Age Pension Age Eligibility, Retirement and Health Outcomes in Australia*

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Abstract

This paper estimates the causal effects of retirement on health outcomes in Australia, exploiting the exogenous variation in retirement induced by the Australian Age Pension qualifying ages. We find that both retirement status and retirement duration have positive and significant effects on health outcomes, and the effects are larger for Australian women. The positive retirement effects on health are found to be heterogeneous, with people in poor health benefiting most from the transition into retirement and the increasing exposure to retirement. We also show that retirement has a causal relationship with participation in more physical activities and less smoking for the full sample, and the results are driven by the large and significant effects for Australian women. Our counterfactual analysis based on causal estimates highlights two potential unintended health consequences from the scheduled increases in the pension qualifying ages for the next decade: the enlargement of male–female health difference and the deterioration in health status of both genders.

JEL classification: I12; J1; J24; J26

Keywords: Retirement, health, Age Pension

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1 Introduction

The last decade has witnessed a growing literature examining the causal effects of retirement on health outcomes. As an important change in lifestyle, retirement can exert positive influence on people's health through reduced stress and increased enjoyment of life, however, the reduction in physical–related activities and the loss of social interactions associated with retirement can also lead to negative health consequences. Understanding the net and causal effects of retirement on health is important under the background of worldwide prolonged life expectancy and increasing population ageing. To alleviate from the burgeoning financial burden on the sustainability of social security systems, many developed countries have already started or will start raising the statutory state pension eligibility age with the intention to induce postponed retirement (Hering and Klassen, 2010).[1] For example, the Australian Age Pension eligibility age for women has increased from 60 in 1995 at the rate of six months every two years during the past decade, reaching the constant eligibility age of 65 for males in 2014. From 2017, the pension qualifying age for the two genders will start rising again from 65 years old by six months every two years until reaching 67 years of age in 2023. The success of such policies in reducing government expenditures on social security programs partially depends on the potential health effects of delayed retirement. If postponed retirement leads to deteriorations in population health, the alleviation of government financial stress from reduced pension expenditures can be offset by the increase in health care spending.

Establishing the causal links between retirement and health is of significance for policy concerns such as postponing retirement ages, however, the identification is confronted

[1] Countries planning to increase pension ages in the next one or two decades include (but are not limited to): the United States, the United Kingdom, Denmark, the Netherlands, Germany, France, Spain and Australia. In the US, the normal retirement age will increase from 65 by two–month increment until reaching 67 years of age in 2025; In the UK, the age at which old people can claim state pension benefits has been 65 for men and 60 for women. The retirement age for women is to be increased gradually and equaled to the retirement age for men in 2018. The pension age will further rise to 67 for both men and women in 2026. In Denmark, the normal pension age is currently 65 but will be increased at the rate of six months per year to age 67 in the period 2024–2027; In the Netherlands, the normal retirement age is 65, and it will increase gradually to 67 years of age in 2025; In Germany, the retirement age is to be increased gradually from 65 and reach 67 years in 2029; In France, the normal retirement age is to be increased gradually from 65 to 67 years old during 2016–2024; And in Spain, the statutory pension age will increase from 65 to 67 during 2013–2024. See Hering and Klassen (2010) for details.

with several difficulties: first, the selection into retirement is not a random process; second, unobserved individual heterogeneity and time–varying confounding factors can affect both retirement decisions and health outcomes; and finally, as documented in the existing literature, a reverse causality problem can exist in the sense that individual health may have direct impacts on retirement decisions, where in many cases economic inactivity is triggered by poor health (Bound et al., 1999; Disney et al., 2006). The endogeneity issue of retirement resulting from these confounding factors implies that the causality from retirement to health cannot be easily established using methods like ordinary least squares estimations or fixed effect panel estimations.[2]

A recent development in the literature convincingly exploits the key retirement ages induced by social security benefits to estimate the causal effects of retirement on health. For example, in the United Kingdom, a significant portion of retirement income become available at age 65 for men and 60 for women (Bound and Waidmann, 2007). In the United State, age 62 is the earliest age at which people can receive social security retirement benefits and age 65 is the age at which retired people can claim full social security benefits (Bonsang et al., 2012). The variations in retirement induced by social security benefits are credibly exogenous, and have been used to identify the causal health effects of retirement. Using the second wave of the English Longitudinal Study of Aging (ELSA), Bound and Waidmann (2007) find that retirement status has a small and positive causal effect on physical health of men, and the effect is not significant for women. With data from the US Health and Retirement Survey (HRS), Charles (2004) and Neuman (2008) both find that being retired preserves subjective health, while Bonsang et al. (2012) highlight a significant negative effect of retirement on cognitive functioning. A few other studies have exploited cross–country differences in the eligibility ages for retirement benefits as the exogenous source of variations in retirement rates in Europe. With data from the Survey of Health, Ageing and Retirement in Europe (SHARE), Rohwedder and Willis (2010) and Mazzonna and Peracchi (2012) find that the causal effects of retirement on cognitive functioning are

[2]For example, with data from the Health and Retirement Survey (HRS), Dave et al. (2008) use fixed effect panel estimations and find that being retired is associated with a decline in both physical and mental health outcomes in the US, however, this relationship may have an interpretation other than causal effect due to the reverse causality problem.

negative and statistically significant, while Coe and Zamarro (2011) find large and positive effects of retirement on self–assessed health and a health index constructed using a rich set of health variables.

This paper aims to contribute to this debated area featuring mixed findings in several important and novel ways. First, this study is the first to estimate the causal effects of retirement on physical and mental health outcomes in Australia.[3] The existing studies designed to establish retirement–health causality all use data from surveys like the HRS, ELSA and SHARE, thus limiting the scope of retirement–health analysis to the US and Europe. However, population ageing is factually a global issue, and delayed retirement is the objective of policies scheduled in many countries (Lutz et al., 2008; Hering and Klassen, 2010). This is a debate to which the unique experience of Australia can contribute. As pointed out by Rohwedder and Willis (2010), "policy variations that affects the timing of retirement is ideally suited as an instrument, but such variation is rarely found, at least *within a single country*, because pension or social security reforms are rare". The recent Australian Age Pension reform offers such a rare experiment, where *within–country* policy variations affecting retirement timing can be found (among Australian women).[4]

Exploiting the exogenous variation in retirement decisions induced by the Age Pension eligibility ages, this paper examines the effects of retirement on health in Australia, and in contrast with most existing studies, we differentiate between the causal health effects of retirement status (being retire or not, as a discrete event) and retirement duration (length of time spent in retirement, as a cumulative process).[5] We find that retirement status has positive and highly significant effects on self–reported health, SF–36 physical and mental health measures, and the effects are all larger for women than for men in Australia. The effects of retirement duration are also found to be positive and highly significant for

[3]The effect of health on labour force participation in Australia has been documented in Cai and Kalb (2006) and Cai (2010), and both studies find that health has a positive and significant impact on people's decision to join the workforce in Australia.

[4]In footnote 1, we mentioned the scheduled increases in pensions ages in the US and European countries. It should be noted that these *within–country* changes either have not started or have just started, and this makes Australia's experience in reforming the Age Pension exceptional.

[5]The only study that has analyzed the health effects of both retirement status and retirement duration is Bonsang et al. (2012). Other existing studies on the causal health effects either focus solely on retirement status (Charles, 2004; Neuman, 2008; Rohwedder and Willis, 2010; Coe and Zamarro, 2011) or retirement duration (Coe et al., 2012; Mazzonna and Peracchi, 2012).

Australian women, however, the effects are smaller and much weaker for Australian men. We also find evidence that the retirement effects are not uniform on different constituents and aspects of physical and mental health.

Second, we highlight the heterogeneity in the effects of retirement on health. We pay particular attention to the different effects of retirement status and retirement duration for people with different health status. More specifically, we examine whether the health effects of retirement are different for individuals whose health is above or below the median value of each of the SF–36 health indexes we use. Our analysis novelly reveals substantial dispersion of the health effects of retirement, and we find that it is mainly the people with poorer health (namely, whose health is worse than at least 50% of observations) that experience the strongest health improvement from the transition into retirement status and increasing exposure to retirement.

