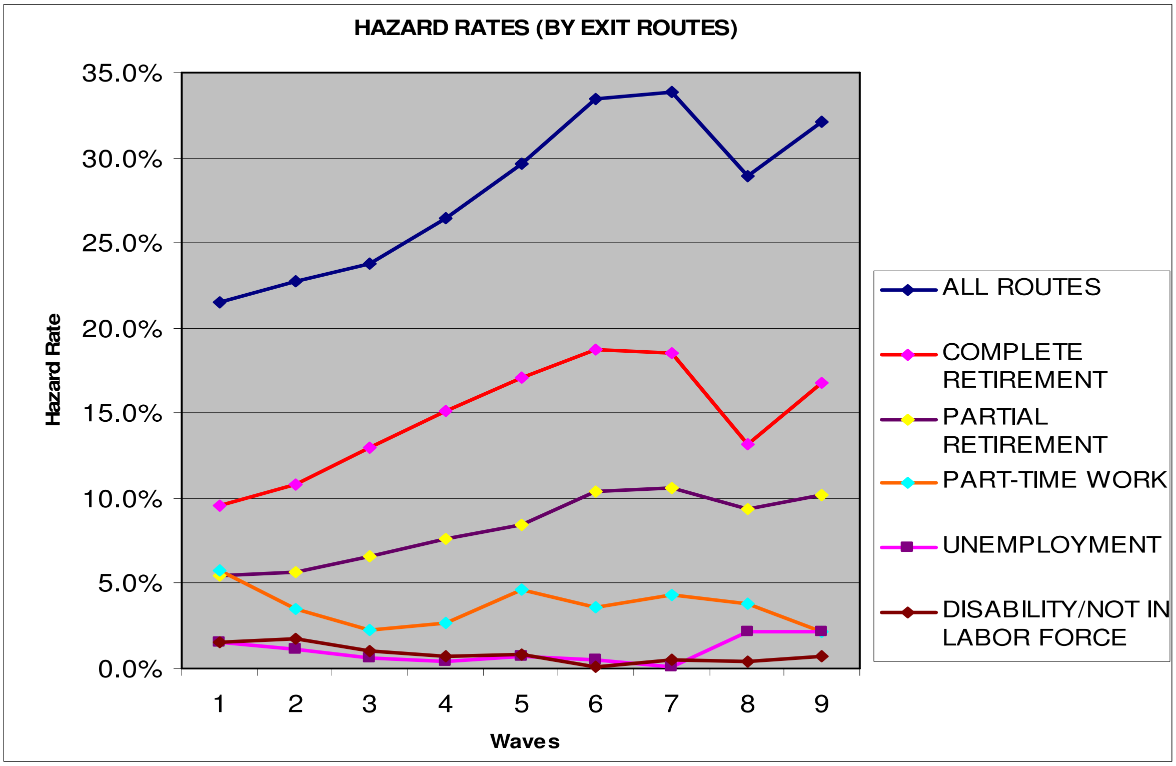
[9] Appendix A, Figure A.1 illustrates each two year transition. The available HRS data allows me to follow the individuals through nine transitions: 1992-94, 1994-96, 1996-98, 1998-00, 2000-02, 2002-04, 2004-06, 2006-08, and 2008-10. The 4,128 individuals who were at least 50 years old and worked full-time in 1992 are followed over the next 18 years (1992-2010). Between 1992 and 1994, 20 individuals leave the sample due to attrition (death or other reason), so 4,108 individuals are "at risk" of retirement (exit) during 1994-1996. Among them 349 individuals already exit via complete retirement route by 1994. Another 148, 209, 70 and 67 individuals exit via partial retirement, part-time work, unemployment and disability/not in labor force routes respectively. Of the 3,265 individuals who remain full-time employed in the sample in 1994, 27 are lost due to attrition, so only 3,238 remain at the risk of retirement. Among them 372 individuals already exit via complete retirement route by 1996. Another 173, 20, 87 and 76 individuals exit via partial retirement, part-time work, unemployment and disability/not in labor force routes respectively. The rest of the illustration follows the same pattern between each two year time period. Finally, among the 4,128 individuals only 142 remain full-time employed through all 18 years while the rest exited via one of the five routes or attrite.

The other type of employment spell I consider in my analysis is a subsequent employment spell (multiple exit model). In other words I drop the assumption that retirement is an absorbing state and allow members of the sample that retire to contribute additional spells of full-time employment if they re-enter the labor market. This adds 740 additional employment spells to the 4,128 initial employment spells described above, for a total of 4,868 full-time employment spells generated by my sample.[10]

Figure 1.1 depicts the baseline hazard rate for individuals to exit over time via any route in general and also via the five different exit routes. It is observed that the hazard rate for exiting full-time employment in general (via any route) cumulatively rises over time over time with a distinct peak occurring in Wave 7 (2004). This is largely driven by the rise in hazard rate of exiting via the complete retirement route which also peaks in Wave 7. This is probably because the individuals who are 50 years of age or older in 1992 become eligible for retirement benefits around the same time. The figure also indicates that the baseline hazard rate for the different exit routes is non-linear and not constant over time which calls for its parametric estimation using a suitable distribution[11]. The Kaplan-Meir survival estimates indicate that the probability of surviving in full-time employment declines over time. However, this decline is larger in the initial waves. This is true for all routes combined and the complete retirement and partial retirement routes. For the part-time work, unemployment and disability or not in labor force routes, the decrease in survival rate almost flattens out over time.

[10] This is reported in Appendix A, Table A.1.
[11] The associated baseline hazard rates are reported in Table A.2, while the Kaplan Meir survivor estimate is depicted in Figure A.2.

Figure 1.1: Cumulative Hazard Rates for Different Exits (1992-2010)



1.4.2 Health Measures

I use a wide range of health measures in this study in an attempt to address the concern that many health measures, such as self-reported health, are based on individual perceptions and may be plagued by misreporting and measurement error. Some of these measures are relatively more objective than others are and have not been used in the previous studies. Below I discuss these health measures by grouping them into four broad categories.

Self-reported health: This is the most subjective measure of health and has been widely used in existing studies. In the HRS, individuals may report their health as excellent, very good, good, fair and poor.

Physical health: Some of my measures of physical health have been used in prior studies, including counts of difficulties with activities of daily living (ADL) and diagnosed chronic conditions. The ADL difficulties include difficulties with daily chores like bathing, eating, getting dressed, getting in or out of bed, and walking across a room. The medically diagnosed chronic conditions include diseases like blood pressure, diabetes, lung disease, heart disease, stroke, cancer, arthritis and psychological disorders in the previous two years. Unlike other studies, in this paper information on medically diagnosed chronic conditions has been additionally matched with prescription drug use information to get relatively more objective indicators of physical health.

Mental health: The existing literature has mostly overlooked measures of mental health. The studies that do include mental health only account for depression while paying no attention to cognitive disorders. I measure mental health by using information on depression and cognition as well as other diseases like Alzheimer's and Dementia. These mental health conditions are also validated with prescription drug use information. In the HRS, depression is measured in a 0-8 scale, as defined by the Center for Epidemiologic Studies on Depression (CESD). This CESD score measures the sum of adverse mental health symptoms for the past week, based on 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 this to be a valid and reliable indicator for incidence of major depression in older adults (Irwin et al., 1999). Information on measures of cognitive functioning is also included in my analysis. The cognitive functioning measures include immediate and delayed word recall, the serial 7's test, counting backwards, naming tasks (e.g., date-naming), and vocabulary questions. In addition to the individual cognitive functioning measures, the HRS also derives three cognition summary indices. The total recall index which is available for all waves is a concise summary of the immediate and delayed word recall tasks. The mental status index adds the scores from counting, naming, and vocabulary. To maintain consistency across waves, I have used the total cognition score in this study, which sums the total recall and mental status indices and thus ranges from zero to thirty-five.

Other health measures: In addition to self-reported health and measures of physical and mental health, some other measures of health (ignored in existing studies) are also used in this study. These measures include body mass index (BMI), work related stress, physical effort at work, extent of physical exercise, number of nights at hospital, number of doctor visits, risky behaviors like smoking and drinking, and out-of-pocket-medical expenditure.

1.4.3. Descriptives

One way to analyze the impact of health status on the decision to exit full-time employment is to investigate whether or not there are baseline differences (in 1992) in health status between those that are observed working full-time throughout the sample and those that are observed exiting full-time work via one of the routes. Table 1.1 presents such a comparison for some important standard measures of health. In general, those that subsequently exit from full-time work seem to have worse baseline measures of health than those that remain working full-time. For example, those that exit from full-time employment via complete retirement are more likely to report poor health, ADL difficulties, multiple chronic conditions, depression, and psychological problems.

A similar pattern is observed for individuals who subsequently exit via other routes. There is statistically significant difference in means of the health outcome measures for samples of working individuals and individuals who exit via one of the routes as reported in Table 1.1.

The baseline differences in socio-demographic and economic variables for the individuals working full-time across all waves and those that subsequently exit via one of the routes are reported in Table 1.2. The individuals who subsequently exit via complete retirement route are older, more likely to be male, married and in blue-collar jobs with lower individual and household income as compared to those that remain in labor market full time.

Table 1.1: Descriptive Statistics for Some Health Outcome Variables Measured in 1992

VARIABLES	No Exit/ Working Full-Time	INDIVIDUALS WORKING FULLTIME IN 1992 WHO SUBSEQUENTLY EXIT FOR THE FIRST TIME VIA:				
		Complete Retirement Route	Partial Retirement Route	Part-time Work Route	Unemployment Route	Disability/Not in Labor Force Route
HEALTH OUTCOMES (Dichotomous)						
Has Poor Health***	0.01	0.14	0.07	0.03	0.01	0.09
Has Good Health	0.62	0.31	0.57	0.58	0.66	0.36
Presence of ADL Difficulty***	0.01	0.07	0.03	0.01	0.01	0.03
Presence of Multiple Chronic Conditions***	0.16	0.46	0.39	0.22	0.19	0.33
Presence of High BP	0.30	0.35	0.24	0.31	0.33	0.31
Presence of Diabetes**	0.06	0.11	0.09	0.08	0.03	0.12
Presence of Cancer	0.04	0.04	0.05	0.06	0.01	0.03
Presence of Heart Disease**	0.07	0.12	0.12	0.08	0.07	0.09
Presence of Lung Disease**	0.02	0.04	0.09	0.03	0.03	0.03
Presence of Arthritis**	0.29	0.35	0.28	0.27	0.24	0.40
Presence of Depression***	0.19	0.43	0.37	0.50	0.50	0.75
Total Congnition Index Score***	24.64	23.59	23.48	23.69	24.31	24.07
Presence of Psychological Problem**	0.03	0.12	0.05	0.05	0.03	0.07
HEALTH OUTCOMES (Non-Dichotomous)						
No. of nights at Hospital*	0.39	1.73	0.53	0.38	0.23	0.60
No. of Doctor Visits*	3.17	4.42	3.57	2.65	2.83	4.58
Out of pocket medical expenditure*	0.03	0.05	0.04	0.02	0.04	0.10
BMI	26.98	28.01	27.09	27.02	26.90	28.30
OBSERVATIONS	3,285	349	148	209	70	67

Note: Sample of individuals at least 50 years old and working full-time in 1992 drawn from the Health and Retirement Study (1992-2010). In the Health Outcomes column, * p<0.05, ** p<0.01, *** p<0.001 indicate the statistical significance of the health measures for the test of equality of means across all samples. For the dichotomous variables, 1 indicates YES and 0 indicates NO.

Table 1.2: Descriptive Statistics for Socio-Demographic Variables Measured in 1992

VARIABLES	INDIVIDUALS WORKING FULLTIME IN 1992 WHO SUBSEQUENTLY EXIT FOR THE FIRST TIME VIA:					
	No Exit/ Working Full-Time	**Complete Retirement Route**	**Partial Retirement Route**	**Part-time Work Route**	**Unemployment Route**	**Disability/Not in Labor Force Route**
SOCIO-DEMOGRAPHIC (Dichotomous)						
Age*	55.67	58.62	59.49	55.93	55.31	54.82
Mother's Age	73.56	73.46	73.41	72.96	70.33	70.54
Father's Age	70.61	70.00	69.76	69.06	68.09	69.91
Years of Schooling**	12.84	12.32	12.80	11.93	12.70	11.43
Individual Income***	31,605.73	28,862.54	31,604.66	19,488.27	27,437.91	18,031.25
Household Income***	54,537.24	51,095.82	57,483.95	51,897.82	46,381.00	35,770.48
SOCIO-DEMOGRAPHIC (Non-Dichotomous)						
Female***	0.43	0.36	0.28	0.66	0.44	0.72
Black**	0.14	0.15	0.09	0.21	0.20	0.22
Hispanic	0.02	0.01	0.03	0.02	0.01	0.01
Other Race	0.06	0.05	0.05	0.11	0.11	0.16
Married**	0.75	0.77	0.84	0.72	0.64	0.58
Blue Collar Worker	0.28	0.33	0.28	0.23	0.36	0.39
Has Religious Preference	0.95	0.96	0.97	0.96	0.91	0.93
Native	0.91	0.96	0.96	0.87	0.86	0.87
Father's Education (>8 yrs)	0.57	0.54	0.55	0.55	0.74	0.51
Mother's Education (>8 yrs)	0.61	0.60	0.63	0.58	0.71	0.55
Has Govt. Insurance***	0.05	0.11	0.11	0.03	0.03	0.10
Has Private Insurance***	0.14	0.13	0.20	0.21	0.09	0.12
Has Employer. Insurance***	0.87	0.86	0.77	0.66	0.76	0.70
Has Non-employer Insurance***	0.06	0.08	0.11	0.15	0.07	0.13
Has No Insurance***	0.07	0.06	0.11	0.19	0.17	0.16
Has Pension DC***	0.20	0.16	0.16	0.12	0.23	0.12
Has Pension DB***	0.27	0.34	0.22	0.14	0.16	0.27
Has Pension Both***	0.18	0.19	0.16	0.06	0.07	0.07
Don't Know about Pension**	0.01	0.01	0.01	0.01	0.01	0.01
OBSERVATIONS	3,285	349	148	209	70	67

Note: Sample of individuals at least 50 years old and working full-time in 1992 drawn from the Health and Retirement Study (1992-2010). In the Health Outcomes column, * p<0.1, ** p<0.05, *** p<0.001 indicate the statistical significance of the health outcome variables for the test of equality of means across all samples. For the dichotomous variables, 1 indicates YES and 0 indicates NO.

1.4.4. Health Indices

To mitigate the potential difficulties arising due to use of subjective self-reported measure of health, (Bound, 1991) (Bound, et al., 1998) suggested an approach that involves estimating a model of self-reported health as a function of more objective measures of health to define a latent 'health stock' variable. This health stock variable is then used as a measure of health in a model of retirement / exit from full-time employment. This idea of constructing a health stock is in many ways analogous to using objective measures of health to instrument for the endogenous and potentially error-ridden self-reported health variable.

In this paper, the latent health stock variable is predicted by using an ordered probit model for self-reported health, where the ordered measure of self-reported health is regressed on a set of relatively more objective health measures described above. More health problems are associated with a lower order of the latent health stock. Unfortunately, this method for creating a latent health stock is not very effective at suggesting how the different individual health measures are weighted. This can be a problem because clearly neither high blood pressure nor diabetes is the same as cancer. Physical health outcomes are also clearly different from mental health outcomes. On the other hand, including every health measure separately in a regression model will make it cumbersome.

Hence principal component factor analysis is used as a comprehensive way to extract eight[12] meaningful factors (indices) from twenty-eight individual health outcomes. For each factor, it is possible to note how the different individual health measures weigh.[13] It is important

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[12] Factors having eigen-values greater than 1 are retained. These eight factors are the "principal components" of the health of individuals in the sample. In other words, they represent perceived health status of individuals in the sample in the best possible objective way. From twenty eight diverse health outcome variables. Eight factors with Eigen value greater than 1 are generated using Principal Component Factor Analysis which is used to create the health indices used as explanatory variable in the hazard model.

[13] Principal Component Analysis results are reported in Appendix Tables A.3 and A.4.

to note that self-reported health does not load heavily in any factor, which implies that it is not the best indicator of health of an individual. Based on the health outcomes that load heavily in each factor[14] I label them: Factor 1: Has chronic conditions, Factor 2: Has functional limitation, Factor 3: Hospital stay, Factor 4: Has cognitive functioning problems, Factor 5: Has depression, Factor 6: Lack of physical exercise, Factor 7: Has cancer, and Factor 8: Has lifestyle behavioral problems.

1.5 Empirical Method

In this paper, a standard proportional hazard model is used to estimate the impact of health on the duration of full-time employment, where time is measured in two-year waves. In some specifications, only initial employment spells are included in the sample, while in other specifications I include subsequent employment spells as well. Another way in which I differentiate the model is to combine all five exit routes in some specifications (a combined risk or lumped risk model) while other specifications each exit route is treated separately (a competing risk model).

More formally, the competing risk proportional hazard model is given by:

$$H_j(t) = H_0(t) * \exp(X'_{it}\beta) \qquad (1.4)$$

Here, j is an index for each of the five exit routes and X_{it} is the vector of covariates that vary with time while $H_0(t)$ is the baseline hazard that only depends on time but not individual covariates which means it is common for all units. The impact of the observable characteristics is parametrically estimated using the standard proportional hazard functional form $\exp(X'_{it}\beta)$. Given that the hazard is not constant over time (time-dependency of hazard rates), it is important to choose a suitable parametric distribution for estimating the baseline hazard. If the chosen distribution correctly characterizes the time-dependency, then the parameter estimates obtained

[14] Refer to Appendix Table A.4 to see the factor loadings (i.e. which measures load heavily in each factor).

are likely to be more precise than the parameter estimates of semi parametric or non-parametric models where the time-dependency is left unspecified. Hence, there are advantages of using a suitable parametric model. But problems may arise if a wrong parametric form is chosen.[15] The most common approach for choosing an appropriate parametric model is based on using the Akaike Information Criterion (AIC).[16] It is based on penalizing the log likelihood to reflect the number of parameters being estimated by different models (distributions) and comparing them. Although the best fitting distribution is the one with the largest log likelihood, the one will smallest AIC is most preferred. Table 1.3 presents the log likelihood and AIC information for different parametric models. Given the smallest AIC, the Weibull distribution is chosen for parametrically estimating the baseline hazard.[17] According to the proportional hazard specification stated earlier, the Weibull hazard rate is given as:

$$H\ (t, X) = \lambda\ p\ (\lambda t)^{p-1} \qquad (1.5)$$

Where, $\lambda_i = e^{X_i\beta}$ and p is the shape parameter.

In all specifications, in addition to the socio-demographic and economic variables reported in Table 1.2, each specification I estimate includes spousal health and work status, occupations, census regions, expected longevity[18] and controls for general economic conditions (through time dummies). In order to estimate the model with standard software, an independence assumption across the exit routes is imposed[19]. Then this independence assumption is tested by estimating Martingale residuals for each exit route and checking their correlations for statistical significance, as in (Borgan & Langholz, 2007; Marton, Ketsche, & Zhou, 2010).

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[15] Please refer to Appendix A.8, Technical Notes for a discussion on different parametric hazard models.
[16] Please refer to Appendix A.8, Technical Notes for details on AIC.
[17] I have also estimated the following other parametric models Gompertz (proportional hazard model), Log normal, Log logistic and Gamma (Accelerated Failure Time models) for all specifications (not reported) and found the time ratios (similar to hazard ratios). In the generalized gamma model, the Wald test for $\kappa = 1$ provides support for adopting the Weibull distribution.
[18] Expected subjective probability of living until age 85.
[19]

Table 1.3: Log likelihood and Akaike Information Criterion for Different Parametric Models.

DISTRIBUTION	**ALL RISKS: All Routes**		**COMPETING RISKS**									
			Exit Route 1: Complete Retirement		**Exit Route 2: Partial Retirement**		**Exit Route 3: Part-time Work**		**Exit Route 4: Unemployment**		**Exit Route 5: Disability and Not in Labor force**	
	Log-likelihood	**AIC**	**Log-likelihood**	**AIC**	**Log-likelihood**	**AIC**	**Log-likelihood**	**AIC**	**Log-likelihood**	**AIC**	**Log-likelihood**	**AIC**
Exponential	-4441.75	8957.49	-2783.79	5641.58	-1786.91	3647.82	-1538.07	3150.14	-616.79	1307.59	-640.41	1354.82
Weibull	-4182.89	7871.98	-2663.72	5185.80	-1747.70	3402.30	-1487.03	2985.92	-591.56	1254.86	-591.30	1253.54
Log normal	-3897.99	8014.04	-2544.90	5233.87	-1663.15	3453.57	-1454.96	3027.67	-589.43	1258.58	-589.49	1255.00
Log logistic	-3969.01	8441.77	-2578.93	5403.45	-1688.78	3571.40	-1475.84	3050.06	-591.28	1259.12	-589.56	1258.61
Generalized Gamma	-3914.14	7997.98	-2547.44	5192.88	1671.37	3440.73	-1465.74	2999.28	-589.97	1256.73	-591.23	1256.43

Note: The table shows the log likelihood and AIC for the different parametric models. The log normal has the highest log likelihood across all exit routes and should be the best fitting model, but the Weibull has the lowest AIC, hence is the most preferred one and used for estimating the baseline hazard in all subsequent regression specifications.

Hazard models may be plagued by duration dependence, which arises due to unobserved heterogeneity.[20] Ignoring unobserved heterogeneity may exaggerate the rate of failure for some individuals and underestimate the rate of failure for others. In this context, unobserved heterogeneity is addressed through the addition of an additional random parameter or "frailty term" to the model.

In the proportional hazards model, the hazard rate increases or decreases with the covariates. The problem is that if there are unmeasured or unobserved 'frailties', then the hazard rate will be a function of the covariates and the frailties. Equation 1.4 may be rewritten as:

$$H_j (t) = H_0 (t) * \exp (X'_{it}\beta + \varepsilon_i) \quad (1.6)$$

or

$$H_j (t) = H_0 . v_i . \exp (X'_{it}\beta) \quad (1.7)$$

where $v_i = \exp (\varepsilon_i)$.

