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Essays on the Well-Being of an Aging Population

Alice Zulkarnain
Graduate Center, City University of New York

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Alice Zulkarnain

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This manuscript has been read and accepted by the Graduate Faculty in Economics in satisfaction of the dissertation requirement for the degree of Doctor of Philosophy.

Professor David A. Jaeger

____________________ ______________________________________

Date Chair of Examining Committee

Professor Wim P.M. Vijverberg

____________________ ______________________________________

Date Executive Officer

Supervisory Committee

Professor Michael Grossman

Professor Sanders D. Korenman

Professor Frank Heiland

THE CITY UNIVERSITY OF NEW YORK

Abstract

Essays on the Well-Being of an Aging Population

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Alice Zulkarnain

Adviser: Professor David A. Jaeger

This dissertation consists of three essays that examine health and labor issues among the middle aged and elderly.

Chapter 1 A Delayed Retirement Policy and Male Labor Supply: Evidence from the Entire Dutch Population

This chapter examines the labor supply effects of a national delayed retirement policy introduced in the Netherlands in 2009. The policy offers a reduction in taxes on labor income for each year after the age of 62 in which a person worked. I estimate the average effect of the policy on male labor supply as well as its responsiveness to the size of the incentive. Comparing differentially affected birth cohorts suggests that labor force participation increased by about 3.8 to 5.5 percentage points in the three years after introduction for cohorts that were eligible before the normal retirement age. I also find that a higher bonus induces a greater increase in participation and in the number of hours supplied by those working.

Chapter 2 Joint Delayed Retirement of Couples

In this chapter, I study the effect of husbands' labor force participation on the participation decision of their wives. I exploit the fact that the introduction of the delayed retirement policy studied in chapter one provides a natural experiment allowing me to estimate the Local Average Treatment Effect (LATE) of husbands working on the probability that their wives work, for couples in which the husband was induced by the policy to remain in the labor force. I also study both the average effect of the policy on wives who were not eligible themselves, as well as the spillover effect of the policy through their husbands' response to the policy.

My results suggest that wives are 30 percentage points more likely to work if their husbands work among couples that were affected by the policy and I find a treatment effect on the labor force participation of wives associated with the policy of about 1.5-2 percentage points.

Chapter 3 The Effect of Divorce on Health in Middle and Older Ages

with Sanders D. Korenman

Both the prevalence and incidence of divorce at older ages have doubled since 1990. We use Health and Retirement Study data to describe associations between divorce and health in middle and later life, using models that follow individuals and couples through divorce (i.e., individual and couple fixed effects).

Divorce in middle and older ages is associated with adverse physical health changes for women but not men, and greater mental health declines for women than men. Following individuals over time, women who divorce experience deteriorations in self-reported health and mental health, including depression. Following couples over time, divorce is associated with deterioration in self-reported health for wives but not their husbands. After divorce, a woman is more likely than her ex-husband to be diagnosed with mental health conditions. Differences in self-reported health associated with divorce appear linked to changes in mental rather than physical health.

Dedicated to

my grandfather Kwee Hwat Djien,

who did great things

and to

Isabel, who is great already.

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Results in chapter one and two are based on calculations by Alice Zulkarnain using non-public microdata from Statistics Netherlands. Under certain conditions, these microdata are accessible for statistical and scientific research. For further information: cvb@cbs.nl.

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Introduction

In the last decades, declining fertility rates, along with rising life expectancy (decreasing mortality rates), have lead to population aging around the world. Due to these demographic changes, the world's population aged 60 and over will double from 841 million in 2013 to 2 billion in 2050 (UN, 2013). As the number of older people increases, interest in their well-being has increased.

The old age dependency ratio, defined as the number of people over the age of 65 divided by the number of people of working age, has been rising rapidly in many developed countries, and in parts of the developing world. Population aging has economic, political and social consequences in part because it puts pressure on public support systems for older persons, such as social security, and, more generally, for public health systems and public budgets.

The implications of population aging on the long-term solvency of social security systems have become a focal point of policy makers around the world. As life expectancy increases, the proportion of people's lives spent in retirement, while being supported by social security, increases, while the proportion of their lives spent working decreases. Many policy experts argue that due to improvements in health at older ages and technological changes that reduce the physical demands of work, today's middle-aged and elderly workers have increased "work capacity", and are able retire later and work longer (Wise, 2016). Many countries' governments have responded to these changes, along with budgetary pressures, by enacting policies, such as increased social security eligibility ages, aimed at increasing labor supply of the elderly and delaying retirement.

Population aging also has implications for public health. Adult mortality rates have declined and people live longer, but for the elderly to remain independent and active members of the community their health is key. Consequently, health maintenance and early-disease detection, that prevents or delays the onset of chronic non-communicable diseases is crucial for their welfare, as well as to the sustainability of public health systems (Beard, Officer, Cassels, 2016). Thus, the World Health Organization emphasizes the need for research to increase understanding of the determinants of healthy aging to inform public health policy.

In this dissertation, I study topics related to the important labor and health aspects of population aging. My first two chapters contribute to the understanding of policy changes that affect labor supply in later life, by empirically studying the effects of a delayed retirement policy on male labor supply and on joint retirement decisions. My third chapter contributes to the understanding of determinants of healthy life in old age by investigating the effects of divorce on health in middle and later life. An important innovation is my focus on the behavioral context of, and impact on, couples, rather than studying individual elderly persons in isolation. For example, I consider the effects of husbands' labor supply incentives on the labor supply behavior of their wives, and examine differences in spouses' health following divorce.

In my first chapter, I analyze the labor supply effects of a national delayed retirement policy introduced in the Netherlands. The policy was aimed at encouraging people older than 62 to remain in the work force by offering a fiscal discount. I estimate the average effect of the policy on male labor supply as well as its responsiveness to the size of the incentive. My results show that men who were eligible before the normal retirement age increased labor force participation by about 4.5 percentage points on average in the three years after introduction of the policy. I also find that a higher financial incentive induces a greater increase in labor supply, in both participation and hours.

In my second chapter, I examine the joint retirement decision of couples by estimating the effect of husbands' labor force participation on the participation decision of their wives. Additionally, I study spill-over effects of the delayed retirement policy in the Netherlands on labor force participation of wives who were not eligible themselves. I find that wives are more likely to work if their husbands work, and that the policy increased labor force participation of wives indirectly by incentivizing the husbands to remain in the labor force. My results suggest, that an analysis that focuses solely on the labor supply behavior of eligible individuals rather than couples would underestimate the total impact of the policy on labor supply.

In the final chapter, I estimate the effect of divorce on health in middle- and later life in the United States and describe associations between divorce and health using models that follow individuals and couples through divorce. Divorce in middle and older ages is associated with adverse physical health changes for women but not men, and greater mental health decline for women than men. After divorce, a woman is more likely than her ex-husband to be diagnosed with mental health conditions. My results suggest that differences in self-reported health associated with divorce are linked to changes in mental rather than physical health.

As population aging continues to put pressure on public support systems for older persons, an understanding of how policy can affect the long-term solvency of both social security and public health systems is important. My results suggest that a fiscal discount policy can be effective in increasing labor supply of eligible individuals and their spouses. My findings also highlight the potential importance of public health policy that could address divorce as a risk factor for mental health in later life.

Promising topics for future research could be to examine the budgetary effects of policies like the one in the Netherlands, and to identify instruments that make it possible to study the causal effect of divorce on health in later life.

Chapter 1

A Delayed Retirement Policy and Male Labor Supply: Evidence from the Entire Dutch Population

1.1 Introduction

Over the past several decades, low labor supply of older workers and population aging have become a growing concern for the Netherlands and many other countries (Gruber & Wise, 1997; 2004). The Netherlands has had very low labor force participation (LFP) among individuals aged 60 and older since the 1980s and 90s (Gruber & Wise, 1999; Kapteyn & De Vos, 1999). In 2006, only 34.6% of Dutch men between ages 60 and 64 were working, compared to 52.2% of males in the OECD countries (OECD, 2015). As a result of a pronounced baby boom after WWII followed by a stark decline in fertility, the Dutch old-age dependency ratio increased from 17 to 26 between 1975 and 2013, and is projected rise to 42 in 2050 (World Bank, 2015; United Nations, 2013).[1] The combination of fewer workers to support retirees, rising life expectancy, and a status quo of early retirement (i.e., short working lives) threatens the fiscal balance and long-term solvency of the social security system in the Netherlands, as it does in many other countries (Gruber & Wise, 1999; 2004; 2007).

The Netherlands has implemented reforms to social security in attempts to improve fiscal sustainability. Like other countries, e.g., the United States, Germany and France, the Netherlands increased the normal retirement age (NRA), the age at which workers become fully eligible for social security (or the equivalent state pension), starting in 2013.[2] Raising the NRA increases the incentive to retire at a later age.[3] In this chapter, I evaluate the impact of a Dutch delayed retirement policy, the *Doorwerkbonus*(DWB) on the labor supply of older male workers.[4]

The DWB was implemented in January 2009 to increase labor supply among those aged 62 and older, providing a fiscal bonus of 1% to 10% of annual labor income between €8,860 and €54,776 (in 2009) for work at those ages.[5] Because the DWB is an individual earnings credit, providing a fiscal discount on income taxes over the year in which work is continued, it is, in effect, a wage increase for that period. This study contributes to the literature that evaluates the effects of these types of retirement policies, reviewed below.

To study the effect of the DWB on male labor supply, I use detailed, high quality administrative data from the Netherlands to estimate the average effect of the policy on LFP

[1] The old age dependency ratio is defined as the ratio of people older than 64 to those aged 15-64. Population aging in the Netherlands has been more rapid than in the United States, where the ratio increased more slowly, from 16.2 to 20.4 between 1975 and 2013 and is projected to rise to 34 in 2050.

[2] Starting in 2013 the Netherlands increased the NRA by 1-3 months per birth cohort, and it is scheduled to be 66 in 2018 and 67 in 2021.

[3] In the United States, retirement (exit from the labor force) and claiming social security benefits are distinct events; therefore, delayed claiming does not necessarily imply delayed exit from the labor force. In the Netherlands this is not the case. The next section provides more detail on the case of the Netherlands.

[4] The direct translation of *Doorwerkbonus* in English is *continued work bonus*.

[5] See p.10 for a more detailed description.

as well as how labor supply in terms of participation (extensive margin) and hours worked (intensive margin) respond to the size of the incentive. To my knowledge, this is the first study that looks at the relationship between the DWB and labor supply using longitudinal administrative data for the entire Dutch population.

A related literature studies how changing the nature of the Delayed Retirement Credit (DRC) in the United States, which increases lifetime social security benefits when retirement is delayed beyond NRA, would affect labor supply and the timing of claiming. Orszag (2001) suggests that a lump sum DRC might boost labor supply more than an adjustment in the monthly benefit because, depending on time preferences, people are more responsive to a lump sum payment than to an equivalent annuity payment. Chai, Maurer, Mitchell & Rogalla (2013) explore theoretically whether a lump sum as a reward for delayed retirement might delay retirement more than an increase in lifetime benefits. Their results suggest that a lump sum DRC option would increase the average retirement age by 1.5-2 years.[6] Building on the work of Chai et al., Maurer, Mitchell, Rogalla & Schimetschek (2014) surveyed respondents about delaying retirement when offered a lump sum payment instead of increased lifetime benefits. Respondents indicated that they would claim about a half year later if a lump sum were paid for claiming any time after the Early Retirement Age (ERA), or two-thirds of a year later if paid for claiming after NRA. Furthermore, they find that people would work one-third to one-half additional months if they were offered the option of a lump-sum payment.

Because the DWB has a similar feature of a direct reward (in the following year), the findings of Maurer et al. (2014) suggest that the DWB could increase LFP. The size of the amounts analyzed, however, were much larger than the DWB, so it is difficult to make inferences about the size of the effects of the DWB on labor supply based on their results. Moreover, in the US setting, a lump sum DRC would replace an existing DRC that increases

[6] Chai et al (2013) assume that people claim benefits and move to full leisure at the same age.

lifetime benefits, whereas the DWB was introduced into a setting without an existing delayed-retirement policy.

Two papers have analyzed European policies aimed at increasing labor supply among older workers. Novella (2012) studies the Belgian "Pensioenbonus" introduced in 2007 to provide incentives for work among persons aged 62 and older. She finds that the Belgian policy had a limited impact on the probability of a male worker remaining in the labor force. Novella concludes, however, that the "Pensioenbonus" had limited effects because LFP had already risen as a result of an earlier increase in the number of years of work required to claim social security benefits.

Using survey data from the *Longitudinal Internet Studies for the Social Sciences*, Da Silva Soca (2013) studies the effect of the DWB on the expected retirement age in the Netherlands. Using a difference-in-differences analysis that compares individuals eligible for the bonus (aged 62 and older) to younger people before and after introduction of the policy, she finds that the policy increased the age at which older workers expected to retire by one year and seven months. These results suggest that the policy should also have had an effect on actual LFP.

The introduction of the DWB provides a natural experiment to study how a direct bonus, a feature of the lump sum payment suggested by Orszag (2001), Chai et al. (2013) and Maurer et al. (2014), affects labor supply. In this chapter, I extend the work by Da Silva Soca (2013) by studying the effect of the DWB on actual male LFP (rather than self-reported expectations of labor supply), as well as the responsiveness of male labor supply to the size of the DWB at both the intensive and extensive margin. I use administrative data from the entire Dutch population to provide accurate estimates of labor supply, and compare the behavior of cohorts that were eligible to those that were not at the same ages (in different years), instead of older to younger people.