Third, we contribute by estimating the economic mechanisms generating the strong health effects of retirement in Australia. While the health effects of retirement have been investigated in the existing literature, we provide the novel evidence on whether the incidence and intensity of health–related behaviors such as physical exercising, smoking and drinking are causally influenced by retirement status and retirement duration. Our analysis show that retirement has a causal relationship with participation in more physical activities and less smoking for the full sample, which indicates that these behaviors are the channels through which the positive and significant effects of retirement on health exist in Australia. However, the results for the full sample are driven by the large and significant effects for Australian women. This finding of gender differences in the effects of retirement on health–related behaviors helps explain why the health effects of retirement are larger for women than for men.

Finally, two important policy changes in the Australian Age Pension qualifying ages have been scheduled for the next decade in Australia: (i) from January 2014, the pension eligibility age requirements are the same for both genders; and (ii) the pension qualifying ages will start rising from 65 in July 2017 to 67 years of age in July 2023 at the rate of six months every two years for both genders. We use counterfactual analysis based on causal estimates to provide a direct and quantifiable evaluation of two potentially unintended health consequences arising from the scheduled increases in the pension qualifying ages for the next decade: (i) the enlargement of male–female health difference; and (ii) the deterioration in health status of both genders. In this sense, this study also contributes to the literature on the gender health differences among old people (Arber and Cooper, 1999; Pinquart and Sorensen, 2001; Bambra et al., 2009) and the literature on health changes around retirement ages (Salokangas and Joukamaa, 1991; Orfila et al., 2000; van Solinge, 2007).

The rest of the paper is organized as follows. Section two describes the Age Pension system in Australia. Section three describes the data and presents summary statistics. The next section discusses the empirical approach. Section five presents the estimation results. The last section concludes.

2 Age Pension System in Australia

The Australian system of retirement income support is consisted of three components (Barrett and Tseng, 2008; Agnew, 2013; Ryan and Whelan, 2013; Atalay and Barrett, 2014): (i) the publicly funded Age Pension; (ii) income from the mandatory employer–contributed superannuation; and (iii) voluntary private retirement savings.

The eligibility for the Australian Age Pension is subject to three qualifying conditions.[6] The first one is a residency condition that requires pension applicants to be a resident in Australia for at least ten years. The second condition indicates that the Age Pension is means tested in the sense that income and asset levels can have an effect on pension eligibility and also on the amount received by a pension beneficiary. Specifically, in terms of income in 2013, an individual (a couple) is entitled to full pension payment if the income per fortnight does not exceed \$156 (\$276 for a couple). Pension benefits are reduced by \$0.5 for each dollar above the threshold value. The asses test depends on the status of home

[6]More details can be found at the website of the Australian Government Department of Human Services: http://www.humanservices.gov.au/customer/services/centrelink/age-pension. Interested readers are referred to Barrett and Tseng (2008) and Agnew (2013) for a comprehensive institutional description of the Australian retirement system.

ownership. For homeowners, the threshold value is $196,750 for singles and $279,000 for couples, while for non-homeowners, the threshold value is $339,250 for singles and $421,500 for couples. Assets over these amounts reduce the pension benefits by $1.50 per fortnight for every $1,000 above the amount. In 2013, the maximum benefit payment is $751.70 per fortnight for individuals and $1333.20 for couples. Generally, around 70 percent of the elderly population in Australia receive some Age Pension benefits, and about two thirds of recipients receive full pension benefits.

Table 1: Age Pension Eligibility Age in Australia

Birth cohort	Eligibility Age	
	Male	Female
Born before 30/06/1935	65.0	60.0
01/07/1935–31/12/1936	65.0	60.5
01/01/1937–30/06/1938	65.0	61.0
01/07/1938–31/12/1939	65.0	61.5
01/01/1940–30/06/1941	65.0	62.0
01/07/1941–31/12/1942	65.0	62.5
01/01/1943–30/06/1944	65.0	63.0
01/07/1944–31/12/1945	65.0	63.5
01/01/1946–30/06/1947	65.0	64.0
01/07/1947–31/12/1948	65.0	64.5
01/01/1949–30/06/1952	65.0	65.0
01/07/1952–31/12/1953	65.5	65.5
01/01/1954–30/06/1955	66.0	66.0
01/07/1955–31/12/1956	66.5	66.5
Born after 01/01/1957	67.0	67.0

Finally, the pension eligibility is subject to an age condition. The qualifying age was 65 years of age for both men and women when the Australian Age Pension was first introduced in 1908. The qualifying age for women was soon reduced to 60 years old in 1910. From then, the pension age requirements for males (65) and females (60) stayed unchanged until July 1995, when the eligibility age for females started increasing at a rate of six months every two years. In January 2014, the Age Pension eligibility age reaches 65 for females, the same as that for Australian men. In addition, the Australian Government announced in 2010 that the qualifying age for the two genders will both start rising again in July 2017 by six months every two years until reaching 67 years of age in July 2023. The age qualifying requirements for the Age Pension for relevant birth cohorts are illustrated by gender in Table 1. In this paper, we exploit the exogenous variation in retirement decisions induced by the Age Pension eligibility ages, and identify the causal effects of retirement on the health outcomes of Australians.

3 Data

3.1 The Household, Income and Labour Dynamics in Australia (HILDA) Survey

For this study, we use the data from the Household, Income and Labour Dynamics in Australia (HILDA) Survey, which is the first and only large–scale, nationally representative household panel survey in Australia. Starting from 2001, HILDA collects rich information on people's demographics, education, labour market dynamics and health status.[7] The first eleven waves (2001–2011) of the unconfidentialised HILDA are used. The unconfidentialised data contains the information on the exact date of birth and the date of survey for each individual, which, together with the Age Pension eligibility ages described in Table 1, enable us to accurately identify whether an individual has attained the pension qualifying age at the interview date.

A few sample restrictions are applied to facilitate the analysis. First, we follow Bonsang et al. (2012) to focus on mature age people aged between 51 and 75. Second, as described in the previous section, the eligibility for the Age Pension is subject to a residency condition of living in Australia for at least ten years, so we exclude a few observations that do not meet the condition. Finally, observations with missing information on core variables used in this study are dropped. Our final sample is an unbalanced panel consisting of 36,713 observations for 7,269 persons in Australia.

[7]More detailed description of the survey can be found in Wooden and Watson (2007) and Richardson (2013).

3.2 Variables and Descriptive Statistics

Our definition of retirement follows those in French (2005), Bonsang et al. (2012) and Mazzonna and Peracchi (2012). An individual is defined to be retired if he/she is not in the labour force.

HILDA contains a rich set of variables measuring individual health status. Respondents were asked to rate their health on a five–point scale: excellent, very good, good, fair and poor, based on which, we generate a dummy variable for subjective good health that is equal to 1 if an individual's self–assessed health is good, very good or excellent (in contrast with poor, fair).