So, the frailty term acts multiplicatively on the hazard rate. The hazard rate is conditional on both the covariates and the frailty. For identification purposes, it is assumed that mean of $v = 1$ and the variance is equal to some unknown finite parameter θ. Then the unobserved heterogeneity or frailty is modeled using a gamma distribution and effectively the frailty variance θ is estimated. The hypothesis that $\theta = 0$ may be tested using a likelihood ratio test to determine whether unobserved heterogeneity is something to worry about in the model.

This is equivalent to the inclusion of a random effects term in a standard panel data model. In some specifications, I include a frailty term that is modeled parametrically using the

[20] Individuals with the same observed characteristics are not identical. The notion of unobserved heterogeneity amounts to observations being conditionally different (heterogeneous) in terms of their hazards in ways that are unaccounted for in the standard hazard model. In other words, some observations are more "frail" than others.

gamma distribution.[21] There is no hazard model equivalent to a fixed effect panel data model. In the results section below, I investigate this potential limitation by estimating standard linear probability models of retirement with both fixed and random effects to see if there is a big different in the coefficients.[22]

1.6 Results

1.6.1 Controlling for Unobserved Heterogeneity in Hazard Models vs. Panel Data Models

I start by estimating a simple linear probability model of complete retirement using the standard health measures from existing studies and only the first five waves of the HRS.[23] Both fixed effect (FE) and random effect (RE) models are presented in panel A of Table 1.4. These results suggest poor self-reported health, multiple ADL difficulties and chronic diseases, heart disease and stroke lead to an increase in probability of complete retirement. In this case, the Hausman-Wu test rejects the null hypothesis that the difference in the coefficients in the FE and RE models is not systematic. This implies that the FE model does a better job of controlling for unobserved heterogeneity. Panel B illustrates that adding an additional five waves to the sample does not affect the coefficient estimates in a major way, except that having psychological problem now leads to a statistically significant increase in probability of complete retirement. The Hausman-Wu test again rejects the hypothesis that the RE and FE coefficients are the same.

As mentioned in Section 1.4, there are advantages associated with using the health indices (factors) that come from a PCA to control for health status, rather than the limited individual health measures typically used in the literature. Panel C includes the eight health

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[21] Competing risk models that include controls for unobserved heterogeneity and allow for correlation in the unobserved heterogeneity across exit routes (semiparametric estimation) are presented in (Butler, Anderson, & Burkhauser, 1989) (Canals‐Cerdá & Gurmu, 2007)

[22] The drawback of such a fixed effects model is that it does not differentiate between full-time employment spells of different duration.

[23] This similar to the method followed in (Dwyer & Mitchell, 1999)

indices described in Section 1.4.4 rather than the typical health indicators from the literature.[24] When we use 10 waves of the HRS and include our PCA health indices to measure individual health status, the Hausman-Wu test cannot reject the hypothesis of equality of the RE and FE coefficients. Given that the RE and FE coefficients are so similar in the linear probability model framework, I have confidence that the lack of a fixed effects specification within a hazard model framework is not a serious limitation in my subsequent analysis presented below. In other words, this implies that the individual random effects (frailty) in my hazard model will control for the same unobserved factors as would individual fixed effects

[24] In both panels, B and C chronic conditions lead to a statistically significant increase in probability of complete retirement. However, from the estimates in panel B it is only possible to say whether the presence of multiple chronic conditions (dichotomous) affect the probability of complete retirement. However, panel C has a more objective measure of chronic illness because Factor 2 includes information on the count of medically diagnosed chronic conditions as well as information on intake of specific prescriptions drugs for those chronic conditions. Similarly, in Panel B it is possible to state that presence of psychological disorder (dichotomous) raises the probability of complete retirement. While in Panel C, factor 5 indicates a high score on CESD scale (depression), having work-related stress and taking prescription medication for depression increases the probability of complete retirement. Therefore, the panel C health factors are clearly more objective than the panel B standard health measures.

Table 1.4: Fixed and Random Effect Estimates in Linear Model

	(A) Using HRS Waves (1992-2000)		**(B) Using HRS Waves (1992-2010)**		**(C) Using HRS Waves (1992-2010)**	
	FE	RE	FE	RE	FE	RE
HEALTH OUTCOMES						
Self Reported Poor Health	0.053***	0.061***	0.088***	0.093***		
	(0.015)	(0.014)	(0.011)	(0.010)		
Has Activity of Daily Living Difficulty	0.030***	0.024***	0.040***	0.051***		
	(0.011)	(0.007)	(0.012)	(0.012)		
Has Multiple Chronic Conditions	0.070***	0.040***	0.030***	0.015**		
	(0.017)	(0.011)	(0.007)	(0.007)		
Has High Blood Pressure	0.013	0.010	0.026	0.033		
	(0.012)	(0.007)	(0.007)	(0.005)		
Has Diabetes	0.021	0.027	0.011	0.026		
	(0.016)	(0.009)	(0.008)	(0.007)		
Has Heart Disease	0.043***	0.036***	0.026***	0.038***		
	(0.014)	(0.009)	(0.008)	(0.007)		
Has Lung Disease	0.036	0.025	0.054**	0.044**		
	(0.023)	(0.014)	(0.012)	(0.009)		
Had Stroke	0.086***	0.028	0.060***	0.050***		
	(0.027)	(0.018)	(0.014)	(0.012)		
Has Cancer	0.023	0.001	0.027*	0.039*		
	(0.012)	(0.009)	(0.010)	(0.007)		
Has Arthritis	0.013	0.021	0.017	0.024		
	(0.018)	(0.017)	(0.007)	(0.005)		
Has Psychological Problem	0.005	0.014	0.029**	0.019**		
	(0.020)	(0.013)	(0.012)	(0.009)		
HEALTH INDICES						
Factor 1: Has Chronic Conditions					0.073***	0.072***
					(0.004)	(0.003)
Factor 2: Has Functional Limitations					0.100***	0.102***
					(0.003)	(0.003)
Factor 3: Hospital Stay					0.059	0.052
					(0.004)	(0.002)
Factor 4: Has Cognitive Disorders					0.121	0.119
					(0.003	(0.003)
Factor 5: Has Depression					0.062***	0.065***
					(0.003)	(0.002)
Factor 6: Lack of Physical Exercise					0.016***	0.024***
					(0.002)	(0.002)
Factor 7: Has Cancer					0.015*	0.019*
					(0.004)	(0.003)
Factor 8: Has Lifestyle Behavioral Problems					0.021	0.011
					(0.009)	(0.007)
OBSERVATIONS	18,428	18,428	32,707	32,707	32,707	32,707

Note: This table shows the FE and RE regression results for effect of health on complete retirement for individuals over 50 years of age and employed full-time in 1992. Panel A uses the first five waves of the HRS (similar to exiting studies). Panel B uses another five additional waves. Both Panels A and B use the standard physical and mental dichotomous health outcome measures used in existing studies. Panel C uses ten waves of the HRS and the health indices (factors) created by PCA from twenty-eight health outcome variables. All panels control for the socio-demographic variables reported in Table 1.2. Also controlling occupations, the wave dummies, census regions, expected mortality and work and health status of spouse, which are not been reported here. The standard errors are reported in parentheses and *** p<0.01, ** p<0.05, * p<0.1

1.6.2 Hazard Model

The hazard ratios from parametric hazard model (Weibull) are reported for initial exit and multiple exit models with and without frailty for combined risk competing risks specification. Table 1.5.1 reports the hazard ratios for the health indices (factors) for both the combined risk and competing risks specifications estimated without a frailty term over all initial employment spells. The latent health stock variable has statistically significant hazard ratios 0.845 and 0.796 for the combined risk model and the complete retirement exit route, respectively. This implies an increase in one's latent health stock (i.e. better self-reported health) makes an individual 15.5 percent less likely to exit from full-time employment in general and 20.4 percent less likely to exit via complete retirement route. The functional limitations factor has statistically significant hazard ratios of 1.101, 1.136 and 1.278 (significant at 1 percent level) for the combined risk model, the complete retirement exit route, and the disability/not in labor-force exit route, respectively. This implies that multiple functional limitations (ADL difficulties) that limit mobility and work, increase the probability of exit from full-time employment by 10.1 percent in general, 13.6 percent via the complete retirement exit route, and 27.8 percent via the disability exit route. More generally, a hazard ratio for an independent variable greater than 1 implies that the presence of (or an increase in) that variable leads to an increase in the likelihood of an exit. The opposite is true if the estimated hazard ratio is less than 1. The p-values are for the hypothesis test that the hazard ratio for the variable in question is equal to 1 (i.e. no effect).

The magnitudes of these effects can be difficult to interpret, because they are relative probabilities. Therefore, the absolute effect[25] associated with each independent variable area also reported. For each exit route, these absolute effects can be compared to the average probability

[25] Here Absolute Effect = Hazard Ratio * Average Exit Probability via that route. Average Exit Probability = No. of Exits / (No. of Spells * Average Spell Length).

of exiting via that route.[26] For example, the absolute effect associated with the functional limitations factor in the combined risk model suggests that an increase in functional limitations makes an individual 18.10 percent more likely to exit from full-time employment, which is greater than the average exit probability of 16.44 percent for every period. An increase in functional limitations also makes an individual 9.58 percent and 1.08 percent more likely to exit via complete retirement and disability routes respectively, which is higher than the average probabilities to exit via those routes (8.44 percent and 0.85 percent, respectively) every wave. Other statistically significant health factors include depression, risky lifestyle behavior like drinking and smoking and cancer. It is observed that an increase in the cancer factors leads to a lower probability of exit via any route in general and the complete retirement route in particular.

In Table 1.5.2, I present the same models but estimate them using both initial and subsequent employment spells (multiple exit model). While this increases the sample size, it does not generate large changes in the coefficient estimates. Higher latent health stock (better self-reported health) still makes an individual less likely to exit. For physical health conditions, an increase in functional limitation factor makes an individual more likely to exit via any route in general and via the complete retirement and disability routes in particular. Among the mental health factors, an increase in depression raises the probability of exit via any route in general and through complete retirement route in particular. It is interesting to note that cognitive functioning disorders factor have no statistically significant effect on exit through the complete retirement route, but an increase in problems related to cognitive functioning makes an individual 1.12 percent more likely to exit via the disability route. Increase in risky behaviors makes an individual 9.47 percent more likely while cancer makes one 7.78 percent less likely to exit via the complete retirement route.

[26] The average exit probabilities are reported at the bottom of Tables 1.5.1, 1.5. .2, and 1.6, 1.7 and 1.8.

Table 1.5.1: Competing Risk Model (Weibull Distribution) for Initial Exit from Full-time Employment (Without Frailty)

HEALTH OUTCOMES	ALL RISKS		COMPETING RISKS									
			Exit Route 1: Complete Retirement		Exit Route 2: Partial Retirement		Exit Route 3: Part-time Work		Exit Route 4: Unemployment		Exit Route 5: Disability and Not in Labor force	
	Hazard Ratio	Absolute Effect	Hazard Ratio	Absolute Effect	Hazard Ratio	Absolute Effect	Hazard Ratio	Absolute Effect	Hazard Ratio	Absolute Effect	Hazard Ratio	Absolute Effect
Latent Health Stock: Self Reported Health	0.845***	13.89%	0.796***	6.71%	1.112	4.29%	0.971	2.46%	0.965	0.71%	0.969	0.82%
	(0.033)		(0.043)		(0.103)		(0.147)		(0.095)		(0.175)	
Factor 1: Chronic Conditions	0.988	16.24%	1.013	8.54%	0.986	3.81%	0.982	2.49%	0.827	0.61%	0.922	0.78%
	(0.023)		(0.033)		(0.050)		(0.056)		(0.088)		(0.077)	
Factor 2: Functional Limitation	1.101***	18.10%	1.136***	9.58%	1.070	4.13%	0.932	2.36%	1.158	0.85%	1.278***	1.08%
	(0.021)		(0.029)		(0.050)		(0.056)		(0.099)		(0.073)	
Factor 3: Hospital Stay	1.016	16.70%	1.012	8.54%	0.924	3.56%	1.076	2.73%	1.078	0.79%	1.133	0.96%
	(0.022)		(0.030)		(0.048)		(0.056)		(0.105)		(0.086)	
Factor 4: Cognitive Functioning	1.075***	17.67%	1.086**	9.16%	0.983	3.79%	1.062	2.70%	0.880	0.65%	1.321***	1.12%
	(0.030)		(0.043)		(0.059)		(0.070)		(0.102)		(0.140)	
Factor 5: Depression	1.088***	17.88%	1.088***	9.18%	0.910*	3.51%	1.091*	2.77%	1.186*	0.87%	1.291***	1.09%
	(0.023)		(0.033)		(0.047)		(0.054)		(0.106)		(0.084)	
Factor 6: Physical Exercise	0.993	16.32%	0.971	8.19%	1.081*	4.17%	1.025	2.60%	0.823**	0.61%	1.051	0.89%
	(0.021)		(0.028)		(0.047)		(0.053)		(0.079)		(0.085)	
Factor 7: Cancer	0.938***	15.42%	0.924***	7.80%	0.952	3.67%	0.940	2.39%	0.797*	0.59%	0.934	0.79%
	(0.020)		(0.028)		(0.043)		(0.052)		(0.097)		(0.077)	
Factor 8: Life Style	1.104***	18.15%	1.144***	9.65%	1.137***	4.38%	1.037	2.63%	1.042	0.77%	1.063	0.90%
	(0.024)		(0.036)		(0.053)		(0.055)		(0.101)		(0.095)	
# Spells	4128		4128		4128		4128		4128		4128	
# Exits	3272		1680		769		505		148		170	
Avg. Spell Length	4.82		4.82		4.82		4.82		4.82		4.82	
Avg. Exit Probability	16.44%		8.44%		3.86%		2.54%		0.74%		0.85%	

Note: Table 1.5.1 uses data from the Health and Retirement Study (1992-2010) for a proportional hazard model in competing risks framework for individuals who were at least 50 years old and worked full-time in 1992. The underlying baseline hazard is parametrically estimated using Weibull distribution where the shape parameter p is approximately close to 2. The hazard ratios and absolute effect for the single time exit scenario are reported. Absolute Effect= Hazard Ratio * Average Exit Probability via that route. Average exit probability= no. of exits/ (no. of spells * average spell length). The dependent variable is duration of full-time employment while the independent variables are health outcome indices constructed by principal component factor analysis. The competing risks in this framework are the different routes of exit from full-time employment. The combined risk model has also been reported in panel A in both tables. Controlling for the socio-demographic variables reported in Table 1.2. Also controlling occupations, the wave dummies, census regions, expected mortality and work and health status of spouse, which have not been reported here. This specification does not control for frailty (unobserved heterogeneity). In both tables standard errors are reported in parentheses and *** p<0.01, ** p<0.05, * p<0.1

Table 1.5.2: Competing Risk Model (Weibull Distribution) for Exiting Full-time Employment Allowing for Multiple Spells of Employment (Without Frailty)

HEALTH OUTCOMES	ALL RISKS		COMPETING RISKS									
			Exit Route 1: Complete Retirement		Exit Route 2: Partial Retirement		Exit Route 3: Part-time Work		Exit Route 4: Unemployment		Exit Route 5: Disability and Not in Labor force	
	Hazard Ratio	Absolute Effect	Hazard Ratio	Absolute Effect	Hazard Ratio	Absolute Effect	Hazard Ratio	Absolute Effect	Hazard Ratio	Absolute Effect	Hazard Ratio	Absolute Effect
Latent Health Stock: Self Reported Health	0.848***	14.36%	0.785***	6.56%	1.101	4.72%	0.978	2.68%	0.968	0.67%	0.568***	0.48%
	(0.030)		(0.040)		(0.090)		(0.090)		(0.088)		(0.063)	
Factor 1: Chronic Conditions	1.010	17.10%	1.036	8.65%	1.027	4.40%	0.982	2.69%	0.846	0.59%	0.944	0.80%
	(0.022)		(0.032)		(0.046)		(0.052)		(0.087)		(0.077)	
Factor 2: Functional Limitation	1.086***	18.39%	1.128***	9.42%	1.037	4.48%	0.932	2.55%	1.133	0.79%	1.257***	1.07%
	(0.020)		(0.028)		(0.044)		(0.051)		(0.093)		(0.071)	
Factor 3: Hospital Stay	1.010	17.10%	1.017	8.49%	0.917	3.93%	1.069	2.93%	1.005	0.70%	1.145*	0.97%
	(0.020)		(0.028)		(0.042)		(0.050)		(0.100)		(0.0841)	
Factor 4: Cognitive Functioning	1.067**	18.08%	1.079	9.01%	0.967	4.14%	1.057	2.89%	0.903	0.63%	1.322***	1.12%
	(0.028)		(0.041)		(0.052)		(0.065)		(0.102)		(0.138)	
Factor 5: Depression	1.078***	18.26%	1.078***	9.00%	0.936	4.01%	1.060	2.90%	1.220**	0.85%	1.290	1.10%
	(0.021)		(0.031)		(0.043)		(0.049)		(0.101)		(0.083)	
Factor 6: Physical Exercise	1.001	16.95%	0.965	8.06%	1.099**	4.32%	1.025	2.81%	0.824**	0.58%	1.077	0.92%
	(0.019)		(0.027)		(0.043)		(0.049)		(0.077)		(0.085)	
Factor 7: Cancer	0.951***	16.10%	0.932**	7.78%	0.966	4.14%	0.967	2.65%	0.896	0.62%	0.917	0.78%
	(0.019)		(0.0265)		(0.038)		(0.047)		(0.095)		(0.075)	
Factor 8: Life Style	1.089***	18.45%	1.134***	9.47%	1.096**	4.70%	1.032	2.83%	1.085	0.76%	1.026	0.87%
	(0.022)		(0.034)		(0.046)		(0.051)		(0.103)		(0.089)	
# Spells	4868		4868		4868		4868		4868		4868	
# Exits	3817		1883		968		617		157		192	
Avg. Spell Length	4.63		4.63		4.63		4.63		4.63		4.63	
Avg. Exit Probability	16.94%		8.35%		4.29%		2.74%		0.70%		0.85%	

Note: Table 1.5.2 uses data from the Health and Retirement Study (1992-2010) for a proportional hazard model in competing risks framework for individuals who were at least 50 years old and worked full-time in 1992. The underlying baseline hazard is parametrically estimated using Weibull distribution where the shape parameter p is approximately close to 2. It reports hazard ratios and absolute effect for the multiple exits scenario. Absolute Effect= Hazard Ratio * Average Exit Probability via that route. Average exit probability= no. of exits/ (no. of spells * average spell length). The dependent variable is duration of full-time employment while the independent variables are health outcome indices constructed by principal component factor analysis. The competing risks in this framework are the different routes of exit from full-time employment. The combined risk model has also been reported in panel A in both tables. Controlling for the socio-demographic variables reported in Table 2. Also controlling occupations, the wave dummies, census regions, expected mortality and work and health status of spouse, which have not been reported here. This specification does not control for frailty (unobserved heterogeneity). In both tables standard errors are reported in parentheses and *** p<0.01, ** p<0.05, * p<0.1

In Table 1.6, I re-estimate the models from Table 1.5.2 on the same sample, but now include a frailty term in the model to control for unobserved heterogeneity (this represents the most complete model).[27] These results suggest that increase in latent health stock makes an individual 13.72 percent less likely to exit from full-time employment in general, 6.44 percent more likely to exit via complete retirement and 0.37 percent (significant at 1 percent level) more likely to exit via disability route. These are slightly lower than the average probabilities associated with these exit routes. For the indices of physical health, an increase in the functional limitations factor increases the likelihood of exit from full-time work by 18.88 percent overall, by 9.50 percent for the complete retirement exit route and by 1.07 percent for the disability exit route (significant at 1 percent level). These are higher than the average exit probabilities associated with these exit routes (bottom of Table 1.6). For mental health factors, an increase in depression factor increases the likelihood of exit from full-time employment for an individual by 18.68 percent in general, 9.06 percent via the complete retirement route (significant at 1 percent level), 0.90 percent via unemployment route (significant at 5 percent level) and 3.04 percent via part-time work route (significant at 10 percent level). Increases in cognitive problems factor have no statistically significant effect on the likelihood of exit via complete retirement, but increases the likelihood of exit via the disability exit route by 1.14 percent (significant at 1 percent). The risky behavior factor leads to 9.59 percent (significant at 1 percent level) and 4.82 percent (significant at 5 percent level) higher probability of exit via complete retirement and partial retirement respectively, while the cancer factor leads 7.71 percent lower likelihood of exit via complete retirement. The likelihood ratio test for the estimates reported in Table 1.6 rejects the null hypothesis of "no frailty", which implies the existence of unobserved heterogeneity that needs to be accounted for.

