DISENTANGLING THE COMPLEX RELATIONSHIP BETWEEN HEALTH, HEALTH INSURANCE AND RETIREMENT

A Dissertation

by

HAO ZHANG

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Chair of Committee,	Robert L. Ohsfeldt
Committee Members,	Michael A. Morrisey
	Hye-Chung Kum
	Hongwei Zhao
Head of Department,	Michael A. Morrisey

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ABSTRACT

Retirement is a major life event which involves changes in the identity, relationship, social status and life style for the retirees. It has a complex relationship with health and health insurance which has not been clearly understood. In this study, we dealt with three topics regarding retirement that are not thoroughly investigated in the current literature. In the first topic, we performed a systematic literature review on the relationship between employer-provided retiree health coverage and early retirement. Nine articles were included in the final analyses and all of them found a significant positive relationship. We also found strong evidence that retiree health coverage has a larger impact on early retirement at the ages of 60 to 64, and among women.

In the second topic, we investigated the impact of Affordable Care Act (ACA) on retirement decisions among the near-elderly population. By using a difference-in-differences model, we compared the early retirement rates between respondents obtaining health coverage from health exchanges and Medicaid expansion, with the rest of the study sample. We found that ACA increased the probability of early retirement by around 15% in the former group. The results are robust to a number of robustness checks. In addition, we found the effect of ACA remains statistically significant when the study sample is restricted to the uninsured population, whose retirement incentives were believed not to be affected by ACA.

In the third topic, we employed a fixed effect instrumental variable model to test the relationship between retirement and health, with a special focus on job

characteristics. The results showed that retirement had an immediate preserving effect on self-rated health, ADLs, IADLs and mental health. This effect was accompanied by a significant adverse effect that accelerated health decline after retirement, which may finally undermine the immediate preserving effect with age. We found limited evidence that job characteristics were associated with health consequences of retirement.

DEDICATION

I would like to dedicate this paper to my son Albert. I'm sorry I could not spend more time with you after you were born, and I hope you will grow up happily and healthy.

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All other work conducted for the dissertation was completed by the student independently.

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1. INTRODUCTION

1.1. Significance

With baby boomers beginning to attain the age of 65 in 2011, the labor force behavior of the near-elderly and the health status of retirees have received much attention. There is growing concern about the sustainability of the Medicare program due to rising health care cost and prolonged life expectancy. In addition, the growth in the population aging into eligibility for Medicare and Social Security programs requires increasing government health care expenditures in the future. Another source of concern is the lagging rate of growth among young workers contributing tax revenue needed to fund these programs for older retirees. With expenditures increasing faster than tax revenues, it is estimated that the hospital insurance (HI) trust fund, also known as Part A of Medicare, will become insolvent in 2026.

One of the aims of the passage of 2010 Affordable Care Act (ACA) was to provide a solution to this financial predicament. However, there has been an ongoing debate about the prospect for ACA to provide relief. Some suggest that ACA would save government spending through new taxes and cost savings from enhanced efficiency from payment system reform (including reduced Medicare Advantage payments), and a reduced need for Medicaid disproportionate share hospital (DSH) payments. Others contend that payment system reforms and new taxes will not be able to cover the growth in expenditures, so that ACA will exacerbate the challenges to sustainability for Medicare.

While these debates exist, the financial outcome of ACA could be more complex and depend on a number of factors. On one hand, ACA has the potential to substantially encourage early retirement and labor force participation rate of the near elderly, which in turn results in a shrinking labor force. On the other hand, people going through retirement may either go through

a decline or an improvement of health, which would in turn influence their health care expenditures. Both statements have seen mixed evidence in the current literature, and have not been clearly understood. In this dissertation research, we will examine these relationships, and the results would disentangle the complex relationships between retirement, health insurance and health, and provide policy implications as well. Specifically, the current paper consists of three independent studies, and I will give an introduction to the background of these studies in the following section

1.2. Background

1.2.1. Topic 1: Employer-Provided Retiree Health Insurance (RHI) and Early Retirement

As the baby boomers begin to retire from 2011, the population of the elderly adults in US is growing rapidly. It is projected that older adults 65 and over will outnumber children under 18 for the first time in U.S. history around 2035. (Vespa, 2018) The fast growing number of older adults brings an increasingly heavy financial burden on government spending for programs for older adults. The 2018 Medicare Trustees report forecasted that Medicare's costs under current law will rise steadily from their current level of 3.7 percent of GDP in 2017 to 5.9 percent in 2042. In addition to the Medicare-eligible populations, the number of the near-elderly in US is also growing rapidly and has received much attention in recent years, especially for their labor force participation and retirement behavior.

The retirement behavior of the older population is an important consideration for public policy. On one hand, the life expectancy of US population has increased from 70.81 in 1970 to 78.69 in 2016, (World Bank, 2018), which substantially increased Medicare and social security expenditures. On the other hand, the birth rate in US has declined from 3.65 in 1960 to 1.8 in 2016. (World Bank, 2018). There will be increasingly fewer younger adults to compensate for

elderly's exit from the labor force, thus creating a shortfall of labor supply. In response, the US government has raised the full retirement age from 65 steadily to 67, encouraging people to work for a longer time. However, the effectiveness of this policy change depends on a number of factors that have an impact on the early retirement decisions of the near-elderly.

Researchers have proposed RHI as an important factor that promotes early retirement among the near-elderly. Due to the fact that the near-elderly are too young to be eligible for Medicare, affordable health insurance would be an important issue when they consider retirement, especially given that the cost of health care and health insurance is likely to continue to rise after retirement. (Dieleman, 2016) For the vast majority of the near elderly population who do not have retiree coverage, early retirement means losing affordable group coverage. The prospect of facing high premiums in the insurance market, especially for those with preexisting conditions, discourages them from retirement or changing jobs, which has been labeled the "job lock" problem. (Cutler, 2002)

Employers are the primary source of RHI for the near elderly, but the proportion offering coverage has been declining in recent years. (Fronstin & Adams, 2012; McCormack et al, 2002) According to Kaiser Family Foundation (2018), 18% of large firms that offer health benefits to their workers offer RHI, a significantly lower percentage than in recent years. In the meantime, labor force participation rate for the near elderly was increasing in the past decades. (Toossi, 2012) Some researchers proposed RHI acts as an income transfer, since their premiums are far less than their true health care costs, which created a financial incentive for them to retire early. (Buchmueller, Johnson & Lo Sasso, 2006; Smeeding, 1987)

This topic is particularly relevant for the health care reforms which have taken place in US in the past years. The 2010 Affordable Care Act (ACA), in particular, contains provisions

that promote universal health coverage and lowered the cost of health insurance outside employment for the near elderly population. These provisions are expected to produce similar effects of the employer-sponsored RHI, encourage early retirement and reduce the labor force participation rate among the near elderly population. The outcome of this study would also shed light on the labor market outcomes for other health care reforms that delinked health insurance coverage with employment, such as the 2006 Massachusetts health care reform and the Department of Veterans Affairs health system expansion in the 1990s.

Indeed, previous studies generally implied that the retirement behavior of the near-elderly population was correlated with their insurance status. (Colie, 2015) Older adults with RHI were found to have higher early retirement rate compared with their counterparts who do not have retiree health insurance. However, the outcomes differ in magnitude, sometimes even in direction, and the target populations are different, thus warrant a study to systematically review the studies and synthesize the results.

Specifically, the first topic of this study would be a systematic literature review, in which we will examine previous studies focusing on the relationship between employer-sponsored RHI and early retirement among the near elderly population and evaluate the quality of these studies. The aim is to provide a better understanding by combining the current knowledge so far in this topic. To my best knowledge, this is the first study that tries to summarize findings on this topic from the current literature.

1.2.2. Topic 2: ACA and Early Retirement

Many individuals in the United States retire before their full Social Security retirement age, but one of the most important considerations in early retirement decisions is the prospect of the loss of employer-sponsored health insurance (ESHI) associated with retirement at an age

before health insurance coverage through Medicare begins (at the age of 65). A number of previous studies have found a positive relationship between the availability of employer-sponsored RHI coverage and early retirement (Blau & Gilleskie, 2001, 2006, 2008; Fitzpatrick, 2014; Gruber & Madrian, 1995; Karoly & Rogowski, 1994; Madrian, Burtless, & Gruber, 1994; Nyce, Schieber, Shoven, Slavov, & Wise, 2013; Robinson & Clark, 2010; Shoven & Slavov, 2014; Strumpf, 2010). However, in recent years, fewer and fewer employers are providing retiree health insurance, which creates an incentive to continue working to avoid losing ESHI(Buchmueller, Johnson & Lo Sasso, 2006).

The Affordable Care Act (ACA) was the most significant health care reform since the passage of Medicare and Medicaid in 1965, and greatly changed the health insurance market in the US. Several provisions of ACA have the potential to impact the retirement behavior of the older population. One such provision is the requirement foreach state to have a health insurance exchange, from which consumers who do not have health insurance coverage can compare and buy individual health insurance plans. Compared to purchasing equivalent insurance coverage as an individual, obtaining health insurance through an exchange has the potential to lower premiums for health plans through pooling risk, standardized plan comparisons, and consumer assistance programs. Plans offered through health insurance exchanges must meet the minimum health benefit requirement specified under ACA, and companies offering insurance cannot deny purchase or renewal of health coverage because of pre-existing health conditions (guaranteed issue and guaranteed renewal). Further, ACA requires exchange plans to use adjusted community rating, which mandates that the premium charged for the older population could not exceed three times the premium charged to a younger enrollee for the same plan. Finally, ACA provides premium subsidies in the form of tax credits provided to people in households with

income levels falling between 100% and 400% federal poverty level (FPL), in addition to income-related subsidies to offset out-of-pocket expenditures associated with required cost-sharing in exchanged-purchased health plans. These features of ACA substantially reduce the cost of health insurance coverage for lower income households.

Another important feature of ACA was the expansion of eligibility for Medicaid program participation to cover all adults with income below 138% of FPL. Previously, aside from low-income pregnant women, very few non-disabled adults were eligible for Medicaid coverage. Due to a Supreme Court decision, the Medicaid expansion requirement specified in ACA was altered to become optional for states. As of January 2019, a total of 14 states had opted not to expand Medicaid coverage.

Overall, provisions in ACA provide the older population with the potential for access to lower-cost health plans not tied to employment, compared to the pre-ACA period, which in turn may have the potential to encourage early retirement.

1.2.3. Health Outcomes of Retirement

With the prolonged life expectancy and growth in the size of the older population, retirement has always been an important public policy issue. Especially in the US, as increasing numbers of baby boomers approach retirement age, government spending on Social Security and Medicare is projected to rise rapidly. (Keehan et al, 2008; Lee & Skinner, 1999) The government has steadily increased the full retirement age, from 65 for those born on 1937 or earlier, to 67 for those born on 1960 or later. However, one critical issue is how retirement affects health. The relationship between retirement and health has an important impact on health care spending as well as government spending, thus deserves special attention.

Retirement is a complicated transition in one's life cycle and may impact health in many different ways. For example, the "identity crisis theory" viewed retirement as a stressful life event, and is detrimental to the health of the retirees. (Bosse et al., 1991; Salokangas and Joukamaa, 1991; Minkler, 1981) According to this theory, occupation and work related identity assumed by an individual represents the basic role in the society, and retirement is a psychosocial process of identity transition. Loss of the identities would lead to decreased self-respect and social status, which in turn leads to isolation and decline in life satisfaction and happiness. (Atchley, 1975; Palmore et al., 1984)

In contrast to the "identity crisis theory", the "identity continuity theory" argues that older adults try to maintain a continuity of lifestyle by adapting strategies that are connected to their past experiences. (Atchley, 1989) As the restrictiveness of the social structure declines, the ability of old people to maintain and continue desired social roles increases. (Covey, 1981) Individuals who manage the transition between work and retirement will be able to preserve a positive self-image as well as a belief to be in control over their lives. (Palmore et al., 1984) As a result, older people who can maintain their social roles are less likely to experience the adverse health effects associated with retirement.

Grossman (1972), on the other hand, developed a health demand model which treats health as an investment and a consumption good at the same time. In this model, health is a durable capital good which is inherited and depreciates over time, and people can invest in health by medical care purchases and other input. Health generates utility to an individual from two ways, indirectly as a capital which produces health time for market and non-market activities, and directly as a consumption good people derive pleasure from due to absence of illness. This leads to the following utility model:

$$U = u(H_t \varphi_t, Z_t)$$

where φ_t is the service flow per unit of stock of health (H_t) and $H_t \varphi_t$ is the total service flow provided by health stock at time t. Z_t contains health and other consumption goods. A rational person tries to maximize this utility function subject to time and income constraints. As a result, the person would equate his marginal product of health capital to the marginal cost of health investment. In the case of retirement, how the marginal benefit changes remains indeterminant. On one hand, the wage rate lowers, leading to decreased marginal benefit. On the other hand, the utility generated from the consumption aspect of health increases, leading to an increased marginal benefit. Depending on the magnitude of these two aspects, an individual may either choose to increase or decrease his health stock.

Retirement has been shown to be correlated with a number of health outcomes, including physical health, mental health and health behaviors. In a systematic review of 22 longitudinal studies, van der Heide et al (2016) found strong evidence for retirement having a beneficial effect on mental health, while contradictory evidence was found for retirement having an effect on perceived general health and physical health. Zantinge et al. (2013) reviewed existing studies on changes in smoking, alcohol consumption, physical activity and dietary habits during the transition to retirement. They found both favorable and unfavorable lifestyle changes, depending on the type of lifestyle, lifestyle indicator and the personal situation of the retiree.

Previous studies implied that the health outcome of retirement was dependent on a variety of social and institutional factors, which would bias the estimator if we fail to control them in the model. For example, Chung et al (2009) found that physical activity decreased with retirement for physically demanding jobs, but increased for retirees from sedentary jobs. Van Zon et al. (2016) found that increase in limitations of mobility functions after retirement was

modified by wealth and social-economic positions. However, while lots of studies have focused on the effects of retirement on health, the role of these factors were largely ignored in the current literature.

Among these factors, job characteristics have been put forward as an important variable in studying retirement and health. However, while the relationship between retirement and health has attracted much attention, few studies tried to investigate how this relationship might be influenced by one's job. And those who do produced contradictory outcomes. For example, some previous studies have shown that job stress is associated with a larger gain in self-reported health (van den Bogaard, Henkens, & Kalmijn,2016), while others suggested job stress is associated with poorer physical function and mental health (Walker-Bone et al, 2018), as well as episodic memory (Andel et al, 2015). Previous study has also found that high complexity in the job contributes to delayed deterioration of cognitive functioning after retirement. (Kajitani, Sakata & McKenzie, 2017)

1.3. Dissertation Outline

Section 2 is a systematic review of previous studies on the impact of employer-sponsored retiree coverage on the near elderly population's early retirement decisions. ACA contains several provisions that would allow the near elderly population to obtain low-cost health insurance outside employment. Therefore the results from the systematic review would shed light on the potential impact of ACA on the early retirement behavior of the near elderly.

In Section 3, we directly estimate the impact of ACA on the probability of retirement before 65 among the near-elderly population by employing a difference-in-differences model. Specifically, using the data from the Health and Retirement Study (HRS), we propose to identify those people who obtained health coverage through the Medicaid expansions and health

insurance exchanges created by ACA, and define those people as the treatment group. The rest of the sample serves as the control group. We then compare the differences in the early retirement trend between these two groups.

In Section 4, we investigate the health outcomes of retirement, also using data form HRS. We emphasize the role of job type in the model, which is missing in the current literature. To account for the endogeneity of retirement, we employ a fixed-effect instrumental variable (FE-IV) approach. FE-IV becomes a popular model to study the relationship between retirement and health in recent years, and we build a model that could estimate the impact of retirement on the immediate change of health as well as the change in the rate of health change in the same time.