Table 2: SF–36: Physical and Mental Health Components

Summary Measures	Scales	Measuring
Physical Health	Physical Functioning (PF)	Limitations to daily activities
	Role–Physical (RP)	Limitations in work or activities caused by physical health
	Bodily Pain (BP)	Pain and limitations therefrom
	General Health (GH)	Health perception
Mental Health	Social Functioning (SF)	Social limitations
	Role–Emotional (RE)	Limitation in work or activities due to emotional health
	Vitality (VT)	Fatigue and energy scales
	Mental Health (MH)	Feelings of anxiety and depression

The self–assessed general health measure may provide a comprehensive picture of one's overall well–being, however, it is subjective and may suffer from reporting bias. If people with different socioeconomic backgrounds perceive self–reporting of their health status differently, then the estimates of the health effects of retirement can be misleading. To alleviate this concern, we also use the health measures derived from the MOS 36–item Short Form Health survey(SF–36), an internationally tested and widely used tool for measuring health (Hemingway et al., 1997). In each wave of HILDA, respondents were asked 36 questions about their physical and mental health. The 36 items are merged into eight distinct and standardized scales, which summarizes different aspects of physical and mental health status (see Table 2). These eight scales have been standardized to range from 0–100 in HILDA, with a higher score indicating better health. For the current analysis, we generate a physical health measure for each observation by calculating a simple average of the four physical health scales: Physical Functioning (PF), Role–Physical (RP), Bodily Pain (BP) and General Health (GH). A mental health measure is obtained similarly by calculating the average score of Social Functioning (SF), Role–Emotional (RE), Vitality (VT) and Mental Health (MH). We also create an overall health variable that summarize both physical and mental health, by taking the average of all the eight scales.

Table 3: Summary Statistics

	All		*Male*		*Female*	
	Mean	SD	Mean	SD	Mean	SD
Demographic characteristics						
Retired	0.49	0.50	0.42	0.49	0.56	0.50
Age	61.27	6.73	61.31	6.72	61.23	6.74
Age eligible for Age Pension	0.35	0.48	0.31	0.46	0.38	0.49
Schooling	11.67	2.40	11.97	2.38	11.41	2.39
Married	0.74	0.44	0.81	0.40	0.69	0.46
Family size	2.24	1.05	2.37	1.12	2.13	0.97
Health measures						
Self–reported good health	0.76	0.43	0.76	0.43	0.76	0.42
Physical health (SF–36)	69.78	24.00	70.92	23.61	68.73	24.29
Physical Functioning (PF)	76.01	23.88	78.11	23.44	74.09	24.12
Role–Physical (RP)	70.90	40.24	72.37	39.59	69.55	40.78
Bodily Pain (BP)	67.33	25.39	68.99	24.93	65.80	25.71
General Health (GH)	64.87	22.41	64.22	22.21	65.48	22.57
Mental health (SF–36)	75.19	20.26	76.38	19.89	74.10	20.54
Social Functioning (SF)	81.36	24.59	82.49	23.94	80.34	25.12
Role–Emotional (RE)	82.32	33.92	83.21	33.29	81.50	34.47
Vitality (VT)	61.05	20.33	62.58	19.91	59.65	20.62
Mental health (MH)	76.03	17.13	77.25	16.72	74.91	17.43
Overall health (SF–36)	72.48	20.65	73.65	20.43	71.41	20.79
N	36,713		17,527		19,186	

Note: Data Source: HILDA 2001–2011.

The summary statistics of demographic characteristics and health measures are presented separately by gender in Table 3. The overall retirement rate is 49 percent in Australia, with the gender–specific rate being 42 percent for males and 56 percent for females. The average ages for men and women are similar, being slightly over 61 years old. As the pension eligibility ages are lower for women, the proportion of women (38 percent) meeting the age requirement of the Age Pension is found to be seven percent higher than that for men (31 percent). Furthermore. men are slightly better educated, more likely to be married and have a larger family size than women. In terms of health measures, 76 percent of Australian people report to have a good, very good or excellent health status, and we find no difference between the two genders. The summary statistics of SF–36 health measures show that Australian men are in slightly better physical, mental and overall health than women.

4 Empirical Approach

To investigate whether retirement causally affects the health outcomes of mature age people in Australia, we consider the following health production function:

$$H_{it} = R_{it}\beta + X'_{it}\gamma + u_i + \epsilon_{it} \quad (1)$$

where H_{it} denotes a health measure, and R_{it} is a binary variable indicating the retirement status of individual i at time t. X_{it} is a vector of control variables including age, age squared, years of schooling, a binary variable indicating marital status and family size. A full set of state of residence dummies and wave dummies are also controlled. u_i is the time–invariant unobserved individual heterogeneity and ϵ_{it} is the error term. If R_{it}, our main variable of interest, is assumed to be uncorrelated with both μ_i and ϵ_{it} when conditional on the covariate vector X_{it}, an ordinary least squares (OLS) estimation of equation (1) will yield a consistent estimate of β. However, this assumption is hardly true in reality.

The retirement variable R_{it} can be endogenous in the health production function for two reasons: (i) the correlation between the time–invariant individual heterogeneity μ_i and retirement status R_{it}; and (ii) the correlation between the idiosyncratic error term ϵ_{it} and the retirement decision R_{it}. For example, a negative health shock can induce both a retirement decision and a decline in health status. Moreover, health status can have a direct impact on people's retirement decisions. The fixed effect (FE) panel estimation can only address the first problem. To further resolve the endogeneity problem from (ii), we use fixed effect instrumental variable regression (FE–IV) to estimate β. The instrument variable we use is a binary variable that equals to one if the age of an individual reaches the corresponding Age Pension eligibility ages displayed in Table 1. This instrument is believed to be highly correlated with the retirement decisions of Australian people, and we will test this relevance condition in the next section. Also, after controlling for a flexible function of individual age, the binary instrumental variable indicating whether people reach certain specific ages is unlikely to have a direct effect on people's health except through the channel of people's retirement decisions. While this instrument exclusion condition is not testable, the variations in retirement that are induced by social security incentives are exogenous (Rohwedder and Willis, 2010).

5 Results

5.1 The Causal Effects of Retirement Status on Health

Table 4 reports the results when equation (1) is estimated with OLS regressions. Retirement status is found to be associated with a significant deterioration in health for each of the four health measures. For example, on average, a retired individual is 22.5 percent less likely to report a good, very good or excellent health status than a labor force participant. The SF–36 physical health and mental health measures are also lower for retirees. We also find that the health of Australian men is more influenced by retirement status than that of women. In addition, being retired seems to exert a larger influence on physical health than on mental health, and this result holds for each gender group.

The fixed effect (FE) panel estimation results displayed in Table 4 show that the associations between retirement status and health measures are negative and significant but much smaller in magnitude than those estimated with OLS regressions. There are two possible explanations for this finding. The first one is that fixed effect estimations take unobserved time–invariant heterogeneity into account. For example, people with higher unobserved ability (which is relatively stable over a short time span), may be more likely to stay in the labor force, and in the meanwhile, they can take better care of their health. Ignoring this individual heterogeneity, as in OLS estimation, can lead to an overstatement of the negative effect of retirement on health. A second explanation is that fixed effect esti-

Table 4: OLS and FE Estimation Results

	OLS Estimation				*FE Estimation*			
	Self–reported good health	Physical health	Mental health	Overall health	Self–reported good health	Physical health	Mental health	Overall health
All	–0.225***	–15.521***	–10.698***	–13.110***	–0.051***	–3.843***	–2.607***	–3.225***
	(0.010)	(0.625)	(0.521)	(0.545)	(0.008)	(0.398)	(0.396)	(0.350)
Male	–0.280***	–18.484***	–12.824***	–15.654***	–0.046***	–3.982***	–2.510***	–3.246***
	(0.016)	(0.932)	(0.811)	(0.834)	(0.011)	(0.570)	(0.541)	(0.505)
Female	–0.184***	–13.562***	–9.148***	–11.355***	–0.057***	–3.727***	–2.695***	–3.211***
	(0.014)	(0.830)	(0.675)	(0.711)	(0.011)	(0.549)	(0.523)	(0.480)

Note: * $p<0.1$; ** $p<0.05$; *** $p<0.01$. Control variables include age, age square, years of schooling, a married dummy, family size, and a full set of state of residence dummies and wave dummies. Huber–White robust standard errors clustered at the individual level are reported in parentheses.

mates are more susceptible to the measure error problem than OLS estimates. A measure error in the retirement variable can result in estimates with smaller magnitude and larger attenuation bias in the fixed effect estimation than in the OLS estimation (Griliches and Hausman, 1986). However, the confounding problems from the correlation between the retirement variable and the idiosyncratic error term, which may result from time–varying confounding factors or reverse causality, disable us from identifying the causal effects of retirement on health with either OLS or fixed effect estimation.