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[27] The initial exit model with frailty is presented in Appendix Table A.5

Table 1.6: Competing Risk Model (Weibull Model) for Exiting Full-time Employment Allowing for Multiple Spells of Employment (With Frailty)

HEALTH OUTCOMES	ALL RISKS		COMPETING RISKS									
			Exit Route 1: Complete Retirement		Exit Route 2: Partial Retirement		Exit Route 3: Part-time Work		Exit Route 4: Unemployment		Exit Route 5: Disability and Not in Labor force	
	Hazard Ratio	**Absolute Effect**	**Hazard Ratio**	**Absolute Effect**	**Hazard Ratio**	**Absolute Effect**	**Hazard Ratio**	**Absolute Effect**	**Hazard Ratio**	**Absolute Effect**	**Hazard Ratio**	**Absolute Effect**
Latent Health Stock: Self Reported Health	0.810*** (0.040)	13.72%	0.772*** (0.044)	6.44%	1.090 (0.109)	4.68%	0.947 (0.115)	2.59%	0.916 (0.192)	0.64%	0.430*** (0.077)	0.37%
Factor 1: Chronic Conditions	0.985 (0.028)	16.69%	1.027 (0.034)	8.58%	0.990 (0.053)	4.25%	0.942 (0.065)	2.58%	0.845 (0.107)	0.59%	0.962 (0.0890)	0.82%
Factor 2: Functional Limitation	1.115*** (0.026)	18.88%	1.138*** (0.030)	9.50%	1.049 (0.051)	4.51%	0.934 (0.061)	2.56%	1.177 (0.126)	0.82%	1.255*** (0.076)	1.07%
Factor 3: Hospital Stay	1.011 (0.026)	17.12%	1.015 (0.030)	8.48%	0.929 (0.050)	3.99%	1.079 (0.064)	2.95%	0.984 (0.117)	0.69%	1.151* (0.092)	0.98%
Factor 4: Cognitive Functioning	1.073** (0.036)	18.17%	1.085 (0.045)	9.06%	0.973 (0.062)	4.18%	1.089 (0.087)	2.98%	0.852 (0.121)	0.59%	1.336*** (0.150)	1.14%
Factor 5: Depression	1.103*** (0.028)	18.68%	1.085*** (0.034)	9.06%	0.947 (0.050)	4.07%	1.110* (0.066)	3.04%	1.289** (0.133)	0.90%	1.319 (0.099)	1.12%
Factor 6: Physical Exercise	0.972 (0.025)	16.47%	0.956 (0.029)	7.99%	1.090* (0.052)	4.67%	1.017 (0.062)	2.78%	0.769** (0.087)	0.53%	1.063 (0.089)	0.91%
Factor 7: Cancer	0.932*** (0.023)	15.78%	0.924** (0.028)	7.71%	0.951 (0.045)	4.08%	0.920 (0.0592)	2.52%	0.888 (0.108)	0.62%	0.904 (0.080)	0.77%
Factor 8: Life Style	1.131*** (0.032)	19.15%	1.148*** (0.038)	9.59%	1.124** (0.059)	4.82%	1.074 (0.070)	2.94%	1.065 (0.124)	0.74%	1.021 (0.0932)	0.87%
# Spells	4868		4868		4868		4868		4868		4868	
# Exits	3817		1883		968		617		157		192	
Avg. Spell Length	4.63		4.63		4.63		4.63		4.63		4.63	
Avg. Exit Probability	16.94%		8.35%		4.29%		2.74%		0.70%		0.85%	

Note: Table 1.6 uses data from the Health and Retirement Study (1992-2010) for a proportional hazard model in competing risks framework for individuals who were at least 50 years old and worked full-time in 1992. The baseline hazard is estimate using the Weibull distribution where the shape parameter p is approximately close to 2. It reports hazard ratios and absolute effect for the multiple exits scenario. Absolute Effect= Hazard Ratio * Average Exit Probability via that route, where average exit probability= no. of exits/(no. of spells * average spell length). The dependent variable is duration of full-time employment while the independent variables are health outcome indices constructed by principal component factor analysis. The competing risks in this framework are the different routes of exit from full-time employment. The combined risk model has also been reported in panel A. Controlling for the socio-demographic variables reported in Table 1.2. Also controlling occupations, the wave dummies, census regions, expected mortality and work and health status of spouse, which has not been reported here. Further, it controls for frailty (unobserved heterogeneity). The standard errors are reported in parentheses and *** p<0.01, ** p<0.05, * p<0.1. Likelihood ratio test rejects the null hypothesis of No Frailty such that there is statistically significant level of unobserved heterogeneity in the data. The shared frailty is estimated assuming an underlying gamma distribution.

The results from the parametric model are compared to the semi parametric Cox proportional hazard model estimates to check for the consistency of the estimates.[28] The hazard ratios from the Weibull parametric model are directly comparable to the hazard ratios reported in the Cox model. The hazard ratios obtained in the Cox proportional hazard model, are qualitatively similar, consistent in statistical significance but slightly smaller in magnitude for the different health indices for both combined risk and competing risks case. The inference drawn about the effect of the health factors on probability of exit from full-time employment for both Weibull and Cox models is similar. Among physical health factors, functional limitation leads to higher likelihood of exit via complete retirement and disability, with the magnitude of the effect being much smaller for the disability route. While for mental health factors, depression leads to higher likelihood of exit via complete retirement and unemployment while cognitive problems lead to higher probability of exit via the disability route. Lifestyle risky behavior also increases the likelihood of exit via complete retirement. In the Cox proportional hazard model, unlike the parametric Weibull model, cancer does not statistically significantly decrease the probability of exit from full-time employment via complete retirement route.

Further, the overall sample for this study may be split by age of the individuals in the baseline (1992). This is because the decision to exit full-time work as well as the route of exit may differ for individuals in different age groups. In the overall sample, which is restricted to individuals who were at least 50 years old and worked full-time in 1992 , 49.27 percent are 55 years of age or younger in the baseline wave (1992). The remaining individuals are strictly above 55 but less than 75 years of age.

There are 2,034 unique individuals who were 55 years or younger in the baseline and contribute 2,465 spells of full-time employment, of which 2,034 spells start in 1992 and the

[28] Cox-Proportional Hazard Model for multiple exits is reported in Appendix Table A.6.

remaining 431 spells start later. Of these, 1,844 of these spells end in exit via one of the routes while 621 are right censored. Similarly, there are 2,094 unique individuals strictly above 55 years of age in 1992 who contribute 2,403 spells of full-time employment. Of these, 2,094 of these spells start in 1992 while the remaining 309 spells start in later waves. In this older sub-sample 1,973 spells end in exit via one of the routes while 430 are right censored.[29]

In Table 1.7 and Table 1.8, I re-estimate the most complete specification (allowing for multiple spells of full-time employment while controlling for unobserved heterogeneity or frailty) for the two sub-samples based on age as described above. The absolute effects in Table 1.7 indicate (at 1 percent level of significance), for individuals who are 55 years of age or younger in 1992, an increase in self-reported latent health stock makes an individual 10.23 percent less likely to exit full-time employment in general and 4.43 percent and 0.45 percent less likely to exit via the complete retirement and disability routes respectively.

Unlike the overall sample, an increase in the chronic conditions factor leads 8.15 percent and 1.49 percent higher likelihood of exit via complete retirement and disability routes. An increase in the functional limitations factor makes an individual 3.56 percent and 0.72 percent (significant at 5 percent level) more likely to exit via part-time work and disability routes respectively. For mental health factors, an increase in the cognitive disorders factor makes an individual 3.40 percent (significant at 5 percent level) 1.34 percent (significant at 10 percent level) more likely to exit via part-time work and disability. Like the overall sample, depression leads to higher likelihood of exit via complete retirement and unemployment while cancer leads to higher likelihood of exit via complete retirement. Hence it can be said that for the younger sub-sample, the increase in both physical and mental health problems not only lead to higher

[29] The K-M survival estimate plots for these age based sub-samples are given in Appendix Figure A.3.1 and A.3.2. The figures indicate older individuals have a lower probability of survival over time.

probability of exit via complete retirement or disability but also via the part-time work (phased retirement) route.

Similarly, the absolute effects in Table 1.8 indicate (at 1 percent level of significance) that for individuals who were strictly above 55 years of age in 1992, an increase in self-reported latent health stock makes an individual less likely to exit via complete retirement or disability. An increase in physical health factors (chronic conditions, functional limitations), like the younger sample, increases likelihood of exit via complete retirement and disability. The magnitude of the effect being larger for complete retirement and smaller for disability route, compared to the younger sample. For the mental health factors, depression leads to higher likelihood of exit via both complete retirement and partial retirement while cognitive problems have no statistically significant effect probably because individuals with cognitive functioning problems already exit via the disability route when they are young.

Table 1.7: Competing Risk Model (Weibull Distribution) for Exiting Full-time Employment Allowing for Multiple Spells of Employment for Individuals 50-55 Years of Age in 1992 (With Frailty)

HEALTH OUTCOMES	**ALL RISKS**		**COMPETING RISKS**									
			Exit Route 1: Complete Retirement		**Exit Route 2: Partial Retirement**		**Exit Route 3: Part-time Work**		**Exit Route 4: Unemployment**		**Exit Route 5: Disability and Not in Labor force**	
	Hazard Ratio	**Absolute Effect**	**Hazard Ratio**	**Absolute Effect**	**Hazard Ratio**	**Absolute Effect**	**Hazard Ratio**	**Absolute Effect**	**Hazard Ratio**	**Absolute Effect**	**Hazard Ratio**	**Absolute Effect**
Latent Health Stock: Self Reported Health	0.706***	10.23%	0.681***	4.43%	0.969	3.25%	0.921	2.62%	0.845	0.63%	0.437***	0.45%
	(0.059)		(0.069)		(0.179)		(0.155)		(0.202)		(0.116)	
Factor 1: Chronic Conditions	1.232***	17.86%	1.253***	8.15%	1.054	3.54%	1.120	3.18%	1.052	0.79%	1.451***	1.49%
	(0.053)		(0.067)		(0.092)		(0.092)		(0.131)		(0.201)	
Factor 2: Functional Limitation	0.993	13.53%	0.932	6.06%	0.943	3.17%	1.256**	3.56%	1.041	0.78%	0.706**	0.72%
	(0.045)		(0.057)		(0.093)		(0.115)		(0.146)		(0.103)	
Factor 3: Hospital Stay	1.043	15.13%	1.018	6.62%	1.090	3.66%	0.941	2.67%	1.076	0.81%	1.195	1.23%
	(0.043)		(0.056)		(0.093)		(0.077)		(0.141)		(0.159)	
Factor 4: Cognitive Functioning	1.089*	15.79%	0.967	6.29%	1.120	3.76%	1.197**	3.40%	0.929	0.70%	1.304*	1.34%
	(0.048)		(0.056)		(0.097)		(0.104)		(0.117)		(0.188)	
Factor 5: Depression	1.050	15.23%	1.136**	7.39%	1.240**	4.16%	0.934	2.65%	1.303*	0.97%	0.757	0.77%
	(0.042)		(0.064)		(0.108)		(0.069)		(0.176)		(0.099)	
Factor 6: Physical Exercise	1.000	14.50%	1.095*	7.13%	1.009	3.39%	0.874*	2.48%	1.131	0.85%	0.850	0.88%
	(0.042)		(0.059)		(0.089)		(0.070)		(0.138)		(0.116)	
Factor 7: Cancer	1.087**	15.76%	1.137**	7.40%	0.996	3.35%	1.044	2.96%	1.150	0.86%	1.267*	1.30%
	(0.043)		(0.062)		(0.084)		(0.076)		(0.146)		(0.158)	
Factor 8: Life Style	1.025	14.86%	0.965	6.28%	1.102	3.70%	1.095	3.11%	1.013	0.76%	0.916	0.94%
	(0.042)		(0.056)		(0.0976)		(0.086)		(0.128)		(0.108)	
# Spells	2465		2465		2465		2465		2465		2465	
# Exits	1844		828		428		361		96		131	
Avg. Spell Length	5.16		5.16		5.16		5.16		5.16		5.16	
Avg. Exit Probability	14.50%		6.51%		3.36%		2.84%		0.75%		1.03%	

Note: Table 1.7 uses data from the Health and Retirement Study (1992-2010) for a proportional hazard model in competing risks framework for individuals who were between 50 to 55 years of age and worked full-time in 1992. It reports hazard ratios and absolute effect for the multiple exits scenario. Absolute Effect= Hazard Ratio * Average Exit Probability via that route.

The average exit probability= no. of exits/(no. of spells * average spell length). The dependent variable is duration of full-time employment while the independent variables are health outcome indices constructed by principal component factor analysis. The competing risks in this framework are the different routes of exit from full-time employment. The combined risk model has also been reported in panel A . Controlling for the socio-demographic variables reported in Table 1.2. Also controlling occupations, the wave dummies, census regions, expected mortality and work and health status of spouse, which has not been reported here. Further, it controls for frailty (unobserved heterogeneity). The standard errors are reported in parentheses and *** p<0.01, ** p<0.05, * p<0.1. Likelihood ratio test rejects the null hypothesis of No Frailty such that there is statistically significant level of unobserved heterogeneity in the data.

Table 1.8: Competing Risk Model (Weibull Distribution) for Exiting Full-time Employment Allowing for Multiple Spells of Employment for Individuals Strictly above 55 Years of Age in 1992 (With Frailty)

HEALTH OUTCOMES	**ALL RISKS**		**COMPETING RISKS**									
			Exit Route 1: Complete Retirement		**Exit Route 2: Partial Retirement**		**Exit Route 3: Part-time Work**		**Exit Route 4: Unemployment**		**Exit Route 5: Disability and Not in Labor force**	
	Hazard Ratio	**Absolute Effect**	**Hazard Ratio**	**Absolute Effect**	**Hazard Ratio**	**Absolute Effect**	**Hazard Ratio**	**Absolute Effect**	**Hazard Ratio**	**Absolute Effect**	**Hazard Ratio**	**Absolute Effect**
Latent Health Stock: Self Reported Health	0.896* (0.059)	19.11%	0.812*** (0.056)	9.26%	1.121 (0.136)	6.54%	1.104 (0.176)	3.05%	1.062 (0.860)	0.70%	0.576*** (0.104)	0.38%
Factor 1: Chronic Conditions	1.050 (0.040)	22.40%	1.154*** (0.046)	13.16%	0.897 (0.062)	5.24%	0.857 (0.082)	2.37%	0.555 (0.307)	0.37%	1.534*** (0.200)	1.01%
Factor 2: Functional Limitation	0.854*** (0.031)	18.21%	0.869*** (0.035)	9.91%	0.982 (0.066)	5.73%	0.810** (0.076)	2.24%	0.560 (0.297)	0.37%	0.771** (0.096)	0.51%
Factor 3: Hospital Stay	1.059 (0.045)	22.59%	1.055 (0.048)	12.03%	1.089 (0.080)	6.36%	0.880 (0.088)	2.44%	1.554 (0.768)	1.02%	0.940 (0.147)	0.62%
Factor 4: Cognitive Functioning	0.986 (0.039)	21.03%	1.000 (0.042)	11.40%	0.949 (0.065)	5.54%	1.126 (0.106)	3.12%	0.211 (0.105)	0.14%	1.078 (0.156)	0.71%
Factor 5: Depression	1.137*** (0.041)	24.25%	1.120*** (0.045)	12.77%	1.114* (0.073)	6.51%	1.044 (0.092)	2.89%	0.576 (0.252)	0.38%	1.240 (0.186)	0.82%
Factor 6: Physical Exercise	0.999 (0.034)	21.31%	0.990 (0.036)	11.29%	1.021 (0.066)	5.96%	1.012 (0.088)	2.80%	0.666 (0.309)	0.44%	0.963 (0.126)	0.63%
Factor 7: Cancer	1.095** (0.040)	23.36%	1.071* (0.042)	12.20%	0.915 (0.059)	5.34%	1.327*** (0.120)	3.68%	1.948 (0.900)	1.28%	1.173 (0.159)	0.77%
Factor 8: Life Style	1.014 (0.036)	21.62%	1.022 (0.039)	11.65%	0.989 (0.064)	5.77%	1.026 (0.087)	2.84%	0.842 (0.487)	0.56%	0.991 (0.143)	0.65%
# Spells	2403		2403		2403		2403		2403		2403	
# Exits	1973		1055		540		256		61		61	
Avg. Spell Length	3.85		3.85		3.85		3.85		3.85		3.85	
Avg. Exit Probability	21.33%		11.40%		5.84%		2.77%		0.66%		0.66%	

Note: Table 1.7 uses data from the Health and Retirement Study (1992-2010) for a proportional hazard model in competing risks framework for individuals who were above 55 years and worked full-time in 1992. It reports hazard ratios and absolute effect for the multiple exits scenario. Absolute Effect= Hazard Ratio * Average Exit Probability via that route.
The average exit probability= no. of exits/(no. of spells * average spell length). The dependent variable is duration of full-time employment while the independent variables are health outcome indices constructed by principal component factor analysis. The competing risks in this framework are the different routes of exit from full-time employment. The combined risk model has also been reported in panel A . Controlling for the socio-demographic variables reported in Table 1.2. Also controlling occupations, the wave dummies, census regions, expected mortality and work and health status of spouse, which have not been reported here. Further, it controls for frailty (unobserved heterogeneity). The standard errors are reported in parentheses and *** p<0.01, ** p<0.05, * p<0.1. Likelihood ratio test rejects the null hypothesis of No Frailty such that there is statistically significant level of unobserved heterogeneity in the data.

As a robustness check, I examine the impact of changes in health outcomes between waves, rather than simply looking at levels[30] for the overall sample (i.e. without splitting by age). Changes in self-reported overall health, counts of chronic conditions, counts of functional limitations (ADL difficulties), and the onset of memory related diseases between waves are considered.[31] Extreme reductions in these measures between waves serve as a proxy for exogenous changes in health. The results suggest that a major reduction in overall self-reported health increases the likelihood of exit from full-time employment via complete retirement, and disability. Increases in counts of chronic conditions and onset of memory related diseases, between waves increase the likelihood of exit via the complete retirement and the disability exit routes. While increases in functional limitations between waves have no statistically significant effect on exiting via complete retirement, but increases the likelihood of exit via disability.

In summary, the overall sample results indicate that physical health problems (functional limitations) lead to increases in the likelihood of exit from full-time employment in general, which one can attribute to the increase in the likelihood of exit via the complete retirement route and the disability route. The magnitude of the effect is much smaller for the disability route. As for mental health problems, depression increases the likelihood of exit via complete retirement, while cognitive disorders increase the likelihood of exit via the disability exit route (with no statistically significant effect on the likelihood of exit via complete retirement).

[30] These results are reported in Appendix Table A.7.

[31] I define a reduction in overall self-reported health by flagging anyone that went from excellent to poor self-reported health between waves. Similarly, I defined a reductions in health associated with ADL difficulties and chronic conditions by flagging anyone that went from reporting a 0 to a 5 between waves. Finally, anyone with an onset of a memory-related disease was flagged.

1.7 Conclusion

This study contributes to the existing literature by empirically modeling the duration of full-time employment of older Americans using a long panel from the Health and Retirement Study. I distinguish between the different exit routes from full time employment and allow for multiple employment spells. Moreover, this study addresses the inherent problem of the subjectivity of health measures in surveys by constructing relatively objective comprehensive indices of physical and mental health that take into account a wide variety of health indicators based on both medical diagnosis and medication. The PCA method used for construction of the health factors (indices) is not only an effective method of data reduction but also helps to get uncorrelated explanatory variables (health factors). This is particularly important because physical and mental health outcomes are likely to be highly correlated which can lead to endogeneity problem and hence biased estimates. The PCA analysis helps to address this issue although the causal effect of the constructed health factors is not strongly established. Moreover, unlike existing studies, I am able to distinguish between different dimensions of physical and mental health (functional limitations versus chronic conditions and depression versus cognition) and their impact on continued employment.

The main inferences drawn from the results of the most complete model (multiple spells with frailty) indicate that better self-reported health decreases the likelihood of exit from full-time employment, while poor physical health (functional limitations factor) increases the likelihood of exit from full-time employment via complete retirement and disability. For mental health, I find that depression increases the likelihood of exit via complete retirement, part-time work and unemployment while cognitive disorders lead to an increase in likelihood of exit via the disability exit route. Hence, physical and mental health problems are both impediments to continued work.

For younger individuals in the age group of 50 to 55 (in 1992), only an increase in the physical health problems (chronic conditions, functional limitations and cancer) leads to an increase in likelihood of exit via complete retirement or disability (with the magnitude of increase being higher for the former route). Among the mental health factors, cognitive problems increase the likelihood of exit via the disability route and part-time work while depression increases the likelihood of exit via complete retirement and unemployment routes. But for the older individuals who were over 55 years of age (in 1992) only, an increase in chronic conditions, functional limitations factors make an individuals exit via complete retirement or disability. Depression leads to higher likelihood of exit via both complete retirement and partial retirement while cognitive problems have no statistically significant effect. This implies that younger individuals do take other routes of exit like part-time work or unemployment due to physical or mental health problems while older workers opt for complete retirement or partial retirement routes.

These results produce targets for policies that seek to improve the health of older working Americans. Improving the health of older workers means they can be retained in the labor force for an extended period of time, which would result in decreased training costs for replacement workers, the ability to maintain the experience and productivity of these older workers, and the ability to defer their Social Security benefits. Given that the relatively older workers leave via complete retirement route makes it less likely that they can be retained in full-time work for long. But there is scope for investing in improving the health of relatively younger, old Americans so that they do not opt for phased retirement.

Limitations of the study stem from not being able to adequately mitigate the existence of "justification bias" although there are mixed empirical findings about the existence and magnitude of such bias. It would also be important to include future leads regarding health for the older workers, in addition to measuring past and current health. This study has opened interesting possibilities for future research. For example, it would be interesting to further investigate transitions in and out from full-time employment to the different exit routes.[32] This could indicate whether improvements in health bring retirees (ones who have exited) back to into the labor force full time.

[32] See (Meghir & Whitehouse, 1997) for UK data on this issue.

II. EFFECT OF RETIREMENT ON HEALTH OUTCOMES OF OLDER AMERICANS

2.1 Introduction

During the last couple of decades, there has been a sharp rise in proportion of the population over 65 years of age across the world (8 percent in 1950 to 12 percent in 2009). This trend has also been observed in the United States, such that through the 20th century the proportion of population over 65 years of age has almost increased by three times. This is primarily the result of a dramatic increase in life expectancy for both males and females and a decrease in the fertility rate. These two factors led to a consistently high growth rate in elderly population in the United States, a trend diminished by some extent due to immigration. In the next few decades, as the baby boom generation (born during 1946-1965) enters their elderly years, the average annual growth rate in the population over 65 years of age is expected to explode. The Census Bureau estimates that between 2010 and 2030 the number of people aged 65 and older is projected to grow by 31.7 million, or 79.2 percent, while the number aged 25 to 64 is only expected to grow by 9.4 percent. This implies that there is a steady increase in the proportion of people nearing their full retirement age (65 years) in the United States, while at the same time the average age at which people typically retire has been declining (Gendell, 2001).

These trends will lead to increased financial strain on the Social Security program, which is projected to pay out more in benefits than it collects in payroll taxes by 2018. Policymakers have responded by pressing for several reforms aimed at increasing the average worker's retirement age. This is because other things being equal, fewer retirements in any given year would result in a greater supply of experienced workers available to employers and fewer people relying on Social Security benefits. However, whether such policies are individually and/or socially favorable depends on how retirement affects subsequent health status, among other things.