Section 5 is a concluding Section that summarizes the findings from the three studies and implications for future research.

2. EMPLOYER-SPONSORED RETIREE HEALTH INSURANCE AND EARLY RETIREMENT: A SYSTEMATIC REVIEW

2.1. Literature Search

Five databases, including Medline, Business Source Ultimate, CINAHL, Econlit and Embase were searched for peer-reviewed articles. Search strategies in each database were listed in table 2.1. Inclusion criteria are: 1) the study should focus on the relationship between employer-sponsored retiree health insurance and early retirement, thus we excluded articles that focused on public health insurance or health care reforms; 2) the study design should use quasi-experimental methods, and we excluded review articles and simulation studies; 3) only articles in English language are included; 4) we further restrict the publication date of the studies to those after 2000. We further checked the references of all included studies for relevant article.

2.1.1. Data Extraction and Quality Evaluation

The study characteristics extracted were target population (country, setting, age, sex), sample size, follow-up duration, definition of early retirement, study design, and key findings. The quality of included articles was assessed using the JBI Critical Appraisal Checklist for Quasi-Experimental Studies (Tufanaru et al, 2017). See table 2.2 for the criteria for the assessment of quality. For each item in table 2.2, a study will get 1 point if it meets the criterion, and 0 if not. The total quality score would be the sum of these scores, and we define a study to be of high quality if it gets a score of 6 or above, i.e., 2/3 of the total score.

Table 2.1 Terms Used for the Database Search in Medline, Business Source Ultimate, CINAHL, Econlit and Embase

Database	Search Strategy
Medline	1. exp Insurance, Health/ 2. (health adj1 insurance).ti,ab. 3. or/1-2 4. exp RETIREMENT/ 5. (retire* or retiring).ti,ab. 6. or/4-5 7. 3 and 6 8. limit 7 to yr="2000 -Current"
Business Source Ultimate	(DE "RETIREMENT" OR DE "BABY boomer retirement" OR DE "CIVIL service retirement" OR DE "DELAYED retirement" OR DE "DISABILITY retirement" OR DE "EARLY retirement" OR DE "EXECUTIVE retirement" OR DE "FARMER retirement" OR DE "GENERATION X retirement" OR DE "INVOLUNTARY retirement" OR DE "MANDATORY retirement" OR DE "PHASED retirement" OR DE "RETIREMENT of Millennials" OR DE "RETIREMENT of legislators" OR DE "RETIREMENT of police" OR DE "RETIREMENT of women" OR DE "TEACHER retirement" OR TI (retire* or retiring) OR AB (retire* or retiring)) AND (DE "HEALTH insurance" OR DE "CRITICAL illness insurance" OR DE "DEFINED contribution health benefit plans" OR DE "DENTAL insurance" OR DE "DEPENDENT coverage in health insurance" OR DE "EMPLOYER-sponsored health insurance" OR DE "GOVERNMENT employees' health insurance" OR DE "GROUP health insurance" OR DE "LABOR unions & health insurance" OR DE "LIFE insurance -- Disability benefits" OR DE "MAJOR medical insurance" OR DE "MANAGED care plans (Medical care)" OR DE "MANAGED competition (Medical care)" OR DE "MEDICAID" OR DE "MEDICAL payments insurance" OR DE "MEDICARE" OR DE "MENTAL health insurance" OR DE "NATIONAL health insurance" OR DE "OPTOMETRIC services insurance" OR DE "PHARMACEUTICAL services insurance" OR DE "PREEXISTING medical condition coverage" OR DE "SINGLE-payer health care" OR DE "WORKERS' compensation" OR TI (health n1 insurance) OR AB (health n1 insurance))
CINAHL	(MH "Insurance, Health+") OR TI health n1 insurance OR AB health n1 insurance AND (MH "Retirement") OR (TI (retire* or retiring)) OR (AB (retire* or retiring))
Econlit	(TI health n1 insurance OR AB health n1 insurance) AND (TI (retire* or retiring)) OR (AB (retire* or retiring))
Embase	1. exp health insurance/ 2. (health adj1 insurance).ti,ab. 3. or/1-2 4. exp retirement/ 5. (retire* or retiring).ti,ab. 6. or/4-5 7. 3 and 6 8. exp decision making/ 9. decision*.ti,ab. 10. or/8-9 11. 7 and 10 12. limit 11 to yr="2000 -Current"

Table 2.2 Criteria List for Assessment of the Quality of Included Studies

1. Is it clear in the study what is the 'cause' and what is the 'effect' (i.e. there is no confusion about which variable comes first)?
2. Were the participants included in any comparisons similar?
3. Were the participants included in any comparisons receiving similar treatment/care, other than the exposure or intervention of interest?
4. Was there a control group?
5. Were there multiple measurements of the outcome?
6. Was follow up complete and if not, were differences between groups in terms of their follow up adequately described and analyzed?
7. Were the outcomes of participants included in any comparisons measured in the same way?
8. Were outcomes measured in a reliable way?
9. Was appropriate statistical analysis used?

2.2. Data Synthesis

If studies show enough homogeneity in terms of study population, statistical analysis strategy, and outcome measure, then we synthesize the data from these studies using meta-analysis. If, on the other hand, the studies included in this systematic review are not similar, then we will use narrative synthesis to summarize the existing research.

2.3. Results

2.3.1. Study Selection

The initial database search strategy yielded 2122 articles in total, of which 891 came from Medline, 370 came from CINAHL, 123 came from Econlit, 556 came from Business Source Ultimate, and 182 came from Embase. After removing duplicates, there were a lot of 1584 left. After reading titles and abstracts, 41 articles were included for eligibility assessment.

Three additional articles were included for eligibility assessment through the references of included articles. Thirty-four articles were determined not to meet the inclusion criteria through full article review. The reasons for exclusion included: insurance type not RHI (n=12), outcome variables is retirement in general or joint retirement of couples (n= 6), RHI is only treated as a covariate in the study (n=11), study methodology used structural models and simulation (n=4) or literature review (n=1). See figure 2.1.

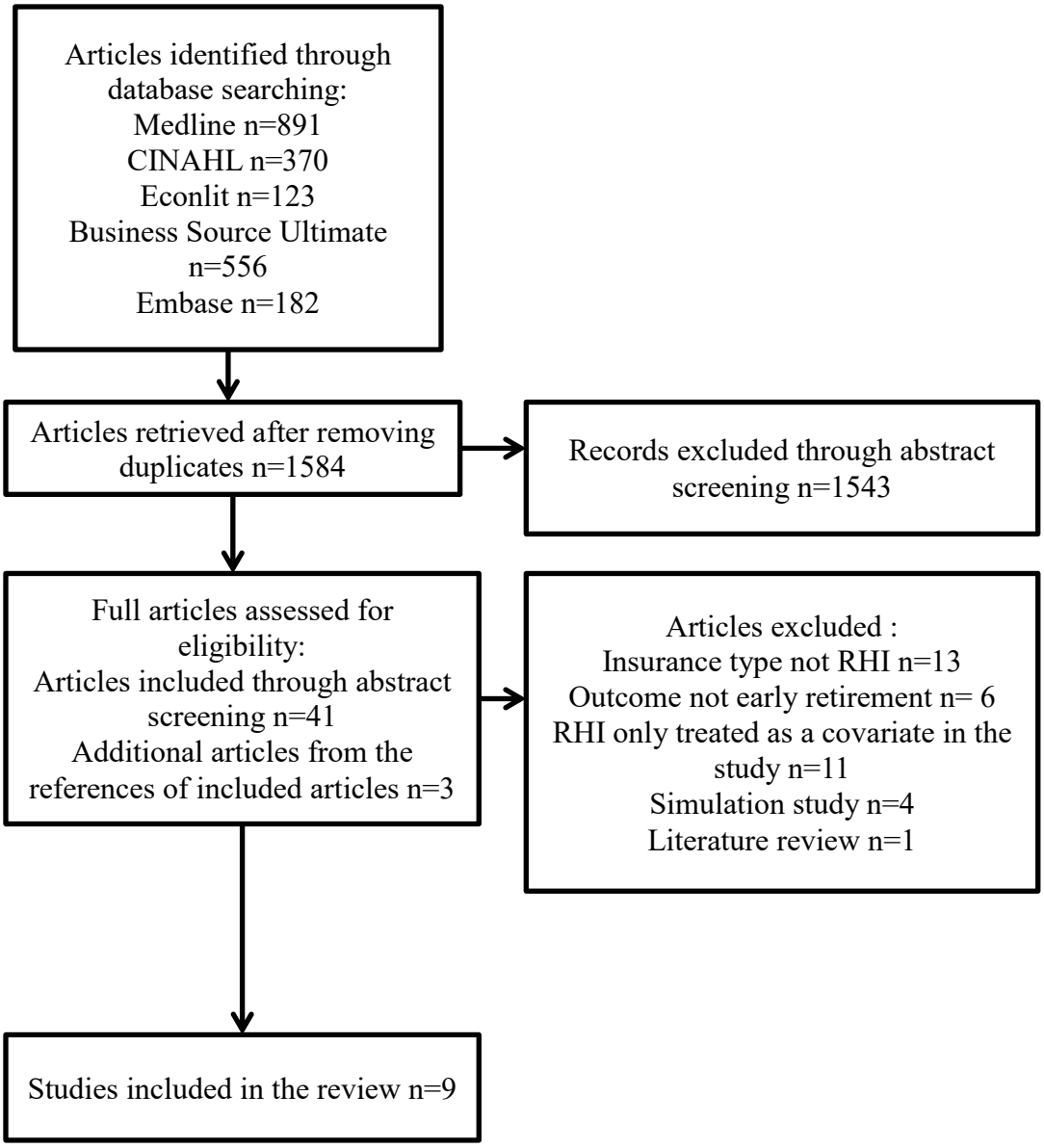

Figure 2.1 Flow Chart of Paper Selection for the Systematic Review

2.3.2. Characteristics of Included Studies

The characteristics of the 9 included studies were summarized in Table 2.3. Among them, 3 focused solely on near-elderly male and 1 on near-elderly female, while others included both genders. Two studies paid special attention to employees from public sectors, and another study

employed data of the employees from 64 firms, which were clients of Towers Watson (TW), a consulting company that provides service with design and administration of employee benefit programs. All 9 studies utilized panel data from a secondary source. Four studies did not provide the number of respondents in the sample, and those who did varied from 2,102 to 6,445. All 9 studies reported number of observations (person-wave/person-year) in their studies, which ranged from 5,276 to 405,139. Follow-up duration ranged from 2 years to 14 years. Seven out of 9 studies utilized data from the Health and Retirement Study (HRS), 1 used data from Teacher Service Record (TSR) from Illinois Public Schools (IPS), and the last one used administrative data from TW.

Table 2.3 Characteristics of Included Studies

Articles	Target Population	Number of Respondents	Number of Observations	Follow up Duration	Data Source
Blau & Gilleskie(2001)	Near-elderly male	4,080	11,317	1992-1994	HRS
Fitzpatrick (2014)	Public school employees in Illinois	Not given	405,139	1971-1992	TSR
Kapur & Rogowski (2011)	Near-elderly female	Not given	24,484	1992-2006	HRS
Marton& Woodbury (2013)	Near-elderly male	3,150	9,657	1992-2004	HRS
Nyce et al. (2003)	Employees of TW clients	Not given	302,871	2006-2009	TW
Robinson & Clark (2010)	Near-elderly adults	2,102	6,065	1992-2006	HRS
Rogowski & Karoly (2000)	Near-elderly male	2,638	5,276	1992-1996	HRS
Shoven & Slavov (2014)	Public sector employees	Not given	16,516	Not given	HRS
Strumpf (2010)	Near-elderly adults	6,445	19,904	1992-2002	HRS

Note: HRS-Health and Retirement Study; TSR - Teacher Service Record; TW - Towers Watson company

Table 2.4 Quality Assessment of the Included Studies

Criterion	Blau & Gilleskie (2001)	Fitzpatrick (2014)	Kapur & Rogowski (2011)	Marton& Woodbury (2013)	Nyce et al. (2003)	Robinson & Clark (2010)	Rogowski & Karoly (2000)	Shoven & Slavov (2014)	Strumpf (2010)
1	√	√	√	√	√	√	√	√	√
2	×	×	√	×	×	√	×	×	×
3	×	√	×	×	×	×	×	×	×
4	√	√	√	√	√	√	√	√	√
5	√	√	√	√	√	√	√	√	√
6	×	√	√	√	√	√	×	×	√
7	√	√	√	√	√	√	√	√	√
8	×	√	√	√	√	√	√	√	√
9	√	×	√	√	√	√	√	√	√
Quality	Low	High	High	High	High	High	High	High	High

Note: Please refer to Table 2.2 for the items of the quality assessment criteria list

Table 2.5 Data Synthesis of Included Studies

Article	Definition of retirement	Age Cutoff Point	Study Design	Control Group	Outcome measure	Main findings
Blau & Gilleskie(2001)	Transition from employed to unemployed	65	Multinomial logistic model	Those with no RHI	Regression Coefficients	RHI is associated with an initial lower labor force exit rate, but the negative effect of RHI on labor force exit diminishes with age and becomes positive by age 57.
Fitzpatrick (2014)	Termination of employment with IPS	65	Difference-in-differences	Those not eligible for TRHIP	Marginal Probability	TRHIP encourage a 5.0 percentage point increase in retirement rate between ages 55 to 59, but insignificant between 60 and 64.
Kapur & Rogowski (2011)	A transition in the labor force status from full-time work to self-reported part or full retirement	65	Probit model	Those with ESHI but no RHI	Marginal Probability	RHI encouraged early retirement by 3.0 percentage points among women in dual-earner couples, 4.8 percentage points among single women, 4.7 percentage points among men in dual-earner couples, and not significant among single men.
Marton & Woodbury (2013)	Self-reported retirement, or in one of the following categories: part-time work, unemployment, partial retirement, disability, or not in the labor force	65	Probit model	Those with ESHI but no RDI	Marginal Probability	RHI encouraged early retirement by an increase of 3.4 percentage points among near-elderly men. By examining age-specific effect, the authors found workers with RHI were less likely to retire at age 50 and 51, but more likely to retire at 60 and 61.

Table 2.5 Continued

Article	Definition of retirement	Age Cutoff Point	Study Design	Control Group	Outcome measure	Main findings
Nyce et al. (2003)	Not being employed by the firm in the current period, conditional on being employed in the previous period	65	Probit model	Those with no RDI	Marginal Probability	RDI encouraged retirement at almost all ages between 55 and 64, but has its strongest effects at ages 62 and 63, resulting in a 3.7 and 5.1 percentage point increase.
Robinson & Clark (2010)	No longer working full time on his/her career job	65	Cox-proportional hazard model	Those with no RHI	Hazard Ratio	Individuals with RHI are 21.2% more likely to disengage from a career job than an individual without RHI (1.212, $p<=0.05$); the effect for male is 1.162 ($p>0.1$) and for female 1.317 ($p<=0.05$)
Rogowski & Karoly (2000)	A transition from full-time work to being out of the labor force and retired as self-reported	65	Probit model	Those with ESHI but no RHI	Marginal Probability	RDI encouraged early retirement by a 10.9 percentage points increase among near elderly male

Table 2.5 Continued

Article	Definition of retirement	Age Cutoff Point	Study Design	Control Group	Outcome measure	Main findings
Shoven & Slavov (2014)	Job exit	65	Logit model	Those with ESHI but no RHI	Marginal Probability	RDI encouraged early retirement by 5.1 percentage points increase among state and local employees between the ages of 60 and 64, but insignificant between 55 and 59; RDI encouraged early retirement by 1.6% among private employees between the ages of 55 and 59, and 3.3% between 60 and 64; no significant relationship was found among federal and military employees.
Strumpf (2010)	full-time retirement	65	Probit model	Those with no RHI	Marginal Probability	RHI encouraged an increase of 6.98 percentage points in early retirement in the full sample, 6.53 among male, and 7.30 among female.