Table 5: First–Stage Results of FE–IV Estimation

	All	*Male*	*Female*
Instrument			
Age eligible for the Age Pension	0.101***	0.105***	0.084***
	(0.007)	(0.010)	(0.009)
Controls			
Age	0.067***	0.058	0.078**
	(0.025)	(0.036)	(0.033)
Agesq/100	–0.000	0.025***	–0.023***
	(0.005)	(0.008)	(0.007)
Schooling	–0.000	–0.027**	0.013
	(0.007)	(0.013)	(0.009)
Married	0.015	–0.015	0.031**
	(0.011)	(0.016)	(0.014)
Family size	0.006*	0.008*	0.005
	(0.003)	(0.005)	(0.005)
State dummies	Yes	Yes	Yes
Wave dummies	Yes	Yes	Yes
F–statistic on the excluded instrument	231.39	117.64	82.45
N	36,713	17,527	19,186

Note: * $p<0.1$; ** $p<0.05$; *** $p<0.01$. Standard errors are reported in parentheses.

We now move to the fixed effect instrumental variable (FE–IV) estimation results where the causality from retirement status to health can be convincingly established. Before discussing the causal effects of retirement status on health, we look at the first–stage regression results from FE–IV estimations. The results reported in Table 5 help assess whether the instrumental variable we use satisfies the relevance condition for a valid instrument. The coefficient estimates of the age eligibility variable are highly significant for the full sample and each gender sample, indicating that the age eligibility for the Age Pension is a strong predictor for retirement behavior in Australia. The first–stage F–statistics on the excluded instrument all far exceed the Staiger and Stock (1997) rule-of-thumb threshold of 10, indicating that the instrument is not weak and has sufficient explanatory power in our specifications. For males, being over the Age Pension eligibility age increases the probability of being retired by 10.5 percentage points, and the retirement–inducing effect is 8.4 percentage points for females.

Table 6: The Causal Effects of Retirement Status on Health

	Self–reported good health	Physical health	Mental health	Overall health
All	0.310***	14.523***	14.364***	14.444***
	(0.074)	(3.382)	(3.258)	(2.950)
Male	0.293***	13.482***	10.863***	12.173***
	(0.100)	(4.556)	(4.181)	(3.890)
Female	0.390***	18.464***	22.201***	20.332***
	(0.129)	(6.005)	(6.101)	(5.410)

Note: * $p<0.1$; ** $p<0.05$; *** $p<0.01$. Control variables include age, age square, years of schooling, a married dummy, family size, and a full set of state of residence dummies and wave dummies. Standard errors are reported in parentheses.

Table 6 reports the FE–IV regression results, which estimates the causal contemporaneous effects of being retired on health measures we use. Unlike the findings from OLS and fixed effect estimations, we find positive and highly significant causal health effects of retirement status in Australia, showing that OLS and FE estimates are inconsistent and misleading. Being retired significantly leads to a 31.0 percent increase in the likelihood of reporting good, very good or excellent health status. The positive effect of retirement on health is also confirmed when using the SF–36 health measures. Both the physical and mental health are improved when transiting from labor force participation into retirement. For example, the SF–36 physical health measure of a typical individual in our sample would be 14.523 higher in retirement than in labor force, which corresponds to about 20.8 percent increase in physical health when compared with the sample average. We also find that the health effects of retirement status are uniformly larger for women than for men in Australia.

5.2 Does Retirement Duration Affect Health?

In the previous section, we consider retirement as a discrete change in lifestyle, and our estimates in Table 6 constrain the retirement effects to be a discontinuous change in health in response to the retirement event. Another perspective to view retirement is a cumulative process of exposure to being out of labor force. In this section, we investigate how the health of Australian people can be affected the length of time spent exposing to retirement. The retirement duration variable (denoted with $RETduration_{it}$) is constructed as the elapse time between self–reported retirement age and the age at the time of survey. For those who are not retired, the value of retirement duration is set to zero. To identify the causal effect of retirement duration on health, the instrumental variable used is the duration of being age eligible for the Age Pension (denoted with $ELIduration_{it}$), which is constructed as the duration between the minimum age when being age qualifying for the pension and the current age of each individual. Similarly, if an individual is not age eligible for the pension, the eligibility duration is equal to zero.

We follow Bonsang et al. (2012) in using the log form of duration

$$H_{it} = \alpha + Log(RETduration + 1)_{it}\beta + X'_{it}\gamma + \mu_i + \epsilon_{it} \tag{2}$$

and estimate this equation with fixed effect instrumental variable (FE–IV) regression. The results are displayed in Table 8. OLS and fixed effect estimation results are displayed in Table 7 for comparison purposes.

OLS estimation results in Table 7 show that retirement duration has negative and statistically significant effects on health measures. A doubling of the time exposing to retirement is associated with 8.8 percent decrease in the probability of reporting good health. The magnitudes of the coefficients on the retirement duration variable are considerably smaller when using the fixed effect estimation method, and almost all estimates are insignificant.[8]

The causal results displayed in Table 8 show that the time spent in retirement has a

[8]The only exception is that the association between the physical health of female and retirement duration is negative and significant at the 10% level when using fixed effect estimation.

Table 7: The Effects of Retirement Duration on Health (OLS and FE Estimates)

	OLS Estimation				*FE Estimation*			
	Self–reported good health	Physical health	Mental health	Overall health	Self–reported good health	Physical health	Mental health	Overall health
All	–0.088***	–5.695***	–3.827***	–4.761***	–0.006	–0.325	–0.135	–0.230
	(0.005)	(0.319)	(0.259)	(0.277)	(0.004)	(0.208)	(0.201)	(0.183)
Male	–0.131***	–8.201***	–5.694***	–6.948***	–0.002	–0.103	0.141	0.019
	(0.008)	(0.491)	(0.425)	(0.438)	(0.007)	(0.321)	(0.318)	(0.284)
Female	–0.069***	–4.645***	–3.024***	–3.835***	–0.008	–0.466*	–0.295	–0.381
	(0.007)	(0.408)	(0.325)	(0.350)	(0.006)	(0.272)	(0.260)	(0.238)

Note: * $p<0.1$; ** $p<0.05$; *** $p<0.01$. Control variables include age, age square, years of schooling, a married dummy, family size, and a full set of state of residence dummies and wave dummies. Huber–White robust standard errors clustered at the individual level are reported in parentheses.

Table 8: The Casual Effects of Retirement Duration on Health

	Self–reported good health	Physical health	Mental health	Overall health
All	0.136***	5.167***	6.843***	6.005***
	(0.037)	(1.663)	(1.628)	(1.444)
Male	0.124*	4.752	5.694*	5.223*
	(0.070)	(3.134)	(2.940)	(2.678)
Female	0.167***	6.346***	9.197***	7.771***
	(0.049)	(2.225)	(2.275)	(1.976)

Note: * $p<0.1$; ** $p<0.05$; *** $p<0.01$. Control variables include age, age square, years of schooling, a married dummy, family size, and a full set of state of residence dummies and wave dummies. Standard errors are reported in parentheses.

positive and significant effect on each of the four health measures for the pooled sample.[9] A doubling of the time in retirement will lead to 13.6 percent increase in the probability of reporting good, very good or excellent health status. While we find highly statistically significant health effects of retirement status for Australian men, the effects of retirement duration are much weaker for them. Actually, we do not find evidence that the physical health of men is affected by the length of exposure to retirement. The effects of retirement duration on self–reported health, mental health and overall health are positive and only significant at the 10% level for males. For females, the effects of retirement duration on health outcomes are positive and highly significant. Similar to the gender differences in the health effects of retirement status reported in Table 6, we find that the effects of retirement duration are also larger for women than for men.