The structure of the policy and the context in which it was introduced create some challenges for an analysis of its impact on labor supply. Specifically, it was introduced several years after the implementation of other law changes intended to reduce early retirement incentives, some of which were sector specific. This creates some challenges for disentangling the policy's effects, which I address by carefully setting up my difference-in-differences model and by including age, year and sector dummies as well as controlling for individual fixed effects when appropriate.

Due to the continued prevalence of early exit from the labor force and the ongoing debate on the sustainability of social security systems, an understanding of the effect of the DWB on labor supply as well its responsiveness to the size of the bonus is relevant not only to policy makers in the Netherlands, but to those in other countries considering policy reforms to stimulate labor supply. This chapter builds on and extends the literature on the effects of retirement policies to the case of the Netherlands, by studying the impact of a policy that raises the effective annual wage for some period when delaying retirement.

1.2 Background

Pension System in The Netherlands

The Dutch pension system consists of three pillars. The first is the state-provided pay-as-you-go pension called the Algemene Ouderdomswet (AOW), established in 1957. The eligibility age (NRA) is 65, for those born before 1948, and has been scheduled to increase gradually by several months per birth cohort starting in 2013.[7] The AOW provides an equal basic income linked to the statutory minimum wage for everyone above the NRA. A single person receives 70% of minimum wage (about €1,000), while couples receive 50% of

[7]The NRA will be 66 in 2018 and 67 in 2021, After 2024, it will be linked to life expectancy and will be fixed 5 years ahead of time.

minimum wage per person (about €700 each). It is not possible to claim early or to delay claiming and enrollment is practically automatic.[8] Every person who has lived or worked in the Netherlands for 50 years receives the full state pension benefits at NRA.[9] Receiving the AOW does not require retiring from the labor force. Compared to other countries, however, the state pension provides only a small portion of retirement income in the Netherlands. At the end of 2007, 2.7 million people received Dutch state pension benefits.

The second pillar, which is very important to income in retirement in the Netherlands, consists of collective, employer-provided pensions. They are managed by a pension fund or insurance company that is a separate legal entity from the employer and therefore are not affected if the employer gets into financial difficulty. Moreover, these pension funds are run as non-profit organizations financed by past contributions from members and from asset returns.[10] Although no law requires individuals to join pension funds, the government can make a pension scheme mandatory for an industry or profession if the representatives of the employers and employees (e.g., unions) within the sector or profession decide to provide a pension scheme for employees. As a result, over 90% of employees take part in a collective pension scheme. Currently, the majority are (hybrid) defined benefit schemes, meaning that there is risk sharing among all parties involved (employer, employees, and current pensioners). At the end of 2008, pension funds in the Netherlands managed an invested capital of about €700 billion. In comparison, the Dutch GNP in 2008 was approximately €600 billion.

The third pillar consists of private individual pension products. The self-employed and employees in sectors without a collective pension scheme build up their pensions with private individual pension products, but anyone can purchase a product in the third pillar.

[8] The Employee Insurance Agency invites people to apply for benefits 6 months before a person reaches NRA via a simple online process. In case an application is filed late, benefits will be paid retroactively up to 12 months later, and in certain cases more.

[9] People that do not work accumulate equal pension rights, but benefits are reduced by 1/50 for each year that a person lived outside of the Netherlands.

[10] Three different types of pension funds exist in the Netherlands: industry-wide pension funds, corporate pension funds, and pension funds for the self-employed

All Dutch citizens will receive retirement income from the first pillar when they reach NRA, and depending on their personal situation, they could also receive income from the second and/or third pillars.

Labor Force Participation in The Netherlands

LFP among older workers in the Netherlands has been low since the 1980s and 90s (Gruber & Wise, 1999; Kapteyn & De Vos, 1999). In 2006, only 34.6% of Dutch men and 19.8% of Dutch women between ages 60 and 64 were working (OECD, 2015). The low LFP in the Netherlands has been attributed to the introduction of early retirement plans.[11] These schemes, intended to create employment opportunities for younger workers, made it possible for older workers to claim pensions and retire early, until they reached an age when their pension income would be supplemented by AOW benefits, i.e. social security (Euwals, Van Vuuren & Wolthoff, 2010). Moreover, Dutch regulations facilitated the use of disability insurance (DI) and unemployment insurance (UI) as pathways to early retirement (Kapteyn & De Vos, 1999; Kerkhofs et al, 1999; Lindeboom, 1998).

Over the last few decades, the Netherlands introduced policies to address the low LFP of older workers. In 2002, retirement through DI and UI was made more difficult. In 2006, laws governing early retirement reduced the generosity of plans for cohorts born after 1950. And since 2013, the age at which workers become eligible for AOW was increased. Precise retirement rules of collective pension funds, however, are negotiated between unions and employer organizations and eligibility rules may differ by pension fund.

The Doorwerkbonus

[11] The early retirement plans, called "VUT" schemes, which stands for "Vervroegde Uittreding en Prepensioen, early exit and pre-pension in English, are part of the second pillar.

The *Doorwerkbonus* (DWB) was implemented in the Netherlands in January 2009 to stimulate labor supply at age 62 and above. In effect, it provides a discount on taxes on labor income, between an income cap and floor, for work after age 62 defined as:

$$D = \begin{cases} p(c-f), & \text{if } w > c. \\ p(w-f), & c \geq w \geq f. \\ 0, & w < f. \end{cases} \tag{1.1}$$

where D is the size of the discount, c is the labor income cap, p is the bonus percentage, w is before-tax labor income and f is the floor.[12] Table 1.1. shows the (claimable) tax credit scheme and maximum bonus amounts by age in the top section and shows the labor income cap and floor in the bottom section. A person aged 62 is eligible for a credit of 5% of taxable income, up to a maximum amount of $p(c-f)$, which was €2,296 in 2009.[13] The DWB percentage increases with age until 64, and decreases thereafter, to 1% for ages 67 and older. The bonus percentage scheme remained the same from 2009 through 2011, but was amended in 2012. The policy was repealed in 2013 and replaced by a less generous bonus aimed at people aged 61 through 64.

Labor Force Participation and Unemployment in the Netherlands

[12] Assuming a fixed tax rate for simplicity gives after tax wages :

$$w^* = \begin{cases} w(1-t) + p(c-f), & \text{if } w \leq c. \\ w(1-t+p) - pf, & c \geq w \geq f. \\ w(1-t), & w < f. \end{cases} \tag{1.2}$$

[13] The Dutch Tax Administration applies the DWB bonus automatically to everyone who is eligible when tax returns are filed in the next year.

Figure 1.1a, shows male LFP rates by year and age. LFP rates increased steadily from 2003 through 2011 for all ages. Participation shows a distinct upturn for ages 61 through 64 after 2006, reflecting two changes in that year: the final implementation of DI restrictions (De Jong, 2008;Van Sonsbeek, 2010), as well a law change that reduced generosity of early retirement schemes for cohorts born after 1950. Even though this law change itself was aimed at cohorts that were not eligible for the DWB in the period of interest and started affecting LFP only after 2012, in 2007, in anticipation of the change, some smaller pension funds introduced a phased reduction of generosity for cohorts born between 1946 and 1950. Although no distinct jump in labor supply is visible immediately after the introduction of the DWB in 2009, there is a slight steepening of the LFP curves for all ages.

Figure 1.1c, shows male LFP by year and by cohort. After 2006, the LFP curves become more concave for younger cohorts born after 1944, reflecting the same changes mentioned earlier. After the introduction of the DWB only a slight divergence between the youngest cohorts is discernable. In Figure 1.1b, showing LFP by age and by cohort, we see that LFP has shifted up across cohorts (after 1944, which is likely at least partly attributable to the 2006 DI restrictions and the phased reduction of generosity of early retirement schemes) and that the slope of the LFP curves has flattened for the younger cohorts. There is little difference in LFP between the cohorts at the older ages even after introduction of the DWB. For the younger cohorts, however, each subsequent cohort that was eligible for the DWB was more likely than the previous cohort to work at each age, suggesting that, with time, the DWB may have induced greater participation.

The "Great Recession" of the late 2000s could also have affected labor supply, although it is likely to be less of a concern in the Netherlands than in other settings. While unemployment rates in many countries started peaking in 2009, figure 1.2 shows that the Dutch unemployment rate for males aged 55 through 65 was relatively stable between 2003 and 2011, at an average around 5.2 percent. The rate only started rising steeply after 2011 reaching 8.5 percent in 2013, but remained below early 2006 levels until spring 2012.

1.3 Empirical Strategy

Data

To study the effect of the DWB on the labor supply of Dutch older workers, I use the highly restricted administrative microdata collected by Statistics Netherlands for all Dutch residents from various administrative sources such as the population registry, the Employee Insurance Agency (the administrative authority that handles AOW, DI, UI, and other social benefits), the tax administration, and other sources for the years 1999-2011. For the current analyses, I use the datasets containing information on labor, income (only available from 2003), pension benefits, social security benefits and demographic data for the entire population of the Netherlands (16.7 million people in 2009), which can be linked together by a personal identifier.[14]

Regression Framework

I study how eligibility for the DWB policy affects LFP and how responsive labor supply is to the size of the bonus. To study the effects of DWB-eligibility, I use a difference-in-differences approach that exploits the panel nature of the data, and the fact that the introduction of the DWB can be seen as a natural experiment, to analyze the effects of a temporary increase in wages on labor supply. The difference-in-differences model is a

[14]To gain access to the data, I traveled to the Netherlands to be fingerprinted. The data is accessible via VPN, through a fingerprint secured network, which requests verification every 20 minutes.

workhorse of the policy-evaluation literature on retirement measures (Gruber and Orszag, 2000; Song and Manchester, 2007; Haider and Loughran, 2008; Novella, 2012). To estimate the responsiveness of participation to the size of the bonus, I estimate an OLS model (linear probability model) and to estimate the responsiveness of hours worked I estimate OLS models with and without individual fixed effects. Here identification comes from both between-cohort and within-cohort-variation in the size of the bonus. In the models with individual fixed effects, identification comes entirely from within-cohort (and within-person) variation in the bonus percentage.

The Effect of DWB-eligibility on Labor Force Participation

To study the effects of DWB-eligibility on participation, I consider the rollout of the program across cohorts. I consider becoming eligible for the DWB as the "treatment", and compare the LFP of cohorts who were eligible to those who were not at the same ages. However, a person turning 63 in 2010 will have been eligible for the DWB for two years, while a person turning 63 in 2009 will only have been eligible for one year. To take these duration differences in eligibility into account and to model cumulative exposure, I pool "exposed" ages from treatment cohorts to form treatment groups and create appropriate comparison groups from control cohorts, thus studying cohorts who were exposed to different "doses" during the period of eligibility.

Table 1.2a shows the matched control and treatment pairs for eight difference-in-differences from the eight distinct "age pools" in my data.[15] For example, the first difference for "age

[15] The treatment cohort for pool 1 is eligible at ages 67, 68 and 69, for pool 2 at ages 66, 67 and 68, for pool 3 at ages 65, 66 and 67, for pool 4 at ages 64, 65 and 66, for pool 5 at ages 63, 64 and 65, for pool 6 at ages 62, 63 and 64. Even though the treated cohort in age pool 7 and 8 were also only eligible from the age of 62, they were aware that they would soon become eligible, therefore I include the entire post-2009 period for these two pools.

pool" 1, with a treatment cohort born in 1942 and a control cohort born in 1939, is given by the change in LFP from the treatment-before period (2006-2008) to the treatment-after period (2009-2011), when the treatment group is aged 67, 68 and 69 and the policy is in effect. The second difference is given by the change in LFP from the control-before period (2003-2005) to the control-after period (2006-2008), when the control group is aged 67, 68, and 69. The treatment effect associated with DWB-eligibility for "age pool" 1 is given by the difference in these differences. [16] For notational ease, I define the 2003-2005 years as period I, years 2006-2008 as period II, and years 2009-2011 as period III.

I estimate the following linear probability difference-in-differences model:

$$Working_{it} = \alpha_0 + X_{it}'\beta + \sum_{k=1939}^{1946} \lambda_k (C^k Y^I) + \sum_{m=1939}^{1949} \pi_m (C^m Y^{II}) + \sum_{n=1942}^{1949} \rho_n (C^n Y^{III}) + \delta A_{it} + \phi Y_t + \xi S_{it} + \epsilon_{it}$$

where $Working_{it}$ is an indicator variable for whether or not person i was working at time t, X_{it} is a vector of controls for marital status, A_{it}, Y_t and S_{it} are full sets of age, year and sector dummy variables.[17] C^kY^I, C^mY^{II} and C^nY^{III} are interactions of cohort dummies and indicators for period I, II and III.[18] The coefficients λ_k, pi_n and ρ_m give the mean LFP for cohort k in period I, cohort m in period II and cohort n in period III respectively.[19]

Continuing with the example for "age pool" 1, the first difference given by $\rho_{1942} - \pi_{1942}$ gives the change in LFP from the before to the after period for the treatment cohort born

[16] For cohorts born between 1942-1946 the 2006-2008 period serves as a control-after period for one "age pool" and as a treatment-before period for another "age-pool".

[17] S_it is the sector person i works in in period t, or the last known sector. I drop the observations after 2008 for the cohorts born in 1939, 1940 and 1941 from the sample I use to estimate the eligibility model, when these cohorts are also eligible for the DWB. Therefore the superscript m on variable C^n only goes from 1942 through 1949. I do not estimate the treatment effects of these older cohorts, since these cohorts hit their 70s after 2009 at ages when LFP rates are very low, and are therefore not likely to be affected by the policy.

[18] Cohort interactions with period I are only included for cohorts 1939 through 1946 and interactions with period III are only included for cohorts born after 1941.