Note: RHI- Retiree Health Insurance; ESHI-Employer Sponsored Health Insurance; TRHIP- Teacher Retiree Health Insurance Program; IPS- Illinois Public Schools.

2.3.3. Quality Evaluation

Table 2.4 shows the quality evaluation of included papers using the JBI Critical Appraisal Checklist for Quasi-Experimental Studies. Eight out of the 9 included papers met the definition of high quality papers. However, it is noteworthy that most studies fail to meet two specific criteria, i.e., similarity between the treatment and control groups, and receiving similar treatment/care, other than the exposure or intervention of interest.

2.3.4. Data Synthesis

Table 2.5 shows the definition of early retirement, study design, choice of control groups, outcome measure and main findings of included studies. Due to different study designs and target population, summarizing the studies using meta-analysis is not feasible. Thus we used narrative synthesis instead. As expected, all 9 studies found a significant positive relationship between RHI and early retirement, but the effect sizes differed depending on a variety of factors. In addition, though all 9 papers used retirement before 65 as cutoff age for early retirement due to the existence of Medicare, the definition for retirement varied. We will summarize these findings below.

2.3.4.1. Definition of Retirement

Due to the difficulty in tracing individual's employment history and the ambiguity of the boundary between retirement and employment, the definitions of retirement varied greatly between different studies. In addition, different surveys captured retirement status of the respondents using a different set of questions, which may bring more variety. However, based on the 9 included studies, the definition of retirement generally fell into 3 categories.

The first category, common in studies utilizing HRS data including Kapur and Rogowski (2011), Rogowski and Karoly (2000) and Strumpf (2010), used self-reported retirement status as the outcome variable. This definition was only concerned about the respondents' subjective opinion rather than the realistic employment status. For example, a respondent can consider himself retired and in the same time being unemployed, part-time employed or self-employed. This definition is quite homogeneous across different studies, with the only divergence in whether part-time retirement should be considered retirement.

The second category, including Fitzpatrick (2014), Nyce et al. (2003), Robinson and Clark (2010) and Shoven and Slavov (2014), used disengagement from a certain full-time job as the outcome variable. This category saw some variations in the definition between different studies, depending on the research purpose. For example, Fitzpatrick (2014) defined retirement to be termination of employment with IPS, regardless of whether the respondents got employed elsewhere. Nyce et al. (2003), similarly defined retirement to be termination of employment with specific firms. The authors treated retirement and job turnover synonymously in the study. On the other hand, Robinson and Clark (2010) defined retirement to be disengagement from a career job, where they defined a career job to be any job that an individual has worked on a full-time basis for at least 10 years and a person is considered a fulltime employee if they spend 30 or more hours per week at work.

The third category, including Blau and Gilleskie (2001) and Marton and Woodbury (2013), is an extension or hybrid of the first two categories. For example,

Marton and Woodbury (2013) used a broad definition of retirement, which included self-reported retirement, and if a respondent reported to be in one of the following categories: part-time work, unemployment, partial retirement, disability, or not in the labor force.

2.3.4.2. Age

Five out of the 9 included studies examined the age effect in the relationship between RHI and early retirement, which shows age is an important modifier. However, the results showed some mixed evidence. Both Blau and Gilleskie (2001) and Marton and Woodbury (2013) found the RHI was associated with an initial negative effect on early retirement during the early 50s, but this effect became positive with respondents aging. By introducing an interaction term of RHI and age, Blau and Gilleskie (2001) predicted that RHI began to have a positive effect on retirement starting from age 57. Marton and Woodbury (2013) used a model that allowed estimating the effect of RHI at each age. They found similar results except that the effect reached its maximum at age 60 and 61 but diminished afterwards.

Nyce et al. (2003) and Shoven and Slavov (2014) produced similar results, though they did not find an initial negative effect, possibly due to the fact that they restricted their samples to be those over 55 at baseline. Both studies found that RHI had positive effect on early retirement at ages 55-64, while Nyce et al. (2003) reported that RHI had the strongest effects at ages 62 and 63, and Shoven and Slavov (2014) found a larger effect on early retirement at the age band 60-64 in comparison to the age band 55-59.

In contrast to the above 4 studies, Fitzpatrick (2014) reported that RHI was associated with a 5.0 percentage point increase in retirement rate between ages 55 to 59, but failed to find any significant effect between the ages 60 and 64.

Overall, the current evidence suggests that RHI has limited, if any, effect on retirement before age 60, and a significant effect on retirement at ages 60 to 64.

2.3.4.3. Gender

Six out of the 9 studies included observations of both genders in the study sample, while the other 3 studies used solely male respondents. For these 6 studies, 3 of them treated gender as a covariate to model the intrinsic differences in the retirement rate between male and female, but assumed RHI had the same effect on retirement rate on both genders. The other 3 studies modeled the relationship differently for male and female, and their results were quite consistent when we compared the effect size for both genders.

Kapur and Rogowski (2011) found similar effect size of RHI among dual-earner male and female, but they did not find any significant relationship among single men and in the meantime they found a significant positive relationship among single women. Similarly, Robinson and Clark (2010) found RHI has a significant effect on the hazard of disengagement from a career job among women, but not among men. Strumpf (2010), on the other hand, found RHI encouraged early retirement both among male and female, but the effect size was larger among female.

Overall, while the evidence is mixed in terms of whether RHI really has an impact on the retirement decisions among male, all these three studies found that RHI has a larger and significant impact among female.

2.3.4.4. Other Factors

There are some other factors included in the 9 studies that might modify the relationship between RHI and early retirement as well. Kapur and Rogowski (2011) compared the impact of RHI on early retirement rates between dual-earner couples and single respondents. They found that RHI has a larger impact for single women compared to women in dual-earner couples, while the impact is larger among men in in dual-earner couples compared to single men. Shoven and Slavov (2014) found that RHI raised the probability of stopping work for state and local employees and private sector employees, but not among federal and military employees. They also found that the effect size was larger among state and local employees compared to private employees. Nyce et al. (2003) found that respondents who possessed RHI with subsidy of 50% or more from the employer had a much higher early retirement rate compared to those without RHI and those with RHI but the subsidy was under 50%. However, since only one study was available for each factor, the evidence was limited.

2.4. Discussion

Although a number of studies found a positive relationship between RHI and early retirement using data from the end of the past century (Gruber & Madrian, 1994; Gruber & Madrian, 1995; Gustman & Steinmeier, 1994; Karoly & Rogowski, 1994; Madrian, Burtless & Gruber, 1994), there is need for studies in this field to assess

whether recent economic trends and changes in the health care system have altered the relationship observed in the past. This is especially true with the introduction of ACA, which has the potential to sever the connection between health insurance and employment. In addition, no prior studies have provided a systematic review to summarize the findings from literature on this topic. To fill this gap, in this study, we reviewed the current literature that investigates the relationship between RHI and early retirement since 2000. We found compelling evidence that RHI was positively related with early retirement, as well as a number of factors that could modify this relationship.

A common feature of studies included in this systematic review is that, due to the nature of the study question, almost all relied on data from a secondary source. Secondary data that were not collected for a specific study may contain different kinds of biases. (Bevan et al, 2013; Terris, Litaker & Koroukian, 2007; Schneeweiss, 2007) A prospective cohort study might provide a remedy, and HRS is a longitudinal tracking a respondent through the period before and after retirement. But the issue of loss to follow up during the study period creates another threat to the validity of the research. During the quality assessment of the included studies, we concluded that most of the studies could not ensure the comparability between the treatment and control groups, neither could they ensure both groups received similar treatment other than RHI. To control for potential biases from the data, researchers employed a number of statistical models, sample selection procedures and sensitivity analyses in these studies, which in turn resulted in highly heterogeneous studies. For this reason, we used narrative synthesis instead of Meta-analysis to summarize the findings.

An key element of heterogeneity across studies was the definition of retirement. We summarized the definitions into three categories, which have been described above. None of these measures were perfect, and they all bear some shortcomings. For example, the self-reported retirement status may not represent an individual's true labor force status, and disengagement from a career job ignores the possibility of job changing. Also, currently there is no agreed measure of retirement and no measure dominates. Indeed, Denton and Spencer (2009) reviewed the measures of retirement that have been proposed, and summarized them into five categories: non-participation or reduced participation in the labor force, receipt of pension income, end-of-career employment, self-assessed retirement, or combinations of those characteristics. Due to this fact, comparing the effect size of RHI on retirement between different studies is often not feasible and will produce meaningless results. As an example, Marton and Woodbury (2013) used a broad definition for retirement, which included self-reported retirement, part-time work, unemployment, partial retirement, disability, or not in the labor force, as well as a narrow definition, which only included self-reported retirement, and they consistently found that the model using the broad definition produced a larger effect size.

We found strong evidence that RHI has a small impact on early retirement before the age of 60, but a larger impact between the ages of 60 to 64. Two studies also found that RHI has an initial negative effect on early retirement during the employee's early 50s. While this may reflect the fact that employees value better health benefits, Marton and Woodbury (2013) provided another potential explanation using the agency theory of delayed payment contracts. This theory originated from Lazear (1979, 1981, 1983),

which stated that employers used RHI as a delayed payment to monitor the effort and honesty of their employees. By shifting the payment to the end of the employee's career life, the employer could reward those hardworking and honest employees with higher compensation. In this way, employees have an incentive to work hard and remain productive until they get eligible for RHI. Future studies are needed to test the validity of this theory. Another finding is that studies using flexible models to investigate the age-specific effect of RHI, including Nyce et al. (2003) and Marton and Woodbury (2013), generally found that the effect of RHI reached its maximum at ages 61 to 63, and then diminished as the age approached 65. This finding implied a non-linear relationship between age and the effect size of RHI. In reality, this may reflect the fact that the value of RHI decreases as the individuals approach the eligibility for Medicare. When an individual reaches 65 and becomes eligible for Medicare, RHI should have little effect on his/her retirement decision.

We also found that RHI has a larger effect on early retirement among women compared to men. This may reflect that women focus more on relationship in the family and take more family responsibilities than men do. For example, a number of studies have found that becoming a grandparent has a significant positive relationship with early retirement among women, but not among men. (Hochman & Lewin-Epstein, 2013; Lumsdaine & Vermeer, 2015; Van Bavel & De Winter, 2013) Another possible reason is that women value leisure time more than men do. Previous studies have found that, due to family burdens, women generally got less leisure time and lower quality as well compared to men. (Bittman & Wajcman, 2000; Mattingly & Blanchi, 2003; Shaw, 1985)

It is logical that this gender inequity may in turn increase the need for leisure time among women. However, no study was found to test this hypothesis. A third reason for RHI's large impact on retirement among women may have to do with the gender inequality at the workplace. Though women's labor force participation rate has increased a lot during the past decades, previous studies have consistently found that women got less pay than for otherwise similar male employees. (Auspurg, Hinz & Sauer; 2017; Blau & Kahn; 2007; Ridgeway, 2011) Therefore, women may have less incentive to work for pay compared to men after they become eligible for RHI.

For future researches, this study revealed several fields that few studies exist. To begin with, the studies included in this systematic review investigated several factors that may modify the relationship between RHI and early retirement, such as employment in public/private sectors, dual-earner versus single earner family, as well as employer's share of premium. However, the role of these factors could not be thoroughly investigated with only a handful of studies exist. Future studies using new datasets and methodologies could shed light in this field. Another gap in the current literature is that, while most studies aimed to investigate the provision of RHI on retirement decisions of the near-elderly population, few of them focused on the impact of RHI cost. The reason RHI could encourage early retirement is that the cost of RHI is usually much lower than buying commercial health insurance. It is reasonable to hypothesize that the effect size of RHI decreases as its cost goes up. Unfortunately, few studies exist to test this hypothesis. In addition, possibly due to lack of data, although RHI is the focus of the included studies, none of these studies tried to incorporate the characteristics and

provisions of RHI itself into the study. Without a measure of generosity of RHI plans, we bear the risk of comparing pear to apple. Future studies were needed to fill this gap.

This study also bears important implication for policymakers. The labor force participation rate of the near-elderly population has attracted much attention from the government, especially during an era when the baby boomers begin to enter their retirement age. The results from this review confirmed that health insurance is an important factor when the elderly considers retirement, and also implied that health care reforms, such as ACA, have the potential to affect the labor force behavior of the elderly population. Government could adjust the policies accordingly to avoid unwanted labor market outcomes.

2.5. Conclusion

In this systematic review, we summarized the current literature on the relationship between RHI and early retirement. The literature search from six databases, including Medline, Business Source Ultimate, CINAHL, Econlit and Embase, yielded 1584 articles, and 9 articles met the criteria and were included in this study. All 9 articles found evidence that RHI has a positive relationship with early retirement. We also found strong evidence that RHI encourage more retirement during the ages of 60 to 64, and among female respondent. We also found some evidence that the effect size of RHI differs between private and public sector employees, single respondents and those from dual-earner families, and across different percentages of premium paid by the employer.

3. AFFORDABLE CARE ACT AND EARLY RETIREMENT: EVIDENCE FROM HEALTH AND RETIREMENT STUDY

3.1. Literature Review

While ACA went into effect in 2010, the state health insurance exchanges were not in operation until 2014. Further, Medicaid expansion was not implemented until January 1, 2014 in 24 states and the District of Columbia, but was not implemented until later in 2014 in 3 states, and during 2015 in 3 additional states. For the remaining 5 that have opted to expand, Medicaid expansion was implemented in 2019 or is currently in process. Thus, these relatively recent implementation dates, coupled with lags in the availability of recent HRS data, hinders the feasibility of using HRS data for research on the relationship between ACA and early retirement. Nonetheless, several studies have already been done to investigate this issue, which we discuss briefly in this introduction.

Levy, Buchmueller, and Nikpay (2015) may be the first paper that attempted to estimate the impact of ACA on retirement among elder adults. In this study, they employed a difference-in-differences model using the monthly Current Population Survey (CPS) data from January 2005 through June 2015. They compared the retirement rate between Medicaid expansion states relative to non-expansion states, and found that there was no significant increase in retirement in 2014, either overall or in Medicare expansion states relative to non-expansion states. They also compared the fraction of older workers working part-time, and also found no statistically significant impact of ACA.

Similarly, Gustman, Steinmeier and Tabatabai (2018) applied a difference-in-differences model to HRS data to estimate the impact of ACA on retirement plans among older adults. They categorized the study sample into three subgroups: the treatment group, defined as those with health insurance at work but not in retirement (whose retirement incentives would be most influenced by ACA), and two control groups, defined as those who, before ACA: a) had ESHI both at work and in retirement; and b) had no health insurance either at work or in retirement. They compared two outcome variables: a) the retirement rate over a four-year period; and b) the expected retirement age of the survey respondents. They concluded that their analysis provided no evidence that ACA increased the propensity to retire or changed retirement expectations.