5.3 The Effects of Retirement Status and Retirement Duration on Health Constituents

Table 6 and 8 report significant causal effects of retirement status and retirement duration on the health of Australian, however, it is not necessarily the case that the effects are uniform for different health constituents, which summarize different aspects of physical/mental health. For example, among the four constituents of the SF–36 physical health component, Role–Physical (RP) measures the limitations in work or activities caused by

[9]Unreported first–stage estimation results show that the duration of being age eligible for the Age Pension is a strong a predictor for the retirement duration.

physical health problem, while quite differently, Bodily Pain (BP) is a measure of physical pains. We separately estimate the causal effects of retirement status and retirement duration on each constituent of physical and mental health components, and results are presented by gender in Table 9.

We find that being retired significantly benefits the physical health of Australian people in three of the four components (Physical Functioning (PF), Role–Physical (RP) and Bodily Pain (BP)) and the effects of retirement status on the three constituents are different for each gender. For example, retirement status has the largest effect on the Physical Functioning (PF) of males, which measures the limitations to daily activities. For females, a very large effect of retirement status on Role–Physical (RP) is found for women, which is considerably larger than that for men, to the extent that it becomes the single important factor that drives the result that the estimated effect of retirement status on physical health as a whole is larger for women than for men.

In terms of the mental health effect of retirement status, the four constituent estimates are all larger for females than for males, and for each gender group, the effects of being retired are not the same on mental health constituents. The Social Functioning (SF) effect of being retired are larger than the effects on other three mental health components for Australian men, while for females, the effect of being retired is the largest on Role–Emotional (RE), which measures the limitations in work or activities caused by emotional health.

The effects of retirement duration on health constituents are also found to be not uniform. While Table 8 documents a significant effect of retirement duration on the physical health measure for the full sample, Table 9 shows that this result is mainly driven by the significant retirement duration effect on Physical Functioning (PF) and Role–Physical (RP). For males, the effects of retirement duration on different constituents of physical and mental health are mostly insignificant, and we only find a significant effect on Physical Functioning (PF) that measures daily activity limitations and Mental Health (MH) that measures feelings of anxiety and depression. For females, most coefficients estimates of retirement duration are positive and statistically significant, showing the influences of

Table 9: The Causal Effects of Retirement Status and Retirement Duration on Health Constituents

	Physical component				Mental component			
	Physical Functioning	Role–Physical	Bodily Pain	General Health	Social Functioning	Role–Emotional	Vitality	Mental health
	The Effects of Retirement Status							
All	17.040***	25.981***	12.064***	3.006	13.882***	18.070***	13.523***	11.982***
	(3.532)	(7.462)	(4.080)	(2.786)	(4.307)	(6.614)	(3.103)	(2.772)
Male	21.165***	16.890*	13.511**	2.362	12.309**	11.260	7.993**	11.890***
	(5.084)	(9.857)	(5.658)	(3.815)	(5.689)	(8.642)	(3.986)	(3.682)
Female	15.102**	41.416***	11.560*	5.866	19.187**	31.504***	22.624***	15.489***
	(5.874)	(13.519)	(6.942)	(4.819)	(7.733)	(12.504)	(5.822)	(4.996)
	The Effects of Retirement Duration							
All	7.152***	8.784**	2.662	2.071	5.365**	10.494***	6.915***	4.602***
	(1.747)	(3.723)	(2.054)	(1.435)	(2.168)	(3.372)	(1.576)	(1.380)
Male	7.510**	7.236	2.929	1.334	5.074	6.322	4.116	7.261***
	(3.416)	(7.007)	(3.967)	(2.755)	(4.016)	(6.180)	(2.850)	(2.602)
Female	8.433***	10.957**	2.456	3.539*	7.023**	15.545***	9.569***	4.648**
	(2.283)	(4.968)	(2.672)	(1.890)	(2.939)	(4.641)	(2.195)	(1.867)

Note: * $p<0.1$; ** $p<0.05$; *** $p<0.01$. Control variables include age, age square, years of schooling, a married dummy, family size, and a full set of state of residence dummies and wave dummies. Standard errors are reported in parentheses.

retirement duration are exerted on most aspects of female physical and mental health. The results of Table 9 also highlight that retirement status and retirement duration affect individual health in different ways.

5.4 Heterogeneity in the Health Effects of Retirement Status and Retirement Duration

We examine whether the health effects of retirement differ for people with different health status in this section. For this purpose, we group observations into two groups by whether individual health index is above or below the median value for each of the SF–36 health indexes we use, and we then carry out fixed effect instrumental variable (FE–IV) estimation separately for each health group. Results are displayed by gender in Table 10.

Table 10: Heterogeneity in the Effects of Retirement Status and Retirement Duration

	Physical health		Mental health		Overall health	
	Below median	Above median	Below median	Above median	Below median	Above median
	The Effects of Retirement Status					
All	31.018***	–1.141	23.573***	–0.176	26.252***	–2.206**
	(8.383)	(1.339)	(8.138)	(0.911)	(7.421)	(1.078)
Male	28.002***	–2.408	25.860**	–1.394	27.300***	–3.812**
	(10.257)	(2.089)	(12.883)	(1.187)	(9.948)	(1.678)
Female	41.351***	0.058	28.246**	1.321	30.649**	–0.722
	(18.434)	(1.935)	(12.575)	(1.686)	(13.881)	(1.586)
	The Effects of Retirement Duration					
All	5.766**	–0.665	8.278***	–0.509	6.245**	–0.578
	(2.768)	(0.784)	(3.028)	(0.521)	(2.650)	(0.612)
Male	6.245	–2.409	12.500**	–1.796*	7.736*	–2.279*
	(5.234)	(1.709)	(6.115)	(0.951)	(4.731)	(1.210)
Female	6.491*	0.120	9.296**	0.270	6.877*	0.382
	(3.686)	(0.919)	(4.103)	(0.695)	(3.724)	(0.759)

Note: * $p<0.1$; ** $p<0.05$; *** $p<0.01$. Control variables include age, age square, years of schooling, a married dummy, family size, and a full set of state of residence dummies and wave dummies. Standard errors are reported in parentheses.

We find that the positive the health effects of retirement status and retirement duration displayed in Table 6 and Table 8 are mainly driven by the large and significant positive effects among people with health index below the median (namely, whose health is worse than at least 50 percent of observations), and this finding holds for all SF–36 health measures, and also for each gender. For people with health above the median, the retirement effects are mostly negative and insignificant. We even find negative and significant causal effects of retirement status in a few cases. Specifically, the effects of retirement status on the SF–36 overall health measure are negative and significant for people whose overall health is higher than the relevant median in the full sample and also the male sample. Moreover, we find that retirement duration can hurt the mental health and overall health of men who are in relatively better health status (health measures above the relevant medians). The results in Table 10 reveals that the positive health effects of retirement found in Table 6 and 8 conceal the coexistence of both positive and negative effects in a population. It should be noted that the insignificant results displayed in Table 10 are hardly driven by the weak instrument problem as the related first–stage F–statistics on the excluded instrument are all greater than 40, far exceeding the rule-of-thumb cutoff of 10 for weak identification not to be considered a problem (Staiger and Stock, 1997).

We also conduct a sensitivity analysis by including household income and the value of household housing asset into our modeling. Two reasons justify our approach here. First, a change in income or wealth may affect medical expenses, health services utilizations and other health–related behaviors that may have an impact on the health outcomes of Australian people. Second and more importantly, our instrument, which describes whether the age of an individual meets the age requirement of the Australian Age Pension, now has a different interpretation. As the observations in our sample all satisfy the pension residency condition, when we include the income levels and the values of housing asset in the modeling, whether the age of an individual is eligible for the Age Pension is equivalent to whether the individual is eligible for the Age Pension.