[19] The cohort dummies and the period indicators are not included as main effects.

in 1942, while the second difference given by $\pi_{1939} - \lambda_{1939}$ gives the change in LFP from the before to after period for the matched control cohort born in 1939. The treatment effect for "age pool" 1, the average change in LFP associated with DWB-eligibility is given by $\overline{\Delta LPF_{Pool1}} = (\rho_{1942} - \pi_{1942}) - (\pi_{1939} - \lambda_{1939})$.[20] Traditional differences-in-differences models include dummy variables for each treatment group, which control for time-invariant differences between the groups. Here it is not possible to include cohort dummies due to multicollinearity with the age and year dummies. I argue, however, that the key difference between the treatment and the control cohorts is that they reach the specific ages in different years, and that the year dummies control for this difference. This model is estimated using a sample that includes birth cohorts 1939 through 1959, observed from 1999 through 2011.[21] I estimate the model using OLS, with robust standard errors to correct for potential heteroskedasticity in the error terms and cluster the standard errors at the cohort level to correct for serial correlation of the error terms within cohorts.[22]

The Effect of the Size of the Bonus on Labor Supply

[20] The treatment effects of the other eight "age pools" are given by $\overline{\Delta LPF_{Pool2}} = (\rho_{1943} - \pi_{1943}) - (\pi_{1940} - \lambda_{1940})$, $\overline{\Delta LPF_{Pool3}} = (\rho_{1944} - \pi_{1944}) - (\pi_{1941} - \lambda_{1941})$, $\overline{\Delta LPF_{Pool4}} = (\rho_{1945} - \pi_{1945}) - (\pi_{1942} - \lambda_{1942})$, $\overline{\Delta LPF_{Pool5}} = (\rho_{1946} - \pi_{1946}) - (\pi_{1943} - \lambda_{1943})$, $\overline{\Delta LPF_{Pool6}} = (\rho_{1947} - \pi_{1947}) - (\pi_{1944} - \lambda_{1944})$, $\overline{\Delta LPF_{Pool7}} = (\rho_{1948} - \pi_{1948}) - (\pi_{1945} - \lambda_{1945})$, $\overline{\Delta LPF_{Pool8}} = (\rho_{1949} - \pi_{1949}) - (\pi_{1946} - \lambda_{1946})$.

[21] I estimate the three-year average effects of the DWB at those older ages, I would need to form control groups from cohorts born before 1939. Since these cohorts reach their 70s after 2009 at ages when LFP rates are very low, they are not likely to be affected much by the DWB.

[22] Due to the large size of my dataset, I choose to estimate linear probability models (OLS) instead of logit models in the interest of reducing estimation run-time. Furthermore, linear probability model coefficients have the advantage of easy interpretation and are the parameters of interest (probability derivatives). My sample has 21 clusters, which is considered a moderate number of clusters according to Bertrand, Duflo, Mullainathan (2004). Their results show that clustering in a finite sample with 20 clusters works quite well in correcting for autocorrelation. They also show that over-rejection due to serial correlation goes down as the number of time periods go down. My sample contains 13 time periods, which would be considered a moderate number of periods according to their results. The combination of my moderate number of periods and the clustering works well on 20 clusters leads me to believe that I have sufficiently taken care of potential serial correlation in my error terms.

To estimate the responsiveness of labor supply to the size of the bonus, I estimate the following model.

$$Z_{it} = \alpha_0 + X'_{it}\beta + \gamma DWB_{it} + \delta A_{it} + \phi Y_t + \xi S_{it} + \epsilon_{it}$$

where DWB_{it} is the size of the bonus a person is eligible for, and Z_{it} is a binary variable indicating whether person i worked in year t or a continuous variable of the log average hours worked per week in year t; all other variables as defined for equation (1).[23] The coefficient γ gives the percentage point increase in LFP or the percent increase in hours worked for a 1-percentage point increase in the DWB. I also estimate a model with an additional control for whether a person's potential gross annual labor income, would reach the capped amount over which a bonus is paid out, as well as an interaction of the capped variable with the treatment and control variables of each age pool. Because someone who does not work has no income, I use the last known hourly wage to calculate what potential gross annual income would be, if they were to work the median number of hours worked among those in the labor force, and use this to determine whether their potential gross labor income would reach the cap. The sample that I use to estimate the bonus size models again includes birth cohorts 1939 through 1949.[24] I estimate the participation model, where the dependent variable indicates whether someone worked or not, using OLS and the labor supply model, where the dependent variable is log hours, using OLS with and without individual fixed effects, to control for unobserved time-invariant characteristics. All estimations use robust standard errors to correct for heteroskedasticity in the error terms and I cluster the standard errors at the cohort level to correct for serial correlation of the error terms within cohorts.[25]

[23] DWB is measured in percentage point units, from 1-100.

[24] For this model all observations after 2008 are kept in the sample for all cohorts.

[25] In this sample I only have 11 clusters. Bertrand et al. (2004) show that clustering standard errors on 10 clusters goes a long way in correcting for serial correlation, but may not do so sufficiently.

1.4 Results

Eligibility: Summary Statistics

Table 1.3a shows descriptive statistics for the control-before and -after period, 2003-2005 and 2006-2008 respectively, and the treatment-before and -after period, 2006-2008 and 2009-2011 respectively, for the eight "age pools" in my eligibility model. The bottom two rows shows the unadjusted change in the average LFP from the before to the after period, and the unadjusted difference-in-differences for the eight "age pools". There is an increase in unadjusted LFP at DWB eligible ages for the treatment cohorts relative the matched control cohorts for "age pool" 5, 6, 7 and 8. The older "age pools", for whom the treated cohorts were DWB eligible at or after NRA, we see that there was a slight decrease in unadjusted LFP.

About 80% of the sample is married among the older cohorts and slightly less for the younger cohorts, about 9% to 13% is divorced, about 2% to 5% is widowed. The table also shows descriptive statistics for binary variables indicating whether they receive pension, welfare, UI, DI or other social benefits. In the younger "age pools", pools 6, 7 and 8, the proportion receiving a pension is lower in the treatment-after period than in the matched control-after periods. About 4-6% of those in age pools below normal retirement age receive unemployment benefits, and 19-25% receive disability benefits. Note that people are only eligible for UI and DI until age 65, therefore no one in the after-periods in "age pools" 1 and 2 receive these benefits.

Bonus Size Model: Summary Statistics

Table 1.3b shows the descriptive statistics for the sample used to estimate the effect of the bonus size, by DWB percentage eligibility category. As expected, LFP and hours worked are decreasing with age, while widowhood increases with age, starting with the 5% bonus recipients (62 year olds), followed by the 7% recipients (63 year olds), 10% bonus recipients (64 year olds), 2% bonus recipients (65 and 66 year olds) and finally the 1% bonus recipients (67 year olds). The 0% category includes men of all ages in the period before 2009 as well as at the younger ages that were not eligible after 2009.

The percentages married and divorced are similar across all groups, about 80% and 8-10 percent, respectively.

The proportion receiving a pension rises with age. People are eligible for UI and DI until age 65; therefore, no one in the 1% bonus group (age 67 and older) receives these benefits.

Eligibility: Regression results

Table 1.4 summarizes results from the eligibility model (full model results are shown in Appendix Table A.1). Row 1 of Table 1.4 shows the average change in LFP, the average treatment effect associated with DWB-eligibility, for each age pool, from the base specification that only controls for marital status, and includes full sets of dummies for age, year and sector. First focusing on the younger cohorts, pools 5 through 8, who have not reached NRA at the time of the introduction of the DWB, the results suggest that DWB-eligibility was associated with an average three-year increase in LFP of 0.3 percentage points for age pool 5, which was eligible at ages 63 through 65, although not statistically significant. For those in age pool 6, who were eligible at ages 62 through 64, LFP increased by an average of 4.8 percentage points over the three years following the introduction of the policy. For age pool 7, exposed to the bonus at ages 61, 62 through 63, LFP increased by 7.4 percentage points;

and for age pool 8, exposed at ages 60, 61 and 62, by 6.3 percentage points. The cohorts in age pools 1 through 4 were aged 64 through 69 at the introduction of the DWB, when almost everyone receives public and private pensions and when LFP is lower than 30%. The results suggest that there was a reduction in average LFP of 1.6 to 2.9 percentage points for age pools 1 through 4. I discuss potential explanations in the limitations section. The estimates for all pools are statistically significant, except for pool 5.

I run the model with additional controls for whether an individual receives a pension, welfare, UI, DI or other social benefits. Even though these covariates might be endogenous, I am interested in how their inclusion affects the estimates of my treatment effect.[26] Row 2 in table 1.4 shows the treatment effects for each age pool. Including these additional controls reduces the negative treatment effect for the oldest age pools 1 through 4 by about half (full results are shown in column 2 of Appendix Table A.1). The results for the younger age pools 6 through 8 become slightly smaller, but seem fairly robust to the inclusion of these additional controls. The estimates for all pools are statistically significant, except for pool 5.

The treatment effects are not directly comparable across age pools, because they represent average effects at different ages. Therefore, I decompose the results to make them comparable. Specifically, I decompose the average treatment effect $\overline{\Delta LPF_p}$ for age pool p into ΔLPF_{pa}, the treatment effect at each age a in each pool p.[27] Figure 1.3 shows the decomposition results for the model that controls for pension receipt and social benefits (the full results are shown in Appendix Table A.2).[28] Figure 1.3 shows that generally, when comparing pool 1 through 8, each younger cohort showed a greater increase in LFP at each

[26] I also estimated models that additionally included gross total personal income at time t and head of household status, but these did not affect the estimates by much. Results are available upon request.

[27] $\Delta LPF_{pa} = DWB_{pa}\frac{\overline{\Delta LPF_p}}{\overline{DWB_p}}$, where DWB_{pa} is the DWB percentage that people are eligible for at age a in pool p, and $\overline{DWB_p}$ is the (arithmetic) mean of the DWB percentages that people are eligible for in age pool p.

[28] Decomposition results for the base model are available upon request.

age, suggesting that the policy had a greater impact on people who had more time to take the DWB into account when planning their retirement. The men in age pool 8, born in 1949, who were only exposed at age 62 (in 2011), increased LFP by 4.2 percentage points, however, which is a similar increase and slightly less than those exposed at age 62 in 2009.[29] I discuss a possible explanation for this result in the limitations section.

I also ran a falsification test, where I assign DWB-eligibility to younger cohorts born between 1950 and 1960, which, in reality, were not eligible, and create eight parallel treatment and control groups. Table 1.2b shows the treatment and control groups for the falsification test for the eligibility model. I should find no effect of the policy on these age pools. Table 1.2b summarizes the treatment effects. (The full results are shown in Appendix Table A.3.) The results from the base model that only controls for marital status, and includes full sets of age, year and sector dummies, suggest that there was little effect for age pools 4 through 8. The results suggest that there was a small increase in LFP for the oldest age groups, who were nearing their 60s, of 1 to 1.9 percentage points over the 3 years after the introduction of the policy. This might be explained by the anticipation of soon becoming eligible for the DWB. After controlling for receiving a pension, UI, DI or other social benefits, the effects reduce to practically zero for most age pools but the eldest age pool, which shows an effect of 1.4 percentage points. All the estimated effects from my falsification test are smaller than those found in my main results.

Bonus Size: Regression Results

Table 1.6a shows the results from the model that estimates the effect of the size of the

[29] The decomposition results for pool 7 and 8 treats the treatment effect as two and one year averages. This gives more conservative decomposition results than treating it as a 3 year average where the DWB percentage was 0% age the ages before 62.

DWB (that a person is eligible for) on LFP. The coefficient of interest is the coefficient on DWB percentage, where the unit of measurement is in percentage points. Column 1 shows the results from the base model that controls for marital status and includes full sets of age, year and sector dummies. The results suggest that a 1-percentage point increase in the bonus increased male LFP by 0.4 percentage points, although not statistically significant.

Adding controls for pension receipt and social benefits does not change the size of the coefficient of interest, but it is now significant at the 5% level. Additionally including an indicator for whether potential annual gross labor income would reach the cap and an interaction of the DWB percentage and the cap indicator in column 3 suggests that a 1-ppt increase in the bonus increased male LFP by 0.2 percentage points. The results in column 3 suggest that men whose bonus is capped are more likely to work and are more responsive to the DWB. This may sound counterintuitive, but reflects an expected substitution effect of earning a higher wage, and could additionally reflect that higher educated people have more job satisfaction and therefore a stronger labor force attachment, since I am not able to control for education.

Table 1.6b shows the results from the bonus size model that estimates the effect of the size of the bonus at the intensive margin, where the outcome is the log of hours worked. The coefficient of interest is again the coefficient on the DWB percentage, measured in percentage points. The OLS results in column 1 suggest that a 1- ppt. increase in the bonus increased hours worked by 1.1 percent, although not statistically significant. After controlling for individual fixed effects, an increase in the size of the bonus by 1-percentage points is associated with an increase in hours worked of 0.6 percent. Including additional controls for pension receipt and social benefits does not affect the size of the point estimates much, but the fixed effect results are now statistically significant. After controlling for whether an individual's potential annual gross labor income would reach the cap and after including an interaction of the capped indicator with the DWB percentage, the results from my fixed effects model suggest that a 1 percentage point increase in the size of the bonus increases labor supply by .3 percent. The coefficient on the capped variable in the OLS model suggests that men with potential gross income above the cap are more likely to work relative to men with income below the cap, reflecting a substitution effect and potentially greater job market attachment of the higher educated, although not statistically significant. The negative sign on the capped variable in the FE model, suggests that when a person's potential gross income hits the cap they are likely to reduce hours.