Ayyagari (2018) also used a difference-in-differences model applied to HRS data to investigate the influence of ACA on the subjective probability of continuing full-time work past age 62. Rather than directly modelling the retirement rate, he argued that people do not immediately adjust their labor supply in response to policy changes but instead slowly revise their plans about retirement at future ages over time. He compared the respondents with employer-sponsored retiree coverage to those without, and found a significant decline in the subjective probability of working past age 62 among persons without employer-sponsored retiree benefits compared to persons with retiree coverage. Other studies used different methodologies or study designs to investigate the relationship between the passage of ACA and the early retirement rate of the elder population below the age of 65. Congdon-Hohman (2018) utilized a survival time

analysis to identify the statistical relationship between ACA and the unretirement hazard rate. Unretirement was defined as retirees who "choose to return to work either on a part-time or full-time basis after fully retiring, or return to full-time work after partially retiring." His results suggested that health insurance sources play a particularly predictive role for time to unretirement among early retirees. When extrapolated to the entire US population, and the results implied that ACA may reduce the number of unretirements by 80,000 to 170,000 annually. French, Gaudecker, and Jones (2016) used a structural labor supply and retirement model that incorporated health insurance, uncertain medical costs, a savings decision, a non-negativity constraint on assets and a government-provided consumption floor. They found that the availability of health insurance encouraged early retirement of the elder population, which they concluded provided evidence that ACA had a negative effect on labor force supply within this population. Coe and Goda (2014) examined the effect of the state-level reforms that are most similar to those included in the ACA on the retirement behavior to predict the potential impact of ACA. They utilized a hazard model framework and found that the non-group health insurance reform significantly increased the hazard of exiting the labor force. Niu (2014) and Heim and Lin (2016) examined the effect of 2006 Massachusetts health reform, which shares many of the same features with ACA, on the likelihood of self-employment and early retirement decisions among the old population. Though small, both of the studies found a statistically significant positive result.

Although a handful of studies already exist on this topic, their results and conclusions are different, even contradictory. Specifically, their estimates should be

considered preliminary and provisional. None of these studies identified the population directly impacted by ACA, and many studies did not directly model the actual retirement rate, relying instead on surrogate outcome variables such as subjective retirement probability.

The aim of the current study is to identify the impact of ACA on the early retirement rate of the older population by comparing the early retirement rate between those whose insurance status were directly impacted by ACA and other respondents. This study would make the following contributions to the current knowledge. First, we will employ a difference-in-differences model comparing those whose insurance sources were directly influenced by ACA with those who were not. As a second aim, we will model the respondent's employment status directly to reveal the relationship between ACA and early retirement.

3.2. Data

The data used in the study comes from RAND Health and Retirement Study (HRS) Longitudinal File. HRS is a longitudinal household survey conducted by the Institute for Social Research at the University of Michigan. The HRS is a biennial, panel survey of a nationally representative sample of older adults above 50 years of age and their spouses. HRS provides data on a number of topics, including demographics, health, health insurance, employment history, retirement, pension and social security, and is a great resource for health services researchers.

In this study, we will restrict the study sample to be those from Early Baby Boomer (EBB) cohort (born in 1948-1953) or Mid Baby Boomer (MBB) cohort (born in

1054-1959) and use the data on wave 10 (year 2010-2011), wave 11 (year 2012-2013) and wave 12 (2014-2015). In order to investigate the early retirement rate, observations between the age of 50 and 64 during the interview in wave 12 are included in the study sample. Observations with missing values on retirement status in all three waves, Medicaid coverage in any wave, or source of private plans in wave 12 were deleted. The outcome variable in this study is retirement status, which comes from the survey question "At this time do you consider yourself to be completely retired, partly retired, or not retired at all?" In this study, we define retirement to be either completely retired or partly retired to capture the full impact of ACA.

The treatment group in this study consists of those whose insurance status was directly related with ACA, which in turn relates to two sources of insurance coverage: a) insurance purchased through state health insurance exchanges; and b) eligibility for Medicaid coverage due to Medicaid expansion. To identify these two groups, two different survey questions were used. The first is the survey question in each wave where the respondent is asked to indicate the source of the respondent's private health insurance plans. Since health exchanges were first operational on January 2014, the option of health exchange on the survey question was only available in wave 12. If the source of the respondent's private health insurance plans includes health exchange in wave 12, this respondent categorized into the treatment group.

The second question in each wave asks whether the respondent was enrolled in Medicaid. We define the respondents who attained Medicaid coverage through Medicaid expansion to be those who were not enrolled into Medicaid in wave 10 and 11, but

enrolled into Medicaid in wave 12, and categorize them into the treatment group. We use this definition because Medicaid expansion became effective January 1, 2014 in nearly all the states that have adopted the Medicaid expansion. Although it is possible that a respondent transitioned into eligibility for Medicaid in wave 12 even if he/she resides in a Medicaid non-expansion state, we believe this group to be relatively small and did not affect the results of the subsequent sensitivity analysis. We will also compare the proportion of Medicaid beneficiaries of each wave in the study sample to provide evidence for this assumption.

Observations that fall into either of the above two groups were classified as the treatment group, and all the other observations served as the control group. Treatment was considered given in wave 12, when health exchanges establishment and Medicaid expansion happened in most states. Other covariates used in the study were: social-demographic variables, including age, gender, race, marital status, years of education; and economic variables, including total household income and pension.

3.3. Statistical Analysis

We start by calculating the proportion of respondents that purchased health insurance form state health insurance exchanges and that get health coverage from Medicaid expansion. Then we compare the characteristics of the treatment and the control group. These analyses help us to get an idea about how many people's health insurance sources were affected by ACA, and which groups are more likely to be affected.

Then we will build a difference-in-differences linear probability model to investigate the relationship between ACA and retirement. We start by a simple difference-in-differences model with the model specification given by

$$y_{ij} = \alpha + \beta * wave_j + \gamma * T_i + \delta * I(wave_j = 12) * T_i + \varepsilon_{ij}$$

Where y_{ij} is a dummy variable denoting the retirement status for individual i in the jth wave, $wave_j$ represents the wave fixed effects, T_i equals 1 if the individual is in the treatment group and 0 otherwise, $I\ (wave_j = 12)$ is an indicator function which equals 1 if $wave_j$ equals 12 and 0 otherwise. Then additional covariates were entered into the model including the social-demographic variables and economic variables described above to check the robustness of the model. For all the difference-in-differences models used in this study, we cluster the error terms at the individual level.

One appealing property of difference-in-differences model is that it is permissible if other (observed or unobserved) factors lead to changes in outcomes, or if there are (observed or unobserved) differences between groups related to outcomes, as long as they affect the treatment and control group similarly. This is called the "parallel trend" assumption and is essential for identifying the treatment effect. We test the "parallel trend" assumption by plotting the trend of early retirement rate for both groups in the pre-treatment period. Considering that the MBB cohort entered the HRS survey after 2010 (which is why we used the data from wave 10 to wave 12), and only two pre-treatment periods were available, we took an alternative approach. We instead only included the EBB cohort which entered the HRS since 2004, and plot their early

retirement rate for both the treatment and control groups. If their trends are similar, it would provide us confidence that the "parallel trend" assumption is not violated. Even if the plot shows that the "parallel trend" assumption is reasonable, one would doubt the feasibility of comparing the treatment with the control group, since the control group is "heterogeneous" in the sense that it is composed of different populations, such as those with ESHI, those already covered in Medicaid and the uninsured. To address this concern and to test the robustness of the model in this study, we conducted a subgroup analysis. We only included those who were uninsured during wave 10 and wave 11 in both groups. Then we repeat the difference-in-differences models described above to this subgroup.

We then conducted two falsification tests to test whether the identifying strategy yields the correct estimates in our study. In the first falsification test, we used a "placebo treatment time" strategy. Specifically, we treated wave 11 as the time when treatment started and ignored the observations from wave 12. Then we refitted the difference-in-differences model described above using the new model setup. Since in wave 11 the observations in the treatment group are not actually treated, we did not expect to see a treatment effect and the model should yield insignificant results. In the second falsification test, we used a "placebo treatment group" strategy. In this test, we deleted observations in the original treatment group and treated observations with employer-sponsored retiree coverage in the original control group as the new treatment group and the other observations as the new control group, and then refitted the above difference-in-differences models. Since the retirement incentives of people with employer-

sponsored retiree coverage are not affected by ACA, there should be no significant treatment effects.

To further test the robustness of our model, we changed the definition of early retirees to be only those who considered themselves fully retired. With this new outcome variable, we repeated the steps described above. Since with ACA some people might turn to part-time job or self-employment rather than fully retired, we expect to see smaller but still significant treatment effects compared with the original outcome variable.

3.4. Results

The sample selection processes were shown in figure 3.1.A total of 6382 observations were included in the study sample, of which 241 get health coverage from Medicaid expansion, 143 bought health insurance form exchanges, and a total of 382 fell into the treatment group compared with 6073 in the control group. Overall, the treatment group accounted for about six percent of the total observations in the study sample.

3.4.1. Characteristics of Each Group

Compared with the control group, respondents in the treatment group were more likely to be female, non-Caucasian, unmarried, and have lower education level and total household income. Relatively few respondents were receiving pension income in both groups. The average ages of the two groups were similar. See table 3.1 for detailed information.

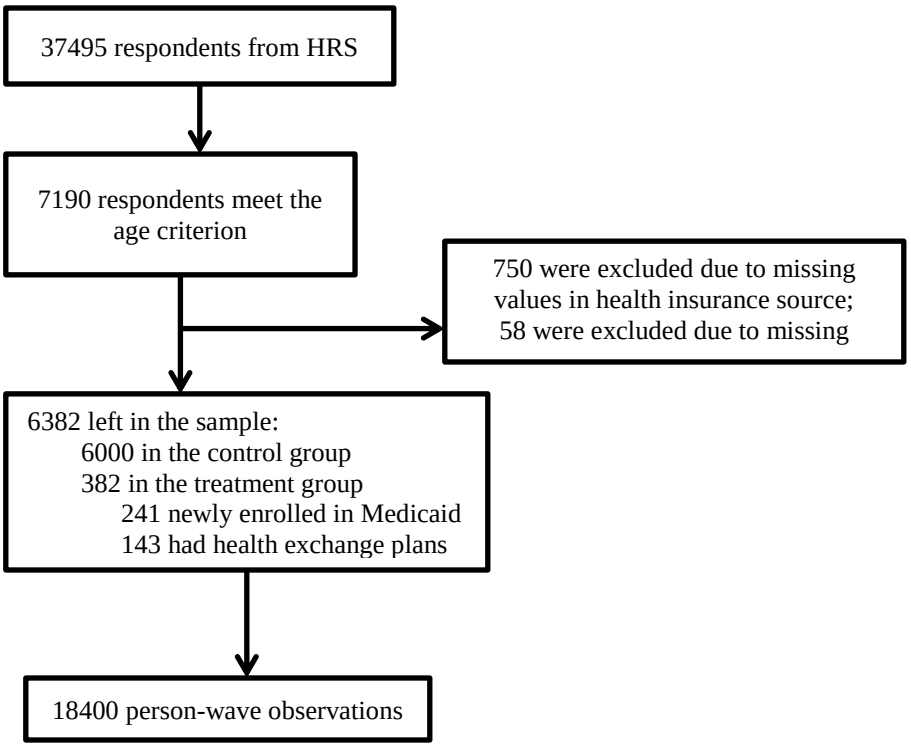

Figure 3.1 Sample Selection Processes

Table 3.1 Demographic Information of the Treatment and Control Groups

Variable		Groups	
		Control	Treatment
Gender	Male	2621 (43.68%)	157 (41.10%)
	Female	3379 (56.32%)	225 (58.90%)
Race	White	3599 (60.37%)	179 (47.35%)
	Black	1599 (26.82%)	123 (32.54%)
	Other	764 (12.81%)	76 (20.11%)
Education	Below High School	905 (15.08%)	80 (20.94%)
	GED	340 (5.67%)	32 (8.38%)
	High School	1473 (24.55%)	83 (21.73%)
	Some College	1770 (29.50%)	106 (27.75%)
	College and Above	1512 (25.20%)	81 (21.20%)
Marital Status	Married/Partnered	4161 (69.35%)	238 (62.47%)
	Unmarried	1839 (30.65%)	143 (37.53%)

Table 3.1 Continued

Variable		Groups	
		Control	Treatment
Household Income	0-<25K	1623 (27.05%)	164 (42.93%)
	25K-<50K	1228 (20.47%)	109 (28.53%)
	50K-<100K	1587 (26.45%)	75 (19.63%)
	100K and above	1562 (26.03%)	34 (8.90%)
Receiving Pension	Yes	191 (3.24%)	6 (1.59%)
	No	5709 (96.76%)	371 (98.41%)
	Age	54.70 (3.48)	55.05 (3.35)

Note: 1. Except for age, numbers are represented with N(%), and age is represented as mean(standard error); 2. Marital status, household income, pension and age were values from wave 10

3.4.2. Medicaid Enrollment

The Medicaid enrollment increased from 9.34% in 2010, 9.95% in 2012, to 12.66% in 2014. The jump of enrollment rate from 2012 to 2014 may largely be due to Medicaid expansion in some states. Also, for the EBB cohort, the Medicaid enrollment increased from 8.48% in 2010, 9.18% in 2012, to 11.96% in 2014, while the rates for the MBB cohort are 9.98%, 10.53%, 13.19% respectively. If we take the enrollment rate from 2010 to 2012 as the normal fluctuation in the absence of ACA, we see it is quite small compared with the effect of Medicaid expansion, which provides support for our definition of the treatment group in the current study. Figure 3.2 depicts the Medicaid enrollment rate for the EBB cohort, MBB cohort and both.

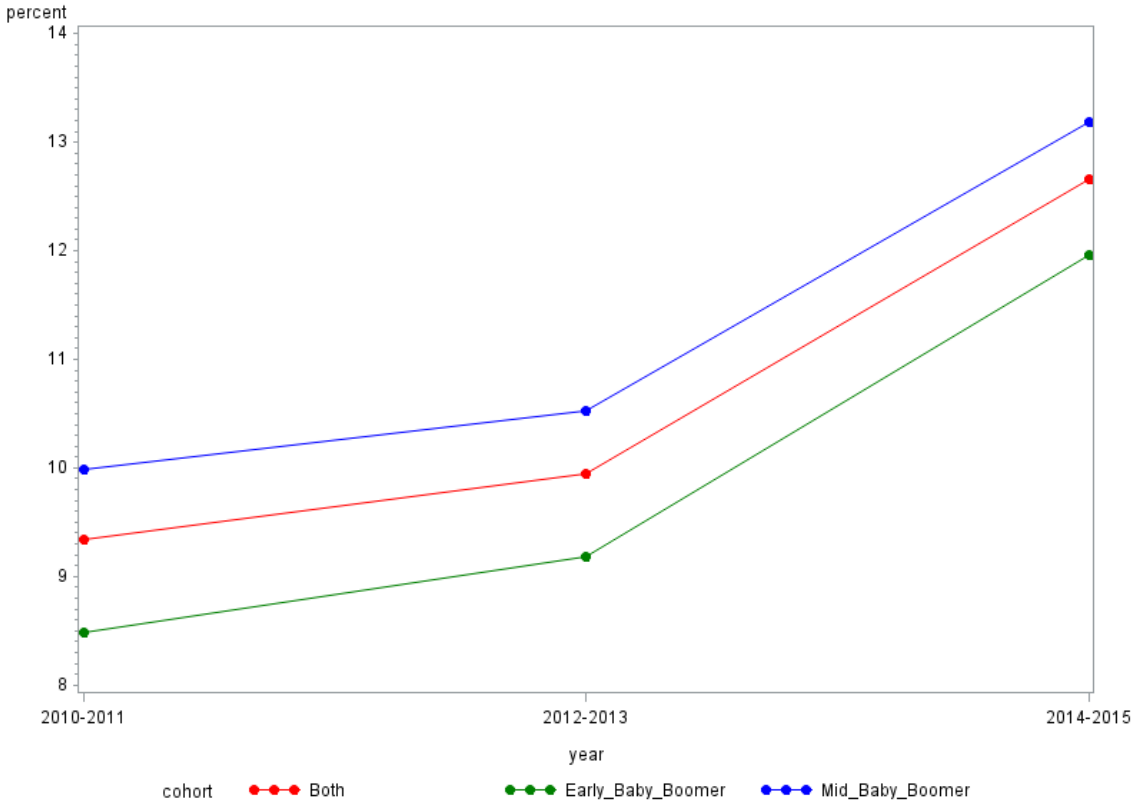

Figure 3.2 Medicaid Enrollment of Each Wave

3.4.3. Early Retirement Rate

We then calculate the retirement rate for both groups of the three waves. For the treatment group, the retirement rates for wave 10, wave 11 and wave 12 were 19.01%, 27.00%, and 47.73% respectively. For the control group, the retirement rates for wave 10, wave 11 and wave 12 were 19.95%, 26.11%, and 33.21% respectively. From the first view, the early retirement rates of the two groups were quite similar for the pre-treatment periods, while that of the treatment group was much higher than the control group in the

post-treatment period, providing preliminary evidence for the impact of ACA on early retirement of the US older population. See figure 3.3.