The results are reported in Table 11. The health effects of retirement status and retirement duration reported herein, which are further conditional on household income and housing wealth, are very similar to those reported in Table 6, 8 and 10. We find very robust evidence that retirement as a discrete event and as an cumulative process can both lead to significant improvement in self–reported health and physical and mental health outcomes. Similarly, we find substantial heterogeneity in the retirement effects on

Table 11: Robustness check using Household Income and Housing Wealth as Additional Controls

	Self–reported good health	Physical health			Mental health			Overall health		
		All	Below median	Above median	All	Below median	Above median	All	Below median	Above median
	The Effects of Retirement Status									
All	0.298***	14.014***	29.605***	–1.125	13.945***	22.868***	–0.181	13.980***	25.248***	–2.200**
	(0.071)	(3.270)	(7.908)	(1.301)	(3.152)	(7.822)	(0.890)	(2.851)	(7.033)	(1.049)
Male	0.289***	13.252***	26.643***	–2.408	10.665***	25.116**	–1.400	12.172***	27.300***	–3.812**
	(0.099)	(4.490)	(9.692)	(2.083)	(4.123)	(12.373)	(1.185)	(3.890)	(9.948)	(1.678)
Female	0.356***	17.211***	38.683**	0.096	20.970***	27.133**	1.248	19.091***	28.778**	–0.736
	(0.120)	(5.615)	(16.506)	(1.823)	(5.701)	(11.935)	(1.584)	(5.043)	(12.820)	(1.495)
	The Effects of Retirement Duration									
All	0.130***	4.994***	5.566**	–0.659	6.709***	8.190**	–0.510	5.851***	6.156**	–0.603
	(0.036)	(1.630)	(2.718)	(0.761)	(1.595)	(2.994)	(0.509)	(1.415)	(2.611)	(0.595)
Male	0.121*	4.618	5.971	–2.400	5.577*	12.416**	–1.777*	5.097*	7.665*	–2.247*
	(0.069)	(3.085)	(5.073)	(1.674)	(2.894)	(5.997)	(0.940)	(2.663)	(4.610)	(1.193)
Female	0.158***	6.076***	6.009*	0.144	8.981***	9.183**	0.253	7.528***	6.609*	0.343
	(0.048)	(2.168)	(3.581)	(0.887)	(2.217)	(4.044)	(0.673)	(1.924)	(3.649)	(0.733)

Note: * $p<0.1$; ** $p<0.05$; *** $p<0.01$. Control variables include age, age square, years of schooling, a married dummy, family size, and a full set of state of residence dummies and wave dummies. Standard errors are reported in parentheses.

the health of Australian people with different levels of health. It is mainly the people with poorer health (namely, whose health measures are below the relevant medians) that experience the strongest health improvement from the transition into retirement status and increasing exposure to retirement.

5.5 The Effects of Retirement on Health–Related Behaviors

In this section, we examine the causal effects of retirement status and retirement duration on three types of health–related behaviors: physical exercising, smoking and drinking. Participation in physical activity is well known for health promotion and disease prevention (Miles, 2007), and smoking and heavy drinking are known causes of chronic health conditions such as cancer, diabetes and heart disease (Sturm, 2002). We check whether these behaviors are the possible channels through which the positive and significant effects of retirement on health exist in Australia and the possible reasons for the larger health effects of retirement for women than for men.

We separately estimate the following models with fixed effect instrumental variable (FE–IV) regressions

$$HB_{it} = R_{it}\beta + X_{it}'\gamma + u_i + \epsilon_{it} \quad (3)$$

$$HB_{it} = \alpha + Log(RETduration + 1)_{it}\beta + X_{it}'\gamma + \mu_i + \epsilon_{it} \quad (4)$$

where HB_{it} denotes one of the following six variables indicating the participation or intensity of health–related behaviors of individual i at time t: (i) whether takes any physical activity; (ii) whether participates in physical exercises at least three times per week; (iii) currently a smoker; (iv) number of cigarettes smoked per week; (v) currently an alcohol drinker and (vi) drinks alcohol at least three time per week. X_{it} refers to the same set of controls as in equation (1). Results are reported in Table 12.

The FE–IV results for the full sample indicate that individuals tend to participate more frequently in physical activities after retirement. The gender results show that the effect is significant for females only. For example, Australian women are found to be 38.9 percent more likely to take physical activities at least three times per week than

Table 12: The Effects of Retirement on Health Related Behaviors

	Exercising		Smoking		Drinking	
	Take physical exercise	At least 3 times per week	Currently a smoker	Number of cigarettes per week	Currently drink alcohol	At least 3 times per week
	The Effects of Retirement Status					
All	–0.092	0.186*	–0.093**	–9.450	0.058	–0.027
	(0.067)	(0.097)	(0.047)	(6.808)	(0.057)	(0.072)
Male	–0.112	0.055	0.025	3.924	0.063	0.079
	(0.092)	(0.135)	(0.064)	(10.368)	(0.067)	(0.102)
Female	–0.062	0.389**	–0.261***	–23.973**	0.053	–0.166
	(0.115)	(0.168)	(12.575)	(0.085)	(0.109)	(0.120)
	The Effects of Retirement Duration					
All	–0.005	0.075	–0.045**	–3.378	0.037	–0.004
	(0.034)	(0.050)	(0.023)	(3.328)	(0.028)	(0.035)
Male	0.043	0.005	–0.040	–1.396	0.014	0.072
	(0.066)	(0.098)	(0.049)	(7.793)	(0.050)	(0.075)
Female	–0.025	0.141**	–0.054*	–3.001	0.052	–0.043
	(0.045)	(0.065)	(0.028)	(3.467)	(0.038)	(0.041)

Note: * p<0.1; ** p<0.05; *** p<0.01. Control variables include age, age square, years of schooling, a married dummy, family size, and a full set of state of residence dummies and wave dummies. Standard errors are reported in parentheses.

when in the labor force. The effect of retirement duration on physical activity is also positive and significant for females only. Moreover, we find that an individual in the full sample is estimated to be 9.3 percent less likely to be a current smoker, however, this decrease in smoking participation is also driven the large and significant effects for females. After the transition into retirement from workforce, Australian women not only are less likely to be a smoker, but also reduce the number of cigarettes smoked. In addition, a doubling of exposure to retirement will lead to 5.4 percent decrease in female smoking participation, and we do not find significant effect of retirement duration on smoking intensity. Finally, neither retirement status nor retirement duration are found to affect the drinking behaviors of Australians. It should be noted that the insignificant results in Table 12 are not attributable to the weak instrument problem as the first–stage F–statistics on the excluded instrument are all greater than the rule-of-thumb cutoff of 10 suggested by Staiger and Stock (1997).

To sum up, we find that for the full sample both retirement status and retirement duration leads to more physical activities and less smoking behaviors, indicating that exercising and smoking are the possible channels through which retirement affect people health in Australia. Our gender analysis show that this finding is primarily driven by the large and significant retirement effects on the health investment behaviors of Australian women. Neither the participation nor intensity of exercising, smoking and drinking behaviors of Australian men are affected by their retirement status or retirement duration. The finding of gender difference in the effects of retirement on health–related behaviors may explain why the health effects of retirement are larger for women than for men.

5.6 Age Pension Eligibility, Retirement and Health: Counterfactual Gender Health Difference and Counterfactual Over–time Health Evolution

The results in previous sections show that the health effects of retirement are larger for females than for males, and Table 3 shows that the retirement rate among women (56 percent) is 14 percent higher than that of Australian men (42 percent). Therefore, we conclude that the health of women benefit more from retirement than that of men. Given that the gender differences in health measures displayed in Table 3 are very small, a natural question to ask is that had the retirement rate of women been the same as that of men, how much worse the health of women would have been than the actual case and how larger the counterfactual gender gap in health would have been. Also, as we have find evidence that pension age eligibility induces retirement, it is of interest to know to what extent the gender differences in retirement rates is induced by the gender differences in the Age Pension eligibility ages.

Given the context that female retirement rate has declined from 61.6 to 51.7 percent during 2001–2011, the second question we answer is that had the retirement rate for women not declined in the last decade, how much better off the health of Australian women in 2011 would have been than the actual level? Also, as the eligibility age for the Age Pension for women has sequentially increased from 61.5 to 64.0 at a rate of six months every two years during 2001–2011, we quantify the contribution of the increase in the pension eligibility ages to the decrease in women's retirement rate during the past decade.