Retirement may have a desirable or adverse effect on health. For instance if an individual considers retirement to be a respite from the stress of his work life, then it could lead to a positive impact on his or her health. But, retirement itself may be a source of anxiety, leading to a negative effect on health (especially mental health). Moreover, there may be a decline in physical activity post-retirement causing adverse health effects (especially mobility difficulties) while some retired individuals may have more free time to engage in healthy lifestyle (physical activity) post retirement leading to better health outcomes. If retirement leads to favorable health outcomes, then the evaluation of policies that delay retirement should account for this positive effect on health. In the presence of negative health effects, policies that aim to defer the retirement age may be desirable because such adverse health effects can be delayed. Increasing the retirement age, by postponing or reducing poor health outcomes, will consequently lead to a fall in health care utilization by older individuals conditional on life expectancy, which may have further connotation for Medicare expenditures. Of course, health could be both cause and consequence of retirement which makes it difficult to establish the causal links (i.e. the standard reverse causality problem) and hence may make the estimates of the impact of retirement on health upward biased due to endogeneity.

In this paper, I estimate the effect of complete retirement on different physical and mental health outcomes and assess the extent these health outcomes are differentially affected by complete retirement. I bring together different approaches given in literature and implement them on a rich U.S. longitudinal dataset. The empirical studies based on U.S. data have not reached any consensus about the health effects of retirement. Hence I attempt some new identification strategies, including both sample stratification techniques and an instrumental variables approach, to obtain more comprehensive results.

I used fixed effects for stratified samples of the elderly drawn from a nationally representative sample of older Americans and their spouses between 1992 and 2010 (Health and Retirement Study (HRS))[33], and find that retirement leads to unfavorable health outcomes with respect to both subjective and objective indicators of physical and mental health. The results indicate that complete retirement leads to an increase in probability of self reporting poor health by 22.60 percent, raises the probability of multiple activities of daily living (ADL) problems by 17.90 percent and the probability of medically diagnosed chronic conditions by 14.88 percent. It leads to an increase in the probability of psychological problems by 6 percent and increases the number of nights in the hospital and office visits by 5.54 percent and 2.49 percent, respectively.

The rest of this paper is organized as follows: section 2.2 discusses the relevant studies in the existing literature. Section 2.3 reviews the theoretical framework. Section 2.4 describes the data and provides descriptive statistics for the sample used in the study. Section 2.5 elaborates on the empirical strategy, while a discussion of the results is included in section 2.6. Finally, section 2.7 offers a conclusion and provides a plan for future work.

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[33] The Health and Retirement Study is a survey is conducted by the Institute for Social Research at the University of Michigan. The HRS is an ongoing longitudinal study that began in 1992 and is repeated biennially. Other details about the data can be found at http://hrsonline.isr.umich.edu/

2.2 Literature Review

Retirement may be influenced by a number of factors, including the availability of health insurance, Social Security eligibility, financial resources, and spousal characteristics, etc. Several studies have also pointed to health status as a significant determinant of retirement. Belgrave, Haug, & Gómez-Bellengé (1987) used data gathered from 258 black and white women in the age group of 62 to 66 years and found that workers in poor health (i.e. who suffer from activity limitations and chronic health conditions) retire earlier than the individuals who are healthy. Dwyer & Mitchell (1999) use data from the Health and Retirement Study (HRS) and report that in the USA health problems affect retirement more strongly than economic factors. Mitigating the potential endogeneity of self-reported health status due to "justification bias," they find that men in poor overall health expect to retire one to two years earlier. Similarly, McGarry (2004) finds that individuals in poor health have a lower probability to continue work than the others in good health. Using data from the HRS, she notes that changes in retirement expectations are relatively more influenced by the changes in health rather than changes in income or wealth.[34]

Studies looking at the impact in the other direction (i.e. how retirement affects health) are much less common. These studies can be classified into two broad categories: those that make an effort to deal with reverse causality (either using instrumental variables –IV or stratified samples) and those that do not (mostly cross-sectional analysis). Those in the latter category (Mein, Martikainen, Hemingway, Stansfeld, & Marmot, 2003; Szinovacz & Davey, 2004), find that retirement leads to adverse physical and mental health outcomes, using data from the United

[34] Several other studies similarly show that poor health motivates early retirement, though the relative impact of health versus economic factors is debated (Anderson & Burkhauser, 1985; (Jones, Rice, & Roberts, 2010).

States, Great Britain, and Greece. As mentioned above, these studies to not address whether or not the magnitude of their findings may be biased due to the potential for reverse causality.[35]

Turning to studies that attempt to address the issue of reverse causality, Dave, Rashad, & Spasojevic (2008) find that retirement leads to declines in both physical and mental health outcomes. They used several waves of the HRS (1992-2005) and employ panel data methodologies with novel sample stratifications and counterfactual tests, as well as an IV approach. They used spousal retirement status as an IV for retirement decision of the individuals who expect to retire at the same time as their spouse. Using data from the National Survey of Families and Households, the Survey of Income and Program Participation (SIPP), and the National Health Interview Survey (NHIS), Ettner (1996) employs an IV approach to find that family income (a correlate of retirement) is significantly related to several measures of physical health and depression. However for IV studies such as these, there is some concern about the validity and strength of the instruments used, i.e. whether they have no direct effect on the health outcome and whether they are uncorrelated with any other variable that affects health.

Nevertheless, Charles (2004) uses linear IV to estimate the effects of retirement on psychological well-being in the U.S., using early or normal retirement age dummies, including a dummy indicating age 65 or above, as instruments.[36] He finds that men feel 'lonely' or 'depressed' less often after retirement. Neuman (2008) uses private and public pensions as an exogenous source of variation to instrument for individual retirement decisions and finds that retirement preserves a change in subjective health status. Insler (2012) instruments for retirement

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[35] Ettner (1996) also indicates that psychiatric disorders significantly reduce employment among both genders. Older cross-sectional studies using U.S. data include Midanik, Soghikian, Ransom, & Tekawa (1995).

[36] However, 65 is also an age at which Americans become eligible for Medicare. This health insurance availability change may confound, or more specifically bias upwards, the measured impact of retirement. In addition, linear IV is problematic given that both retirement and health measures are binary.

using one's subjective expectation of retiring at age 62 years or 65 years when an individual first appears in the sample and finds the effect on a composite index of health (that includes both subjective and objective measures). All of these studies unanimously find positive health effects of retirement.

Among non-US studies, one of the first to address concerns about direction of causation between health and retirement is Morris, Cook, & Shaper (1994). The authors compare groups of employed and retired British individuals, controlling for baseline health and demographic characteristics, to investigate whether or not the loss of employment was due to poor health. They find that men who retire due to other reasons than poor health and who were apparently healthy at baseline have an 86 percent increase in mortality compared with men who remained continuously employed. In particular, they have a significant increase in both cardiovascular mortality and cancer mortality.

Age specific instruments for retirement have also been used with European datasets (Bound & Waidmann, 2007; Coe & Lindeboom, 2008). Much like studies based on U.S data, these studies also find positive health effects of retirement. A recent study (Behncke, 2012), uses a similar IV approach to investigate the effect of retirement on various health outcomes using data from the first three waves of the English Longitudinal Study of Ageing (ELSA). They report that retirement leads to an increase in the risk of a chronic condition diagnosis, especially cardiovascular disease and cancer, and also leads to worse self reported health.

Overall there is little agreement in the literature about the impact of retirement on physical and mental health outcomes. Many studies only use the subjective self-reported measures of health (involving justification bias or role bias) and are based on small samples, so that the results may not be generalized to the overall population. Several studies are based on cross-sectional comparisons between workers and retirees and thus ignore the issue of reverse causality. Data limitations also often prevent researchers from using a wide set of controls. My paper exploits ten longitudinal waves of a large-scale population survey of older adults in the United States in order to attempt to address these issues present in the existing literature and estimate the causal effect of retirement on post-retirement health.

2.3 Theoretical Framework

The theoretical foundation for investigating the effect of retirement on health outcomes can be based on the "Grossman" human capital model for the demand for health (Grossman, 1972). He combines a household production model of consumer behavior with the theory of human capital investment to examine an individual's demand for health. In his model, individuals demand for health has two dimensions based on consumption and investment purposes. In other words, health capital directly increases utility and also reduces the number of sick days, consequently increasing healthy time and increasing income. This implies that post complete retirement, the investment objective for investing in health in order to raise productivity and income is absent. This means that it could be expected that health status declines post retirement. However, since healthy (non-sick) days are accounted in the utility function as consumption good and the opportunity cost of time intensive health investment (like exercise) is less, retirees may invest more in their health post-retirement.

Hence, the effect of retirement on health is ambiguous, and depends on the difference between the marginal benefit and the marginal cost of health capital. This in turn depends on whether the marginal value of time increases or decreases after retirement. It is important to note that for a retiree, the marginal value of time is necessarily higher (based on standard theory) than the potential wage rate in that period. If the marginal value of time is increasing, this means that the retiree values his time more and may increase investment in health, as previously noted, due to the increased emphasis on importance of health for consumption purposes. If, on the other hand, the marginal value of time is decreasing post-retirement, we would expect the retiree to decrease investment in health. Yet a decreased value of time also implies that the time cost of visiting a physician or waiting in a queue to fill prescriptions would be lower, which may result in an increase in health.

The change in marginal cost relative to the change in marginal benefit partly depends on the relative importance of time versus market inputs in the production of health. If investment in health is more time-intensive relative to other goods, then a low marginal value of time may actually lead to better health. On the other hand, a high marginal value of time after retirement implies a high marginal cost of investing in health. Under the assumption of health production being sufficiently more time-intensive, investment in health capital would decline post-retirement in this case. Due to this theoretical uncertainty, the effect of retirement on health status still makes an interesting empirical question to investigate.

2.4 Data

The analysis presented in this paper exploits a long panel of data for Americans (1992-2010) from the Health and Retirement Study (HRS) conducted by the Institute for Social Research at the University of Michigan.[37] The HRS is an ongoing longitudinal survey, which began in 1992, and is conducted in biennial waves. Prior to 1998, the main HRS cohort included individuals born between 1931 and 1941, and another distinct cohort, the Study of Assets and Health Dynamics among the Oldest Old (AHEAD), included individuals born before 1924. Since

[37] "The HRS (Health and Retirement Study) is sponsored by the National Institute on Aging (grant number NIA U01AG009740) and is conducted by the University of Michigan. More information is available at: http://hrsonline.isr.umich.edu/

1998, the data for theses two cohorts is collected jointly, and the sample frame has been expanded to include cohorts born between 1924 and 1930 and those born between 1942 and 1947. The HRS is administered for the specific purpose of studying life-cycle changes in health and economic resources, and includes detailed information on various subjective and objective health outcomes. It allows for a rich set of controls, excluding which may have biased previous studies.

The sample is restricted to individuals who are 50-80 years of age and were either working full-time, part-time or were unemployed during the first wave (1992), which results in 88,075 person-wave observations generated by more than 20,000 unique individuals. As reported in Table 2.1, based on information about labor force participation, 51.90 percent of this sample is completely retired.[38] A dichotomous indicator is created for complete retirement is considering assuming it to be an absorbing state (i.e. an individual who reports retirement in one wave is considered to be retired in all subsequent waves). Among the retirees, 42.34 percent report being completely satisfied in retirement, 24.12 percent are moderately satisfied, and 5.12 percent are not at all satisfied. Partially retired, disabled individuals, home makers and those who have withdrawn from the labor force are dropped from the analysis.

Table 2.1 also provides the definitions of the various health outcomes analyzed in this paper. A dichotomous variable, "*poor health*" indicates whether respondent self reports poor health in a particular wave. Additional dichotomous indicators are defined separately for whether respondent reports being medically diagnosed with the following diseases: diabetes, heart disease, lung disease, cancer, stroke, high blood pressure, arthritis, and psychological problems in the

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38 In the HRS, if the respondent is not working and not looking and there is any mention of retirement, his labor force participation status is retired (completely retired). If he/she is looking for a part-time job and mentions retirement, then it is set to partly retired. If retirement is not mentioned and a disabled employment status is given, then it is set to disabled. Otherwise, it is set to "not in the labor force".

previous two years. I also created a composite dichotomous index, called "*multiple chronic conditions*" which indicates whether a person has been medically diagnosed with more than two chronic conditions.

Additional dichotomous indices are defined to indicate whether an individual faces difficulties associated activities of daily living (ADL)[39] and whether am individual is obese[40]. Some other relatively objective health measures which are not included in prior studies, such as out of pocket medical expenditures, number of nights in the hospital, and the number of office (doctor) visits has also been incorporated into the analysis.

The HRS contains information on mental health status as well, primarily focusing on depression and cognition. Depression is measured in a 0-8 scale, as defined by the Center for Epidemiologic Studies on Depression (CESD). This CESD score measures the sum of adverse mental health symptoms for the past week, based on 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. Information on measures of cognitive functioning is also included in my analysis. The cognitive functioning measures include immediate and delayed word recall, the serial 7's test, counting backwards, naming tasks (e.g., date-naming), and vocabulary questions. In addition to the individual cognitive functioning measures, the HRS also derives three cognition summary indices. The total recall index which is available for all waves is a concise summary of the immediate and delayed word recall tasks. The mental status index adds the scores from counting, naming, and vocabulary. To maintain consistency across waves, I have used the total cognition score in this study, which sums the total recall and mental status indices and thus ranges from zero to thirty-five.

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[39] The ADL difficulties include difficulties in bathing, eating, getting dressed, getting in or out of bed, and walking across a room

[40] Obesity refers to Body Mass Index (BMI) greater than 29.9

The weighted sample means presented in Table 2.1 suggest that completely retired individuals experience worse health outcomes, relative to those who are still in the labor force. For instance, more than 86 percent complete retirees report having more than two medically diagnosed chronic illnesses as compared to 67 percent non-retirees. In addition, 19.6 percent retirees report having functional limitations (ADL difficulties), as compared to 11.2 percent non-retirees. Further they report more nights in the hospital, office visits, and higher out of pocket medical expenses per wave. Similar differences are observed for all other indicators of physical and mental health reported in Table 2.1. It is also observed that the individuals who are satisfied in retirement have better physical and mental health status that the ones who are moderately satisfied or not at all satisfied.[41]

[41] Means for different health outcomes for these samples are given in Appendix Table B 1.

Table 2.1: Weighted Sample Means for Health Outcomes

VARIABLES	Full Sample	Completely Retired	Non-Retired
Completely Retired **(=1 if individual is fully retired)**	0.519 (0.489)	1.000	0.000
Poor Health **(=1 if individual reports poor health)**	0.052 (0.223)	0.0730 (0.260)	0.016 (0.127)
Activity of Daily Living Difficulty **(based on index ranging from 0-5)** **(=1 if individual has more than two functional limitations)**	0.163 (0.605)	0.196 (0.709)	0.112 (0.326)
Multiple Chronic Condition (Medically Diagnosed) **(based on Index ranging from 0-8)** **(=1 if individual has more than two chronic conditions)**	0.569 (0.340)	0.860 (0.403)	0.474 (0.130)
Heart Disease **(=1 if individual has cardio-vascular disease)**	0.165 (0.371)	0.198 (0.398)	0.106 (0.308)
High Blood Pressure **(=1 if individual has high BP)**	0.446 (0.497)	0.483 (0.499)	0.381 (0.486)
Diabetes **(=1 if individual has diabetes)**	0.143 (0.349)	0.161 (0.368)	0.110 (0.313)
Lung Disease **(=1 if individual has lung disease)**	0.073 (0.260)	0.093 (0.291)	0.036 (0.187)
Cancer **(=1 if individual has cancer)**	0.099 (0.210)	0.114 (0.318)	0.074 (0.262)
Stroke **(=1 if individual had Stroke)**	0.042 (0.201)	0.056 (0.229)	0.019 (0.136)
Arthritis **(=1 if individual arthritis/rheumatism)**	0.476 (0.499)	0.532 (0.499)	0.377 (0.485)
Obesity **(=1 if individual has BMI over 29.9)**	0.283 (0.451)	0.279 (0.448)	0.287 (0.452)
Psychological Problem **(=1 if individual has emotional, nervous disorder)**	0.124 (0.330)	0.140 (0.347)	0.097 (0.295)
Out of Pocket Medical Expenditure **(=1 if individual spends more than $5000 in prev. 2 yrs)**	0.119 (0.324)	0.123 (0.328)	0.112 (0.316)
Depression (CESD Scale) **(index ranging from 0-8)**	1.259 (1.844)	1.393 (1.940)	1.024 (1.634)
Total Cognition **(index ranging from 0-35)**	23.874 (4.482)	23.561 (4.566)	24.857 (4.052)
No. of Nights at Hospital	1.624 (7.229)	2.056 (8.383)	0.724 (3.690)
No. of Doctor Visit	8.543 (15.761)	9.494 (17.788)	6.870 (11.157)
No. of Observations	88,075	45,781	42,294

Note: The table shows the weighted sample means for the health outcomes in a sample of individuals who were 50-80 years of age who are the drawn from the Health and Retirement Study (1992-2010). Retired and Non-Retired samples exclude individuals who are partially retired. The difference in means between Retired and Non-retired samples is statistically significant. The standard errors are reported in parenthesis.

Health outcomes also generally differ across several observable socio-economic and demographic factors. Table 2.2 provides descriptive statistics (weighted sample means) for these factors, including indicators for gender, race, ethnicity, years of schooling, marital status, whether a person worked as in a blue collar occupation, whether a person has some religious preference, and whether a person is native born. The table also reports parental characteristics such as education and age of parents. Age of parents can proxy for one's initial endowment of health, which can influence health in later life. Parent's educational background may proxy for health awareness at a young age, which can influence later outcomes.

Retirement is usually a joint decision; hence the impact of retirement must take into account spousal characteristics. The HRS provides information on the work and health status of spouses which have been taken into account in the study. Household income is the sum of the total income of the reference individual and their spouse from all available sources (including earnings, pension, supplemental security, social security retirement, and other government transfers payments.[42] Additionally dichotomous indicators are added for participation in a defined benefit or a defined contribution pension plan or both. An individual's health status may also depend on access to care, which in turn is a function of health insurance coverage. Besides a dichotomous indicator for uninsured, we define additional coverage indicators 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.

Table 2.2 suggests that retirement is also correlated with other demographic characteristics. For example retired individuals have completed fewer years of schooling as well

[42] Individual income and other indicators of income, such as individual income and net wealth, were also analyzed, but do not cause much material difference in the results.

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. Thus there may be "positive selection" based on these observed characteristics – individuals who are retired may not a random sample. This rich set of demographic variables in the HRS allows us to include controls for many individual characteristics in my regression models.

Table 2.2: Weighted Sample Means for Socio-Demographic Variables

VARIABLES	Full Sample	Completely Retired	Non-Retired
Age	62.153 (6.510)	63.894 (6.448)	59.065 (5.376)
Female*	0.519 (0.500)	0.539 (0.499)	0.484 (0.500)
Black*	0.082 (0.274)	0.087 (0.281)	0.072 (0.259)
Hispanic*	0.055 (0.228)	0.053 (0.224)	0.059 (0.236)
Other Race*	0.024 (0.152)	0.020 (0.140)	0.030 (0.170)
Married*	0.673 (0.469)	0.662 (0.473)	0.692 (0.462)
Years of Schooling	13.134 (2.798)	12.754 (2.813)	13.806 (2.640)
Blue Collar*	0.120 (0.325)	0.088 (0.284)	0.176 (0.380)
Religious Preference*	0.922 (0.269)	0.934 (0.2481)	0.900 (0.300)
Native*	0.9226 (0.2673)	0.929 (0.257)	0.911 (0.285)
Mother's Age	76.041 (13.278)	75.970 (13.789)	76.166 (12.315)
Father's Age	72.055 (13.614)	71.783 (13.900)	72.538 (13.076)
Father's Education* (> 8yrs)	0.625 (0.484)	0.588 (0.492)	0.691 (0.462)
Mother's Education* (> 8yrs)	0.691 (0.462)	0.648 (0.478)	0.767 (0.423)
Household Income	74250.301 (334.426)	58.836 (322.275)	102.021 (356.824)
Married, Spouse Working*	0.310 (0.462)	0.231 (0.422)	0.449 (0.497)
Married, Spouse Not Working*	0.364 (0.481)	0.431 (0.495)	0.244 (0.429)
Govt. Insurance*	0.400 (0.490)	0.531 (0.499)	0.166 (0.372)
Private Insurance*	0.155 (0.362)	0.185 (0.388)	0.103 (0.304)
Non-employer Insurance*	0.299 (0.458)	0.387 (0.487)	0.144 (0.351)
Employer Insurance*	0.634 (0.482)	0.563 (0.496)	0.760 (0.427)
Uninsured*	0.067 (0.251)	0.051 (0.220)	0.096 (0.295)
Pension (DC)*	0.134 (0.340)	0.066 (0.248)	0.254 (0.436)
Pension (DB)*	0.099 (0.300)	0.077 (0.267)	0.140 (0.347)
Pension (Both)*	0.063 (0.242)	0.042 (0.200)	0.099 (0.300)
No. of Observations	88,075	45,781	42,294

Note: The variables with asterisk are dichotomous (where 1 =Yes) Retired and Non-Retired samples exclude individuals who are partially retired. The standard errors are reported in parenthesis. The difference in means between Retired and Non-retired samples is statistically significant.

2.5 Estimation Approach

My estimation strategy exploits the longitudinal panel nature of the data to control for biases arising due to individual unobserved heterogeneity. For the presented results appropriate models[43] for different health outcomes is estimated with individual fixed effects (FE) of the following form is estimated.

$$H_{it} = c + \alpha_1 R_{it} + \alpha_2 X_{it} + \alpha_3 T_t + \mu_i + \varepsilon_{it} \qquad (2.1)$$

here, H_{it} is a "typical" health outcome, R_{it} is a dichotomous indicator for complete retirement, X_{it} is a vector of time varying observable characteristics, T_t is a vector of time dummies, and μ_i controls for time invariant unobservable individual characteristics.

Besides the usual demographic factors, the HRS also contains a rich set of information on parental characteristic, health and employment status of spouse and labor force participation, insurance status, and indicators for risk aversion etc. Even including these controls, does not completely mitigate the possibility health status being affected unobserved characteristics. Since observed health outcomes and labor force behavior for older adults are affected by several factors over the life time, there may be unobserved individual characteristics (genetic structure early life medical history, work environment, etc.) that may impact current health status and retirement decision. Given the long panel data, I can estimate individual fixed effects (FE) models that control for unobserved time-invariant heterogeneity across individuals.