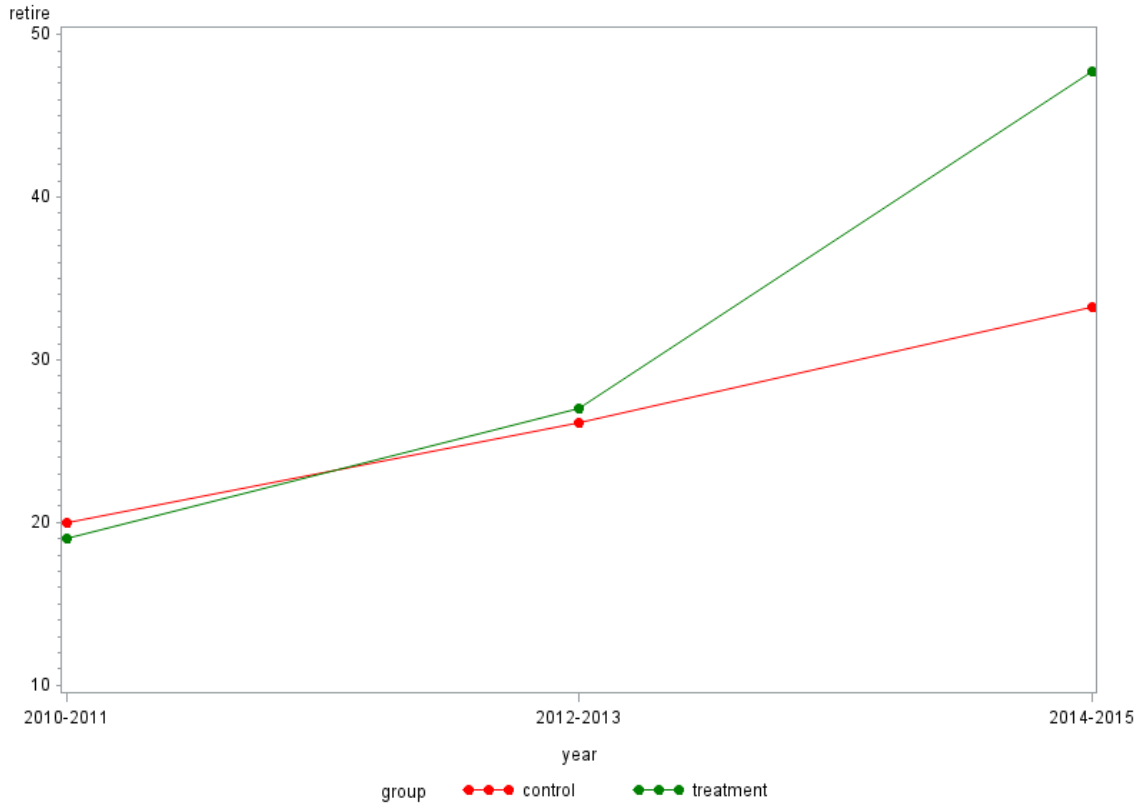

Figure 3.3 Early Retirement Rate of Each Wave

3.4.4. Difference-in-differences Estimation

Table 3.2 shows the difference-in-differences estimators from three regression models. Model 1 controls for group, wave and I(wave=12)×Group, model 2 controls for additional covariates including age, gender, race, marital status and education, and model 3 controls additionally for total household income and pension. The term I(wave=12)×Group equals one if the observation is from a respondent in the treatment group in wave 12 and 0 otherwise, and is the treatment effect where our research interest

resides in. In all three models, the treatment effect is highly significant, indicating a positive effect of ACA on early retirement rate. On average, the respondent in the treatment group is associated with a 13.66 percentage point increase in the probability of early retirement than his counterparts from the control group. When we control for social-demographic and economic covariates, this percentage increases to 14.43%. Also, when we control for age and other covariates in model 2 and 3, the parameters of wave fixed effects become insignificant.

Table 3.2 Regression Estimates of Difference-in-differences Models

Variable		Model 1	Model 2	Model 3
Group	Treatment	-0.0007(0.0203)	-0.0268 (0.0205)	Group
	Control		Reference	
Wave	12	0.1276 (0.0052)**	0.1272 (0.0052)**	Wave
	11	0.0619 (0.0043)**	0.0612 (0.0043)**	
	10		Reference	
I(wave=12)×Group		0.1366 (0.0222)**	0.1395 (0.0224)**	0.1443 (0.0224)**

Note: Model 1 controls for group, wave and I(wave=12)×Group, model 2 controls for additional covariates including age, gender, race, marital status and education, and model 3 controls additionally for total household income and pension; * significant at 0.05 level, ** significant at 0.01 level.

3.4.5. Parallel Trend Assumption

We verify the parallel trend assumption using the observations from the EBB cohort which entered HRS since wave 7 (2004-2005), thus provide us with a longer pre-treatment period. As shown in figure 3.4, for both groups the early retirement rates were increasing steadily and were quite parallel until wave 12, the post-treatment period, when we see a big jump in the treatment group while the trend in the control group

remains steady. Overall, this figure provides support for the parallel trend assumption underlying the difference-in-differences model used in this study, as well as strong evidence of the positive effect of ACA on early retirement rates among the US older population.

3.4.6. Subgroup Analysis Using the Uninsured

In this analysis, we restrict our study sample to respondents who were uninsured during the pre-treatment periods, and either remain uninsured or get health insurance coverage through health insurance exchanges or Medicaid expansion. There are a total of 706 observations remained with this restriction, among which 108 qualify for Medicaid expansion, 47 bought health insurance from exchanges and 552 remained uninsured in wave 12. We then refitted the same difference-in-differences models using this subgroup. Regression estimates were shown in Table 3.3. In general, the treatment effect estimates were smaller than those from the analyses using the full sample, but remain highly significant.

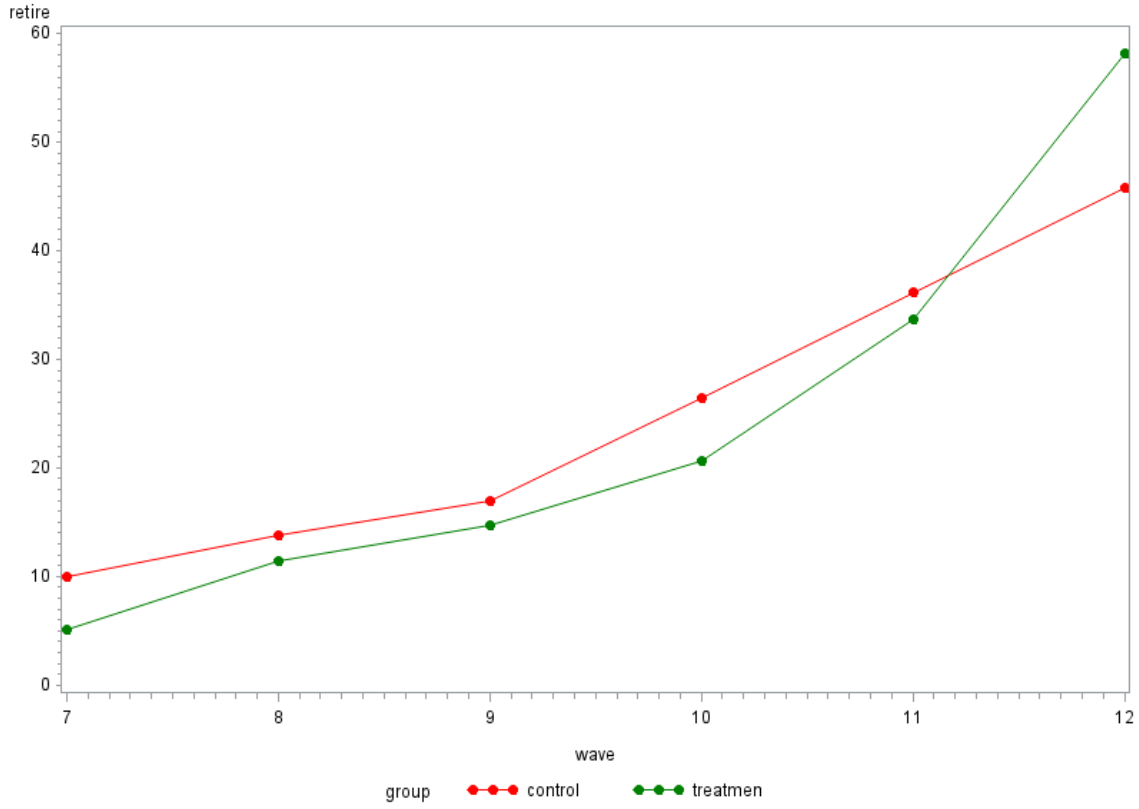

Figure 3.4 Early Retirement Trend Since Wave 7 (2004-2005) of the Early Baby Boomer (EBB) Cohort

Table 3.3 Regression Estimates of Difference-in-differences Models for the Uninsured

Variable		Model 1	Model 2	Model 3
Group	Treatment	0.0563 (0.0298)	0.0524 (0.0297)	0.0480 (0.0295)
	Control		Reference	
Wave	12	0.1537 (0.0176)**	0.1540 (0.0178)**	0.1470 (0.0180)**
	11	0.0581 (0.0126)**	0.0573 (0.0127)**	0.0547 (0.0129)**
	10		Reference	
I(wave=12)×Group		0.0956 (0.0392)*	0.1009 (0.0398)*	0.1033 (0.0399)**

Note: Model 1 controls for group, wave and I(wave=12)×Group, model 2 controls for additional covariates including age, gender, race, marital status and education, and model 3 controls additionally for total household income and pension; * significant at 0.05 level, ** significant at 0.01 level.

3.4.7. Falsification Tests

Table 3.4 and Table 3.5 presents the results from the falsification tests introduced in the method section. We see indeed that the estimates for the treatment effect from all difference-in-differences models were insignificant as we expected, which provides further evidence for the robustness of our model.

Table 3.4 Regression Estimates of Difference-in-differences Models for the Falsification Test Using Placebo Treatment Time

Variable		Model 1	Model 2	Model 3
Group	Treatment	-0.0125 (0.0212)	-0.0381 (0.0217)	-0.0648 (0.0219)**
	Control	Reference		
Wave	11	0.0583 (0.0044)**	0.0578 (0.0044)**	0.0425 (0.0043)**
	10	Reference		
I(wave=11)×Group		0.0195 (0.0195)	0.0188 (0.0198)	0.0287 (0.0202)

Note: Model 1 controls for group, wave and I(wave=11)×Group, model 2 controls for additional covariates including age, gender, race, marital status and education, and model 3 controls additionally for total household income and pension; * significant at 0.05 level, ** significant at 0.01 level.

Table 3.5 Regression Estimates of Difference-in-differences Models for the Falsification Test Using Placebo Treatment Group

Variable		Model 1	Model 2	Model 3
Group	Treatment	-0.0051 (0.0129)	-0.0266 (0.0124)*	-0.0127 (0.0112)
	Control		Reference	
Wave	12	0.1228 (0.0057)**	0.1223 (0.0057)**	0.1032 (0.0056)**
	11	0.0605 (0.0044)**	0.0598 (0.0044)**	0.0453 (0.0044)**
	10		Reference	
I(wave=12)×Group		0.0191(0.0103)	0.0193 (0.0103)	0.0112 (0.0102)

Note: Model 1 controls for group, wave and I(wave=12)×Group, model 2 controls for additional covariates including age, gender, race, marital status and education, and model 3 controls additionally for total household income and pension; * significant at 0.05 level, ** significant at 0.01 level.

3.4.8. Difference-in-differences Models Using Alternative Definition of Early Retirees

Though we wanted our model to capture the effect of ACA on transferring into partial retirement among the study sample, we also want to test how the treatment effect estimates will change if we define the early retirees to be only those fully retired. Table 3.6 reports the estimates for the treatment effect using alternative definition of early retiree. As we expected, the estimates are smaller but remain highly significant. This result provides further evidence that ACA has a positive effect on early retirement.

Table 3.6 Regression Estimates of Difference-in-differences Models Using Alternative Definition for Early Retiree

Variable		Model 1	Model 2	Model 3
Group	Treatment	-0.0062 (0.0162)	-0.0266 (0.0163)	-0.0453 (0.0164)**
	Control		Reference	
Wave	12	0.0970 (0.0045)**	0.0963 (0.0045)**	0.0811 (0.0044)**
	11	0.0454 (0.0037)**	0.0449 (0.0037)**	0.0345 (0.0038)**
	10		Reference	
I(wave=12)×Group		0.0431 (0.0192)*	0.0449 (0.0193)*	0.0481 (0.0195)*

Note: Model 1 controls for group, wave and I(wave=12)×Group, model 2 controls for additional covariates including age, gender, race, marital status and education, and model 3 controls additionally for total household income and pension; * significant at 0.05 level, ** significant at 0.01 level.

3.5. Discussion

While most pre-ACA studies have shown that the availability of health insurance after retirement encouraged early retirement among older population (Boyle & Lahey, 2010; Kapur & Rogowski,2011; Rogowski & Karoly, 2000), to what extent these

findings continue to apply in the post-ACA setting is unclear. In this study, we investigated the impact of ACA on early retirement using a difference-in-differences model. Our results showed that ACA indeed has a positive relationship with early retirement, although its effect becomes much smaller when we only consider its impact on full retirement. This finding is in agreement with Madrian and Lefgren (1998) that availability of health insurance increases transitions to self-employment.

While in this study our outcome variable of interest is binary, we stick with linear models in our analyses. The reason is twofold. First, with a linear probability model, the parameters are readily interpretable, while in nonlinear difference-in-differences models, the interpretation of the interaction terms is different and do not represent the true treatment effect. (Puhani, 2012; Karaca-Mandic, Norton & Dowd, 2012) In addition, applying a nonlinear difference-in-differences model may actually render the parallel trend assumption violated. Although several techniques have been presented by researchers, they are generally mathematically complex and hard to implement. See Athey and Imbens (2006) and Blundell and Dias (2009) for further references.

Our results differ from Levy, Buchmueller, and Nikpay (2015) and Gustman, Steinmeier and Tabatabai (2018), who employed similar difference-in-differences models but found no significant results by comparing Medicare expansion states to non-expansion states, and by comparing respondents with health insurance at work but not in retirement with those who had ESHI both at work and in retirement, and those who had no health insurance either at work or in retirement respectively. There are two possible reasons for the difference of the conclusions. First, the percentages of respondents who

get health insurance from Medicaid expansion and health exchanges are low. In this study, we saw only less than 6% observations fell into the treatment group. Even if ACA has a big impact in this population, its effect will be diluted in a large pool of respondents. In this case, comparing Medicaid expansion with non-expansion states, or population with different health insurances would yield a much smaller, or even insignificant estimates.