My results are slightly higher than wage elasticities of labor supply for prime-age men in the Netherlands, which is 0.1 based on a meta-analysis of empirical estimates in the literature (Evers, De Mooij & Van Vuuren, 2008), but are in line with Mastrogiacomo, Bosch, Gielen & Jongen's (2010) findings that labor supply elasticities are higher for the elder Dutch in their sample, although the oldest in their sample are aged 58. The literature for the United States, (Wise and Gruber 1999, Laitner and Silverman, 2012) and for France and the UK, (Blundell, Bozio and Laroque 2011) has also found that labor supply elasticities tend to be more responsive closer to retirement, as those people are more likely than the overall population to adjust their labor force status. Even though, the size of my results from my preferred estimates are in the range found in the literature, my results suggest a similar response at both the intensive and the extensive margin, even though the general consensus in the literature is that elasticities at the extensive margin are higher (e.g. Heckman, 1993). However, my results cannot directly be compared to typical labor supply estimates, because the independent variable in my specifications is the bonus percentage people are eligible for instead of log wages. Moreover, these are not results from structural models. My results are an estimate of the average effect of the size of the bonus on labor supply.

Limitations

I have argued that the "Great Recession" did not affect labor supply behavior in the Netherlands for the years I study, because Dutch unemployment only started rising after 2011. I include year fixed effects in my models to control for business cycle effects, but it is possible that different cohorts were affected differentially. Even though the average unemployment rate is the same in the period in which the control group is observed (2003 - 2008) as in the period the treatment group is observed (2006 - 2011), figure 1.2 shows that unemployment fell in the control-after period relative to the control-before period, while it rose slightly in the treatment-after period relative to the treatment-before period. This means that labor market conditions likely were slightly more favorable for the control group, than the treatment group, which could explain the unexpected sign on treatment effects for the oldest age pools in my eligibility model. Moreover, worldwide implications of the recession were apparent before Dutch unemployment rose in 2012. This could also explain why the decomposition results suggest that the youngest cohort, only eligible for the DWB at age 62 (in 2011), increased LFP by less than earlier cohorts, as changing conditions could have made it less attractive for this youngest group to delay retirement.[30] Both these phenomena could have biased my estimated effects of the DWB downwards.

The final implementation of policies aimed to reduce DI use in the Netherlands (Burkhauser & Daly, 2001; De Jong, 2008; Van Sonsbeek, 2010) might also affect my identification strategies. However, DI entry was already drastically reduced in 2002, and a two-year waiting period for entry was introduced in January 2004, more than five years prior to implementation of the DWB. Therefore, both the control and treatment group faced similar challenges to exiting the labor force through DI.

The law change in 2006, aimed at reducing the generosity of early pension plans for

[30]Dutch GDP growth fell over 2008 and 2009, and was slow in 2010, while debt-to-GDP ratios have been rising since 2009.
Source: http://data.worldbank.org/indicator/NY.GDP.MKTP.KD.ZG/countries/NL?display=graph and OECD (2010), "OECD Economic Outlook No.88", OECD Economic Outlook: Statistics and Projections (database), doi: 10.1787/data-00533-en. (Last accessed on April 20th, 2015)

cohorts born after 1950, should theoretically not affect my results. However, some of the smaller pension funds took the law change as an opportunity to reduce generosity of benefits for older cohorts. In the eligibility models, it was not possible to control for cohort effects or individual fixed effects, due to multicollinearity with the treatment and control indicators. I include a full set of sector dummies to control for changes in pension funds as well as a full set of year dummies in the model to control for sector effects, like the early pension reforms. But because I can not observe whether someone participated in one of these smaller pension plans that made changes, there could still be uncontrolled differences between the cohorts in this setup, and this should be taken into consideration when interpreting the results.

Furthermore, the results from my falsification analyses in table 1.5 suggests that my results were not driven by the periods selected for my difference-in-differences model, because parallel difference-in-differences for younger cohorts who were not eligible, show very little effects. I argue that the larger effects found for the older cohorts in the falsification set up, can be attributed to anticipation for DWB-eligibility, as they were approaching their 60s. For a more conservative interpretation, I would argue that that my estimates may overstate the true effect of the DWB by about 1-1.5 percentage points, but that they are not fully driven by period effects that affected older and younger cohorts differentially.

In my bonus size models I am able to control for possible cohort differences by including individual fixed effects, which control for unobserved time-invariant cohort characteristics as well as well as unobserved time-invariant individual characteristics. I have addressed serial correlation of the error terms by clustering the standard errors at the cohort level. However, results from Bertrand et al. (2004) suggest that the 11 clusters in the bonus size model may not sufficiently correct this issue, and that care should be taken when making inferences.[31]

Figure 1.1c shows that LFP at 62 increased by 18 percentage points between the 1949

[31] I intend to explore the wild cluster bootstrap t procedure suggested by Cameron, Gelbach and Miller (2008).

cohort and the 1944 cohort (and before). My current best estimate is that about 1/4 of that increase is due to the introduction of the DWB and the rest is due to other changes.

1.5 Conclusion

This chapter studies two aspects of the Dutch *Doorwerkbonus* (DWB). First, it examines the effect of DWB-eligibility on male labor force participation. Second, it explores the responsiveness of labor supply to the size of the DWB. To my knowledge this study is the first to assess the effect of the reform on labor supply of older Dutch men using administrative data.

In my eligibility model, I compare cohorts and look at the effect in the three-year period after introduction. The results from my preferred estimation suggest that the three cohorts that had the opportunity to take up the benefit at the youngest eligibility age, 62, saw the greatest increase in LFP. As a result of the policy, participation for these cohorts increased by 3.8 to 5.5 percentage points in the three years following the introduction of the policy. The next oldest age pool, which still became eligible for the DWB before reaching NRA, showed an increase in LFP of 0.7 percentage points. As expected the DWB did not induce the oldest four age pools that were already at or above NRA to increase LFP. Decomposing the results by age shows that, with each successive cohort, the take up of the bonus tends to increase at each age, suggesting that the DWB had a greater effect on those who had more time to take it into account when planning their retirement.

The results from the bonus size model suggest that after controlling for pension and social benefits receipt, a 1-percentage point increase in the size of the DWB increased participation by 0.4 percentage points (the extensive margin). Results from a model that also controls for individual fixed effects suggests that a 1-percentage point increase in the size of the bonus increased the hours worked by 0.6 percent (intensive margin). My estimates are not directly comparable to estimates of labor supply elasticities, because they do not represent responses to increases in wages, but increases in the DWB bonus that a person is eligible for. My results are an estimate of the average effect of the size of the bonus on labor supply.

This chapter extends earlier work (e.g., Da Silva Soca, 2013), by estimating the effects of the DWB on LFP, by providing more precise estimates using administrative data for the entire population, and by comparing people of the same ages. In future work, I intend to study how the DWB affects spousal retirement behavior as well as female LFP.

Since the debate about increasing labor supply among older workers continues, an understanding of the effects of the DWB on labor supply is relevant to policy makers in the Netherlands and to those in other countries that are actively seeking ways to achieve this goal.