Even after ruling out within-person time invariant differences through individual fixed effects, the issue of reverse causality and hence endogeneity still remains a concern. This endogeneity can bias the health effects of retirement. I check for this in Appendix Table B2 and find that this may be occurring. In a restricted sample of risk averse individuals who have never

[43] Binary choice model (logit) is used for the dichotomous health outcomes, count data model (Poisson) is used for the count health outcomes while OLS is used for the others.

reported smoking or drinking and do not have any history of high blood pressure, heart disease, diabetes, hypertension and obesity complete retirement is found to raise the probability of stroke by over 0.02 percentage points (i.e. over 50 relative to the sample mean). It is questionable that post-retirement lifestyle changes can cause such a large rise in probability of stroke in this restricted sample; although, it is true that lifestyle factors have the potential to affect the chance of having stroke. But if anything, complete retirement should have negligible effect on the probability of having stroke for individuals who do not engage in risky activities and have no history of medical conditions that enhance the chance of stroke.

Hence to address this problem of reverse causality, a series of sample stratifications are used. All the stratified samples include individuals for whom it would be possible to identify the health effects of retirement by dismissing that their retirement is driven by poor health status.

2.5.1 Stratified Sample Specifications

First, a stratified sample of individuals who retired exactly at 62 years of age is considered. This is because it has been established that retirement spikes at 62 or 65 (Song & Manchester, 2007). This is also called the "anchoring effect." Retirees appear to anchor on ages that have some retirement significance (e.g. some form of incentive like eligibility for Social Security), however arbitrary. (Brown, Coe, & Finkelstein, 2006), using data from the HRS, finds that 62 and 65 are the ages most frequently reported as being the usual retirement age. In the sample studied for this paper, nearly 26 percent individuals retired at age 62 (or before turning 63 years). By restricting the sample in this way, it is expected that the retirement decision observed is a consequence of the age anchoring effect rather than being caused by poor health.

The next sample stratification involves restricting attention to individuals who had no major health problems in the waves prior to retirement, (Dave, et al., 2008). For these individuals, retirement is more likely to be exogenous to health, since they report being healthy (no ADL difficulties, no chronic illness and no psychological problem) in the waves prior to retirement. Individual FE specifications are estimated for this pre-retirement healthy sample. The underlying assumption for identification is that these sample individuals who are mentally and physically healthy at baseline prior to retirement will provide purer health effects for complete retirement.

I try to identify other similar samples of individuals who are healthy prior retirement based on different restrictions to check the robustness of this approach. I consider the individuals who do not report spending more than 10 minutes for their own health purposes[44] in the pre-retirement waves. Another sample of individuals who report not foreseeing any health limitation in next ten years in their pre-retirement waves is also considered. It is expected that for individuals in these samples, their retirement is not a consequence of poor health.

Next, I consider a smaller sample of individuals who have been offered early retirement windows. The HRS has information about non-discriminatory offerings of early retirement windows. Employers sometimes encourage older workers to leave a firm at a particular time by offering a special financial incentive such as cash, a bonus, or improved pension benefits. These are typically limited time offers lasting 6 weeks to 3 months.[45] An early retirement window is exogenous to an individual's health because firms cannot limit eligibility to

[44] Either for medication or treatment: taking medicines, applying treatment, taking care of surgical problems or doing any kind of rehabilitation.

[45] In our sample of Americans at least 50 years of age and less than 80 years (who were working full time at age 50), 3 percent were offered an early retirement window at least once. Among the ones who were offered an early retirement window at least once, 35 percent accepted the offer. Of those that accepted such an offer, 70.5 percent stated that the offer of an early retirement window was important for their decision to leave the job and 20 percent of the individuals who were given the offer stated that they would have accepted the offer if the incentive was doubled. (Coe, von Gaudecker, Lindeboom, & Maurer, 2012) used early retirement window as an instrument for retirement duration to study its impact on the cognitive functioning of the elderly. Since a very small proportion of the population is offered early retirement window it may not serve as a good source of exogenous variation and hence an IV for complete retirement.

specific employees. Hence in the sample of individuals who are offered an early retirement window it is possible to more clearly observe the health effects of retirement.

The comparison of the full-sample and these stratified-sample estimated effects will also provide a check for whether the endogeneity bias is being diminished in the hypothesized direction. Further stratifications are based on individual health insurance status and information on the reported reasons for retirement. All specifications include age, occupation, year and census division indicators. The age indicator controls for any declines in health over the life cycle, allowing the retirement indicator to pick up shocks beyond general age related worsening of health status. The occupation indicator captures any declines in health over one's career due to the job characteristics/environment. The year indicator captures unobserved time variant factors (e.g. use of certain medication) and the eight census division indicators capture unobserved differentials in health care and outcomes across the regions (e.g. air pollution level, availability of parks, greenery etc).

2.5.2 IV Approach

The most trusted method to deal with endogeneity resulting due to reverse causality is the use of an appropriate instrumental variable (IV).[46] However, it is difficult to find a variable that satisfies the characteristics of a valid IV for complete retirement. I have used five different IVs, some of which have been used in the literature, to exogenously proxy for complete retirement. First, age specific retirement incentives have been used as an instrument for complete retirement (Behncke, 2010). Second, the retirement status of the spouse (complete or partially retired) has been used as instrument for the retirement decision in a sample of individuals who expect to retire at the same time as their spouse and do not worry about their post-retirement income (Dave et al., 2008). Third, I use the individual's subjective expectation of post-retirement

[46] A detailed discussion of the IVs used is given in Section 2.6.

standard of living at the baseline (1992). Fourth is based on the type of pension plan that an individual is affiliated with in his last reported job is used. Fifth a constructed index of work environment for older workers (in the last reported job) is used to instrument retirement. It is expected that these variables are highly correlated with retirement but not correlated with health outcomes. Each of these instruments is discussed further in the following section.

2.6 Results

The results discussed here are based on the estimates obtained from the individual fixed effects model (equation 2.3) for various health outcomes estimated using both the full sample, as well as a set of stratified samples, and the use of IVs for complete retirement. The results predominantly indicate that complete retirement is associated with declines in both physical and mental health. However the extent of the association differs across the various health outcomes.

2.6.1 Basic Results

The estimates for the association between complete retirement and health outcomes under different sample specifications are reported in Table 2.3.1 and 2.3.2. The first table shows the results for the dichotomous health outcomes while the latter shows the results for the non-dichotomous or count health outcomes. In both tables the marginal effects of complete retirement from the appropriate regression model have been reported.

Column (1) in both these tables is the baseline model which shows the estimates associated with complete retirement for various health outcomes, controlling for basic demographic measures, health insurance status, pension status, parental characteristics, spousal characteristics, an indicator of risk aversion, age, occupation, census division and year indicators, but without any individual fixed effects.

Conditional on these covariates, complete retirement is associated with a statistically significant negative impact on health. For instance, in Table 2.3.1 complete retirement is significantly (at 1 percent level) associated with an increase in the probability of reporting poor health by 6.8 percentage points, an increase in the probability of ADL difficulties by 18.4 percentage points, an increase in the probability of being medically diagnosed with multiple chronic conditions by 36.5 percentage points, an increase in probability of psychological problems by 5.3 percentage points, and an increase in probability of over $5,000 in out-of-pocket medical expenditures by 2.1 percentage points. In Table 2.3.2, complete retirement is significantly (at 1 percent level) associated with an increase in depression and decline in cognitive functioning by 35.0 and 79.8 percentage points respectively. Complete retirement is also significantly (at 1 percent level) associated with 0.57 and 0.25 additional nights of hospital stay and office visits respectively. Relative to the overall weighted sample means, these marginal effects for the health measures are quite large in magnitude. For example, complete retirement raises the probability of self-reporting poor health by over 100 percent, medical diagnosis of multiple chronic conditions by 64.14 percent, and having a psychological problem by 42.30 percent.

These large magnitudes could be due in part to selection on unobservable characteristics, such as childhood medical history (whether an individual was prematurely born or was considered low birth weight) that may impact health outcomes in later life, genetics, or a preference for labor over leisure. The long panel nature of the HRS allows for us to account for such unobserved heterogeneity by estimating an individual fixed effect (FE) models. The results in Column (2) in both Tables 2.3.1 and 2.3.2 give the individual FE model estimates and imply that retirement is still associated with significant adverse impacts on health outcomes. The size of the estimated impacts are much smaller (nearly 40 percent) than the Column (1) estimates. The Column (2) estimates indicate that, relative to sample means, complete retirement statistically significantly raises (at 1 percent level) probability of self reporting poor health by 66.20 percent, the probability of having multiple ADL difficulties by 48.20 percent, the probability of multiple medically diagnosed chronic conditions by 16.90 percent, the probability of reporting psychological problems by 12.30 percent, and the probability of having over $5,000 in out-of-pocket medical expenditures by 10.44 percent. Complete retirement also raise increases depression and decreases cognitive functioning by 9.70 percent (significant at 1 percent level) and 2.20 percent (significant at 10 percent level) respectively. This indicates that there was positive selection on unobservable characteristics in the Column (1) results, which is consistent with the inference drawn from the unadjusted differences between retired and non-retired individuals reported in Table 2.1.[47]

2.6.2 Sample Stratification Results

Despite obtaining significant FE estimates, concern about the potential for reverse causality causing upward bias in the FE estimates remains. As mentioned, one potential solution to this issue is to restrict the sample to individuals who retired at 62 years of age, since it is expected that such a retirement decision is substantially exogenous to health and more likely due an age "anchoring" effect. The marginal effects of complete retirement from this sample stratification exercise are reported in Column (3) in Tables 2.3.1 and 2.3.2. The results (relative to the full-sample means) indicate that complete [48]retirement increases probability of having an ADL difficulty and a medical diagnosis of chronic conditions by 12.20 and 8.29 percent

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[47] The same specifications (with and without individual FE) are executed separately for relatively homogenous group of retirees (based on retirement satisfaction- satisfied, moderately satisfied and not at all satisfied) and reported in Appendix Table B 3. The adverse health effects of complete retirement are found to be more pronounced for the group of retirees who are not at all satisfied in retirement.

[48] Marginal effects relative to full-sample means help to compare across the different stratified samples.

respectively (significant at 5 percent level). Complete retirement also increases the number of nights in the hospital and office visits by 10.71 percent and 4.08 percent respectively, as well as decreasing cognitive functioning by 1.60 percent (all significant at 1 percent level).

Another potential way to address the problem of reverse causality is by restricting the sample to those that reported being in good health prior to retirement (Dave, et al., 2008). It is expected that the retirement of workers in this sample is less likely to be motivated by health reasons. The results of this specification are reported in Column (4) of Tables 2.3.1 and 2.3.2. The estimate sizes are expected to be smaller in this case if the upward bias mentioned above is present in the Column (2) results. The negative impact of complete retirement is indeed found to be smaller in magnitude in Column (4) but still remains statistically significant. Relative to sample means, complete retirement causes a 22.60 percent increase in the probability of reporting poor health, a 17.90 percent increase in the probability of having ADL difficulties, a 14.88 percent increase in the probability of having a medical diagnosis of multiple chronic conditions, and a 2.10 percent increase in the probability of spending more than $5,000 out-of-pocket for medical expenses. There is also a 7.40 percent increase in depression, as well as 5.54 and 2.49 percent increases in the number of nights in the hospital and office visits respectively.

The robustness of these results is checked through an analysis of other similar samples of individuals, based on different restrictions, who are healthy prior to retirement. Column (5)[49] in the same tables reports results for a larger sample of individuals who report having spent less than 10 minutes per day on their own health either for medication, treatment, or rehabilitation. Retirement of such individuals is not expected to be driven by poor health status. The results are

[49] The stratified samples presented in Column 3,5,6 and 8 of Tables 2.3.1 and 2.3.2 have not been used in any existing studies.

found to be robust in favor of adverse effects of complete retirement on physical and mental health outcomes for this sample.

Similarly the Column (6) reports the marginal effects of complete retirement for different health outcomes for individuals who did not expect health to limit work for 10 years in the future in waves prior to their retirement. For this sample too it is conjectured that their retirement is unlikely to be driven by poor health status. The statistically significant results are similar in direction compared to the two other pre-retirement healthy samples used in Column (4) and Column (5).

Another cause of concern is that withdrawal from the labor force before the age of 65 may come along with by a change in health insurance status, which may also be endogenous to health outcomes. The adverse post-retirement health effects observed 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 tendency to be in poorer health. The sample means from Table 2.2 also show that retirees are more likely to be insured. To test whether or not retirement effects are caused by discerning changes in health insurance coverage or retiree access to insurance coverage, the sample is further constrained to individuals who are consistently insured in all waves (Dave, et al., 2008). The marginal effects, presented in Column (7) of Tables 2.3.1 and 2.3.2, are similar to Column (4) and remain statistically significant. This implies that conditional on individual fixed effects and good health prior to retirement; the shifts in and out of health insurance coverage do not play a major role in post-retirement health outcomes.

The results for my next sample stratification exercise are reported in Column (8) of Table 2.3.1 and 2.3.2. This sample comprises of individuals who are offered non-discriminatory early retirement windows. It is expected that the retirement of such individuals is highly associated with early retirement window offers and hence not motivated by poor health status. Again in this sub-sample the marginal effect of complete retirement for different health outcomes is similar in direction as the previous stratified samples but much smaller in magnitude and not statistically significant. The loss of statistical significance of the coefficients is probably due to the very small sample size. Hence the adverse effect of complete retirement on both physical and mental health outcomes is found to be robust across various stratified samples.

Table 2.3.1: Average Marginal Effect of Complete Retirement for Health Outcomes (Dichotomous) in Stratified Samples

HEALTH OUTCOMES	Full Sample Without Individual FE (1)	Full Sample With Individual FE (2)	Retired at Age 62 years With Individual FE (3)	Healthy Pre-Retirement With Individual FE (4)	Pre Retirement consistently spend less than 10 minutes/day on own health problems or conditions With Individual FE (5)	Pre Retirement consistently do not expect health to limit work in next 10 years With Individual FE (6)	Healthy Pre Retirement Consistently Insured in All Waves With Individual FE (7)	Offered Early Retirement Window With Individual FE (8)
Poor Health	0.0682***	0.0348***	0.0087	0.0119***	0.0383***	0.0153***	0.0092***	0.0075
	(0.0021)	(0.0026)	(0.0130)	(0.0039)	(0.0090)	(0.0232)	(0.0035)	(0.0126)
	129.60%	66.20%	16.50%	22.60%	72.81%	29.09%	17.40%	14.28%
Activity of Daily Living Difficulty	0.1840***	0.0784***	0.0200**	0.0291***	0.0515***	0.0122	0.0168**	0.0100
	(0.0057)	(0.0064)	(0.0097)	(0.0084)	(0.0071)	(0.0320)	(0.0080)	(0.0155)
	113%	48.20%	12.20%	17.90%	31.63%	7.49%	10.30%	6.14%
Chronic Conditions	0.3650***	0.0962***	0.0472**	0.0847***	0.0325**	0.0531***	0.0699***	0.0160**
	(0.0114)	(0.0086)	(0.0194)	(0.0235)	(0.0158)	(0.0753)	(0.0267)	(0.0730)
	64.14%	16.90%	8.29%	14.88%	5.71%	9.33%	12.28%	2.81%
Heart Disease	0.0545***	0.0451	0.0208	0.0146**	0.0418***	0.0025**	0.0084	0.0183***
	(0.0036)	(0.0409)	(0.0178)	(0.0072)	(0.0131)	(0.0459)	(0.0084)	(0.0031)
	33.09%	27.38%	12.60%	8.80%	25.38%	1.54%	5.10%	11.01%
High Blood Pressure	0.0599***	0.0128***	0.0275	0.0088	0.0108	0.0052	0.0089	0.0107
	(0.0045)	(0.0037)	(0.0210)	(0.0112)	(0.0159)	(0.0659)	(0.0125)	(0.0419)
	13.40%	2.80%	6.10%	2.00%	2.42%	1.16%	1.90%	2.40%
Diabetes	0.0195***	0.0131***	0.0050***	0.0052	0.0046***	0.0054	0.0018	0.00418
	(0.0032)	(0.0034)	(0.0175)	(0.0057)	(0.0128)	(0.0426)	(0.0063)	(0.0256)
	13.64%	9.16%	3.50%	3.64%	3.22%	3.78%	1.26%	2.92%
Lung Disease	0.0205***	0.0145***	0.0023**	0.0035	0.0027***	0.00169	0.0028	0.0045
	(0.0024)	(0.0026)	(0.0120)	(0.0044)	(0.0092)	(0.0144)	(0.0048)	(0.0401)
	28.08%	19.86%	3.15%	4.79%	3.69%	2.32%	3.84%	6.16%
Cancer	0.0085***	0.0063**	0.0030**	0.0017**	0.0006	0.0014	0.0018**	0.0022
	(0.0029)	(0.0031)	(0.0142)	(0.0067)	(0.0109)	(0.0438)	(0.0075)	(0.0215)
	8.59%	6.36%	3.03%	1.71%	0.06%	1.14%	1.82%	2.22%
Stroke	0.0245***	0.0213***	0.0202***	0.0109***	0.0047***	0.0016	0.0011**	0.0029
	(0.0021)	(0.0022)	(0.0094)	(0.0041)	(0.0090)	(0.0248)	(0.0046)	(0.0034)
	58.33%	50.71%	48.09%	25.95%	11.19%	3.80%	2.61%	6.90%
Arthritis	0.0225***	0.0097**	0.0114***	0.0061***	0.0023	0.0106	0.0056***	0.0117
	(0.0044)	(0.0046)	(0.0247)	(0.0101)	(0.0165)	(0.0718)	(0.0111)	(0.0727)
	4.72%	2.03%	2.39%	1.28%	0.48%	2.22%	1.17%	2.45%
Obesity	0.0077*	0.0054	0.0041*	0.0017	0.0021	0.0257	0.0086	0.0008
	(0.0042)	(0.0054)	(0.0226)	(0.0116)	(0.0132)	(0.0666)	(0.0110)	(0.0728)
	2.72%	1.90%	1.44%	0.60%	0.74%	0.90%	0.30%	0.28%
Psychological Problem	0.0526***	0.0153***	0.0059	0.0075**	0.0422***	0.0037***	0.0073**	0.0044
	(0.0028)	(0.0023)	(0.0097)	(0.0032)	(0.0106)	(0.0411)	(0.0034)	(0.0095)
	42.30%	12.30%	4.70%	6.00%	33.95%	2.94%	5.80%	3.56%
Out of Pocket Medical Expenditure	0.0210***	0.0119***	0.0027	0.0025***	0.0301**	0.0025**	0.0021**	0.0077
	(0.0029)	(0.0043)	(0.0176)	(0.0105)	(0.0127)	(0.0629)	(0.0110)	(0.0697)
	11.90%	10.44%	2.20%	2.10%	25.32%	2.09%	1.70%	6.50%
Observations	88,075	88,075	4,890	9,209	27,422	6,088	8,497	1,643

Note: Each cell reports the marginal effect of complete retirement on the respective dichotomous health outcomes, from separate regressions (logit model). The standard errors in parentheses. Statistical significance is defined as ***p< 0.01, **p< 0.05, * p< 0.1. Percentage figures are relative to the full-sample means. Sample is limited to individuals 50-80 years of age. No. of observations for all specifications represent number of person-waves. All regressions have been controlled for the socio-demographic variables, spousal characteristics, last reported occupation, year and census division.

Table 2.3.2: Average Marginal Effect of Complete Retirement for Health Outcomes (Non-dichotomous) in Stratified Samples

HEALTH OUTCOMES	Full Sample Without Individual FE (1)	Full Sample With Individual FE (2)	Retired at Age 62 years With Individual FE (3)	Healthy Pre-Retirement With Individual FE (4)	Pre Retirement Consistently Spend Less than 10 Minutes/Day on Own Health Problems or Conditions With Individual FE (5)	Pre Retirement consistently Do Not Expect Health to Limit Work in Next 10 Years With Individual FE (6)	Healthy Pre Retirement Consistently Insured in All Waves With Individual FE (7)	Offered Early Retirement Window With Individual FE (8)
Depression (CESD)	0.3500***	0.1230***	0.0689	0.0941**	0.1160***	0.0189**	0.0965**	0.0457
	(0.0163)	(0.0191)	(0.0929)	(0.0470)	(0.0657)	(0.3430)	(0.0479)	(0.3070)
	27.80%	9.70%	5.40%	7.40%	9.20%	1.50%	7.60%	3.63%
Cognition (Total Cognition Score)	-0.798***	-0.531*	-0.383***	-0.265	-0.183	-0.474	-0.262	-0.230
	(0.0451)	(0.2750)	(0.1830)	(0.1690)	(0.4970)	(0.970)	(0.1740)	(1.226)
	3.30%	2.20%	1.60%	1.10%	0.76%	1.99%	1.00%	0.96%
No. of Nights at Hospital	0.5740***	0.4110***	0.1740***	0.0900***	0.0426***	0.0434	0.07580***	0.0879
	(0.0295)	(0.0365)	(0.0379)	(0.1850)	(0.1110)	(0.6570)	(0.2000)	(0.874)
	35.34%	25.30%	10.71%	5.54%	2.62%	2.67%	4.67%	5.41%
No. of Doctor Visits	0.2540***	0.2440***	0.3494***	0.2130***	0.2910***	0.0569	0.2300***	0.3027**
	(0.0066)	(0.0069)	(0.6980)	(0.0271)	(0.0608)	(0.2040)	(0.0289)	(0.1263)
	2.97%	2.85%	4.08%	2.49%	3.40%	0.66%	2.69%	3.54%
Observations	88,075	88,075	4,890	9,209	27,422	6,088	8,497	1,643

Note: Each cell reports the marginal effect of complete retirement on the respective non-dichotomous health outcomes, from separate regressions (count data model for the count health variables and OLS model for the truncated health variables /scores). The standard errors in parentheses Statistical significance is defined as ***p< 0.01, **p< 0.05, * p< 0.1. Percentage figures are relative to the full-sample means. Sample is limited to individuals 50-80 years of age. Observations for all specification are reported in number of person-waves. All regressions have been controlled for the socio-demographic variables, spousal characteristics, last reported occupation, year and census divisions.