A second reason has to do with the wide spread perception that the retirement incentives of certain populations, such as those without ESHI or those with employer-sponsored retiree coverage, were not greatly affected by ACA. Results from this study cast doubt on this perception. In the subgroup analysis, we included only the uninsured population, whose retirement incentives were believed not to be affected by ACA. But still, we found a highly significant impact of ACA, although the estimates were about five percent smaller compared with full sample analyses. This implied that the identifying strategy used by Gustman, Steinmeier and Tabatabai (2018) may not yield an estimate of the impact of ACA as large as expected.

Our study has several important limitations. First, our method of identifying respondents obtaining health coverage via Medicaid expansion poses the problem of differential misclassification. It is possible that we included respondents in the treatment group who belong to the control group, but not the other way around. If it is true, our estimates of the impact of ACA could be biased downward. However, based the Medicaid enrollment rates, even if misclassification error exists, the bias could be very small. Second, our study did not attempt to examine the dynamic effect of ACA. It is

possible that ACA may have a larger effect in the short run, when people who were trapped in "job lock" in the pre-ACA years who able to obtain health coverage and exit the labor force as soon a availability increased due to ACA implementation, but the effect might have dissipated in the longer run, after most of these people who were likely to change retirement behavior due to ACA had already retired. Due to the limited availability of HRS data in the post-ACA period, we could not address this issue in the current study. Finally, we could not assess the heterogeneous effects of ACA on different populations, due to inadequate subgroup sample size.

4. DYNAMIC HEALTH OUTCOMES OF RETIREMENT AND THE ROLE OF JOB CHARACTERISTICS

4.1. Literature Review

Investigating the health outcomes of retirement can be hard, since retirement is endogenous in the analysis. There are two pathways for the endogeneity. On one hand, there are unobserved variables that are correlated with both retirement and health. For example, health shocks can both increase the probability of retirement and decrease health. Failing to control these variables would lead to the "omitted variable" problem, which leads to the endogeneity of retirement. On the other hand, low health can itself increase the probability of retirement. This pathway is often referred to as the "reverse causality" problem.

Unfortunately, most of the studies trying to investigate the effect of retirement on health failed to deal with the endogeneity problem. Due to the endogeneity problem, studies using conventional regression models tend to give biased estimates. While fixed effects models can deal with the unobserved time-invariant heterogeneity problem, it is unable to deal with the reverse causality problem, thus leading to biased estimates as well. Study results are mixed. Lee and Kim (2017) used cross-sectional analysis and found that that transition into retirement leads to poor physical health in Korea. Westerlund et al. (2009) and Westerlund et al. (2010) used repeated measures logistic regression with generalized estimating equations to investigate the effect of retirement on self-rated health and chronic diseases respectively, and found that perceived health is

substantially relieved by retirement. They further concluded that retirement did not change the risk of major chronic diseases, but was associated with a substantial reduction in mental and physical fatigue and depressive symptoms. Other studies used different settings and health outcome measures. (Chung et al, 2009; Kim & Moen, 2002; Mein et al, 2003; Moon et al, 2012; Reitzes, Mutran, & Fernandez, 1996; Van Solinge, 2007)

Other studies attempt to address with the endogeneity problem using more rigorous identifying strategies. One of the most popular methods is the instrumental variable approach. The key to the success of the instrumental variable model is to find a good instrumental variable that is strongly related with retirement (the relevance assumption), and that the variable affects health only through retirement (the "only through" assumption). Public pension benefits eligibility has been widely used as an instrumental variable in this area. For example, Charles (2004) used discreet jumps in the financial incentives to retire when a person reaches 62, 65, 70 and 72 as instrumental variables, and found that retirement had a positive effect on psychological well-being. Behncke (2012) used age specific retirement incentives as instrumental variables and found that retirement significantly increases the risk of being diagnosed with a chronic condition. Coe and Zamarro (2008) used the differences in statutory retirement ages among European countries as an instrumental variable, and found that retirement has a health-preserving effect on overall general health. Neuman (2008), on the other hand, proposed three different sets of instrumental variables, including the individual's eligibility for social security benefits, spouse's eligibility for social security benefits, and

individual's eligibility for private pension. Bound and Waidmann (2007), Coe and Lindeboom (2008), Hessel (2016) also used the instrumental variable to control for endogeneity, among other examples.

Recently, some researchers combined instrumental variable with fixed effects model, yielding the so called fixed effect instrumental variable (FE-IV) model. The idea is that fixed effects model can control for the individual time-invariant attributes, while instrumental variable can deal with the endogeneity of retirement. Bonsang, Adam, and Perelman (2012) utilized the FE-IV model to investigate the effect of retirement on cognitive functioning, and found a negative effect. Using the same model, Godard (2016) found that retirement induced by discontinuous incentives in early retirement schemes causes a 13 percentage point increase in the probability of being obese among men within a two to four-year period. In contrast, Zhu (2016) found that retirement status has positive and significant effects on women's self-reported health, physical and mental health outcomes.

Another commonly used identification strategy to control for the endogeneity of retirement is the regression discontinuity design (RDD). The idea behind this method is the probability of retirement is a discontinuous function of age, with individuals above the retirement age viewed as treated, while individuals below the retirement serve as controls. The controls need not to provide a good counterfactual for the treated because of many underlying differences. Yet, as we approach the threshold, these differences shrink to zero. Using this strategy, Eibich (2015) found that retirement improves subjective health status and mental health, while also reducing outpatient care utilization.

In contrast, Clouston and Denier (2017) found that retirement is positively related with cognitive decline. On the other hand, Johnson and Lee (2009) found that retirement increases an individual's sense of well-being and their mental health, but not necessarily their physical health.

Other identification strategies were utilized in studying the effect of retirement on health as well. Dave, Rashad and Spasojevic (2006) deal with the endogeneity problem by utilizing panel data methods to a sample of respondents who did not report health change during retirement, thus partially addressed the reverse causality problem. Behncke (2012) used nonparametric matching and found that retirement increased the hazard of developing chronic disease and worsened physical health. However, he could not match on observed variables, thus could not fully deal with the endogeneity problem.

Although the methods introduced above successfully controlled for the endogeneity problem of retirement, they all consider the impact of retirement on health as a one-time effect. That is, retirement caused an immediate change in health but no impact afterwards, while in reality we expect retirement to cause a change in the rate of change of health for retirees. Two studies were found to fill this gap, both by incorporating an interaction term for retirement and time to the FE-IV model. One study is by Oshio and Kan (2017), which used a ten-year panel survey in Japan and found that retirement was accompanied by favorable changes in self-rated health and health behaviors. Another study, by Calvo, Sarkisian, and Tamborini (2012), found that early retirees experience worse health outcomes, while delaying retirement provides no health benefits.

In this paper, we investigate the effect of retirement on health using the method utilized in Oshio and Kan (2017) and Calvo, Sarkisian, and Tamborini (2012). Furthermore, we make the following improvements. First, we try to investigate how the effect of retirement on health is influenced by different job types. Second, we combined subjective self-reported health with objective health measures. Although self-reported health is a widely used health measure, it is subject to several kinds of potential biases, such as recall bias and justification bias. (Donaldson & Grant-Vallone, 2012; McGarry, 2004) Finally, we use the most recent data form Health and Retirement Study, which bears more interests for policymakers in US.

4.2. Data

The data we use in this study comes from the Health and Retirement Study (HRS) 1992-2014, which is a longitudinal study conducted biennially. HRS interviewed a sample of old adults over age 50, and the spouses of married respondents regardless of age. The initial HRS cohort, born 1931 to 1941, was first interview in 1992, and subsequently every two years. After that, different cohorts, including the AHEAD cohort (born before 1924), Children of Depression cohort (born 1924 to 1930), War Baby cohort (born 1942 to 1947), Early Baby Boomer cohort (born 1948 to 1953) and Mid Baby Boomer cohort (born 1954 to 1959), were introduced. The latest data available were from 2014, the twelfth wave. HRS contains a rich set of variables, including demographic information, health status, wealth and income, employment history and retirement planning, and fully meets our study purpose.

4.2.1. Study Sample

In this study, we use 9 waves of the available data, spanning the years 1998 to 2014. We restrict the sample to those who have at least two records before retirement and another two records after retirement. We made this restriction because other records do not contribute to the estimation of the effect of retirement on health and rate of health change. We further exclude respondents who went back to employment after retirement to prevent those who transited multiple times between employment and retirement from confounding our estimates. In addition, respondents below the age of 50 during the entry of the survey were excluded.

4.2.2. Health Measures

We used both subjective and objective health measures in this study. Subjective self-rated health was measured using this question: “Would you say your health is excellent, very good, good, fair, or poor?” Codes range from "1" for Excellent to "5" for Poor. ADLs ware measured using five questions, which asked the respondents if they have difficulty walking across a room, dressing, bathing, eating, and getting in and out of bed respectively. These questions are binary, with “1” indicating some difficulty and “0” otherwise. We use the sum of the five questions as the ADLs score, which reports how many daily activities an individual has difficulty with. IADLs score was similarly defined, but with five different questions, including whether the respondents have difficulty with shopping, using telephone and looking up numbers, preparing meal, managing finance and managing medications. The presence of chronic conditions was measured by the number of chronic diseases the respondents reported in each wave,

including high blood pressure, diabetes, cancer, lung disease, heart diseases, stroke, arthritis, and psychology problems. Mental health was measured using Center for Epidemiologic Studies Depression Scale (CES-D). The final score is a summary of eight questions with higher scores represent negative feelings.

4.2.3. Retirement

The retirement status of the respondents come from the survey question "At this time do you consider yourself to be completely retired, partly retired, or not retired at all?" We dichotomize the responses into binary values, with "1" indicating completely retired and partly retired, and "0" otherwise.

4.2.4. Job Type

While an individual can change jobs during each wave, for our study we are more interested in the job from which the individual retired. To capture this, we use the job reported in the wave immediately prior to the wave when the individual retired. The characteristics of the job come from two different questions: one indicates the extent to which the respondent says her/his job requires lots of physical effort, and the other indicates the extent to which the respondent agrees with the statement that her/his job involves lots of stress. The original responses were rated in a four-likert scale, i.e. strongly agree, agree, disagree, and strongly disagree, and we categorize both questions into binary variables.

4.2.5. Covariates

Since fixed effects model controls for time invariant variables, we only include time variant variables including age, marital status, public/private insurance enrollment

and total household income in the model. We use time invariant variables including gender, race, and education level to describe our study sample.

4.3. Statistical Analysis

4.3.1. Fixed Effects Model Setup

We use the fixed effects model to control for unobserved time invariant heterogeneities. To see this, suppose the true model specification is:

$$\mathrm{H}_{ij} = AGE_{ij} + R_{ij} + R_{ij} * AGE_{ij} + X_{ij} + Z_i + u_i + \varepsilon_{ij}$$

where H_{ij}, AGE_{ij}, and R_{ij} denotes the health measure, age and retirement status of individual i at time j. X_{ij} denotes the observed time variant variables, Z_i denotes the observed time invariant variables, u_i denotes the unobserved time invariant variables, and ε_{ij} denotes the error term. In this model, the coefficient of R_{ij} is the immediate health change due to retirement, and the coefficient of the interaction term $R_{ij} * AGE_{ij}$ represents the change in health trend with age after retirement. We assume ε_{ij} to be strict exogenous while the relationship between u_i and other regressors can be arbitrary. Omitting u_i in the analysis would leave the error term related with regressors, violating the assumption for linear model that the regressors are predetermined. Fixed effects models address the unobserved heterogeneity problem by subtracting the mean from the dependent variable and independent variables, leaving

$$\mathrm{H}_{ij} - \overline{\mathrm{H}_{\iota J}} = AGE_{ij} - \overline{AGE_{\iota J}} + R_{ij} - \overline{R_{\iota J}} + R_{ij} * AGE_{ij} - \overline{R_{\iota J} * AGE_{\iota J}} + X_{ij} - \overline{X_{\iota J}} + \widetilde{\varepsilon_{\iota J}}$$

where

$$\overline{\mathrm{H}_{iJ}} = \frac{1}{J}\sum_{j=1}^{J} \mathrm{H}_{ij}$$

($\overline{AGE_{iJ}}$, $\overline{R_{iJ}}$, $\overline{R_{iJ} * AGE_{iJ}}$, $\overline{X_{iJ}}$ are similarly defined), and

$$\widetilde{\varepsilon_{iJ}} = \varepsilon_{ij} - \frac{1}{J}\sum_{j=1}^{J} \varepsilon_{ij}$$

is the new error term. Since the values of Z_i and u_i do not change at different periods, these two terms disappear from the fixed effects model. Note under the strict exogeneity assumption, $\widetilde{\varepsilon_{iJ}}$ is uncorrelated with the regressors, thus our regression coefficient estimator will be unbiased and consistent.

4.3.2. Instrumental Variable

Fixed effects model can deal with the omitted time invariant variable problem, but could not address the endogeneity of retirement completely. We use two instrumental variables, whether the individual reaches 62, the earliest age to claim social security, and whether the individual reaches the full retirement age, the age at which a person may first become entitled to full or unreduced retirement benefits. Note the full retirement age differs between different birth cohorts. Individuals born in 1937 or earlier reaches the full retirement age at 65, and the full retirement age gradually increases to 67 for those who were born in 1960 and later.

Since we have two instrumental variables and one endogenous variable, the model is over-identified and the estimation amounts to a two-stage least squares procedure (2SLS). The regression model in the first step is:

$$R_{ij} = AGE_{ij} + I\big(AGE_{ij} \geq 62\big) + I\big(AGE_{ij} \geq FRA_i\big) + X_{ij} + Z_i + u_i + \xi_{ij}$$

where I(.) is the indicator function which equals 1 if the condition in the parenthesis is true and 0 otherwise, and FRA_i denotes the full retirement age for individual i. The regression model in the second step is:

$$\mathrm{H}_{ij} = AGE_{ij} + +\widehat{R_{\iota J}} + \widehat{R_{\iota J}} * AGE_{ij} + X_{ij} + Z_i + u_i + \varepsilon_{ij}$$

where $\widehat{R_{\iota J}}$ is the predicted value from the first-stage model.

We apply fixed effects model to both steps. Since male and female face different retirement incentives and life-time trajectories, we estimate the model separately for male and female. We use regression coefficients and the F statistic for from the first stage regression to test the predictive power of the instrumental variables. A commonly used rule is that an F value larger than 10 is deemed acceptable.

4.3.3. The Role of Job Characteristics

To investigate the role of job characteristics on the health outcomes of retirement, we introduced three additional interaction terms into the model. We apply the 2SLS procedure described above. The model specification in the first stage is the same as above, while the model for the second stage becomes:

$$\mathrm{H}_{ij} = AGE_{ij} + \widehat{R_{\iota J}} + \widehat{R_{\iota J}} * AGE_{ij} + \widehat{R_{\iota J}} * J_i + AGE_{ij} * J_i + \widehat{R_{\iota J}} * AGE_{ij} * J_i + X_{ij} + Z_i + u_i + \varepsilon_{ij}$$

where J_i is a binary variable indicating whether the job is physically demanding/ stressful. Note in the above model, we allowed job to have an influence on the original health trend before retirement, the immediate health impact of retirement, as well as the change in health trend after retirement. The first interaction term introduced in this model, $\widehat{R_{\iota J}} * J_i$, allowed retiring from a physically demanding/ stressful job to have a

different immediate impact on health from those retired from jobs that were not physically demanding or stressful. The second interaction term, $AGE_{ij} * J_i$, allowed individuals with physically demanding/ stressful jobs to have a different intrinsic health trend with age. The last interaction term, $\widehat{R_{ij}} * AGE_{ij} * J_i$, allowed retiring from a physically demanding/ stressful job to have a to have a different influence on the health trend change after retirement.