1.6 Figures

Figure 1.1a: Unconditional Male LFP by Year and Age

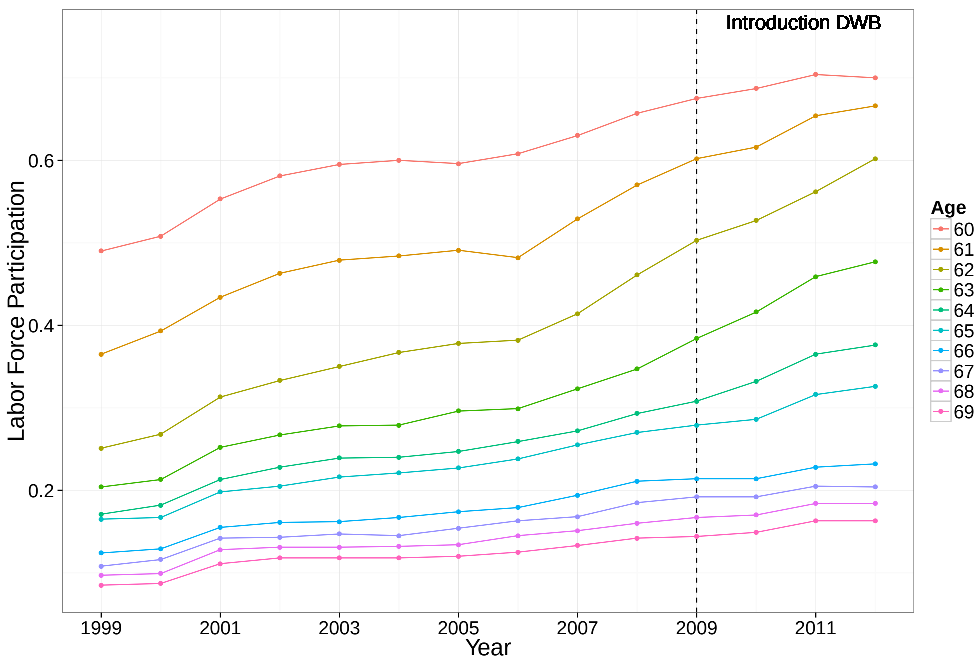


Figure 1.1b: Unconditional Male LFP by Year and Cohort

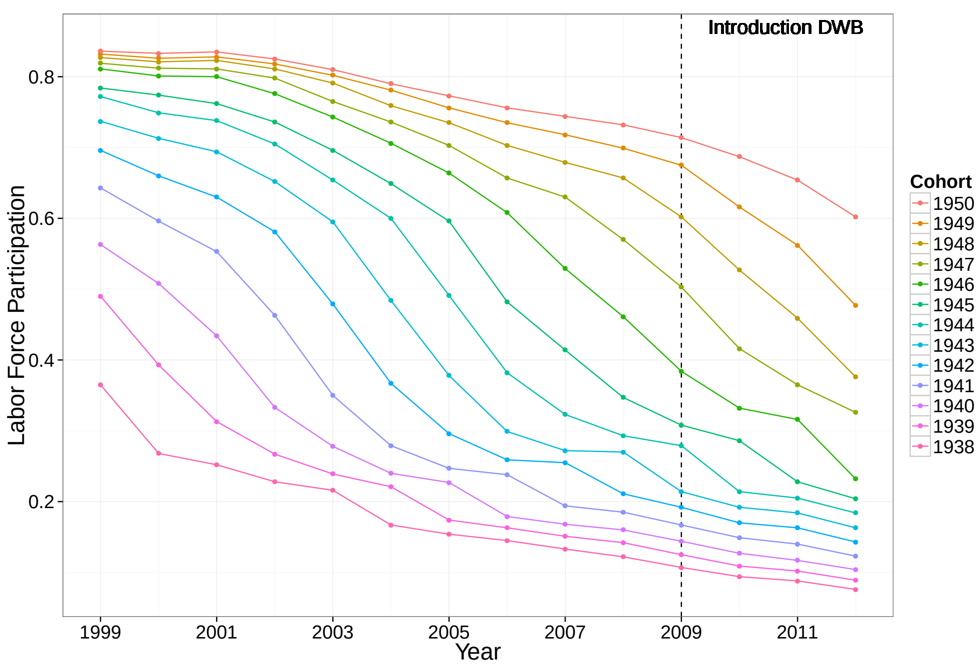


Figure 1.1c: Unconditional Male LFP by Age and Cohort

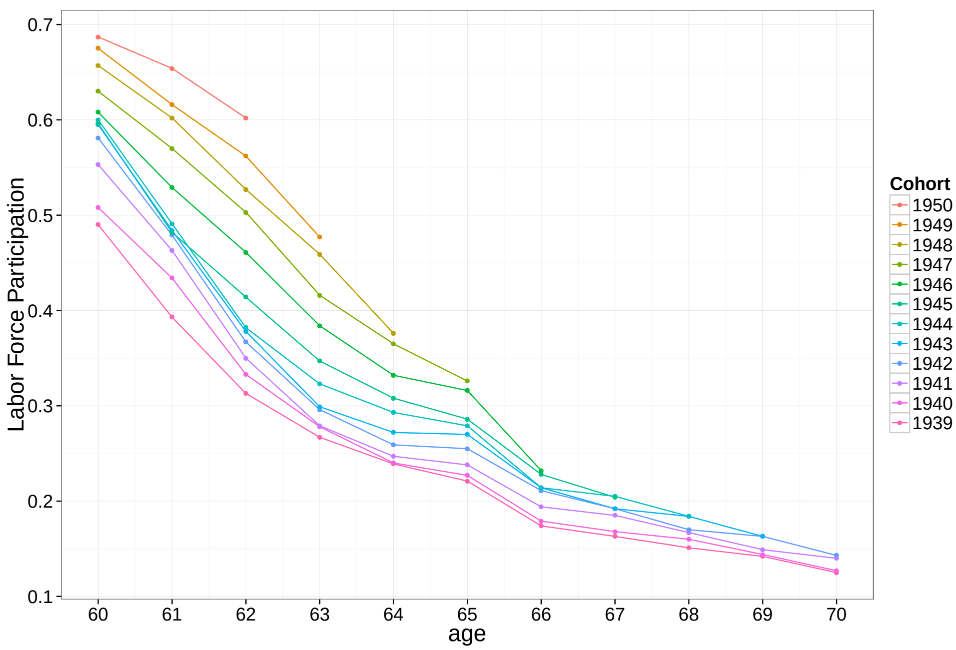
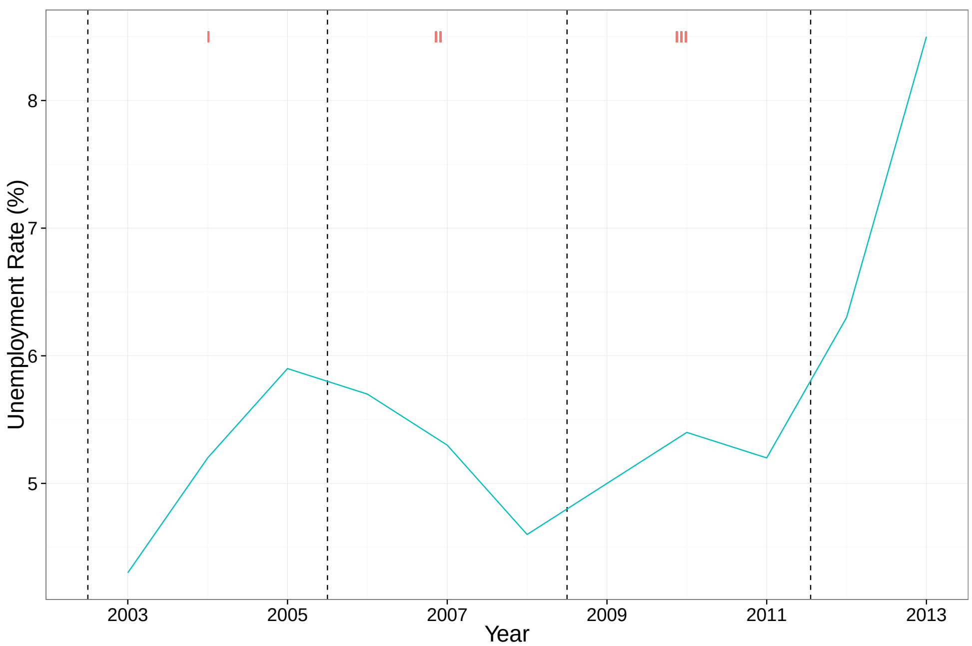
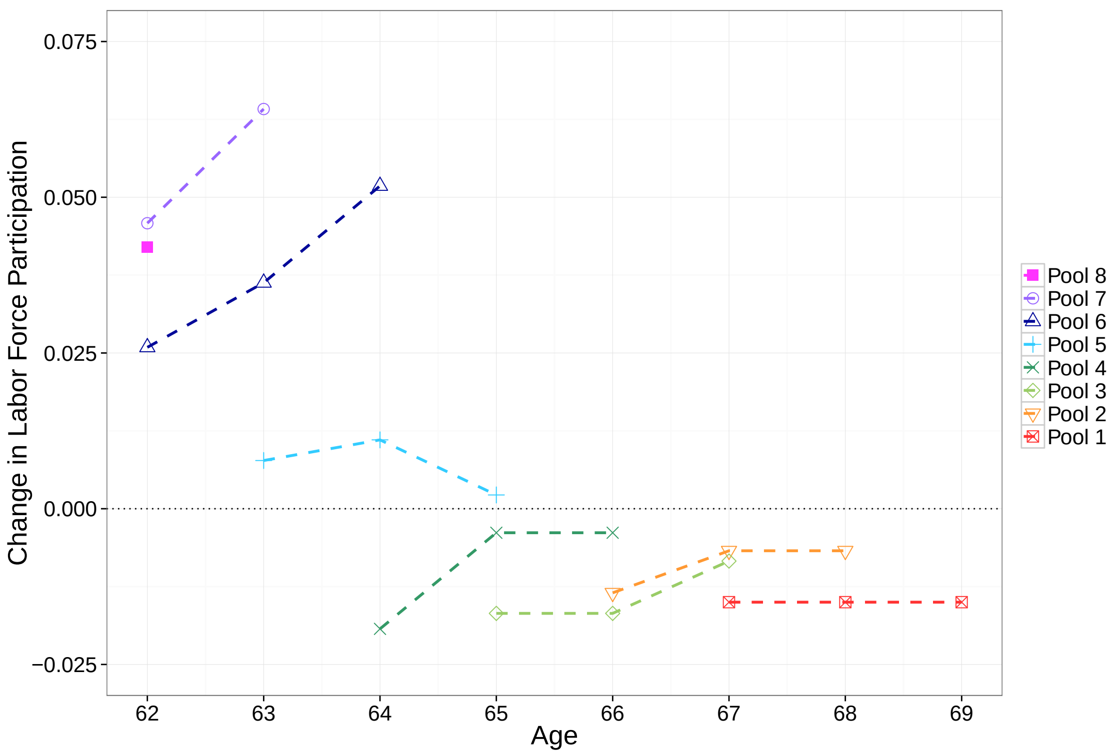


Figure 1.2: Dutch Male Unemployment Rates (Age 55-65)



Source: Statistics Netherlands

Figure 1.3: Decomposing the Treatment Effect by Age



Note: This figure shows results from a decomposition of the treatment effects from the eligibility model that includes controls for pension receipt and social benefits (Appendix table A.2).

1.7 Tables

Table 1.1: The *Doorwerkbonus*

	2009			**2010**			**2011**		
Birth Cohort	**Age**	**Bonus**	**Maximum**	**Age**	**Bonus**	**Maximum**	**Age**	**Bonus**	**Maximum**
1939	70	1%	€459	71	1%	€468	72	1%	€471
1939	70	1%	€459	71	1%	€468	72	1%	€471
1940	69	1%	€459	70	1%	€468	71	1%	€471
1941	68	1%	€459	69	1%	€468	70	1%	€471
1942	67	1%	€459	68	1%	€468	69	1%	€471
1943	66	1%	€918	67	1%	€468	68	1%	€471
1944	65	2%	€918	66	1%	€936	67	1%	€471
1945	64	10%	€4,592	65	2%	€936	66	1%	€942
1946	63	7%	€3,214	64	10%	€4,679	65	2%	€942
1947	62	5%	€2,296	63	7%	€3,276	64	10%	€4,708
1948	-	-	-	62	5%	€2,340	63	7%	€3,295
1949	-	-	-	-	-	-	62	5%	€2,354
Income Cap	**€54,776**			**€55,831**			**€56,280**		
Income Floor	**€8,860**			**€9,041**			**€9,209**		

Source: Belastingdienst (Dutch Tax Administration)

Table 1.2a: Eligibility Model: Treatment and Control Groups

											DWB Policy in Effect		
					I			II			III		
					Control								
					Before			After					
	1999	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
1939	60	61	62	63	64	65	66	67	68	69			
1940	59	60	61	62	63	64	65	66	67	68			
1941	58	59	60	61	62	63	64	65	66	67			
1942	57	58	59	60	61	62	63	64	65	66	67	68	69
1943	56	57	58	59	60	61	62	63	64	65	66	67	68
1944	55	56	57	58	59	60	61	62	63	64	65	66	67
1945	54	55	56	57	58	59	60	61	62	63	64	65	66
1946	53	54	55	56	57	58	59	60	61	62	63	64	65
1947	52	53	54	55	56	57	58	59	60	61	62	63	64
1948	51	52	53	54	55	56	57	58	59	60	61	62	63
1949	50	51	52	53	54	55	56	57	58	59	60	61	62
1950	49	50	51	52	53	54	55	56	57	58	59	60	61
⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮
1959	40	41	42	43	44	45	46	47	48	49	50	51	52
								Treatment					
								Before			After		

Pool 1	**Treatment**	**1942**
	Control	**1939**
Pool 2	**Treatment**	**1943**
	Control	**1940**

Pool 3	**Treatment**	**1944**
	Control	**1941**
Pool 4	**Treatment**	**1945**
	Control	**1942**

Pool 5	**Treatment**	**1946**
	Control	**1943**
Pool 6	**Treatment**	**1947**
	Control	**1944**

Pool 7	**Treatment**	**1948**
	Control	**1945**
Pool 8	**Treatment**	**1949**
	Control	**1946**

Table 1.2b: Eligibility Model: Treatment and Control Groups - Falsification Test

											PLACEBO POLICY		
					I			II			III		
					Control								
					Before			After					
	1999	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
1950	49	50	51	52	53	54	55	56	57	58			
1951	48	49	50	51	52	53	54	55	56	57			
1952	47	48	49	50	51	52	53	54	55	56			
1953	46	47	48	49	50	51	52	53	54	55	56	57	58
1954	45	46	47	48	49	50	51	52	53	54	55	56	57
1955	44	45	46	47	48	49	50	51	52	53	54	55	56
1956	43	44	45	46	47	48	49	50	51	52	53	54	55
1957	42	43	44	45	46	47	48	49	50	51	52	53	54
1958	41	42	43	44	45	46	47	48	49	50	51	52	53
1959	40	41	42	43	44	45	46	47	48	49	50	51	52
1960	39	40	41	42	43	44	45	46	47	48	49	50	51
1961	38	39	40	41	42	43	44	45	46	47	48	49	50
⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮
1969	31	32	33	34	35	36	37	38	39	40	41	42	43
								Treatment					
								Before			After		

Pool 1	**Treatment**	**1953**
	Control	**1950**
Pool 2	**Treatment**	**1954**
	Control	**1951**
Pool 3	**Treatment**	**1955**
	Control	**1952**
Pool 4	**Treatment**	**1956**
	Control	**1953**
Pool 5	**Treatment**	**1957**
	Control	**1954**
Pool 6	**Treatment**	**1958**
	Control	**1955**
Pool 7	**Treatment**	**1959**
	Control	**1956**
Pool 8	**Treatment**	**1960**
	Control	**1957**

Table 1.3a: Eligibility Model: Descriptive Statistics

Sample means (SD) and Proportions

	Pool 1				Pool 2				Pool 3				Pool 4			
Ages	64, 65, 66	67, 68, 69	64, 65, 66	67, 68, 69	63, 64, 65	66, 67, 68	63, 64, 65	66, 67, 68	62, 63, 64	65, 66, 67	62, 63, 64	65, 66, 67	61, 62, 63	64, 65, 66	61, 62, 63	64, 65, 66
Period	Control		Treatment		Control		Treatment		Control		Treatment		Control		Treatment	
Birth Year	1939		1942		1940		1943		1941		1944		1942		1945	
Period	Before	After	Before	After	Before	After	Before	After	Before	After	Before	After	Before	After	Before	After
Working	0.211	0.152	0.242	0.175	0.249	0.169	0.290	0.197	0.292	0.206	0.333	0.233	0.381	0.242	0.414	0.274
Hours Worked	4.52	2.53	4.75	2.77	5.71	2.82	6.20	3.10	7.22	3.66	8.24	4.13	10.75	4.75	11.56	5.56
	(10.11)	(6.18)	(10.14)	(6.6)	(11.62)	(6.75)	(11.98)	(7.18)	(13.23)	(8.36)	(13.91)	(9.02)	(15.86)	(10.14)	(16.05)	(11.03)
DWB [%]								1.33				1.67				4.67
								(0.47)				(0.47)				(3.77)
Age	65	68	65	68	64	67	64	67	63	66	63	66	62	65	62	65
	(0.82)	(0.82)	(0.82)	(0.82)	(0.82)	(0.82)	(0.82)	(0.82)	(0.82)	(0.82)	(0.82)	(0.82)	(0.82)	(0.82)	(0.82)	(0.82)
Married	0.80	0.79	0.80	0.79	0.80	0.79	0.80	0.79	0.80	0.80	0.79	0.79	0.80	0.80	0.79	0.78
Divorced	0.09	0.09	0.10	0.10	0.10	0.09	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.11	0.11
Widowed	0.04	0.05	0.04	0.05	0.04	0.05	0.04	0.05	0.04	0.05	0.04	0.04	0.03	0.04	0.03	0.04
Pension	0.73	1.00	0.77	1.00	0.59	1.00	0.65	1.00	0.57	0.88	0.61	0.90	0.50	0.77	0.51	0.78
UI	0.04	0.00	0.04	0.00	0.06	0.00	0.06	0.00	0.06	0.02	0.06	0.02	0.06	0.04	0.06	0.03
DI	0.19	0.00	0.19	0.00	0.29	0.00	0.26	0.00	0.28	0.09	0.24	0.08	0.27	0.19	0.24	0.16
	0.03	0.02	0.03	0.02	0.04	0.02	0.03	0.02	0.04	0.02	0.03	0.02	0.03	0.03	0.03	0.02
Other Soc. B.	0.09	0.02	0.05	0.01	0.10	0.02	0.06	0.01	0.09	0.04	0.05	0.02	0.07	0.05	0.05	0.04
Person Years	248,886	248,886	269,799	269,799	260,394	260,394	292,674	292,674	255,765	255,765	307,560	307,560	269,799	269,799	294,792	294,792
Unadj. Working ΔAfter-Before	-0.059		-0.067		-0.080		-0.093		-0.086		-0.100		-0.139		-0.140	
Unadj. DiD	-0.008				-0.013				-0.014				-0.001			