I also follow Dave, et al., (2008) and estimate the effect of complete retirement on selected health outcomes for individuals who do not cite health as a reason for retirement (Table 2.4 Column (1)). In addition, I further restrict the sample to those who report being healthy prior to retirement and not cite health as a reason for retirement (Table 2.4 Column (2)). For this group who are healthy prior to retirement and do not attribute their retirement to health reasons, retirement can be argued to be exogenous to health status. The marginal effects of complete retirement on different health outcomes still suggest worse health outcomes post-retirement, but the magnitudes are smaller in Column (2) as compared to Column (1). Table 2.4 Columns (3)-(5) further stratify the pre-retirement healthy sample by different non-health reasons for retirement.[50] While addressing potential justification bias, these measures give information about retirement preferences. They allow us to identify relatively homogeneous groups of retirees, at least with respect to their reported reason for retirement. The coefficient magnitudes are robust across most of these specifications, and also similar to the earlier models. Relatively smaller sample sizes inflate the standard errors, although the inferences are qualitatively not affected.

[50] In the HRS, there are four indicators for reasons for retirement. These include (i) poor health; (ii) wanted to do other things: (iii) wanted to spend more time with family; and (iv) did not like work.

Table 2.4: Average Marginal Effect of Complete Retirement in Samples Stratified by Reasons to Retire

HEALTH OUTCOMES	**Full Sample**	**Healthy Pre-Retirement Sample**			
	Health not a Reason for Retirement (1)	**Health not a Reason for Retirement (2)**	**Retired to Do Other Things (3)**	**Retired to Spend More Time with Family (4)**	**Retired Did not Like Work (5)**
Activity of Daily Living Difficulty	0.0379***	0.0074	0.0332***	0.0156	0.0102
	(0.0058)	(0.007)	(0.0117)	(0.0137)	(0.0604)
	23.20%	4.50%	2.00%	9.53%	6.21%
Chronic Conditions	0.0676***	0.0488**	0.0835***	0.0745***	0.1881***
	(0.00910)	(0.023)	(0.0286)	(0.0274)	(0.0437)
	4.30%	3.18%	5.36%	4.77%	11.91%
Depression	0.0647***	0.0432	0.0477	0.00334	0.0216
	(0.0198)	(0.047)	(0.0629)	(0.0685)	(0.1213)
	5.10%	3.42%	3.70%	0.34%	1.71%
Heart Disease	0.0113***	0.0087*	0.0171	0.00602	0.103**
	(0.00325)	(0.0055)	(0.0123)	(0.0096)	(0.0434)
	6.80%	5.22%	10.33%	3.63%	6.21%
Out of Pocket Medical Expenditure	0.0089*	0.0030***	0.0039**	0.0018	0.0017
	(0.0046)	(0.0106)	(0.0197)	(0.0180)	(0.0478)
	7.42%	2.52%	3.31%	1.50%	1.45%
Observations	79,881	8,576	2,960	3,556	1,625

Note: Each cell reports the marginal effect of complete retirement on the respective health outcomes, from separate regressions (linear probability model) .The same specifications were run for other health outcomes but the marginal effects for complete retirement were not statistically significant. All samples are limited to individuals 50-80 years of age. Standard errors in Parentheses. Statistical significance is defined as ***p< 0.01, **p< 0.05, * p< 0.1. Observations for all specification are reported in number of person-waves. Percentage figures are relative to the full-sample means. All regressions have been controlled for the socio-demographic variables, spousal characteristics, last reported occupation, year and census divisions.

2.6.3 Instrumental Variable Approach Results

The next set of results are drawn from an alternative and commonly used technique for dealing with reverse causation, and hence endogeneity, the use of instruments. The results from our IV regressions (Two Stage Least Square for LPM)[51],[52] for some physical and mental health outcomes are summarized in Table 2.5. Each column in this table represents the use of a different IV for complete retirement (the endogenous regressor). These IVs are theoretically valid in the context of physical health however some may be weak instruments for mental health[53].

First, age specific retirement incentives have been used as an instrument for complete retirement in the literature (Behncke, 2012). The instruments used are indicators that individual is exactly 62 years old, in the age group of 63-64, or above 70. Undoubtedly health declines as people age, but an individual's health does not change discretely based on reaching a birthday and officially becoming a year older than the day before, whereas retirement benefits and thus retirement probabilities do change discretely at these relatively arbitrary dates. The sharp jumps in benefits and retirement, but not health changes, upon reaching a birthday make the age thresholds effective instruments. The same may not be true for age 65 as eligibility for normal retirement benefits also makes an individual eligible for Medicare, potentially influencing health as well as retirement.[54] The results for this IV

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[51] Robustness of IV results checked using special regressor method (Dong & Lewbel, 2012).
[52] First stage results reported in Appendix Table B4.
[53] Discussed in Section 2.6.4
[54] There could be two violations in using such an instrument- first, turning 1 year older could have a direct effect on mental health if this age is perceived as a milestone (e.g. round birthdays) in one's life. Second, the pension eligibility age is predictable or anticipated by individuals. Therefore, they might adjust their behavior and thereby offset any health effects or might experience mental health effects in anticipation of retirement. However, the HRS allows us to observe the subjective expectation of individuals to remain in work in the future and to experience a health shock that limits work capability. Conditional on these expectations and on their gender, the exclusion restriction should not be violated.

regression are presented in Table 2.5, Column (1). The coefficient is not significant for self-reported health status (not reported) but the statistically significant results (at 1 percent level) for the other relatively more objective physical and mental health outcomes reaffirm that complete retirement leads to adverse physical and mental health outcomes. The large F-statistic[55] in Column (1) points toward the strength of the instrument, which passed the over-identification test[56].

Second, the retirement status of the spouse has been used as instrument for the retirement decision of the individual for a sample of individuals who expect to retire at the same time as their spouse and do not worry about having enough income for their planned post-retirement standard of living (Szinovacz & Davey, 2004). Retirement is definitely a joint decision, hence retirement status of one's spouse may be strongly related to an individual's retirement decision, and however it is unlikely to have a direct impact on the health of an individual (especially physical health outcomes). The results from this IV regression are presented in Column (2) of Table 2.5. The estimates show that complete retirement leads to a 56.1 percentage point increase in the probability of being medically diagnosed with multiple chronic conditions. This result is statistically significant at the 1 percent level.

The next instrument used for complete retirement is the subjective expectation of individuals about their post-retirement standard of living in the baseline wave (1992). This is correlated with the subsequent retirement decision of individuals. Since all individuals are working in the first wave and over 88 percent of the sample is less than 60 years old in 1992, it is expected that their subjective expectation is uncorrelated with their physical or mental

[55] Rule of thumb F statistic for valid, strong instrument should be over 10.
[56] Implying that the error term is uncorrelated with the instruments.

health status in the subsequent years. The results from this IV regression are presented in Column (3) of Table 2.5. The estimates indicate that complete retirement leads to an increase in probability of medical diagnosis of multiple chronic conditions (significant at the 5 percent level), an increase in probability of arthritis, and a decrease in cognitive functioning score (significant at the 1 percent level).

Fourth, the type of pension plans - whether it is Defined Benefit (DB) or not - has been used to instrument complete retirement[57]. Pension wealth in traditional DB plans is a complicated function of earnings, tenure, and age. DB pension wealth typically accumulates slowly early in a job, accelerates or jumps after many years of tenure, and then ultimately slows down or declines if one stays in the job long enough. Therefore, DB pensions encourage workers to stay early on in order to gain access to large future pension accruals, and later to leave, after 25-30 years of tenure. Hence this is likely to be correlated with the retirement decision for a sample of relatively older workers. DC pensions accumulate a lump sum which depends strictly on contributions and returns accumulated in a portable account, so the timing of pension wealth accruals is not tied to the timing of retirement as in DB pensions. The estimates obtained in this IV regression reported in Column (4) of Table 2.5 indicate mixed results - complete retirement decreases the probability of having multiple ADL difficulties but increases the probability of having multiple chronic conditions and being obese (all significant at the 5 percent level).

The next instrument used for complete retirement is an indicator for the work environment faced by the older workers in their last reported jobs. The work environment measure is constructed within the HRS by using information about whether co-workers are

[57] It is observed that there is no statistically significant association between having DB pension plan and the reported occupation in the last job.

biased towards younger people and whether the employer is more inclined to promote younger individuals. If both co-workers and employers favor younger individuals then that creates an unfavorable work environment for older workers, which is highly correlated with their retirement decision and does not have a direct bearing on their objective physical health.[58] This IV regression result is presented in Table 2.5, Col (5). Contrary to the negative effects found for the other instruments, in this case it is observed that complete retirement (when instrumented by work environment) is associated with statistically significant (at the 1 percent level) decrease in probability of multiple chronic conditions, arthritis, and obesity. It is also associated with a statistically significant (at the 10 percent level) decreasing in the probability of functional limitations (ADL). The large reported F-statistics confirm the strength of the instrument used.

To summarize these results, unlike with the sample stratification strategy results, when one uses instruments, the effect of complete retirement on health outcomes (either positive or negative) depends on the choice of the instrument for complete retirement. It may be interesting to further elaborate on what leads to this disparity in the direction and magnitude of the estimates for the use of different instruments.

[58] There may a correlation between work environment and stress and hence mental health outcomes (Thayer et al., 2010))

Table 2.5: Alternate Identification by Using Instruments for Complete Retirement (2SLS)

HEALTH OUTCOMES	Age Specific Retirement Incentive (1)	Spouse Retirement Status (2)	Subjective Expectation about Post Retirement Standard of Living (3)	Pension Plan Type (4)	Work Environment (5)
Activity of Daily Living	0.0547***	0.0280	0.0031	-0.226**	-0.0291*
	(0.0165)	(0.0449)	(0.0041)	(0.660)	(0.0170)
Chronic Conditions	0.229***	0.561***	0.0234**	0.1733**	-0.237***
	(0.0240)	(0.192)	(0.0119)	(0.0862)	(0.0378)
Arthritis	0.0680**	0.262	0.119***	-0.114	-0.263***
	(0.0337)	(0.205)	(0.0205)	(0.5411)	(0.0446)
Obesity	0.597***	0.0900	0.00149	2.379**	-0.120***
	(0.0347)	(0.187)	(0.0056)	(0.2783)	(0.0401)
Depression	1.246***	0.505	0.207	-0.241	-
	(0.134)	(0.560)	(0.1690)	(5.527)	
Cognition	7.823***	-3.334	1.467***	-8.231	-
	(0.342)	(2.176)	(0.1082)	(11.04)	
Partial R^2	0.514	0.508	0.464	0.502	40.67

Note: Each cell represents the marginal effect of complete retirement on the given health outcome from a separate IV regression. Standard errors are reported in parentheses. Statistical significance is defined as ***p< 0.01, **p< 0.05, * p< 0.1

The F-statistic on the excluded instruments are found to be significantly large. They satisfy the thumb rule of greater than 10 for valid instruments.

(1) The excluded instruments are indicators for age-specific retirement incentive. Hansen J, the Chi-squared statistic on the test of over identifying shows that the error term is uncorrelated with the instruments.

(2)The sample only includes married individuals who reported that they plan to retire at the same time as their spouse and are not concerned about not having enough retirement income. The excluded instrument is indicator for retirement status (complete or partial) of the spouse.. Hansen J, the Chi-squared statistic on the test of over identifying shows that the error term is uncorrelated with the instruments.

(3) The excluded instrument is indicator of an individual's subjective expectation of post-retirement standard of living in 1992 (Wave 1). Individuals who joined the survey in later waves are excluded.

(4) The excluded instrument is an indicator for the type of pension plan an individual is entitled to i.e. Defined Benefit or not . (5) The excluded instrument is indicator for favorability work environment for older workers (in last reported job).

2.6.4 Strength of the Instruments for Complete Retirement

The use of an instrument for complete retirement is conditional upon the fact that complete retirement is an endogenous regressor.[59] If complete retirement was exogenous in my model then OLS estimates would be more efficient and the use of IV would lead to a loss of efficiency. Hence the Durbin and Wu-Hausman tests[60] are first conducted to confirm the endogeneity of complete retirement. The null hypothesis for these tests considers complete retirement to be exogenous. For all regressions (presented in Table 2.5), these test statistics are highly significant, so that the null of complete retirement being exogenous is rejected. Hence complete retirement is treated as endogenous in my analysis, supporting the use of IV strategy.

A valid instrument must satisfy two conditions: the excluded exogenous variable (IV) must be highly correlated with the endogenous variable and it must be uncorrelated with the error term. The IV estimators are likely to be less biased if the instruments are strongly correlated with the endogenous variable. This may be indicated by a high value of the adjusted R^2, but may also give misleading inferences due to the fact that the adjusted R^2 may be high due to a strong correlation between the endogenous variable and the other included exogenous variables, but weakly correlated to the IV (known as the weak instrument problem). Bound, Jaeger & Baker (1995) have encouraged the use of the partial R^2 (reported in Table 2.5) in such a scenario.

There are multiple problems arising due to weak instruments. First, weak instruments makes the IV estimators (2SLS estimators) biased. Second, the 2SLS standard errors become very small. Finally, the hypothesis tests for the parameters estimated by these IV estimators involve size distortions (Stock, Wright, & Yogo, 2002). For testing the strength of instruments these

[59] The endogeneity issue here is generated by reverse causality between health and retirement.
[60] The Durbin test estimates error variance considering a model where the variables being tested are exogenous while the Wu-Hausman test estimates the same considering a model where the variables being tested are endogenous.

authors suggest a rule of thumb: if the first stage F-statistic is greater than 10, then reliable conclusions may be drawn from the 2SLS estimator with one endogenous regressor. The first stage F-statistic for all five IVs used in this study satisfy this rule (exceeds 10).

Stock & Yogo (2005) suggested further tests for weak instruments. The test statistic for these tests is exactly identical to the first stage F-statistic.[61] The null hypothesis for the test is that the IV is weak.[62] To draw conclusions about the strength of the instruments it is first important to choose the largest rejection rate for a 5 percent Wald test that could be tolerated. The IV is considered to be weak if a Wald test at the 5 percent level can have an actual rejection rate of no more than 10 percent, 15 percent, 20 percent, or 25 percent.[63]

For my sample if I allow a rejection rate of 10 percent, then the test statistic for the following IVs: (1) the subjective expectation about post-retirement standard of living (10.45) and (2) pension plan type (13.08) are less than the 10 percent critical value of 16.38 respectively. This suggests that these IVs used in my study are relatively weak. However, if I allow for a rejection rate of 15 percent then the test statistic values exceed the critical value, which leads to rejection of the null hypothesis that these IVs are weak. For the other IVs: (3) age specific retirement incentives, (4) spousal retirement status and (5) unfavorable work environment, the respective test statistics are greater than the 10 percent critical values, which implies that these IVs are not weak.

61 The weak IV tests are reported in Appendix Table B 5. For one endogenous regressor the test statistic is identical to the first stage F statistic. For multiple endogenous regressors, the Craig and Donald F-statistic is used.

62 More precisely it is a test of the null hypothesis that the true significance of hypothesis tests about the endogenous regressor's coefficient is smaller than 10% (and 15%, 20%, 25%) when the usually stated significance level is 5%. Hence if the test statistics is lower than the 25% level critical value then 2SLS standard errors are not at all trustworthy (i.e. the IV is very weak).

63 The critical values for the rejection rates are reported in Appendix Table B 5.

2.7 Conclusion

This paper is aimed at isolating the effect of complete retirement on health and to report to what extent the magnitude of the health effects are different for different health outcomes using different strategies executed in existing literature in addition to taking a step further in attempting to address the inherent issue of reverse causality between health and retirement. Retirement from full time employment is associated with both physical and mental health effects. From the perspective of Unites States public policy, measuring the health effects associated with retirement is important for evaluating policies which increase the minimum age for retirement, given concern over financing entitlement programs, such as Social Security and Medicare.

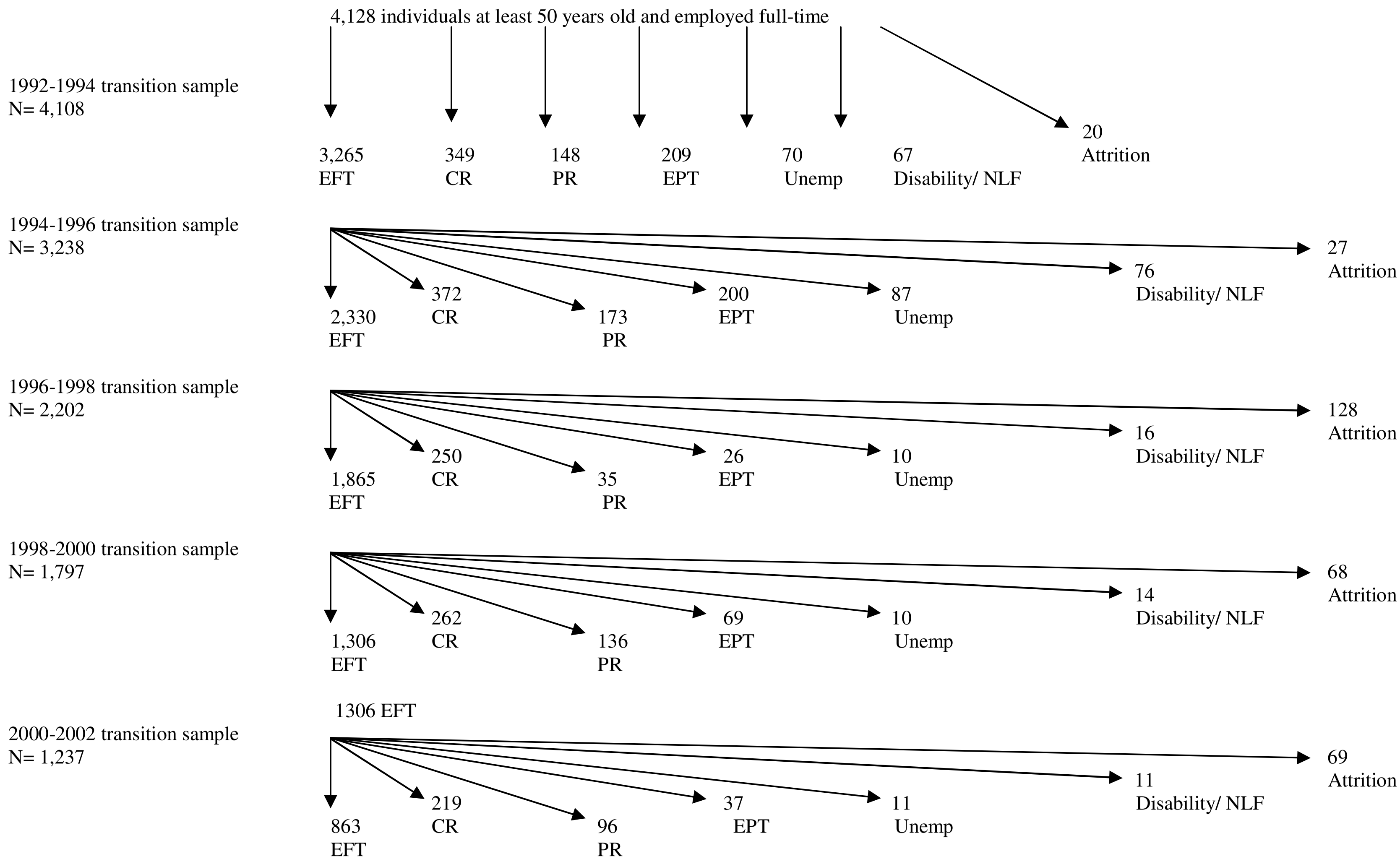
The results based on sample stratification indicate that complete retirement is associated with adverse physical and mental health outcomes. The extent of the association is differential depending on the health outcome. The estimates are for the most part similar in magnitude and direction with the (Dave, et al., 2008) paper that employs similar stratification strategies. But my paper is able to check for the robustness of the association between health and complete retirement for other stratification approaches.

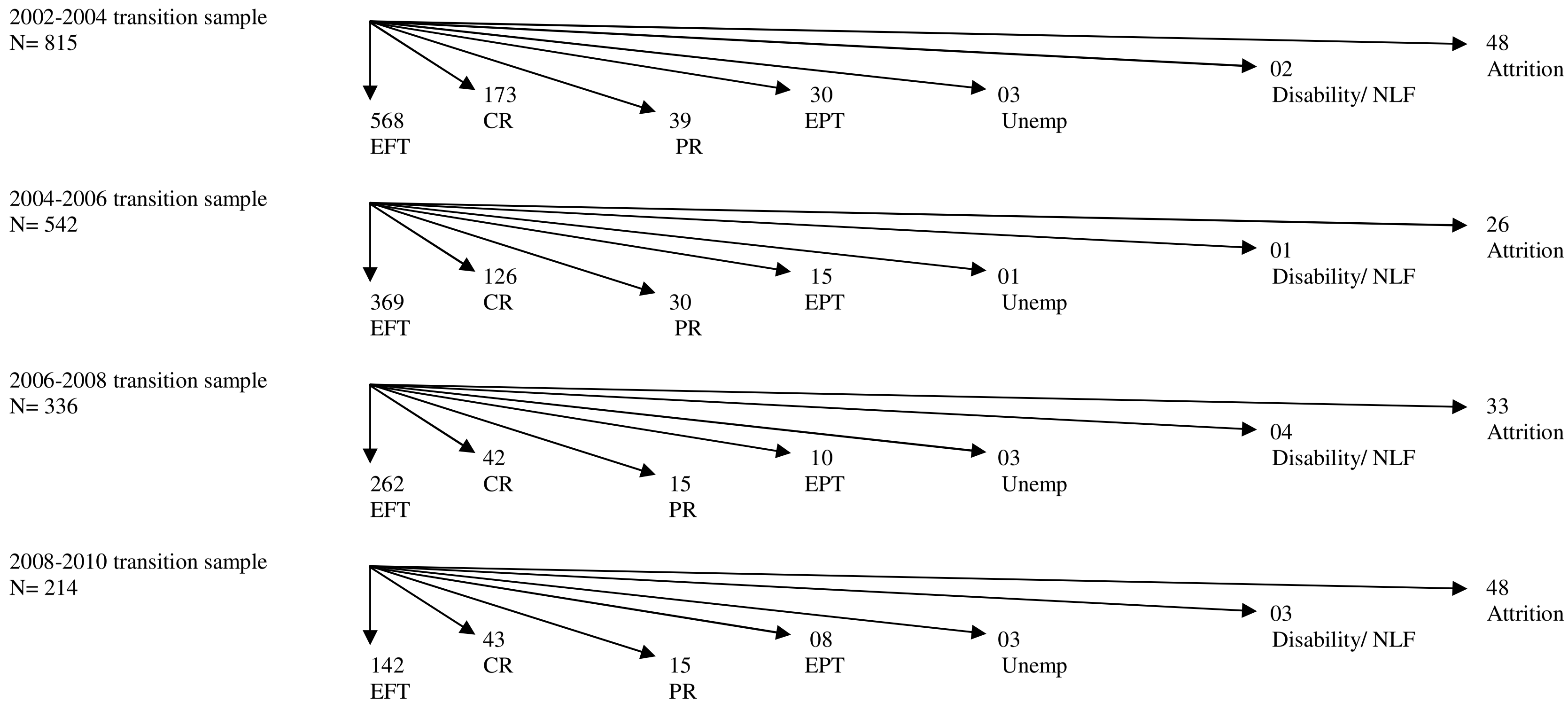
However the results obtained by using the five different instruments for complete retirement show a wide disparity in both the direction and magnitude of the effect on the health outcomes. This differs from existing studies that hinge on a particular instrument and find positive health effects of retirement. This strongly points towards the results being driven by the choice of instruments. As a part of future research, it would be interesting to elaborate on the reasons for such disparity in the IV approach results.