The counterfactual analysis is important as it sheds light on the possible health consequences of two important scheduled changes in the pension qualifying ages for the next decade: (i) from January 2014, the pension eligibility age requirements are the same for both genders; (ii) the pension qualifying ages will start rising from 65 in July 2017 to 67 years of age in July 2023 at a rate of six months every two years. The following discussions provide a direct and quantifiable evaluation of two potential unintended health consequences resulting from the scheduled increases in the pension qualifying ages for the next decade: the enlargement of male–female health difference and the deterioration in health status of both genders. As the analysis based on retirement status and retirement duration come to similar conclusions, the following discussions will be based on retirement status only.

5.6.1 Counterfactual Gender Differences in Health Had Women Shared the Same Retirement Rate as Men

As shown in the empirical approach section, the equation we estimate with fixed effect instrumental variable (FE–IV) regression is

$$H_{it} = R_{it}\beta + X'_{it}\gamma + u_i + \epsilon_{it} \tag{5}$$

where H_{it} is the health for individual i at time t, R_{it} is the retirement status variable and X_{it} denotes the vector of control variables. u_i is the time–invariant unobserved individual heterogeneity and ϵ_{it} is the error term.

When the equation is estimated separately for males (denoted with M) and females (denoted with F), we can get the following equations for each gender (g=M,F):

$$\overline{H}_g = \overline{R}_g\widehat{\beta}_g + \overline{X}'_g\widehat{\gamma}_g + \overline{u}_g \tag{6}$$

where $\overline{H}_g$, $\widehat{R}_g$ and $\overline{X}_g$ denote respectively the mean values of health measures, retirement rates and control variables for gender group g.

Now consider the case, when the female retirement rate is equal to any counterfactual value $\overline{R}_F^C$ (superscript C is used to indicate counterfactual variables) and all other factors stays the same, equation (6) becomes

$$\overline{H}_F^C = \overline{R}_F^C \widehat{\beta}_F + \overline{X}'_F \widehat{\gamma}_F + \overline{u}_F \tag{7}$$

Take a difference between equation (7) and (5) (when $g = F$) gives

$$\overline{H}_F^C - \overline{H}_F = (\overline{R}_F^C - \overline{R}_F)\widehat{\beta}_F \tag{8}$$

Let the counterfactual female retirement rate be $\overline{R}_F^C = \overline{R}_M$, equation (8) is equivalent to

$$\overline{H}_F^C - \overline{H}_F = (\overline{R}_M - \overline{R}_F)\widehat{\beta}_F \tag{9}$$

where $\overline{H}_F^C$ is the counterfactual health of women had females shared the same retirement rate as males ($\overline{R}_F^C = \overline{R}_M$). $\overline{H}_F^C - \overline{H}_F$ shows how much worse the health of women in the counterfactual case than in the actual case, and $\overline{H}_M - \overline{H}_F^C$ indicates the counterfactual gender difference in health where there was no gender difference in retirement rates.

To answer the question to what extent the gender health difference in retirement rates is induced by the different Age pension eligibility rules for males and females, we turn to the first–stage of the FE–IV estimation:

$$R_{it} = E_{it}\theta + X'_{it}\lambda + u_i + \varepsilon_{it} \tag{10}$$

where E_{it} is a binary variable showing whether individual i is age eligible for Age Pension at time t.

The mean gender difference in retirement rates can be written as:

$$\overline{R}_M - \overline{R}_F = (\overline{E}_M \widehat{\theta}_M - \overline{E}_F \widehat{\theta}_F) + (\overline{X}'_M \widehat{\lambda}_M - \overline{X}'_F \widehat{\lambda}_F) + (\overline{u}_M - \overline{u}_F) \tag{11}$$

$(\overline{E}_M \widehat{\theta}_M - \overline{E}_F \widehat{\theta}_F)$ in the above equation is the term that relates to pension age eligibility rates to retirement rates, and it can be written as a standard Oaxaca–Blinder decomposition:

$$\overline{E}_M\widehat{\theta}_M - \overline{E}_F\widehat{\theta}_F = (\overline{E}_M - \overline{E}_F)\widehat{\theta}_F + \overline{E}_M(\widehat{\theta}_M - \widehat{\theta}_F) \quad (12)$$

As the first–stage estimates the causal effect of pension eligibility on retirement, the amount of gender difference in retirement rates causally induced by the gender difference in pension eligibility rates is given by $(\overline{E}_M-\overline{E}_F)\widehat{\theta}_F$. As the overall gender difference in retirement rates is $(\overline{R}_M-\overline{R}_F)$, $\frac{(\overline{E}_M-\overline{E}_F)\widehat{\theta}_F}{\overline{R}_M-\overline{R}_F}$ is the proportion of gender difference in retirement rates that is induced by the gender difference in Age Pension eligibility rules.

Table 13: Counterfactual Gender Difference in Health Had $\overline{R}_F^C=\overline{R}_M$

	Self–reported good health	Physical health	Mental health	Overall health
Actual case				
$\overline{H}_M$	0.759	70.921	76.383	73.652
$\overline{H}_F$	0.765	68.731	74.098	71.415
$\overline{H}_M-\overline{H}_F$	–0.006	2.190	2.287	2.237
Counterfactual case when $\overline{R}_F^C=\overline{R}_M$				
$\overline{H}_F^C=\overline{H}_F+(\overline{R}_M-\overline{R}_F)\widehat{\beta}_F$	0.710	66.636	69.336	67.988
$\overline{H}_F^C–\overline{H}_F=(\overline{R}_M-\overline{R}_F)\widehat{\beta}_F$	–0.055	–2.095	–4.762	–3.427
$\frac{\overline{H}_F^C-\overline{H}_F}{\overline{H}_F}=\frac{(\overline{R}_M-\overline{R}_F)\widehat{\beta}_F}{\overline{H}_F}$	–7.190%	–3.044%	–6.427%	–4.799%
$\overline{H}_M-\overline{H}_F^C$	0.049	4.285	7.049	5.664
Proportion of the gender retirement difference that was induced by gender difference in Age Pension qualifying ages				
$\frac{(\overline{E}_M-\overline{E}_F)\widehat{\theta}_F}{\overline{R}_M-\overline{R}_F}$		4.200%		

The counterfactual results are displayed in Table 13. In the actual case, Australian men are 0.6 percent less likely to report good health than women $(\overline{H}_M-\overline{H}_F)$. In terms of SF–36 health measures, males are slightly better off in physical, mental and overall health. When considering the counterfactual case when females shared the same retirement rate as males $(\overline{R}_F^C=\overline{R}_M)$, the health of Australian women became worse than the actual health $(\overline{H}_F^C–\overline{H}_F<0)$. This is expected as females have a larger retirement rate than males and retirement are found to have positive and significant effects on health. More specifically, had $\overline{R}_F^C=\overline{R}_M$, women are 5.5 percent less likely to report good, very good or excellent health status $(\overline{H}_F^C–\overline{H}_F)$ than the current rate, representing a 7.19 percent decrease from the actual level $(\frac{\overline{H}_F^C-\overline{H}_F}{\overline{H}_F})$. The physical and mental health measures would be respectively

3.04 percent and 6.43 percent lower than the current levels in 2011. Had females shared the same retirement rate as males, the male–female health gap ($\overline{H}_M - \overline{H}_F^C$) would become more than doubled the actual health gap ($\overline{H}_M - \overline{H}_F$). The positive retirement gap between females and males (56%–42%=14%) helps narrow the gender health differentials with the contribution of gender difference in retirement rates being $-(\overline{H}_F^C - \overline{H}_F)$. We further find that 4.2 percent of the gender difference in retirement rates is explained by the gender difference in the eligibility ages for the Age Pension ($\frac{(\overline{E}_M - \overline{E}_F)\widehat{\theta}_F}{\overline{R}_M - \overline{R}_F}$).