	Pool 5				Pool 6				Pool 7				Pool 8			
Ages	60, 61,62	63, 64, 65	60, 61,62	63, 64, 65	59. 60, 61	62, 63, 64	59. 60, 61	62, 63, 64	58, 59, 60	61, 62, 63	58, 59, 60	61, 62, 63	57, 58, 59	60, 61, 62	57, 58, 59	60, 61, 62
Period	Control		Treatment		Control		Treatment		Control		Treatment		Control		Treatment	
Birth Year	1943		1946		1944		1947		1945		1948		1946		1949	
Period	Before	After	Before	After	Before	After	Before	After	Before	After	Before	After	Before	After	Before	After
Working	0.485	0.290	0.533	0.344	0.582	0.333	0.619	0.428	0.647	0.414	0.680	0.530	0.704	0.533	0.717	0.618
Hours Worked	15.30	6.20	16.85	8.30	19.58	8.24	20.77	11.78	22.59	11.56	23.76	16.38	25.24	16.85	25.53	20.62
	(17.8)	(11.98)	(17.91)	(13.82)	(18.5)	(13.91)	(18.25)	(16.06)	(18.44)	(16.05)	(18.05)	(17.7)	(18)	(17.91)	(17.65)	(18.21)
DWB [%]				6.33				7.33				4.00				1.67
				(3.30)				(2.06)				(2.94)				(2.36)
Age	61	64	61	64	60	63	60	63	59	62	59	62	58	61	58	61
	(0.82)	(0.82)	(0.82)	(0.82)	(0.82)	(0.82)	(0.82)	(0.82)	(0.82)	(0.82)	(0.82)	(0.82)	(0.82)	(0.82)	(0.82)	(0.82)
Married	0.80	0.80	0.78	0.78	0.80	0.79	0.77	0.77	0.79	0.79	0.76	0.76	0.78	0.78	0.75	0.75
Divorced	0.10	0.10	0.11	0.11	0.10	0.10	0.12	0.12	0.11	0.11	0.12	0.12	0.11	0.11	0.13	0.13
Widowed	0.03	0.04	0.03	0.04	0.03	0.04	0.03	0.03	0.03	0.03	0.02	0.03	0.02	0.03	0.02	0.03
Pension	0.39	0.65	0.38	0.65	0.29	0.61	0.26	0.55	0.19	0.51	0.18	0.42	0.15	0.38	0.14	0.29
UI	0.07	0.06	0.06	0.04	0.07	0.06	0.06	0.04	0.06	0.06	0.06	0.04	0.05	0.06	0.05	0.05
DI	0.26	0.26	0.21	0.21	0.24	0.24	0.21	0.21	0.24	0.24	0.19	0.2	0.21	0.21	0.18	0.19
Welfare	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
Other Soc. B.	0.06	0.06	0.05	0.05	0.05	0.05	0.04	0.04	0.04	0.05	0.04	0.04	0.04	0.05	0.03	0.04
Person Years	292,674	292,674	408,612	408,612	307,560	307,560	394,893	394,893	294,792	294,792	376,803	376,803	408,612	408,612	364,140	364,140
Unadj. Working ΔAfter-Before	-0.195		-0.189		-0.249		-0.191		-0.233		-0.150		-0.171		-0.099	
Unadj. DiD	0.006				0.058				0.083				0.072			

Note: This table shows the means of each variable by before and after period for the treatment and control groups for each age pool. Means are three year averages. Age, hours worked and are continues variables, all other variables are binary variables. The sample includes men born between 1939 and 1959 the period from 1999 through 2011. For the cohorts that only serve as controls (cohorts 1939, 1940, 1941) the observations after 2008 are not included in the sample. The means for cohorts 1950 through 1959, that are neither in the control nor the treatment groups are not shown here, but are available upon request.

Table 1.3b: Bonus Size Model: Descriptive Statistics

Sample means (SD) and Proportions

DWB Percentage	**0%**	**1%**	**2%**	**5%**	**7%**	**10%**
Working	0.58	0.15	0.26	0.53	0.42	0.34
Working	0.58	0.15	0.26	0.53	0.42	0.34
Hours Worked	16.98	2.51	4.98	16.35	11.34	8.08
	(18.34)	(6.07)	(10.23)	(17.67)	(15.82)	(13.68)
Age	59.05	68.99	65.47	62	63	64
	(4.19)	(1.53)	(0.50)	-	-	-
Married	0.79	0.79	0.78	0.76	0.77	0.77
Divorced	0.11	0.10	0.10	0.12	0.12	0.11
Widowed	0.03	0.06	0.04	0.03	0.03	0.04
Receiving Pension	0.29	1.00	0.85	0.42	0.57	0.64
Receiving Ul Benefits	0.05	0.00	0.02	0.04	0.04	0.04
Receiving Dl Benefits	0.20	0.00	0.12	0.20	0.21	0.22
Receiving Welfare	0.03	0.02	0.02	0.03	0.03	0.03
Receiving Other Social Benefits	0.04	0.01	0.03	0.04	0.04	0.05
Person Years	11,949,421	1,332,480	635,330	378,612	393,436	366,099

Note: This table shows the means for each variable for each DWB percentage eligibility group. The group indicated with 0% consists of people of all ages prior to the reform and of people younger than 62 after the reform. Hours worked and age are continues variables, all other variables are binary variables. The sample includes men born between 1939 and 1949 the period from 1999 through 2011.

Table 1.4: Eligibility Model: Treatment Effects

		Pool 1	Pool 2	Pool 3	Pool 4	Pool 5	Pool 6	Pool 7	Pool 8
	Ages	**67, 68, 69**	**66, 67, 68**	**65, 66, 67**	**64, 65, 66**	**63, 64, 65**	**62, 63, 64**	**61, 62, 63**	**60, 61, 62**
	Treatment Cohort	**1942**	**1943**	**1944**	**1945**	**1946**	**1947**	**1948**	**1949**
	Control Cohort	**1939**	**1940**	**1941**	**1942**	**1943**	**1944**	**1945**	**1946**
	Base Model								
(1)	Treatment Effect	-0.022	-0.020	-0.030	-0.016	0.003	0.048	0.074	0.063
		(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)
	Base Model + Controls for Social Benefits								
(2)	Treatment Effect	-0.015	-0.010	-0.014	-0.009	0.007	0.038	0.054	0.042
		(0.004)	(0.005)	(0.004)	(0.004)	(0.004)	(0.005)	(0.005)	(0.005)

Note: This table shows the main results from the eligibility model, specified as a linear probability model. The dependent variable is an indicator variable for whether or not a person worked. The treatment effects are defined as the difference in differences between the coefficient on the before and after period indicators of the treatment and control groups for each age pool. Row (1) shows the treatment effect from the base model, which includes controls for marital status and full sets of dummies for age, year and sector. Full results are shown in Appendix Table A.1 (column 1). Row (2) shows the results from the model includes controls for marital status, whether someone is receiving pension, welfare, DI, UI, other social benefits, and full sets of dummies for age, year and sector. Full results are shown in Appendix Table A.1 (column 2). The standard errors are clustered at the cohort level, 21 clusters in total. The sample includes men born between 1939 and 1959 the period from 1999 through 2011. For the cohorts that only serve as controls (cohorts 1939, 1940, 1941) the observations after 2008 are not included in the sample.

Table 1.5: Eligibility Model: Treatment Effects - Falsification Test

		Pool 1	Pool 2	Pool 3	Pool 4	Pool 5	Pool 6	Pool 7	Pool 8
	Ages	**67, 68, 69**	**66, 67, 68**	**65, 66, 67**	**64, 65, 66**	**63, 64, 65**	**62, 63, 64**	**61, 62, 63**	**60, 61, 62**
	Treatment Cohort	**1942**	**1943**	**1944**	**1945**	**1946**	**1947**	**1948**	**1949**
	Control Cohort	**1939**	**1940**	**1941**	**1942**	**1943**	**1944**	**1945**	**1946**
	Base Model								
(1)	Treatment Effect	0.019	0.010	0.009	0.004	0.005	0.003	0.003	0.003
		(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
	Base Model + Controls for Social Benefits								
(2)	Treatment Effect	0.014	0.007	0.006	0.002	0.003	0.002	0.002	0.002
		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)

Note: This table shows the main results from the falsification test for the eligibility model, specified as a linear probability model. The dependent variable is an indicator variable for whether or not a person worked. The treatment effects are defined as the difference in differences between the coefficient on the before and after period indicators of the treatment and control groups for each age pool. Row (1) shows the treatment effect from the base model, which includes controls for marital status and full sets of dummies for age, year and sector. Full results are shown in Appendix Table A.3 (column 1). Row (2) shows the results from the model includes controls for marital status, whether someone is receiving pension, welfare, DI, UI, other social benefits, and full sets of dummies for age, year and sector. Full results are shown in Appendix Table A.3 (column 2). The standard errors are clustered at the cohort level, 20 clusters in total. The sample includes men born between 1950 through 1969 the period from 1999 through 2011. For the cohorts that only serve as controls (cohorts 1950, 1951, 1952) the observations after 2008 are not included in the sample.

Table 1.6a: Bonus Size Model: Extensive Margin

	(1)	(2)	(3)
DWB Percentage	0.004	0.004	0.002
	(0.000)	(0.000)	(0.000)
Capped * DWB Percentage			0.010
			(0.000)
Capped			0.031
			(0.001)
Married or partnered	0.058	0.061	0.058
	(0.001)	(0.001)	(0.001)
Divorced or separated	0.033	0.036	0.034
	(0.002)	(0.002)	(0.002)
Widowed	0.006	0.108	0.107
	(0.002)	(0.002)	(0.002)
Receiving Pension		-0.400	-0.401
		(0.001)	(0.001)
Receiving Ul Benefits		-0.354	-0.353
		(0.002)	(0.001)
Receiving Dl Benefits		-0.176	-0.173
		(0.001)	(0.001)
Receiving Welfare		-0.488	-0.485
		(0.005)	(0.005)
Receiving Other Social Benefits		-0.178	-0.178
		(0.002)	(0.002)
N	6,855,956	6,855,956	6,855,956

Note: This table shows coefficients from linear probability models. The dependent variable in an indicator variable for whether or not a person worked. The sample includes men born between 1939 and 1949 the period from 1999 through 2011. The standard errors are clustered at the cohort level, 11 clusters in total. DWB percentage is defined in percentage points [1-100].

Table 1.6b: Bonus Size Model: Intensive Margin

	(1)	(2)	(3)	(4)	(5)	(6)
DWB Percentage	0.011	0.006	0.010	0.006	0.005	0.003
	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Capped * DWB Percentage					0.028	0.025
					(0.001)	(0.001)
Capped					0.029	-0.043
					(0.003)	(0.002)
Married or partnered	0.169	0.010	0.182	0.010	0.178	0.189
	(0.005)	(0.023)	(0.004)	(0.018)	(0.004)	(0.004)
Divorced or separated	0.097	0.024	0.108	0.010	0.105	0.118
	(0.006)	(0.024)	(0.005)	(0.019)	(0.005)	(0.005)
Widowed	0.010	-0.057	0.449	0.217	0.447	0.425
	(0.008)	(0.024)	(0.007)	(0.02)	(0.007)	(0.007)
Receiving Pension			-1.682	-1.808	-1.683	-1.775
			(0.003)	(0.003)	(0.003)	(0.002)
Receiving Ul Benefits			-1.405	-1.210	-1.403	-1.250
			(0.005)	(0.004)	(0.005)	(0.004)
Receiving Dl Benefits			-0.747	-0.670	-0.743	-0.703
			(0.004)	(0.005)	(0.004)	(0.004)
Receiving Welfare			-1.906	-0.891	-1.900	-1.248
			(0.015)	(0.016)	(0.015)	(0.013)
Receiving Other Social Benefits			-0.728	-0.799	-0.728	-0.783
			(0.006)	(0.005)	(0.006)	(0.005)
Individual Fixed Effects	No	Yes	No	Yes	No	Yes
N	6,584,600	6,584,600	6,584,600	6,584,600	6,584,600	6,584,600

Note: This table shows coefficients from OLS models with and without individual fixed effects. The dependent variable is the log of average hours worked per week. The sample includes men born between 1939 and 1949 the period from 1999 through 2011. The standard errors are clustered at the cohort level, 11 clusters in total. DWB percentage is defined in percentage points [1-100].

Chapter 2

Joint Delayed Retirement of Couples

2.1 Introduction

Over the past several decades, concerns have grown in many countries about the rising life expectancy and the future fiscal solvency of social security systems. Declines in labor force participation (LFP) of the middle-aged, attributed to incentives built into many social security systems (Gruber & Wise, 1999), have become the focal point of policy makers around the world.

In the Netherlands, low labor supply of older workers have been a particular concern, because LFP among individuals aged 60 and older has been low since the 1980s and 90s (Gruber & Wise, 1999; Kapteyn & De Vos, 1999). In 2006, only 34.6% of Dutch men and 19.2% of Dutch women between the ages 60 and 64 were working, compared to 52.2% of men and 32.1% of women in the OECD countries (OECD, 2015). Due to a pronounced baby boom after WWII and a stark decline in fertility, the Dutch old-age dependency ratio experienced a steep increase from 17 to 27 over the last 30 years, and is projected rise to 42 in 2050 (World Bank, 2015; United Nations, 2013).[1]

The combination of rising life expectancy, fewer workers to support retirees and a status quo of early retirement (i.e., short working lives) threatens the fiscal balance and long-term solvency of the social security system in the Netherlands and in many other countries (Gruber & Wise, 1999; 2004; 2007). To address this issue, the Dutch government has implemented reforms to social security, e.g. by increasing the normal retirement age (NRA), the age at which workers become fully eligible for the state pension (social security).[2]

In 2009, the Netherlands also implemented a delayed retirement policy, called the *Doorwerkbonus* (DWB), which offered a fiscal discount in each year that a person worked after the age of 62.[3] My results from the previous chapter suggest that in the three years after introduction, the DWB increased male LFP by about 4.5 percentage points on average among cohorts that were eligible before NRA.

A burgeoning strand of literature has shown that household labor supply decisions are interdependent. Furthermore, it has highlighted that there could be important policy implications due to spillover effects from jointly determined retirement decisions within the couple (Hurd, 1989; Blau, 1998; Coile, 2004; Blau and Gilleski, 2006).

To study the retirement decisions of couples and potential spillover effects from retirement policies, natural experiments have been used in difference-in-differences models (e.g. Baker, 2002) and in instrumental variable models (e.g. Bloemen, Hochguertel and Zweerink, 2015).

In this chapter, I exploit the introduction of the DWB, to study the Local Average Treatment Effect (LATE) of husbands working on the probability that their wives work, for

[1]The old age dependency ratio is defined as the ratio of people older than 64 to those aged 15-64. The Dutch population aged more rapidly than in the United States, where the ratio increased more slowly, from 16.2 to 20.4 between 1975 and 2013 and is projected to rise to 34 in 2050.

[2]Starting in 2013 the Netherlands increased the NRA by 1-3 months per birth cohort, and it is scheduled to be 66 in 2018 and 67 in 2021.