APPENDIX A: ESSAY 1

ADDITIONAL FIGURES

Figure A.1: HRS Analysis Sample Transitions Illustrated





Note: EFT, CR, PR, EPT, Unemp and Disability/NLF refer to employed full-time, complete retirement, partial retirement, working part-time, unemployment, disability or not in labor force respectively. See text for discussion.

Figure A.2: Kaplan-Meir Survival Estimate for Different Exits

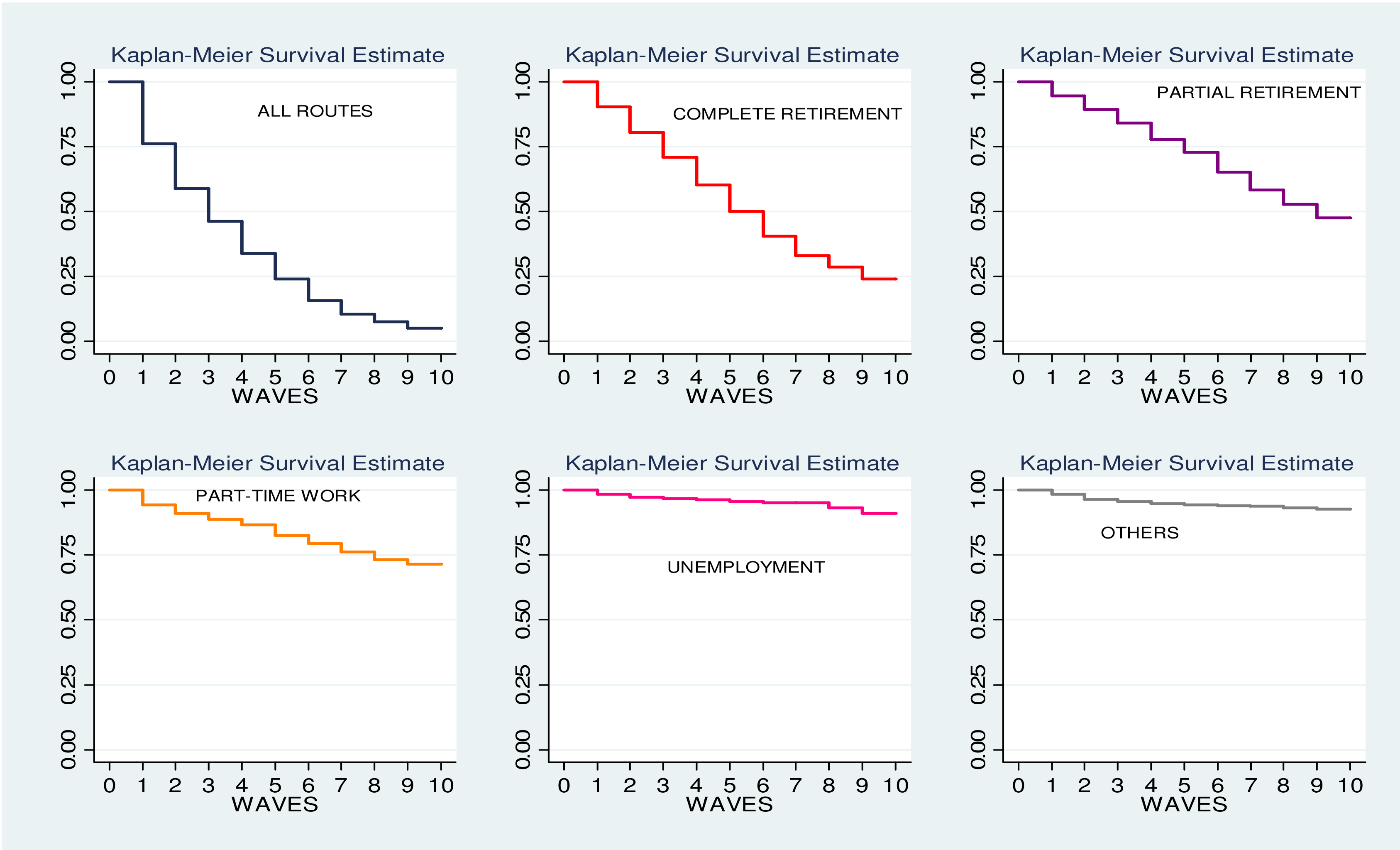


Figure A.3.1: Kaplan Mier Survivor Estimate
for Individuals between 50-55 Years of Age in 1992 (Wave 1)

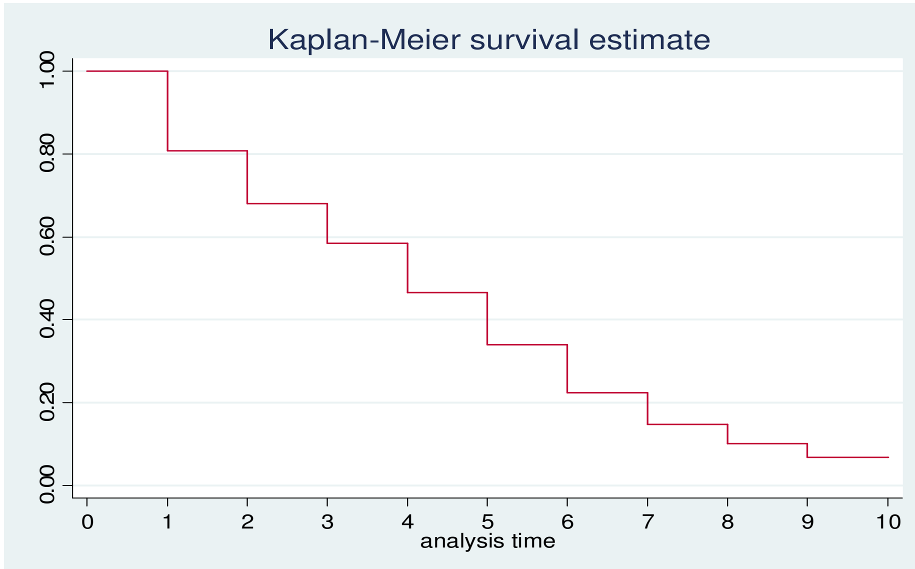
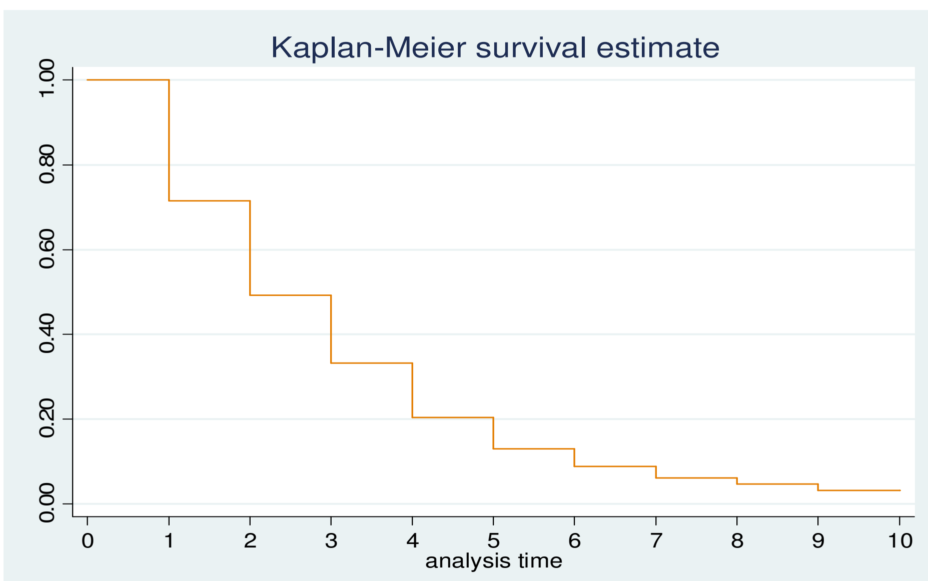


Figure A.3.2: Kaplan Mier Survivor Estimate
for Individuals Strictly Above 55 Years of Age in 1992 (Wave 1)



ADDITIONAL TABLES

Table A.1: Frequency Distribution for Spells (1992-2010)

Spells	Frequency	Percent	Cumulative
Starting in Wave 1	4,128	26.73	95.21
	Adds 740		
Starting in Wave 2	166	1.07	96.28
Starting in Wave 3	127	0.82	97.11
Starting in Wave 4	92	0.6	97.7
Starting in Wave 5	94	0.61	98.31
Starting in Wave 6	90	0.58	98.89
Starting in Wave 7	70	0.45	99.35
Starting in Wave 8	65	0.42	99.77
Starting in Wave 9	36	0.23	100
Total Spells	4,868		
Total Observations (person-waves)	15,442		
Still Working Full-Time (person-waves)	10,574		

Note: Using data from the Health and Retirement Study (1992-2010) spells of full-time employment are set up for 4128 individuals, at least 50 years of age and working full-time in 1992. Exits are first considered absorbing state- single time exits such that there are 4128 unique spells of full-time employment for 4128 individuals. On considering multiple exits from full-time work, another 740 spells are added later such that there are 4868 spells of full-time employment.

Table A.2: Kaplan Meir Baseline Hazard Rates by Different Exit Routes

Waves	Year	ALL RISKS: All Routes	COMPETING RISKS				
			Exit Route 1: Complete Retirement	**Exit Route 2: Partial Retirement**	**Exit Route 3: Part-time Work**	**Exit Route 4: Unemployment**	**Exit Route 5: Disability and Not in Labor force**
1	1992	21.5%	9.6%	5.4%	5.7%	1.6%	1.6%
2	1994	22.8%	10.8%	5.6%	3.5%	1.1%	1.8%
3	1996	23.8%	13.0%	6.6%	2.3%	0.6%	1.1%
4	1998	26.4%	15.1%	7.6%	2.7%	0.5%	0.7%
5	2000	29.6%	17.1%	8.4%	4.6%	0.7%	0.8%
6	2002	33.4%	18.8%	10.4%	3.6%	0.6%	0.1%
7	2004	33.9%	18.5%	10.6%	4.3%	0.1%	0.5%
8	2006	28.9%	13.2%	9.4%	3.8%	2.1%	0.4%
9	2008	32.1%	16.8%	10.2%	2.2%	2.2%	0.7%

Note: The table represents the baseline hazard rates associated with different kinds of exits- all routes (all risks) lumped together versus five different routes of exit (competing risks) over time. The cumulative hazard rate for exit from full-time employment via any route in general as well as individual routes increases over time. This is distinctly observed for complete retirement and partial retirement.

Table A.3: Principal Component Analysis

Factor	Eigen Value	Difference	Proportion	Cumulative Proportion Explained
Factor1	3.57	1.03	0.13	0.13
Factor2	2.54	0.12	0.09	0.22
Factor3	2.42	0.20	0.09	0.30
Factor4	1.22	0.05	0.08	0.38
Factor5	1.17	0.05	0.04	0.43
Factor6	1.12	0.09	0.04	0.47
Factor7	1.02	0.01	0.04	0.50
Factor8	1.02	0.03	0.04	0.54
Factor9	0.98	0.01	0.04	0.57
Factor10	0.97	0.03	0.03	0.61
Factor11	0.94	0.01	0.03	0.64
Factor12	0.93	0.07	0.03	0.67
Factor13	0.86	0.03	0.03	0.71
Factor14	0.83	0.00	0.03	0.74
Factor15	0.82	0.01	0.03	0.76
Factor16	0.81	0.04	0.03	0.79
Factor17	0.77	0.01	0.03	0.82
Factor18	0.76	0.01	0.03	0.85
Factor19	0.75	0.05	0.03	0.88
Factor20	0.70	0.00	0.03	0.90
Factor21	0.70	0.09	0.03	0.93
Factor22	0.61	0.09	0.02	0.95
Factor23	0.52	0.20	0.02	0.97
Factor24	0.32	0.02	0.01	0.98
Factor25	0.30	0.09	0.01	0.99
Factor26	0.21	0.09	0.01	1.00
Factor27	0.12	0.10	0.00	1.00
Factor28	0.01	.	0.00	1.00

Note: From twenty eight diverse health outcome variables. Eight factors with Eigen value greater than 1 are generated using Principal Component Factor Analysis which is used to create the health indices used as explanatory variable in the hazard model.
Proportion indicates the relative weight of each factor in the total variance. For example Factor 1 (Chronic Condition Factor) explains 13 percent of the total variance.
Cumulative Proportion Explained shows the amount of variance explained by n+ (n-1) factors. For example Factor 1 (Chronic Conditions Factor) and Factor 2 (Functional Limitations) explain 22 percent of total variance. Similarly the eight chosen factors together explain 54 percent of the total variance.

Table A.4: Principal Component Analysis- Rotation (Pattern Matrix)

INCLUDED VARIABLES	Factor1	Factor2	Factor3	Factor4	Factor5	Factor6	Factor7	Factor8	Uniqueness
Self Reported Health	0.25	0.29	0.12	0.33	0.14	-0.15	0.03	0.07	0.29
No. of ADL Difficulties	-0.15	0.76	0.01	0.01	-0.03	-0.01	0.09	-0.04	0.47
No. of Mobility Difficulties	0.05	0.72	0.01	0.00	0.10	-0.20	-0.07	0.01	0.38
Whether Health Limits Work	0.01	0.60	0.18	-0.05	-0.01	0.09	-0.05	0.03	0.57
No. Of Chronic Conditions	0.96	-0.04	0.07	-0.03	0.06	-0.02	0.15	0.00	0.02
Has High BP	0.69	-0.16	-0.02	-0.01	-0.08	-0.35	-0.05	-0.01	0.44
Has Diabetes	0.34	-0.12	0.15	0.20	-0.06	-0.31	0.03	0.01	0.60
Has Heart Disease	0.35	0.05	0.50	-0.11	-0.07	0.20	-0.12	0.06	0.51
Has Lung Disease	0.36	0.05	0.04	-0.03	0.08	0.41	-0.10	0.20	0.60
Had Stroke	0.12	-0.08	0.50	0.01	0.01	0.05	-0.23	-0.12	0.24
Had Cancer	0.18	-0.06	-0.08	-0.05	-0.06	0.05	0.77	0.06	0.39
Has Arthritis	0.62	0.20	-0.30	-0.08	0.06	0.10	0.10	-0.08	0.46
Has Psychological Problem	0.25	-0.12	-0.10	0.04	0.58	0.19	0.17	-0.03	0.51
Depression	-0.08	0.20	-0.06	0.32	0.62	-0.06	-0.05	-0.03	0.46
Total Cognition Score	0.06	0.02	0.01	-0.77	-0.05	0.03	0.06	-0.10	0.43
Alzheimer's	0.13	0.02	0.01	0.69	0.18	0.02	0.06	0.11	0.33
Dementia	0.11	0.01	0.01	0.71	0.12	0.02	0.02	0.06	0.31
BMI	0.28	0.25	-0.15	0.02	-0.21	0.54	-0.07	-0.12	0.46
Out of Pocket Expenditure	-0.02	-0.14	0.35	0.00	0.23	-0.13	0.27	-0.04	0.65
No. of Nights Hospital Stay	0.07	0.13	0.68	-0.01	-0.09	0.07	0.10	0.02	0.51
No. of Doc Visits	0.07	0.25	0.26	-0.10	-0.01	0.01	0.53	0.06	0.49
No. of Nights Nursing Home Stay	0.05	0.10	0.67	-0.02	-.0.05	0.04	0.19	0.01	0.38
Ever Smoked	0.02	-0.03	0.04	0.25	-0.04	0.07	0.01	0.79	0.35
Drinks Alcohol	-0.07	0.02	-0.09	-0.26	-0.06	-0.12	0.06	0.65	0.46
Does Vigorous Physical Activity	0.01	-0.09	0.07	0.15	-0.20	-0.56	0.07	-0.19	0.54
Has Stress At Work	-0.01	0.03	-0.01	-0.31	0.57	-0.05	-0.23	-0.07	0.40
Job Requires Physical Effort	-0.02	0.03	-0.13	0.50	0.01	0.25	-0.07	-0.09	0.57
Average Age of Parents	-0.01	-0.02	-0.01	0.01	0.02	0.01	-0.05	0.01	0.11

Note: Information on chronic conditions and specific mental problems are based on medical diagnosis in previous two years and intake of prescription drug. The shaded cells show the health variables that load heavily in the respective factors. The sign of the respective variables in each factor indicates how they weigh in that factor. A positive sign indicates a positive relation between the variable and the factor while a negative sign indicates an inverse relationship. Each factor is named keeping in mind the variables that load heavily in them. These factors are orthogonal to each other which means they are not correlated to each other.

Table A.5: Competing Risk Model (Weibull Distribution) for Initial Exit from Full-time Employment (With Frailty)

HEALTH OUTCOMES	ALL RISKS		COMPETING RISKS									
			Exit Route 1: Complete Retirement		Exit Route 2: Partial Retirement		Exit Route 3: Part-time Work		Exit Route 4: Unemployment		Exit Route 5: Disability and Not in Labor force	
	Hazard Ratio	Absolute Effect	Hazard Ratio	Absolute Effect	Hazard Ratio	Absolute Effect	Hazard Ratio	Absolute Effect	Hazard Ratio	Absolute Effect	Hazard Ratio	Absolute Effect
Latent Health Stock:	0.812***	13.34%	0.785***	6.62%	1.106	4.26%	0.971	2.46%	0.971	0.72%	0.425***	0.36%
Self Reported Health	(0.042)		(0.047)		(0.120)		(0.147)		(0.244)		(0.078	
Factor 1: Chronic Conditions	0.960	15.78%	1.004	8.48%	0.945	3.65%	0.892	2.26%	0.793	0.59%	0.939	0.80%
	(0.029)		(0.035)		(0.056)		(0.079)		(0.123)		(0.084)	
Factor 2: Functional Limitation	1.126***	18.51%	1.146***	9.67%	1.084	4.18%	0.916	2.32%	1.225	0.91%	1.278***	1.08%
	(0.026)		(0.032)		(0.057		(0.074)		(0.158)		(0.078)	
Factor 3: Hospital Stay	1.016	16.70%	1.010	8.52%	0.931	3.59%	1.099	2.79%	1.061	0.79%	1.135	0.97%
	(0.027)		(0.032)		(0.054)		(0.082)		(0.145)		(0.092)	
Factor 4: Cognitive Functioning	1.089**	17.90%	1.092	9.23%	1.003	3.87%	1.146	2.91%	0.770	0.57%	1.338***	1.13%
	(0.038)		(0.047)		(0.069		(0.116)		(0.135)		(0.151)	
Factor 5: Depression	1.112***	18.28%	1.096***	9.25%	0.916	3.54%	1.207**	3.07%	1.262*	0.93%	1.329	1.13%
	(0.029)		(0.036		(0.054)		(0.093)		(0.161)		(0.094)	
Factor 6: Physical Exercise	0.963	15.83%	0.963	8.12%	1.069	4.12%	0.999	2.54%	0.714**	0.53%	1.035	0.88%
	(0.026)		(0.031)		(0.056		(0.078)		(0.099)		(0.087)	
Factor 7: Cancer	0.915***	15.04%	0.915***	7.72%	0.929	3.59%	0.845**	2.14%	0.775*	0.57%	0.919	0.79%
	(0.025)		(0.030)		(0.049)		(0.070)		(0.119)		(0.081)	
Factor 8: Life Style	1.142***	18.78%	1.154***	9.74%	1.172***	4.52%	1.068	2.71%	0.995	0.74%	1.059	0.90%
	(0.034)		(0.040)		(0.066)		(0.089)		(0.138)		(0.098)	
# Spells	4128		4128		4128		4128		4128		4128	
# Exits	3272		1680		769		505		148		170	
Avg. Spell Length	4.82		4.82		4.82		4.82		4.82		4.82	
Avg. Exit Probability	16.44%		8.44%		3.86%		2.54%		0.74%		0.85%	

Note: Table A.5 uses data from the Health and Retirement Study (1992-2010) for a proportional hazard model in competing risks framework for individuals who were at least 50 years old and worked full-time in 1992. The baseline hazard is estimate using the Weibull distribution where the shape parameter p is approximately close to 2. It reports hazard ratios and absolute effect for the initial exits scenario. Absolute Effect= Hazard Ratio * Average Exit Probability via that route, where average exit probability= no. of exits/(no. of spells * average spell length). The dependent variable is duration of full-time employment while the independent variables are health outcome indices constructed by principal component factor analysis. The competing risks in this framework are the different routes of exit from full-time employment. The combined risk model has also been reported in panel A. Controlling for the socio-demographic variables reported in Table 1.2. Also controlling occupations, the wave dummies, census regions, expected mortality and work and health status of spouse, which has not been reported here. Further, it controls for frailty (unobserved heterogeneity). The standard errors are reported in parentheses and *** p<0.01, ** p<0.05, * p<0.1. Likelihood ratio test rejects the null hypothesis of No Frailty such that there is statistically significant level of unobserved heterogeneity in the data. The shared frailty is estimated assuming an underlying gamma distribution.