4.3.4. Alternative Specification and Robustness Check

As a robustness check, we run four separate FE-IV models using respondents with physical demanding jobs, those with physical undemanding jobs, those with stressful jobs and those with non-stressful jobs. This strategy is very flexible in the sense that it allowed the parameters of the same variable to vary arbitrarily between different populations, while our FE-IV model restricted a linear relationship.

While we classified completely retirement and partly retirement together as retirement, one can argue that they are completely different in the sense of labor force status and have different health outcomes. Combining these two groups together would mask the true effect of retirement and yield biased estimates. In view of this, we redefine retirement to be only those consider themselves completely retired, and exclude the observations who reported being partly retired in some wave.

According to Neuman (2008), it is possible that career workers have the most to gain by withdrawing from the labor force because they have had little leisure time to invest in health while working, including individuals with little labor force history in the sample would under-estimate the positive effect of retirement. Using the same strategy,

we check the estimates from the FE-IV model using a sample consists only of those who have worked at least 20 years of life time.

4.4. Results

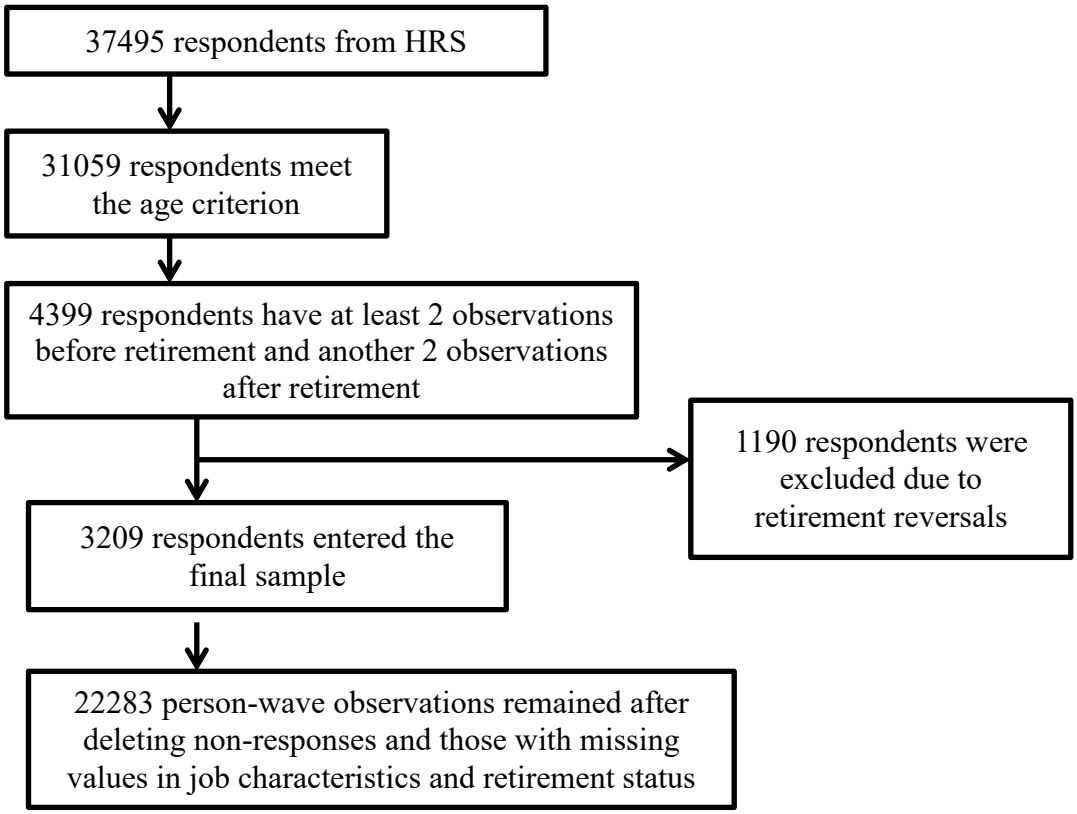

Figure 4.1 Sample Selection Processes

4.4.1. Sample Characteristics

The sample selection process was shown in figure 4.1. There were a total of 22283 observations from 3209 respondents in the sample. Of the 3209 respondents, 1415 of them were male and 1794 were female. The majority were white (81.48%), have high school education (31.66%), and born between 1935 and 1950 (85.92%). Male and

female were quite comparable in terms of the demographic variables, except that female respondents were more likely to be black. See Table 4.1.

Table 4.1 Demographics of the Study Sample

		Male		Female		Total	
		N	%	N	%	N	%
Race	White	1182	83.59	1432	79.82	2614	81.48
	Black	154	10.89	296	16.5	450	14.03
	Other	78	5.52	66	3.68	144	4.49
Education	Below High School	215	15.19	271	15.11	486	15.14
	GED	66	4.66	76	4.24	142	4.43
	High School	399	28.2	617	34.39	1016	31.66
	Some college	327	23.11	452	25.2	779	24.28
	College and above	408	28.83	378	21.07	786	24.49
Birth Year	before 1930	47	3.32	69	3.85	116	3.61
	1931-1935	116	8.2	146	8.14	262	8.16
	1935-1940	434	30.67	507	28.26	941	29.32
	1940-1945	424	29.96	607	33.84	1031	32.13
	1946-1950	300	21.2	369	20.57	669	20.85
	after 1950	94	6.64	96	5.35	190	5.92
Retirement Rate	Wave 6	282	26.78	313	21.9	595	23.97
	Wave 7	533	40.84	618	38.05	1151	39.3
	Wave 8	692	53.94	874	54.76	1566	54.39
	Wave 9	876	68.38	1084	69.27	1960	68.87
	Wave 10	1078	85.22	1419	88.14	2497	86.85

Note: 1. Due to the method we selected our sample, retirement rates in wave 4 and 5 were 0% and in wave 11 and 12 were 100%;
2. Since different cohorts were introduced at different waves, the denominators in the calculation of the retirement rate at each wave were different.

4.4.2. Retirement and Health

The predictive power of the two instrumental variables turned out to be acceptable. Both variables had F value larger than 10 and the R squared was 0.72.

Results from the FE and FE-IV model for male and female were shown in Table 4.2 and Table 4.3 respectively. For male, both FE and FE-IV model indicated that retirement did not have an immediate impact on self-rated health, nor did it change the health trend with age after retirement. We did find that there is a beneficial effect on ADL and IADL upon retirement, but its effect on health trend with age after retirement worked to the other direction. Thus, we may see that the beneficial effect of retirement on ADL and IADL gradually fading away. Chronic conditions were found to be only associated with age, while the effect of retirement was not significant. With FE model, retirement was found to have an immediate beneficial effect on mental health as well as an adverse effect for the health trend with age after retirement, however, the adverse effect became insignificant after we use instrumental variables to control for the endogeneity of retirement.

Table 4.2 Relationship between Retirement and Health Among Male

	Panel 1: Fixed Effects Model				
	Self-rated health	ADL	IADL	Chronic Conditions	Mental Health
age	0.0296**	0.0046	0.0032	0.1001**	-0.0152*
retirement	-0.3483	-0.5695*	-0.6048**	-0.2102	-0.9103*
age*retirement	0.0059	0.0010**	0.0102**	0.0049	0.0144**
	Panel 2: Fixed Effects Instrumental Variable Model				
age	0.0450**	0.0025	0.0084	0.1081**	-0.0038
retirement	-0.2068	-0.6700**	-0.6170**	-0.2751	-1.2499**
age*retirement	0.0008	0.0118**	0.0093**	0.0041	0.0168

Note: 1) * significant at 0.05 level, **significant at 0.01 level; 2) Models adjust for age, marital status, public/private insurance enrollment and total household income, parameter estimates not reported.

In contrary, we found that retirement did have an impact on self-rated health among female. This effect consists of an immediate beneficial effect and an adverse effect in the health trend with age after retirement. We also found similar patterns with ADL, IADL and mental health. Similar to male, chronic conditions were only related with age.

Table 4.3 Relationship between Retirement and Health Among Female

	Self-rated health	ADL	IADL	Chronic Conditions	Mental Health
Panel 1: Fixed Effects Model					
age	0.0241**	0.0075**	0.0076**	0.0960**	-0.0211**
retirement	-0.7128**	-0.5321**	-0.6166**	-0.0918	-1.3594**
age*retirement	0.0118**	0.0090**	0.0103**	0.0024	0.0215**
Panel 2: Fixed Effects Instrumental Variable Model					
age	0.0181	0.0011	0.0024	0.0971**	-0.00564
retirement	-0.9704**	-0.7271**	-0.8191**	-0.2049	-1.4727**
age*retirement	0.0167**	0.0131**	0.01421**	0.0037	0.0196*

Note: 1) * significant at 0.05 level, **significant at 0.01 level; 2) Models adjust for age, marital status, public/private insurance enrollment and total household income, parameter estimates not reported

4.4.3. The Role of Job Characteristics

The results from the FE-IV model for male are shown in Table 4.4. Panel 1 shows the results from the model testing the effect of physically demanding jobs, and panel 2 shows the results from the model testing the effect of stressful jobs. Only parameter estimates for interaction terms were shown to save space. Consistent with separate estimation, retiring from a physically demanding job was found to be associated with reduced health benefits of self-rated health of retirement compared to retiring from a physically non-demanding job, and this reduction was large enough to reverse the

direction of the effect. The results also showed that physically demanding job was associated with decreased self-rated health with age before retirement and improved self-rated health with age after retirement. Retiring from a physically demanding job was not found to impact ADL, IADL, chronic conditions and mental health. We did not find evidence that retiring from a stressful job has an impact on any of the health measures.

Table 4.4 Role of Job Characteristics Among Male: Results from FE-IV Model

	Self-rated health	ADL	IADL	Chronic Conditions	Mental Health
Panel 1: Effect of Physically Demanding Jobs					
phys*age	0.0539*	0.0246	0.0225	0.0203	0.1900
phys*retirement	1.2772*	-0.5720	-0.3541	1.1008	0.9380
phys*age*retirement	-0.0262*	0.0049	0.0022	-0.0184	0.4890
Panel 2: Effect of Stressful Jobs					
stress*age	0.0573*	0.0496**	0.0348**	-0.0317	0.0147
stress*retirement	0.1520	0.2057	-0.0200	-0.1348	-0.6732
stress*age*retirement	-0.0125	-0.0116	-0.0057	0.0087	0.0072

Note: 1) * significant at 0.05 level, **significant at 0.01 level; 2) phys: whether the job is physically demanding; 3) stress: whether the job is stressful;

Table 4.5 showed the results of FE-IV model for the female. In contrary to male, we did not find evidence that retiring from a physically demanding job has an impact on any of the health measures among female. However, we found that retiring from a stressful job was associated with reduced health benefits for ADL of retirement compared to retiring from a non-stressful job.

Table 4.5 Role of Job Characteristics Among Female: Results from FE-IV Model

	Self-rated health	ADL	IADL	Chronic Conditions	Mental Health
Panel 1: Effect of Physically Demanding Jobs					
phys*age	0.0366	0.0270	0.0260*	0.0238*	0.0171
phys*retirement	0.1458	-0.3381	-0.1290	0.6287	-1.4353
phys*age*retirement	-0.0097	0.0006	-0.0021	0.0102	0.0155
Panel 2: Effect of Stressful Jobs					
stress*age	0.0300	-0.0002	0.0065	0.0148	0.0111
stress*retirement	-0.0190	0.9263*	0.3043	0.4159	-0.7744
stress*age*retirement	-0.0056	-0.0126*	-0.0049	-0.0070	0.0091

Note: 1) * significant at 0.05 level, **significant at 0.01 level; 2) phys: whether the job is physically demanding; 3) stress: whether the job is stressful;

4.4.4. Robustness Checks

4.4.4.1. Separate Estimation

The findings from estimating four different models provided similar results with the FE-IV model. Among males, all the models found that retirement was associated with a positive relationship with improvement in ADLs and IADLs, but not self-rated health and chronic disease. We found a significant positive relationship between retirement and mental health status from two models, while the estimates were not significant for the other two models, implying that retirement may be relevant to mental health in a subgroup of the population.

For women, all four models predicted that retirement has a preserving effect on self-rated health, ADLs and IADLs, but not chronic disease. We again found that there was a significant positive relationship between retirement and mental health status from two models, and insignificant results from the others.

One thing worth noting is that, although not significant, we found that retirement tended to lower self-rated health among male respondents with physical demanding jobs, and increase self-rated health otherwise. A similar relationship was not observed among female respondents. For both genders, there seemed to be a larger gain in ADL and IADLs from retirement for respondents with physically demanding and non-stressful jobs. We also observed a larger gain in mental health from respondents retiring from stressful jobs for both male and female. The full results were shown in Appendix table A.1 and A.2.

4.4.4.2. Restrict the Sample to Those Working Over 20 Years in Their Last Jobs

By restricting the study sample to respondents with over 20 years working experience in their last jobs, we were able to investigate the impact of retirement on health measures among a population who were presumed to enjoy the full benefits from retirement. We found similar results to those from the full sample, except that the relationship between retirement and mental health for women became insignificant. We also found the a larger gain in ADL and IADLs from retirement for respondents with physically demanding and non-stressful jobs, as well as a larger gain in mental health from respondents retiring from stressful jobs for both genders, but none of them were significant. The full results were shown in Appendix table A.3 and A.4.

4.4.4.3. Alternative Definition of Retirement

The results from focusing only on self-reported full retirement were also similar to the main analyses. We found retirement had a significant preserving effect on ADLs and IADLs among male, and a significant preserving effect on self-rated health, ADLs,

IADLs and mental health among female. We again did not find any significant impacts of job characteristics on the health outcome of retirement. See Appendix table A.5 and A.6 for the full results.

4.5. Discussion

In this study, we examined the effect of retirement on a comprehensive set of health measures, including both objective and subjective measures, and both physical health and mental health. We used the FE-IV model to control for the endogeneity of retirement, and our model is flexible enough to catch both the immediate health impact of retirement and rate of health change after retirement. Furthermore, we applied this framework to test whether job characteristics have an impact on the health outcomes of retirement. The results from our study would contribute to the current knowledge of the relationship between health and retirement, especially the role of job characteristics.

Consistent with Coe and Zamarro (2011), Westerlund et al. (2009), Van Solinge (2007) and Neuman (2008), we found retirement has a preserving effect on self-rated health, but only for women. For male, there was a positive effect found using the FE model, but this effect became insignificant after we used IV to control for endogeneity. Besides the immediate beneficial effect, we also found retirement deteriorate the change of self-rated health after retirement, which may gradually undermine its initial preserving effect. This pattern is quite consistent against our robustness tests. This may explain, at least to some extent, the contradictory findings in this topic. For example, studies using identification strategies focusing on the immediate health change, such as RDD and FE-IV model, would most likely to find a positive relationship, such as Eibich

(2015) and Zhu (2016). While studies employing longitudinal designs, such as cohort study, would produce positive, negative or insignificant results. (Nuttman-Shwartz, 2004; Ekerdt, Bosse, & LoCastro, 1983; Gall, Evans, & Howard, 1997; Kremer, 1985)

The second set of health measures used in our study is functional capacity. We included both ADLs and IADLs in health measures because these measures were important for independent living of the elderly population, but have attracted little attention in its relationship with retirement. The difference between these two measures is that ADL measures the essential activities for an independent life, while carrying out IADL requires greater personal autonomy to make decisions and interactions. (Millán-Calenti et al, 2010) We found that, for both male and female, retirement has an immediate beneficial effect as well as a detrimental effect on the rate of change in ADL and IADL after retirement. This result is consistent with Tomioka, Kurumatani, and Hosoi (2017) that participation in social activities is associated with reduced IADL disabilities among community-dwelling elderly adults.