[3]The direct translation of *Doorwerkbonus* in English is *continued work bonus*.

couples in which the husband was induced by the policy to remain in the labor force. I also study the spillover effects of the policy through the husbands' labor force response to the policy, as well as the average effect of the policy on wives that were not eligible themselves.

The literature on household labor supply has found that retirement decisions are jointly determined. It has identified three potential drivers behind the interdependence between spouses' labor market decisions: 1) income effects, 2) assortative mating and 3) complementarity of leisure. Using data from the New Beneficiary study, Hurd (1990) finds that husbands and wives tend to retire at the same time. Blau (1998) similarly finds strong evidence for joint retirement using HRS data.

Besides the timing of retirement, Coile (2003) finds that men are very responsive to their wives' financial incentives from social security and private pensions, but that women are not very responsive to their husbands' incentives, which is suggested to be caused by asymmetric complementarities of leisure. Gerard and Nekby (2012) find large spillover effects of Swedish pension reforms on spousal retirement probabilities. Using data from eleven European countries from the Survey on Health, Ageing and Retirement in Europe (SHARE), Hospido and Zammaro utilize early retirement eligibility ages in a fuzzy regression discontinuity design, and find that when husbands are induced to retire, the retirement probability of their wives increases by 16 to 18 percentage points. Bloemen, Hochguertel and Zweerink (2015), use a policy change that offered an early retirement opportunity for civil servants in the Netherlands in an instrumental variables model, and find large effects of retirement opportunities for male civil servants on their wives' probability to retire in the Netherlands. They find that early retirement opportunities of husbands increase their wives' probability to retire by 24.6 percentage points.

This chapter builds on and extends the literatures on joint retirement of couples and on spillover effects of retirement policies to the case of the Netherlands, by studying the impact of a national policy that raises the effective annual wage for some period when delaying retirement.

Studies have suggested that the omission of spillover effects will bias estimates of the effects of social security policy changes (e.g. Coile, 2004). Due to the ongoing debate on the sustainability of social security systems, an understanding of the spillover effects of delayed retirement policies, such as the DWB, on the labor supply of spouses is relevant not only to policy makers in the Netherlands, but also to those in other countries considering policy reforms.

2.2 Background

The institutional background in the Netherlands, including the pension system and the details of the *Doorwerkbonus* are described in chapter 1.2.

Labor Force Participation and Unemployment in the Netherlands

Figure 2.1a shows male LFP by year and by cohort, for the cohorts born between 1944 and 1949. After 2006 the LFP curves become more concave, reflecting two changes in that year: the final implementation of disability insurance restrictions (De Jong, 2008; Van Sonsbeek, 2010), as well a law change that reduced generosity of early retirement schemes for cohorts born after 1950. Even though this law change itself was aimed at younger cohorts and started affecting LFP only after 2012, in 2007, in anticipation of the change, some smaller pension funds introduced a phased reduction of generosity for cohorts born between 1946 and 1950. After the introduction of the DWB only a slight divergence between the youngest cohorts is discernable.

Figure 2.1b shows female LFP by year and cohort, for cohorts born between 1950 and

1959. In this figure we also see that the 2006 policy change had a slight effect on female LFP, making the curves flatter. The figure is also suggestive of a change of the slope after the introduction of the DWB in 2009.

The "Great Recession" of the late 2000s could also have affected labor supply, although it is likely to be less of a concern in the Netherlands than in other settings. While unemployment rates in many countries started peaking in 2009, figure 2.2a shows that the Dutch unemployment rate for males aged 60 through 65 was relatively stable between 2003 and 2011, at an average around 5.2 percent. The rate only started rising steeply after 2011 reaching 8.5 percent in 2013, but remained below early 2006 levels until spring 2012.

Figure 2.2b shows the Dutch unemployment rate for females aged 55 through 60. The shape is similar to that of older males in that same period, although the peak and trough are a little less sharp for females.

2.3 Empirical Strategy

Data

To study the impact of the husbands' choice to delay retirement on their wives' labor supply decision, I use the highly restricted administrative microdata on all Dutch residents collected by Statistics Netherlands from various administrative sources such as the population registry, the Employee Insurance Agency (the administrative authority that handles AOW, disability insurance (DI), unemployment insurance (UI), and other social benefits), the tax administration, and other sources for the years 1999 - 2011. I use the datasets containing information on labor, pension benefits, social security benefits and demographic data for the entire population of the Netherlands (16.7 million people in 2009), which can be linked together by a personal identifier.[4]

I will focus on couples with younger wives that were not eligible for the DWB and only include married and partnered couples that were continuously married in the observed period.[5]

Regression Framework

I am interested in how the husbands' working status affects their wives' probability of working. Typically, reverse causality makes it challenging to estimate the causal effect of one spouse's labor supply decision on the partner's labor supply, and OLS estimations of the effect of husbands' LFP on their wives' LFP would likely be biased. To correct for endogeneity, I use an instrumental variables model and exploit the introduction of the DWB in a Two-Stage-Least-Squares (2SLS) model, to estimate the Local Average Treatment Effect (LATE) of husbands working on the probability that their wives work, for couples in which the husband was induced by the DWB to remain in the labor force.[6]

I am also interested in the average effect of the DWB-eligibility of the husbands on the wives that were not eligible for the policy themselves.

Joint Retirement: The Effect of the DWB on Husbands' Labor Force Participation

In the previous previous chapter, I exploited the panel nature of the data, and the fact that the introduction of the DWB can be seen as a natural experiment to study the effect of

[4]To gain access to the data, I traveled to the Netherlands to be fingerprinted. The data is accessible via VPN, through a fingerprint secured network, which requests verification every 20 minutes.

[5]I also ran my analyses on a sample that included couples that changed marital status (either due to divorce or widowhood), but excluded observations during which they were single but included them after remarriage. This did not affect my estimates much. Results available upon request.

[6]See Imbens (2014) for a recent review of instrumental variable models.

DWB-eligibility on male labor force participation using a series of difference-in-differences, the workhorse of the policy-evaluation literature on retirement measures (Gruber and Orszag, 2000; Song and Manchester, 2007; Haider and Loughran, 2008; Novella, 2012). For cohorts that were eligible before NRA, I found a treatment effect associated with the DWB of 4.5 percentage points on average over the three years after introduction. Because my previous results suggest that the cohorts born in 1947, 1948 and 1949 were the most responsive to the DWB policy, I focus my analysis in this chapter on couples with husbands born in these years.[7]

I first revisit the question of what the treatment effect of the DWB is on labor force participation for these husbands specifically. I estimate the average effect of DWB-eligibility for these husbands, in a difference-in-differences model that pools the three birth cohorts into a treatment group. I consider husbands that become eligible for the DWB as the "treatment" group, and compare them to cohorts who were not eligible at the same ages, the "control" group. The treatment and control groups are shown in table 2.1. Even though the DWB is only offered for work after the age of 62, and those born in 1948 and 1949 only turn 62 in 2010 and 2011 respectively, my previous results suggest that people stayed in the labor force in anticipation of eligibility. Therefore, I consider all the post-2009 years as the treatment-after period.

In the ideal difference-in-differences model I would construct a control group that would have been the same ages in the same years, but that were not eligible for the DWB. Because the DWB is a national policy, however, I do not have an appropriate control group that was born in the same years, but that was not eligible. Unfortunately, younger cohorts would also not be an appropriate control group, as they are likely to show very different labor market behavior. Therefore, I match my treatment group to slightly older cohorts that were not

[7] The 1947, 1948 and 1949 cohorts correspond to the treatment groups from difference-in-differences age pools VI, VII and VIII in my previous chapter.

eligible at the same ages.

My identifying assumption is, that the only dissimilarities between the groups are that the treatment group is eligible for the bonus while the control group is not, and that they experience specific ages in different periods. I argue that a full set of year dummies will account for these dissimilarities.

The first difference in my difference-in-differences model represents the change in husbands' average LFP in the treatment group and is given by the change in average LFP from the treatment-before period (2006-2008) to the treatment-after period (2009-2011). The second difference represents the change in husbands' average LFP in the control group and is given by the change in average LFP from the control-before period (2003-2005) to the control-after period (2006-2008). The treatment effect associated with the husbands' DWB-eligibility is given by the difference in these differences.

I estimate the following linear probability model:

$$HW_{ct} = \alpha_0 + X_{ct}'\beta + \lambda Control_{ct}^{before} + \pi Control_{ct}^{after} + \rho Treat_{ct}^{before} + \theta Treat_{ct}^{after} + \epsilon_{ct} \quad (2.1)$$

where HW_{ct} is an indicator variable for whether or not the husband in couple c was working at time t, vector X_{ct} is a vector of controls for whether the husband or the wife in couple c are recipients of a pension, UI, DI or other social benefits, and full sets of dummy variables for year, husbands' age, wives' age, husband's sector at time t.[8] $Control_{ct}^{before}$, $Control_{ct}^{after}$, $Treat_{ct}^{before}$ and $Treat_{ct}^{after}$ are indicators for whether a husband in couple c is in the before or after period of the treatment or control groups at time t.[9] The coefficients λ and π give

[8]Due to the large size of my dataset, I choose to estimate linear probability models (OLS) instead of logit models in the interest of reducing estimation run-time. Furthermore, linear probability model coefficients have the advantage of easy interpretation and are the parameters of interest (probability derivatives).

[9]I include indicators for each of the four before and after periods for the control and treatment groups, because I cannot use the standard difference-in-differences treatment and after interaction, since my treatment and control groups are observed in different periods.

the husbands' mean LFP in the before and after period for the control group and ρ and θ give the husbands' mean LFP in the before and period for the treatment group respectively. The first difference, $\theta - \rho$, gives the change in the husbands' mean LFP from the before to the after period for the treatment group, while the second difference, $\pi - \lambda$, gives the change in husbands' mean LFP from the before to the after period for the control group. The treatment effect, the average change in the husbands' mean LFP associated with DWB-eligibility is given by $\overline{\Delta\, husbands'\, LPF} = (\theta - \rho) - (\pi - \lambda)$.

I use robust standard errors to correct for potential heteroskedasticity in the error terms and cluster the standard errors at the husband-wife birth cohort level to correct for serial correlation of the error terms within spouses' birth cohort combinations.[10]

My sample includes couples with husbands born between 1944 and 1955, and wives born between 1949 and 1959.[11] None of the wives of these couples were eligible for the DWB. Couples with husbands born after 1949 are neither in the treatment or control group, but are in the sample to help estimate the year effects.[12]

The results from this model will confirm whether the DWB had an effect on husbands' LFP, and whether there is variation in husbands' LFP due to the DWB that can explain variation in LFP of their wives. It will also provide evidence for whether the policy can be a valid instrument.

Uninstrumented Case: Joint Retirement

Before describing the 2SLS model, in which I will estimate the effect of the husbands'

[10] My sample contains 114 clusters in total.

[11] For the majority of all couples of which the husband was born between 1944 and 1949, the husband was between 0 to 4 years older than the wife.

[12] Observations of couples in the control group are dropped after 2008, because the husbands are also eligible for the DWB in these years.

LFP on the LFP of their wives, I will first discuss an uninstrumented version, the structural equation, of this model, in which I regress the wife's working status on the husband's working status without correcting for endogeneity caused by reverse causality or omitted variables.

I estimate the following linear probability model:

$$WW_{ct} = \gamma_0 + \gamma_1 HW_{ct} + X'_{ct}\beta + \upsilon_{ct} \tag{2.2}$$

where WW_{ct} and HW_{ct} respectively, are indicator variables for whether or not the wife or the husband in couple c was working at time t, X_{ct} includes the same controls as defined above, but now additionally includes a full set of dummy variables for wife's sector.

I use robust standard errors to correct for potential heteroskedasticity in the error terms and cluster the standard errors at the husband-wife birth cohort level to correct for serial correlation of the error terms within spouses' birth cohort combinations.

Two-Stage-Least-Squares: Joint Retirement - Instrument Validity

I use DWB-eligibility to instrument for husband's LFP in the 2SLS model, which estimates the effect of the husband's work status on the wife's probability of working. For this instrument to be valid it needs to satisfy three conditions: 1) it needs to be as good as randomly assigned, 2) satisfy the exclusion restriction (not belong in the structural equation), and 3) affect the husbands' LFP.

I argue that because the policy was introduced nationally and eligibility was based on age, and age can not be chosen, the policy can be seen as having been randomly assigned across the treatment and control groups. Furthermore, I argue that wives' own LFP should not be affected by DWB-eligibility, if they were not eligible themselves. The results from the previous chapter show that the policy increased men's LFP. The results from my difference-in-differences model on the husbands of the couples in my sample will confirm that the policy affected their LFP.

There may be reasons why these arguments do not hold, however, which I will discuss in the final section of this chapter.

Two-Stage-Least-Squares: Joint Retirement - First Stage

The first stage of the model is specified as follows:

$$HW_{ct} = \delta_0 + X'_{ct}\beta + \delta_1 DWB^{Husb}_{ct} + \eta_{ct} \tag{2.3}$$

where HW_{ct} is an indicator variable for whether or not the husband in couple c was working at time t, vector X_{ct} is the same as defined above. The instrument DWB^{Husb}_{ct} indicates whether the husband of couple c, was DWB-eligible at time t.

As noted earlier, my previous results suggest that men stayed in the labor force in anticipation of becoming eligible. Thus, I consider all husbands born in 1947, 1948, 1949 as DWB-eligible after 2009.

Two-Stage-Least-Squares: Joint Retirement - Second Stage

The second stage is specified as follows:

$$WW_{ct} = \zeta_0 + X'_{ct}\beta + \omega\widehat{HW}_{ct} + \nu_{ct} \tag{2.4}$$

where the dependent variable WW_{ct} is again the wife's work status, $\widehat{HW}_{ct}$ is the husband's predicted work status from the first stage and the other variables are the same as defined above. ω, the coefficient of interest, gives the LATE, the probability that the wife works if the husband is working, among couples in which the husband was induced to work by the DWB.