Table A.6: Competing Risk Model (Cox Proportional Hazard) for Multiple Exit from Full-time Employment

HEALTH OUTCOMES	**ALL RISKS**		**COMPETING RISKS**									
			Exit Route 1: Complete Retirement		**Exit Route 2: Partial Retirement**		**Exit Route 3: Part-time Work**		**Exit Route 4: Unemployment**		**Exit Route 5: Disability and Not in Labor force**	
	Hazard Ratio	**Absolute Effect**	**Hazard Ratio**	**Absolute Effect**	**Hazard Ratio**	**Absolute Effect**	**Hazard Ratio**	**Absolute Effect**	**Hazard Ratio**	**Absolute Effect**	**Hazard Ratio**	**Absolute Effect**
Latent Health Stock: Self Reported Health	0.843***	14.28%	0.778***	6.49%	1.080	4.64%	0.970	2.66%	0.933	0.65%	0.511***	0.43%
	(0.031)		(0.040)		(0.089)		(0.089)		(0.164)		(0.064)	
Factor 1: Chronic Conditions	1.038*	17.58%	1.065**	8.89%	1.051	4.51%	1.018	2.79%	0.889	0.62%	1.001	0.85%
	(0.022)		(0.033)		(0.047)		(0.054)		(0.091)		(0.083)	
Factor 2: Functional Limitation	1.065***	18.04%	1.111***	9.28%	1.024	4.40%	0.898**	2.46%	1.112	0.77%	1.200***	1.02%
	(0.019)		(0.027)		(0.044)		(0.049)		(0.095)		(0.069)	
Factor 3: Hospital Stay	1.016	17.21%	1.016	8.48%	0.933	4.01%	1.089*	2.98%	1.024	0.71%	1.159	0.98%
	(0.020)		(0.028)		(0.043)		(0.050)		(0.100)		(0.088)	
Factor 4: Cognitive Functioning	1.039	17.60%	1.053	8.79%	0.943	4.05%	1.026	2.81%	0.892	0.62%	1.307**	1.11%
	(0.027)		(0.040)		(0.051)		(0.063)		(0.102)		(0.139)	
Factor 5: Depression	1.059***	17.93%	1.064**	8.88%	0.931	4.00%	1.028	2.81%	1.166*	0.81%	1.256***	1.07%
	(0.021)		(0.031)		(0.042)		(0.047)		(0.095)		(0.079)	
Factor 6: Physical Exercise	1.019	17.26%	0.970	8.10%	1.094**	4.69%	1.073	2.94%	0.889	0.62%	1.123	0.96%
	(0.020)		(0.028)		(0.045)		(0.053)		(0.084)		(0.091)	
Factor 7: Cancer	0.984	16.66%	0.964	8.04%	0.983	4.22%	1.009	2.76%	0.958	0.67%	0.981	0.84%
	(0.018)		(0.026)		(0.038)		(0.046)		(0.095)		(0.073)	
Factor 8: Life Style	1.041*	17.64%	1.083***	9.04%	1.053	4.52%	0.989	2.71%	1.020	0.71%	0.959	0.82%
	(0.021)		(0.033)		(0.044)		(0.048)		(0.096)		(0.082)	
# Spells	4868		4868		4868		4868		4868		4868	
# Exits	3817		1883		968		617		157		192	
Avg. Spell Length	4.63		4.63		4.63		4.63		4.63		4.63	
Avg. Exit Probability	16.94%		8.35%		4.29%		2.74%		0.70%		0.85%	

Note: Table A.6 uses data from the Health and Retirement Study (1992-2010) for a proportional hazard model in competing risks framework for individuals who were at least 50 years old and worked full-time in 1992. The underlying baseline hazard is assumed not to have any parametric functional form It reports hazard ratios and absolute effect for the multiple exits scenario. Absolute Effect= Hazard Ratio * Average Exit Probability via that route, where average exit probability= no. of exits/(no. of spells * average spell length). The dependent variable is duration of full-time employment while the independent variables are health outcome indices constructed by principal component factor analysis. The competing risks in this framework are the different routes of exit from full-time employment. The combined risk model has also been reported in panel A. Controlling for the socio-demographic variables reported in Table 1.2. Also controlling occupations, the wave dummies, census regions, expected mortality and work and health status of spouse, which has not been reported here. Further, it controls for frailty (unobserved heterogeneity). The standard errors are reported in parentheses and *** p<0.01, ** p<0.05, * p<0.1.Likelihood ratio test rejects the null hypothesis of No Frailty such that there is statistically significant level of unobserved heterogeneity in the data. The shared frailty is estimated assuming an underlying gamma distribution.

Table A.7: Competing Risk Model for Exiting Fulltime Employment Due to Health Changes Allowing for Multiple Spells of Employment (With Frailty)

HEALTH CHANGE	**(A) ALL RISKS**		**(B) COMPETING RISKS**									
			Exit Route 1: Complete Retirement		**Exit Route 2: Partial Retirement**		**Exit Route 3: Part-time Work**		**Exit Route 4: Unemployment**		**Exit Route 5: Disability and Not in Labor force**	
	Hazard Ratio	**Absolute Effect**	**Hazard Ratio**	**Absolute Effect**	**Hazard Ratio**	**Absolute Effect**	**Hazard Ratio**	**Absolute Effect**	**Hazard Ratio**	**Absolute Effect**	**Hazard Ratio**	**Absolute Effect**
Change in Overall Self-Reported Health	1.231*** (0.041)	20.85%	1.212*** (0.060)	10.12%	1.114 (0.080)	4.78%	1.125 (0.102)	2.86%	1.187 (0.189)	0.87%	1.099*** (0.222)	0.93%
Change in Count of Functional Limitations	1.095 (0.103)	18.54%	1.169 (0.146)	9.76%	1.146 (0.282	5.31%	1.099 (0.273)	2.80%	1.371 (0.425)	1.01%	1.631** (0.291)	1.39%
Change in Count of Chronic Conditions	1.109** (0.059)	18.79%	1.085** (0.078)	9.06%	1.029 (0.105)	4.41%	1.194 (0.121)	3.03%	1.250 (0.234)	0.93%	1.354* (0.201)	1.15%
Onset of Memory Related Disease	1.101* (0.112)	18.65%	1.127* (0.153)	9.41%	1.067 (0.257)	4.57%	0.585 (0.311)	1.49%	1.384 (0.517)	1.02%	1.761* (0.406)	1.50%
# Spells	4,868		4,868		4,868		4,868		4,868		4,868	
# Exits	3,817		1,883		968		505		148		170	
Avg. spell length (in 2 year waves)	4.63		4.63		4.63		4.82		4.82		4.82	
Avg. exit probability	16.94%		8.35%		4.29%		2.54%		0.74%		0.85%	

Note: Health changes between waves are accounted for self-reported over all health (individuals who report health being same as previous wave to either much better or much worse in next wave; increase in count of ADL difficulties (functional limitations) and chronic conditions from 0 in previous wave to 5 or reverse and onset of memory related diseases between waves. Controlling for the socio-demographic variables reported in Table 1.2. Also controlling occupations, the wave dummies, census regions, expected mortality and work and health status of spouse, which has not been reported here. Unobserved heterogeneity has also been controlled. The standard errors are reported in parentheses and *** p<0.01, ** p<0.05, * p<0.

A.8 Technical Notes

Duration Analysis and Parametric Hazard Models

The most important component in duration analysis is the hazard rate H(t), which is defined as the probability of occurrence of an event at time t_i, provided the subject has survived till the period t_i. Hence, duration analysis is very effective is modeling the history of events (like exit from full-time work or retirement). The hazard rate is "time dependent" which means it can increase, decrease or remain constant over time. This leads to the primary logic for parametric hazard models.

The parametric hazard models help to model the baseline hazard assuming that it follows a certain shape (or distribution). The different parametric models are based varied assumptions about the shape of the hazard rate or nature of its time dependency.

The most important parametric hazard models are: Exponential (which assumes that hazard rate is flat), Weibull (monotonic hazard rate), Log normal and Log logistic (which assume non-monotonic hazard). In these models the hazard rate is not only time dependent but also depends on the characteristics of the individuals under consideration (X). The specification of the hazard rate for the different parametric models is as follows:

(1) Exponential

The hazard rate is given as –

$H(t, X) = \lambda_i = \exp(X_i \beta)$, which implies that the hazard rate is constant over time.

(2) Weibull

The hazard rate is given as-

$H(t, X) = \lambda p(\lambda t)^{p-1}$, where $\lambda_i = \exp(X_i \beta)$ and λ is the location parameter while p is the shape parameter.

The Weibull model assumes non-constant but monotonically increasing or decreasing hazard rate. If the estimated p>1 then the hazard rate is monotonically increasing and if p< 1 then the hazard rate is monotonically decreasing. However if the estimated p= 1 then the hazard rate is constant or in other words the Exponential model is nested in Weibull.

(3) Log logistic

The hazard rate is characterized as-

H (t,X) = $\frac{\lambda^{\frac{1}{\gamma}} t^{[\frac{1}{\gamma}-1]}}{\gamma\left[1+(\lambda t)^{\frac{1}{\gamma}}\right]}$, where, λ_i = - exp (X_i β) and λ is the location parameter while γ is the shape parameter.

If the estimated γ < 1 then the hazard rate first rises and then falls, while estimated γ >= 1 implies that the hazard rate is falling.

(4) Log normal

The hazard rate is γ given as- given as-

H(t) = $\frac{\frac{1}{t\sigma\sqrt{2\pi}}\exp\left[\frac{-1}{2\sigma^2}\{\ln(t)-\mu\}^2\right]}{1-\Phi\left\{\frac{\ln(t)-\mu}{\sigma}\right\}}$, where Φ is the standard normal cdf and $\mu = X\beta$

The hazard rate is similar to the Log logistic distribution for the case of estimated γ < 1, first increase and then decrease.

(5) Generalized Gamma

This is a complex specification where the density function is given as-

f(t) = $\frac{\lambda\rho(\pi t)^{\rho\kappa-1}\exp(-\lambda t)^{\rho}}{\Gamma(\kappa)}$, where λ_i = - exp (X_i β) and ρ and κ are the two shape parameters.

If $\kappa = 1$, then Weibull is implied

If $\kappa = \rho = 1$, then exponential is implied.

If $\kappa = 0$, then log normal is implied

If $\rho = 1$ then gamma is implied.

It is possible to test for each in standard software.

The choice of incorrect parametric distribution can lead to imprecise estimates of the hazard rate while choosing the correct distribution leads to more precise estimates than semi parametric or non-parametric models. The choice of a model is most commonly based on the Akaike Information Criterion (AIC).

AIC= -2(log likelihood) + 2(c + p + 1), where c is the number of model covariates and p is the number of model ancillary parameters.

The hazard models may be grouped into proportional hazard (PH) models and AFT (Accelerated Failure Time) hazard models based on their interpretation. Exponential and Weibull can be in PH and AFT specifications while the others are only in AFT. In the PH specification the hazard rate is multiplicative function of the baseline hazard while the AFT specification assumes a linear relationship between the log of the latent survival time T and the individual characteristics X. For proportional hazard models, the hazard rate would increase or decrease based on the covariates related to each unit. Due to the proportional hazard property the absolute differences in X would imply the proportionate difference in the hazard rate at each time period.

APPENDIX B: ESSAY 2

ADDITIONAL TABLES

Table B.1: Sample Mean of Health Outcomes for Different Category of Workers and Retirees

HEALTH OUTCOMES	**Full Sample**	**Pre-Retirement Always Healthy**	**Pre-Retirement Always Healthy and Consistently insured**	**Does Not Spend 10 Minutes on Own Health**	**Health Won't Limit Work in Next 10 Years**	**Early Retirement Window**	**Satisfied in Retirement**	**Moderately Satisfied in Retirement**	**Not at All Satisfied in Retirement**
Poor Health	0.053	0.007	0.006	0.036	0.015	0.477	0.045	0.116	0.343
Activity of Daily Living Difficulty	0.045	0.005	0.005	0.025	0.016	0.014	0.038	0.103	0.263
Chronic Conditions	0.780	0.173	0.185	0.753	0.604	0.697	0.876	0.922	0.953
Heart Disease	0.165	0.033	0.035	0.159	0.079	0.120	0.259	0.315	0.383
High Blood Pressure	0.446	0.076	0.081	0.451	0.339	0.400	0.560	0.618	0.656
Diabetes	0.143	0.019	0.020	0.136	0.091	0.113	0.171	0.241	0.313
Lung Disease	0.073	0.029	0.031	0.102	0.062	0.063	0.159	0.162	0.156
Cancer	0.099	0.010	0.011	0.065	0.034	0.034	0.076	0.137	0.229
Stroke	0.042	0.008	0.009	0.039	0.021	0.025	0.061	0.104	0.178
Arthritis	0.476	0.081	0.086	0.474	0.325	0.402	0.576	0.672	0.726
Obesity	0.283	0.130	0.128	0.279	0.251	0.288	0.260	0.328	0.379
Psychological Problem	0.124	0.007	0.008	0.084	0.067	0.051	0.084	0.180	0.348
Out of Pocket Medical Expenditure	0.1139	0.060	0.062	0.098	0.080	0.072	0.138	0.167	0.229
Depression (CESD)	1.260	0.700	0.661	1.139	0.961	0.950	0.956	1.906	3.679
Cognition	23.874	23.982	24.051	23.721	23.873	25.217	22.540	21.405	19.926
No. of Nights at Hospital	1.624	0.124	0.128	0.297	0.183	0.232	0.400	0.617	1.082
No. of Doctor Visits	8.543	4.311	4.504	7.740	5.822	7.503	9.868	12.474	18.956
Observations		9,209	8,497	6,088	27,422	1,643	19,384	11,046	2,354
		10.50%	**9.60%**	**6.90%**	**31.00%**	**2.00%**	**42.34%**	**24.12%**	**5.14%**

Note: Table reports the weighted sample means for the health outcomes in a sample of individuals who were 50-80 years of age who are the drawn from the Health and Retirement Study (1992-2010). The difference in means between the samples is statistically significant.

Table B.2: Average Marginal Effect of Complete Retirement on Stroke

HEALTH OUTCOME	**Without FE**	**With FE**
Stroke	0.0234***	0.0211***
	(0.0083)	(0.0063)
	55.71%	50.23%
Observations	3,112	3,112

Note: Sample of risk averse individuals who have never reported smoking or drinking and do not have any history of high blood pressure, heart disease, diabetes, hypertension and obesity.
Observations are reported in number of person-waves. The percentage figures are relative to full-sample mean.
Standard Errors in Parentheses Statistical significance is defined as ***p< 0.01, **p< 0.05, * p< 0.1. The linear probability regression has controlled for the socio-demographic variables, spousal characteristics, last reported occupation and census divisions.

Table B.3: Average Marginal Effect of Complete Retirement in Samples Stratified by Retirement Satisfaction

HEALTH OUTCOMES	Retirement Satisfying		Retirement Moderately Satisfying		Retirement Not at all Satisfying	
	Without FE	With FE	Without FE	With FE	Without FE	With FE
	(1)	(2)	(1)	(2)	(1)	(2)
Poor Health	0.0048 (0.1230)	0.0014 (0.129)	0.0254 (0.0211)	0.0214 (0.0307)	0.0783*** (0.0481)	0.0776*** (0.0330)
Activity of Daily Living Difficulty	0.0293*** (0.0584)	0.00569*** (0.0113)	0.0580 (0.0461)	0.0342 (0.1011)	0.0973** (0.1051)	0.0577** (0.0280)
Chronic Conditions	0.0600 (0.0515)	0.0183 (0.0489)	0.0666 (0.0409)	0.0259 (0.0376)	0.0776 (0.0574)	0.0515 (0.0830)
Heart Disease	0.0857** (0.0647)	0.0280** (0.0386)	0.0783** (0.0706)	0.0442** (0.0327)	0.177*** (0.1341)	0.127*** (0.0838)
High Blood Pressure	0.0253 (0.0603)	0.0169 (0.0737)	0.0284** (0.0735)	0.0138** (0.0631)	0.197*** (0.1760)	0.157*** (0.1300)
Diabetes	-0.0180 (0.0397)	-0.0371* (0.0214)	0.1010** (0.0487)	0.0805 (0.0904)	0.2310* (0.1310)	0.0312 (0.0585)
Lung Disease	-0.0301 (0.0289)	-0.0391 (0.0667)	0.0291 (0.0424)	0.0324 (0.0712)	0.2680** (0.1161)	0.4570*** (0.0532)
Cancer	-0.1010** (0.0404)	-0.1030 (0.1061)	0.0246 (0.0450)	-0.0041 (0.0374)	-0.0504 (0.105)	0.0220 (0.0495)
Stroke	0.0152 (0.0281)	0.0899 (0.0638)	-0.0064 (0.0362)	-0.0285*** (0.0081)	0.1200 (0.1021)	-0.0050 (0.0453)
Arthritis	0.0048 (0.0520)	-0.0360 (0.0351)	0.0220 (0.0538)	0.0125 (0.0774)	0.1370 (0.1271)	-0.0627 (0.0618)
Obesity	-0.0443 (0.0522)	-0.1340** (0.0652)	-0.0856 (0.0614)	-0.0472 (0.0386)	-0.0843 (0.1420)	-0.0252 (0.0897)
Psychological Problem	0.0176 (0.0431)	0.00168 (0.0127)	0.0832 (0.0638)	0.0365 (0.0620)	0.524* (0.7882)	0.324* (0.1862)
Out of Pocket Medical Expenditure	-0.123* (0.0669)	-0.109** (0.0547)	0.00737 (0.0558)	0.00268 (0.0639)	0.209** (0.133)	0.193** (0.0911)
Depression	0.020*** (0.2971)	0.0110*** (0.2230)	0.946*** (0.3380)	0.800*** (0.4190)	0.524*** (0.7881)	0.247*** (1.0431)
Cognition	-0.232 (0.8060)	-0.103 (0.765)	-0.921 (0.8860)	-0.515 (0.7953)	-0.988 (1.3550)	-0.746 (2.000)
No. of Nights at Hospital	-0.0594 (0.1540)	-0.249 (0.2221)	-0.0332 (0.2600)	-0.1310 (0.2842)	0.1870 (1.0241)	0.6570 (0.6232)
No. of Doctor Visits	0.845 (1.7000)	0.766 (2.424)	3.268** (1.7981)	3.041** (3.7872)	8.123*** (11.1200)	5.601*** (11.1600)
Observations	19,384	19,384	11,046	11,046	2,354	2,354

Note: Each cell reports the marginal effect of complete retirement on the respective health outcomes, from separate regressions (linear probability model). The samples are stratified by self-reported retirement satisfaction. All samples are limited to individuals 50-80 years of age. Standard Errors in Parentheses Statistical significance is defined as ***p< 0.01, **p< 0.05, * p< 0.1. Observations for all specification are reported in number of person-waves. All regressions have been controlled for the socio-demographic variables, spousal characteristics, last reported occupation, year and census divisions.

Table B.4: Complete Retirement First Stage Regression (Linear Probability Model)

Instruments	**Complete Retirement**	
	Estimate	**S.E**
Age 62	0.0614***	0.0048
Age 70	0.142***	0.0032
Spouse Retirement Status	0.115***	0.0202
Subjective Expectation of Retirement Standard of Living	0.0488***	0.0072
Defined Benefit Pension	0.0131	0.0039
Work Environment Unfavorable for Older Workers	0.0175***	0.0037

Note: Standard Errors in Parentheses Statistical significance is defined as ***p< 0.01, **p< 0.05, * p< 0.

Table B.5: Test for Weak Instruments

HEALTH OUTCOMES	**Age Specific Retirement Incentive (1)**	**Spouse Retirement Status (2)**	**Subjective Expectation about Post Retirement Standard of Living (3)**	**Pension Plan Type (4)**	**Work Environment (5)**
F statistic	105.27	48.74	10.45	13.08	29.27
Stock and Yogo Weak IV Test Critical Values					
2SLS Size of Nominal 5% Wald test	10 % = 22.30 15 % = 12.83 20 % = 9.54 25 % = 7.80	10 % = 19.93 15 % = 11.59 20 % = 8.75 25 % = 7.25	10 % = 16.38 15 % = 8.96 20 % = 6.66 25 % = 5.53	10 % = 16.38 15 % = 8.96 20 % = 6.66 25 % = 5.53	10 % = 16.38 15 % = 8.96 20 % = 6.66 25 % = 5.53

Note: The table shows the F-statistic (identical to first stage F-statistics, since only one endogenous regressor-complete retirement is included). The lower panel shows the critical values for the Stock and Yogo identification of weak IV test.

Table B.6: Average Marginal Effect of Complete Retirement in the First Post-Retirement Wave

HEALTH OUTCOMES	**Full Sample With Individual FE**	**Healthy Pre-Retirement Sample With Individual FE**
ADL Difficulty	0.0275**	0.00250
	(0.0129)	(0.00586)
Chronic Conditions	0.0085	0.136*
	(0.0222)	(0.0730)
Diabetes	0.0256	0.0791*
	(0.0173)	(0.0435)
High Blood Pressure	0.0292	0.0508
	(0.0221)	(0.0483)
Heart Disease	0.0161	0.0113
	(0.0160)	(0.0393)
Lung Disease	0.0058	0.0308
	(0.0140)	(0.0196)
Cancer	0.0050	0.0279
	(0.0145)	(0.0285)
Stroke	0.0182	0.0226
	(0.0119)	(0.0194)
Arthritis	0.0196	0.105**
	(0.0219)	(0.0516)
Psychological Problem	0.0312**	0.0256
	(0.0137)	(0.0168)
Depression	0.036	0.0731
	(0.122)	(0.163)
Cognition	-0.4960	-0.7920
	(0.324)	(0.816)
Out of Pocket Medical Expenditure	0.0337	0.0493
	(0.0237)	(0.0462)
No. of Nights Hospital Stay	0.141**	0.126
	(0.0637)	(0.0956)
No. of Doctor Visits	0.299**	0.9790
	(0.920)	(0.889)
Observations	10,384	1,109

Note: Each cell reports the marginal effect of complete retirement on the respective health outcomes, from separate regressions (linear model). All samples are limited to individuals 50-80 years of age. Standard Errors in Parentheses Statistical significance is defined as ***p< 0.01, **p< 0.05, * p< 0.1. Observations for all specification are reported in number of person-waves. All regressions have been controlled for the socio-demographic variables, spousal characteristics, last reported occupation, year and census divisions.

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VITA

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