5.6.2 Counterfactual Health of Women Had Women's Retirement Rate not Changed During 2001–2011

In this section, we quantify the contribution of the reduction of female retirement rate (from 61.6 percent in 2001 to 51.7 percent in 2011) to the change in women's health from 2001 to 2011. The over–time health difference of women can be written as:

$$\overline{H}_{F,2011} - \overline{H}_{F,2001} = (\overline{R}_{F,2011} - \overline{R}_{F,2001})\widehat{\beta}_F + (\overline{X}_{F,2011} - \overline{X}_{F,2001})'\widehat{\gamma}_F + (\overline{u}_{F,2011} - \overline{u}_{F,2001}) \quad (13)$$

Now consider the counterfactual case where women's retirement rate in 2011 is $\overline{R}_{F,2011}^C$, and everything else stays the same, the counterfactual health difference between year 2011 and 2001 will be given by:

$$\overline{H}_{F,2011}^C - \overline{H}_{F,2001} = (\overline{R}_{F,2011}^C - \overline{R}_{F,2001})\widehat{\beta}_F + (\overline{X}_{F,2011} - \overline{X}_{F,2001})'\widehat{\gamma}_F + (\overline{u}_{F,2011} - \overline{u}_{F,2001}) \quad (14)$$

From equation (13) and (14), we get

$$\overline{H}_{F,2011}^C - \overline{H}_{F,2011} = (\overline{R}_{F,2011}^C - \overline{R}_{F,2011})\widehat{\beta}_F \quad (15)$$

Let the counterfactual female retirement rate in 2011 be the same as in 2001 ($\overline{R}_{F,2011}^C = \overline{R}_{F,2001}$), equation (15) becomes

$$\overline{H}_{F,2011}^C - \overline{H}_{F,2011} = -(\overline{R}_{F,2011} - \overline{R}_{F,2001})\widehat{\beta}_F \quad (16)$$

where $\overline{H}^{C}_{F,2011}$ denotes the counterfactual health of women had $\overline{R}^{C}_{F,2011}$=$\overline{R}_{F,2001}$.

The proportion of the amount of variation in retirement during 2001–2011 that can be explained by the changes in women's Age Pension eligibility can be similarly obtained with $\frac{(\overline{E}_{F,2011}-\overline{E}_{F,2001})\widehat{\theta}_F}{\overline{R}_{F,2011}-\overline{R}_{F,2001}}$.

Table 14: Counterfactual Health of Women in 2011 when $\overline{R}^{C}_{F,2011}$=$\overline{R}_{F,2001}$

	Self–reported good health	Physical health	Mental health	Overall health
Actual case				
$\overline{H}_{F,2001}$	0.768	68.979	74.501	71.740
$\overline{H}_{F,2011}$	0.767	67.902	73.286	70.594
$\overline{H}_{F,2011}-\overline{H}_{F,2001}$	–0.001	–1.077	–1.215	–1.146
Counterfactual case when $\overline{R}^{C}_{F,2011}$=$\overline{R}_{F,2001}$				
$\overline{H}^{C}_{F,2011}$=$\overline{H}_{F,2011}$–$(\overline{R}_{F,2011}-\overline{R}_{F,2001})\widehat{\beta}_F$	0.806	69.730	75.4846	72.607
$\overline{H}^{C}_{F,2011}$–$\overline{H}_{F,2011}$=–$(\overline{R}_{F,2011}-\overline{R}_{F,2001})\widehat{\beta}_F$	0.039	1.828	2.198	2.013
$\frac{\overline{H}^{C}_{F,2011}-\overline{H}_{F,2001}}{\overline{H}_{F,2011}}$	5.085%	2.692%	3.000%	2.852%
$\overline{H}^{C}_{F,2011}-\overline{H}_{F,2011}$	0.038	0.751	0.983	0.867
Proportion of the retirement rate different between 2001 and 2011 that was induced by the change in Age Pension qualifying ages for females				
$\frac{(\overline{E}_{F,2011}-\overline{E}_{F,2001})\widehat{\theta}_F}{\overline{R}_{F,2011}-\overline{R}_{F,2001}}$		7.042%		

The counterfactual results are presented in Table 14. The actual health measures in 2011 are found to be smaller than those in 2001 ($\overline{H}_{F,2011}$–$\overline{H}_{F,2001}$<0), indicating the worsening of women's health during the past decade. Had the retirement rate of Australian women in 2011 been the same as in 2001, women's counterfactual health in 2011 would be better than the actual case ($\overline{H}^{C}_{F,2011}$–$\overline{H}_{F,2011}$>0). For example, in 2011, 76.7 percent of women factually report a good, very good or excellent health status. The counterfactual percentage of women reporting good health ($\overline{H}^{C}_{F,2011}$) would reach 80.6% when women's retirement rate had not changed between 2001 and 2011, representing an increase of 5.085 percent ($\frac{\overline{H}^{C}_{F,2011}-\overline{H}_{F,2001}}{\overline{H}_{F,2011}}$) from the current rate of 76.7 percent. The SF–36 physical, mental and overall health measures would respectively be 2.692 percent, 3.000 percent and 2.852 percent higher than the current levels in the hypothetical case. We also find that 7.042 percent of the decrease in women's retirement rates between 2001 and 2011 is causally induced by the sequential increases in the Age Pension eligibility age from 61.5 in 2001 to 64.0 in 2011 among Australian women ($\frac{(\overline{E}_{F,2011}-\overline{E}_{F,2001})\widehat{\theta}_F}{\overline{R}_{F,2011}-\overline{R}_{F,2001}}$). We safely predict that the scheduled sequential increase in pension qualifying ages for the next decade will result in further reduction in retirement rates of mature age people, which will subsequently lead to unintended health deteriorations among both genders.

6 Conclusion

The paper contributes to the literature on the causal effects of retirement on health in several important ways. First, we extend the scope of current literature to a country outside the US and Europe: Australia. Exploiting the Australian Age Pension eligibility ages as the source of exogenous variations in retirement, we identify the causal effects of both retirement status and retirement duration on health outcomes, using unconfidentialised data from the Household, Income and labor Dynamics in Australia (HILDA) Survey. Second, we uncover the heterogeneous effects of retirement status and retirement duration for people with different levels of health status, and this type of heterogeneity was not analyzed in the previous literature. Third, this paper is the first to establish the causal links between retirement and health investment behaviors such as physical exercising, smoking and drinking. And finally, we provide a direct and quantifiable evaluation of the potential unintended health consequences from the scheduled increases in the pension qualifying ages for the next decade, using counterfactual analysis based on the causal estimates we have obtained.

Our analysis show that both retirement status and retirement duration have positive and significant effects on self–reported health, physical health and mental health outcomes in Australia, and the effects are larger for Australian women. For example, Australian men are 29.3 percent more likely to report good health when in retirement than in the labor force, and effect is 39 percent for females. The retirement effects on health are found to be very heterogeneous, and it is mainly the people with health index below the relevant median that experience the strongest health improvement from the transition into retirement and the increasing exposure to retirement. Our analysis also show that retirement has a causal relationship with participation in more physical activities and less smoking, and the results are driven by the large and significant effects for Australian women. Furthermore, our counterfactual analysis based on causal estimates show that had there been no gender difference in retirement rates, women's counterfactual health measures would be 3.0 to 7.2 percent lower than actual health. Had the female retirement rate remained the same in 2011 as in 2001, female health indexes would be 2.7 to 5.1 percent higher. Our counterfactual analysis highlights two potentially unintended health consequences among mature age people from the scheduled increases in the pension qualifying ages for the next decade: the enlargement of male–female health difference and the deterioration in health status of both genders. This implies that the anticipated alleviation of financial stress from reduced government pension expenditures comes at the cost of greater gender health inequality and increase in health care spending.

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