The relationship between retirement and chronic conditions is inconclusive in the current literature, possibly due to different chronic conditions included and study design. In this study, we used the count of eight chronic conditions as the health measure, i.e. high blood pressure, diabetes, cancer, lung disease, heart diseases, stroke, arthritis, and psychology problems. Our results implied that retirement did not affect the risk of developing chronic conditions. This is consistent with Westerlund et al. (2010), who investigated the effect of retirement on the prevalence of respiratory disease, diabetes, and coronary heart disease and stroke, but fail to find any significant evidence, and

Berge et al (1998) that found similar prevalence of chronic musculoskeletal symptoms among active and retired workers. In contrast, Moon et al (2012) found that being retired was associated with increased risk of developing cardiovascular diseases, both in the short term and in the long term. Behncke (2012) also found retirement was positively associated with being diagnosed with a chronic condition.

The last health measure we included is mental health, and the results are quite ambiguous. While, consistent with a handful of previous studies (Butterworth et al, 2006; Eibich , 2015; Gorry, Gorry & Slavov, 2018; Jokela et al, 2010; Kolodziej & Garc á-G ómez, 2019; Mein et al, 2003; Mojon-Azzi, Sousa-Poza& Widmer, 2007; Nuttman-Shwartz , 2004; Oksanen et al, 2011; Westerlund et al, 2010;), we found that retirement has a preserving effect on mental health among both male and female, this effect became insignificant during the robustness checks by restricting our sample to those worked at least 20 years and using a different definition of retirement. This volatility may imply that retirement may impact mental health in some population but not others. One study by Vo et al. (2015) claimed that retirees of certain age groups, retirement due to ill health, becoming redundant to the employer or caring for others.

Another contribution we made in this study was that we integrated job characteristics in our FE-IV model to test its significance in the health outcomes of retirement. Depending on the job type, retirement may have different health outcomes. For example, it is reasonable to hypothesize that workers retiring from physically demanding jobs could have the largest gain in physical health, while those retiring from mentally stressful jobs gain most from mental health. However, in this study, we found

limited evidence that job characteristics really have an impact. While we found evidence that retiring from a physically demanding job has a negative effect on the gain of self-rated health from retirement among male, and that retiring from a stressful job has a negative effect on the gain of ADLs from retirement among female, both effects disappeared using alternative specifications. This is consistent with Van Solinge (2007) who also failed to find any evidence that health consequences of retirement differ according to working conditions or job characteristics.

One interesting phenomenon we found through our study was that, in almost all the cases where we found retirement had a significant preserving health effect, it was always associated with a significant negative effect on the rate of health change, or more straightforward, acceleration of health decline after retirement. This result, similar to "regression to the mean" phenomenon, will gradually undermine the health preserving effect of retirement in the long run. However, we could not determine the reason for this phenomenon in this study, but some explanations may be relevant, including the winding-away of the passion from retirement, reduced participation in social activities, and change of health behavior.

Our study is also subject to several drawbacks. First, in this study, we did not differentiate between voluntary and involuntary retirement. It is reasonable to hypothesis that the health benefits of retirement be reduced for those who retired involuntarily, possibly due to health issues and unemployment. Second, in our model we assumed a linear relationship between health and age, while some other studies imply that the relationship is quadratic. Since we included a number of interaction terms of age in our

models, especially for those testing the impact of job characteristics, including a quadratic term for age would render our model quite sensitive to the data, due to the multicollinearity problem. Finally, job characteristics may themselves be endogenous if people choosing jobs according to their health status. However, no evidence so far has been found for this hypothesis, and the results from restricting our sample to those working at least 20 years yielded similar results to the main analyses.

4.6. Conclusion

In this study, we employed FE-IV model to test the relationship between retirement and health, with a special focus on job characteristics. We found evidence that retirement had an immediate preserving effect on self-rated health, ADLs, IADLs and mental health. This effect was accompanied with a significant adverse effect that accelerated health decline after retirement, which may finally undermine the immediate preserving effect with age. In addition, we found limited evidence that job characteristics were associated with health consequences of retirement.

5. CONCLUSIONS

5.1. Summary of the Findings

In this study, we investigated several topics related with retirement, health, and health insurance. We provide a summary of our findings in this section.

First, we performed a systematic literature review on the relationship between employer-provided RHI and early retirement. Searching the relevant literature from five databases, including Medline, Business Source Ultimate, CINAHL, Econlit and Embase, we reviewed 2122 articles for eligibility, and 9 articles were kept in the final review. We found all the included studies found a positive relationship between employer-provided RHI and early retirement. However, these studies differ greatly in terms of target population and study design, which makes comparison difficult. Even for the definition of retirement, the included studies used substantially different versions. We also found strong evidence that the impact of RHI on early retirement was modified by age and gender. The findings suggest that RHI had the largest effect between the ages of 60 to 64, and women were more likely to retire early than male once they became eligible for RHI. There was also evidence that the impact of RHI also differed between employees from public and private sectors, dual-earner families and single families, as well as the amount of subsidy available from employers. However, these factors were rarely investigated in the current literature.

In the second topic, we investigated the impact of ACA on the early retirement decisions among the near-elderly population. We assumed that ACA could encourage

early retirement through Medicaid expansion and health insurance marketplaces establishment. Using HRS, we identified a specific population who got health coverage through these two pathways, and built a difference-in-differences model which compared the early retirement rate between this population and the rest of the survey respondents. We found that ACA increased the probability of early retirement by around 15 percentage points and was highly significant statistically. This effect remained statistically significant even after we restricted our study sample to the uninsured population, or redefined retirement to include only self-reported full-time retirement. We also found that although ACA had a large impact on early retirement rates among this specific population, this population was relatively small and only constitutes around 5% of the study sample, which may explain the insignificant findings from previous studies.

In the last topic, we investigated how retirement impacts health among the retirees, with a special focus on the role of job characteristics. To control for the endogeneity of retirement, we combined fixed effects model with instrumental variable methods. For the choice of instrumental variables, we used eligibility for social security which was popular in previous studies. We found that retirement was associated with an immediate health promoting effect in terms of ADLs and IADLs among male respondents, and with an immediate health promoting effect in terms of self-rated health, ADLs, IADLs and mental health among female respondents. In most cases, this immediate health promoting effect was accompanied by an accelerated health deterioration trend which tends to undermine health promoting effect eventually. We also found some evidence that retiring from physically demanding or non-stressful jobs

resulted in a larger gain in ADL and IADLs, and retiring from a stressful job is associated with a larger gain in mental health. However, these effects were not statistically significant.

5.2. Future Plans

One of my future research goals is to update my statistical analyses incorporating the 13th wave of HRS data, conducted in 2016-17, which was released as I was completing the analysis reported in this dissertation. With an additional wave of data, the updated analyses will be able to yield more precise estimates, and reflect the most recent trend as well.

In addition, building on the results from the second topic, I plan to pursue a deeper understanding of the relationship between ACA and early retirement. One direction would be to investigate how the impact of ACA differs between different populations, such as the uninsured, those with ESHI but no employer-provided RHI, respondents from low-income families, and so on. Another topic that interests me is to study the dynamic impact of ACA to test whether ACA has the largest impact on early retirement during the first few years when it took effect, and whether this impact gradually diminishes after that. This is made possible with an additional wave of data.

Finally, I plan to extend the third topic to encompass more detailed measures of job characteristics. In this study, I only used two measures, whether the job is physical demanding and whether the job is stressful. There are certainly other characteristics that could possibly have an impact on the health outcome of retirement, such as whether a

job requires frequent travelling or has stable payment. Using health behavior instead of health measures as the outcome variable provides another study direction.

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APPENDIX A

REGRESSION RESULTS FOR THE ROBUSTNESS CHECK IN SECTION 4

Table A.1 Role of Job Characteristics Among Male: Results from Separate Estimation

	Self-rated health	ADL	IADL	Chronic Conditions	Mental Health
Panel 1: Job is not physically demanding					
age	0.0283	-0.0072	0.0026	0.1020**	-0.0246
retirement	-0.6065	-0.4877*	-0.5201**	-0.6463	-1.1751*
age*retirement	0.0090	0.0108*	0.0088**	0.0105	0.0199
Panel 2: Job is physically demanding					
age	0.0786**	0.0181	0.0213	0.1241**	0.0325
retirement	0.6798	-1.055*	-0.8393*	0.4915	-1.1299
age*retirement	-0.0170	0.0150*	0.0103	-0.0097	0.0077
Panel 3: Job is not Stressful					
age	0.0094	-0.0285*	-0.0077	0.1283**	0.0158
retirement	-0.2913	-0.7878**	-0.6092*	-0.2655	-0.7998
age*retirement	0.0090	0.0189**	0.0118*	-0.0006	0.0066
Panel 4: Job is Stressful					
age	0.0677**	0.0218*	0.0208*	0.0920**	-0.0015
retirement	-0.1022	-0.5818	-0.6233*	-0.3888	-1.5234*
age*retirement	-0.0055	0.0070	0.0071	0.0095	0.0201

Note: 1) * significant at 0.05 level, **significant at 0.01 level; 2) Models adjust for age, marital status, public/private insurance enrollment and total household income, parameter estimates not reported

Table A.2 Role of Job Characteristics Among Female: Results from Separate Estimation

	Self-rated health	ADL	IADL	Chronic Conditions	Mental Health
Panel 1: Job is not physically demanding					
age	0.0120	0.0035	0.0020	0.0779**	-0.0046
retirement	-1.0104**	-0.6258**	-0.7941**	-0.2357	-0.9525
age*retirement	0.0185**	0.0109**	0.0136**	0.0081	0.0125
Panel 2: Job is physically demanding					
age	0.0256	0.0007	0.0050	0.1208**	-0.0167
retirement	-0.8536*	-0.9417**	-0.8795*	-0.0717	-2.4967**
age*retirement	0.0135	0.0169**	0.0152*	-0.0031	0.0355*
Panel 3: Job is not Stressful					
age	-0.0093	-0.0078	0.0003	0.0861**	0.0132
retirement	-0.9105**	-1.2897**	-1.0166**	-0.4951	-1.0897
age*retirement	0.0214**	0.0225**	0.0167**	0.0089	0.0097
Panel 4: Job is Stressful					
age	0.0383*	0.0058	0.0004	0.10456**	-0.0222
retirement	-0.9390**	-0.3730	-0.7349**	-0.0858	-1.7833**
age*retirement	0.0118*	0.0072	0.0138**	0.0011	0.0282*

Note: 1) * significant at 0.05 level, **significant at 0.01 level; 2) Models adjust for age, marital status, public/private insurance enrollment and total household income, parameter estimates not reported

Table A.3 FE-IV Model Results for Male from the Restricted Sample

	Self-rated health	ADL	IADL	Chronic Conditions	Mental Health
Panel 1: Base FE-IV Model					
age	0.0208	-0.0261*	-0.0144	0.0875**	-0.0126
retirement	-0.3006	-1.0697**	-1.2591**	-0.6296	-0.9705
age*retirement	0.0065	0.0224**	0.0229**	0.0115	0.0136
Panel 2: Effect of Physically Demanding Jobs					
phys*age	0.0186	0.0339	0.0770	0.0647	0.2399
phys*retirement	-0.1211	-0.9534	-0.5410	0.1396	0.5045
phys*age*retirement	0.0001	0.0101	-0.0041	-0.0140	-0.0517
Panel 3: Effect of Stressful Jobs					
stress*age	0.0995	0.0703*	0.0966*	0.0097	0.0585
stress*retirement	-0.2996	0.2210	0.0969	0.5659	-0.9937
stress*age*retirement	-0.0141	-0.0160	-0.0182	-0.0085	0.0030

Note: 1) * significant at 0.05 level, **significant at 0.01 level; 2) phys: whether the job is physically demanding; 3) stress: whether the job is stressful;

Table A.4 FE-IV Model Results for Female from the Restricted Sample

	Self-rated health	ADL	IADL	Chronic Conditions	Mental Health
Panel 1: Base FE-IV Model					
age	0.0378	0.0111	0.0106	0.1065**	-0.0365
retirement	-0.7484*	-0.5871	-0.7332**	-0.4691	-1.0967
age*retirement	0.0099	0.0085	0.0109*	0.0049	0.0210
Panel 2: Effect of Physically Demanding Jobs					
phys*age	0.0237	0.0292	0.0320	0.0114	-0.0010
phys*retirement	1.1442	-0.0505	0.7704	1.8824	0.2615
phys*age*retirement	-0.0218	-0.0057	-0.0170*	-0.0302	-0.0059
Panel 3: Effect of Stressful Jobs					
stress*age	0.0333	-0.0196	-0.0125	0.0309	0.0286
stress*retirement	-1.0560	0.9343	0.2038	0.6047	-2.3814
stress*age*retirement	0.0091	-0.0085	0.0004	-0.0110	0.0274

Note: 1) * significant at 0.05 level, **significant at 0.01 level; 2) phys: whether the job is physically demanding; 3) stress: whether the job is stressful;

Table A.5 FE-IV Model Results for Male Using Alternative Definition of Retirement

	Self-rated health	ADL	IADL	Chronic Conditions	Mental Health
Panel 1: Base FE-IV Model					
age	0.0335	0.0026	0.0049	0.0959**	0.0164
retirement	-0.7135	-1.1923**	-1.1999**	0.1278	-0.7248
age*retirement	0.0100	0.0193**	0.0191**	0.0018	0.0055
Panel 2: Effect of Physically Demanding Jobs					
phys*age	0.0157	0.0216	0.0027	-0.0032	0.0638
phys*retirement	1.1316	-0.4129	-0.6628	0.2405	-0.0742
phys*age*retirement	-0.0184	0.0033	0.0104	-0.0002	-0.0116
Panel 3: Effect of Stressful Jobs					
stress*age	0.0699	0.0477	0.0349	0.0176	0.0510
stress*retirement	1.1216	-0.1225	-0.3711	-0.3727	0.9041
stress*age*retirement	-0.0301	-0.0065	-0.0007	0.0039	-0.0205

Note: 1) * significant at 0.05 level, **significant at 0.01 level; 2) phys: whether the job is physically demanding; 3) stress: whether the job is stressful;

Table A.6 FE-IV Model Results for Female Using Alternative Definition of Retirement

	Self-rated health	ADL	IADL	Chronic Conditions	Mental Health
Panel 1: Base FE-IV Model					
age	0.0204	-0.0065	-0.0022	0.0938**	-0.0158
retirement	-0.8823**	-0.6117*	-1.0222**	-0.3437	-1.4877*
age*retirement	0.0147**	0.0135**	0.01878**	0.0063	0.0223*
Panel 2: Effect of Physically Demanding Jobs					
phys*age	0.0267	0.0089	0.0270*	0.0228	0.0230
phys*retirement	0.5775	-0.4840	0.0032	0.0976	-1.7053
phys*age*retirement	-0.0142	0.0058	-0.0046	-0.0064	0.0209
Panel 3: Effect of Stressful Jobs					
stress*age	0.0546*	0.0054	0.0070	0.0480	0.0792
stress*retirement	-0.0395	-0.2470	-0.0300	0.4530	-0.0343
stress*age*retirement	-0.0097	0.0030	0.0003	-0.0146	-0.0122

Note: 1) * significant at 0.05 level, **significant at 0.01 level; 2) phys: whether the job is physically demanding; 3) stress: whether the job is stressful;