I estimate this model with robust standard errors to correct for potential heteroskedasticity in the error terms and cluster the standard errors at the husband-wife birth cohort level to correct for serial correlation of the error terms within husband and wife birth cohort combinations.

Reduced Form: Policy Effects from the DWB

I am also interested in the average effect effect of the DWB on the LFP of wives who were not eligible themselves. There are two potential pathways through which the DWB could affect the LFP of a wife who is not eligible herself: 1) her LFP could be affected because she anticipates becoming eligible in the future, or 2) she adjusts her LFP because her husband adjusts his LFP due to the DWB.

I compare the LFP of wives whose husbands were DWB-eligible to the LFP of wives whose husbands were not, in a difference-in-differences model. The treatment and control groups are determined by their husbands' birth cohorts following the previous difference-in-differences model described in equation 2.1 and in table 2.1.

The change in the average LFP for wives in the treatment group with husbands born in 1947, 1948 and 1949 is the first difference in my difference-in-difference model and it is given by the change in wives' average LFP from the treatment-before period (2006-2008) to the treatment-after period (2009-2011). The change in average LFP of wives in the control group with husbands born in 1944, 1945 and 1946 (thus not DWB-eligible) is the second difference and is given by the change in wives' average LFP from the control-before period (2003-2005) to the control-after period (2006-2008). The treatment effect associated with the husbands' DWB-eligibility is given by the difference in these differences.

I estimate the following linear probability model:

$$WW_{ct} = \xi_0 + X_{ct}'\beta + \kappa Control_{ct}^{before} + \sigma Control_{ct}^{after} + \tau Treat_{ct}^{before} + \phi Treat_{ct}^{after} + \mu_{ct} \quad (2.5)$$

where all the variables are the same as defined above.[13] In this regression the coefficients κ and σ give the wives' mean LFP in the before and after period for the control group and τ and ϕ give the wives' mean LFP in the before and period for the treatment group respectively. The first difference, $\phi - \tau$, gives the change in the wives' mean LFP from the before to the after period for the treatment group, while the second difference, $\sigma - \kappa$, gives the change in wives' mean LFP from the before to the after period for the control group. The treatment effect, the average change in the wives' mean LFP associated with DWB-eligibility is given by $\overline{\Delta\, wives'\, LPF} = (\phi - \tau) - (\sigma - \kappa)$.

I use robust standard errors to correct for potential heteroskedasticity in the error terms and cluster the standard errors at the husband-wife birth cohort level to correct for serial correlation of the error terms within spouses' birth cohort combinations.

[13]I drop the observations after 2008 for the couples with husbands born in 1944, 1945 and 1946 from the sample

2.4 Results

Summary Statistics

Table 2.2 shows means and proportions for husbands and wives in the before and after period by the husbands' treatment and control group status.

The husbands and wives are very similar to each other in the before periods across the treatment and control groups in all characteristics except working status. In the after period the husbands and wives are very similar across the treatment and control groups except for working status, pension and UI receipt for husbands.

Joint Retirement: The Effect of the DWB on Husbands' Labor Force Participation

Table 2.3 shows the coeficients from the difference-in-differences models. The second to last row shows the difference-in-differences estimates, the treatment effects on husbands' LFP associated with DWB-eligibility. The first column shows the results from the model that only additionally controls for full sets of husband and wife age dummies, year dummies, and husband's sector dummies.[14] The difference-in-differences estimate suggests an increase of 7.9 percentage points in husbands' LFP that was associated with the DWB.

After including controls for whether the husband is receiving a pension, UI, DI, welfare or other social benefits, the treatment effect is reduced to 5.4 percentage points. Including additional controls for whether the wife receives a pension or social benefits does not affect the treatment results much and are comparable to the results I found in my previous study in which I estimated the treatment effect on all men.

[14]I also estimated models that included a full set of dummies for the wife's sector, but this did not affect the main results

These findings support my hypothesis that the policy fullfills the condition required to make it a valid instrument, that it affects the endogenous variable, husbands' LFP.

Uninstrumented Case: Joint Retirement

Table 2.4 shows the results from the uninstrumented structural model of interest, in which I regress the wife's working status on the husband's working status. Column 1 shows the results from the base model, which only additionally includes full sets of dummies for the husband's age, the wife's age, husband's and wife's sector and year. The results from this model suggest that wives are 13 percentage points more likely to work if their husbands work than when they do not work.

Adding controls for whether the husband receives a pension or social benefits does not change the coefficient of interest. Adding controls for whether the wife receives a pension or social benefits reduces the point estimate to 12 percentage points. These models do not correct for potential endogeneity, however, and are likely biased due to reverse causality or omitted variables.

Two-Stage-Least-Squares: Joint Retirement

To address endogeneity, I instrument the husband's working status with DWB-eligibility in a 2SLS model. Table 2.5 shows the results from the second stage of this analysis. First stage results are shown in appendix table B.1.

The main coefficient of interest is the coefficient on the predicted working status of the husband, the LATE. The results from my base model (column 1), which only additionally includes full sets of year, husbands' age, wives' age, husband and wife sector dummies, suggest that wives are 35 percentage points more likely to work if their husbands work, among couples in which the husband was induced by the DWB to remain in the work force. The F-statistic from the first stage is 62.8.

After including additional controls for whether the husband receives a pension or social benefits the effect increases to 43.8 percentage points. The F-statistic from the first stage is 74.8. The results show that if a husband receives welfare, this has a large negative effect on the wife's LFP. This suggest that there is likely omitted variable bias and that she also receives welfare. After adding controls for whether the wife receives a pension or social benefits, the LATE is reduced to 30 percentage points.

The effects that I find are larger than IV retirement estimates found in the literature, although they are also large. Banks, Blundell and Casanova (2010) find that in the UK a husband is 14-20 percentage points more likely to retire when his wife retires, while Hospido and Zamarro (2014) find that wives are 21 percentage points more likely to retire when their husbands retire (they do not find an effect for men upon retirement of their wives). My models estimate the spouse's probability of working instead of to retire, and are larger, which could be due to asymmetry between remaining in the labor force and exiting the labor force.

My IV results are also larger than my results from my uninstrumented model, which could be due to heterogenous treatment effects.

Multiplying my earlier estimate of the husband's treatment effect of a 5.3 percentage points increase in LFP with the LATE estimate suggests that there was a spillover effect from the policy of about 1.5 percentage points on the wives' LFP.

Reduced Form: Policy Effect on Uneligible Wives

I estimate the average effect of the husbands' eligibility for the DWB on the labor force participation of wives who were not eligible themselves in a reduced form difference-in-differences model. In this model I compare LFP of wives' whose husbands were DWB-eligible to the LFP of wives whose husbands were not. Table 2.6 shows the coefficients from this model. The second to last row in this table shows the average changes in the wife's LFP, the average treatment effects associated with the husband's DWB-eligibility from the three different models. The results from the base specification, which only additionally includes full sets of dummies for the husband's age, the wife's age, husband's and wife's sector and years, suggest that the DWB increased the wives' LFP by 3 percentage points. After additionally controlling for whether the husband receives a pension or social benefits the size of the coefficient is reduced to 2.6 percentage points. Adding controls for whether the wife receives a pension or social benefits reduces the treatment effect to 2.1 percentage points. These three estimates are significant at the 1% level.

These results are slightly higher than the spillover effects that I estimate by multiplying the treatment effect on husbands by the LATE from my 2SLS model. It is likely that the average treatment effect is larger, because it includes both the spillover effect of the policy through the husband's LFP, as well as the direct effect of the policy on wives' LFP, the wives' anticipation of becoming eligible for the bonus them selves (especially for wives who are nearing the eligibility age).

2.5 Conclusion

This chapter studies the joint retirement of couples by using the introduction of the Dutch *Doorwerkbonus* (DWB) in an instrumental variables model to estimate the effect of husbands' labor force participation (LFP) on their wives' LFP, among couples that were affected by the DWB. I also study the potential spillover effect of the husband's eligibility to the policy on the LFP of wives that were not eligible themselves. To my knowledge this study is the first to use this policy change as an instrument to study the joint retirement of couples, and to assess the spillover effects of the reform on the labor supply of their wives, using administrative data.

I first estimate the policy effect on the husbands' LFP among couples, with eligible husbands born between 1947 and 1949 and younger wives who were not eligible for the policy. My results suggest that the DWB increased the husbands' LFP by 5.3 percentage points. These results are consistent with earlier results found in a previous study in which I studied the effect of the DWB on male LFP.

To study the effect of the husband's work status on his wife's probability of working, I first estimate an uninstrumented linear probability model, the structural model, which does not address potential endogeneity from omitted variables or reverse causality. Results from this model suggest that wives are 12 percentage points more likely to work if their husbands work.

To address endogeneity due to omitted variables or potential reverse causality of spouses' LFP, I estimate 2SLS models, in which I instrument the husbands' LFP with DWB-eligibility. My preferred IV estimates suggest that wives are 30.1 percentage points more likely to work if their husbands work, among couples in which the husbands were responsive to the DWB policy. Multiplied with the DWB-treatment effect estimated above, an increase in husbands' LFP of 5.3 percentage points, my IV results suggest that there could be a spillover effect of the policy through the husband's LFP on wives' LFP of about 1.5 percentage points.

I also study the effect of the DWB on wives' LFP in a reduced form difference-in-differences model, by comparing the LFP of wives whose husbands were DWB-eligible to the LFP of wives whose husbands were not. These results suggest an average treatment effect of 2.1 percentage points associated with husband's eligibility to the DWB. This estimate includes both the spillover effect as well as the direct effect of the bonus on wives' LFP due to the potential anticipation among the older wives who are nearing eligibility.

I have argued that my instrument fulfills the three required conditions that make it a valid instrument. I argued that the instrument satisfies the exclusion restriction and does not belong in the structural equation. One could argue, however, that whether a wife's husband is in the treatment group or not, could be correlated to their age difference. Because I include full sets of age dummies for both husbands and wives, I cannot additionally control for the age difference. Moreover, if there is a direct effect of the DWB on non-eligible wives, because they respond by staying in the labor force due to anticipation of becoming eligible in the future, this would also suggest that the instrument may not be a valid instrument.

Regardless of whether my instrument is valid, my reduced form findings still confirm that a retirement policy can affect spouses even if they themselves are not eligible. In the case of the DWB, the policy could have affected women's LFP via two path ways, either via the husband's eligibility and his response to the policy, and through their own anticipation of becoming eligible. In my sample, it is possible that couples with wives nearing eligibility may have experienced both effects, but for the majority of the couples it is likely that the increase in wives' LFP is mostly driven by the complementarity of leisure between spouses. Thus these results confirm the importance for policy makers to take spillover effects into account when reforming policy.

This work contributes to the literature that studies joint retirement and spillover effects of retirement policies, by studying the effects of a fiscal policy aimed at delaying retirement, and by using administrative data for an entire population. In future work, I intend to study how the DWB affects female LFP and whether potential spillover effects exist on younger husbands, who were not eligible for the DWB themselves.

As population aging continues and as the debate about increasing labor supply among older workers remains on the foreground, an understanding of joint retirement decisions, the effects of retirement policies and their spillover effects on labor supply decisions of couples is relevant to policy makers in the Netherlands and to those in other countries that are actively seeking ways to achieve this goal.

2.6 Figures

Figure 2.1a: Labor Force Participation Men (1944-1949)

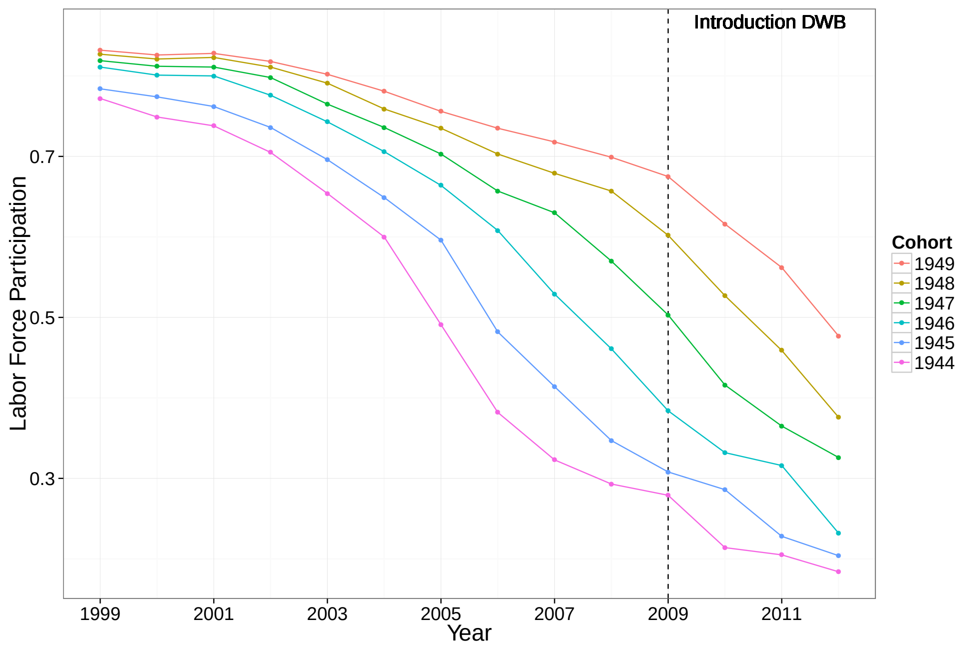


Figure 2.1b: Labor Force Participation Women (1950-1959)

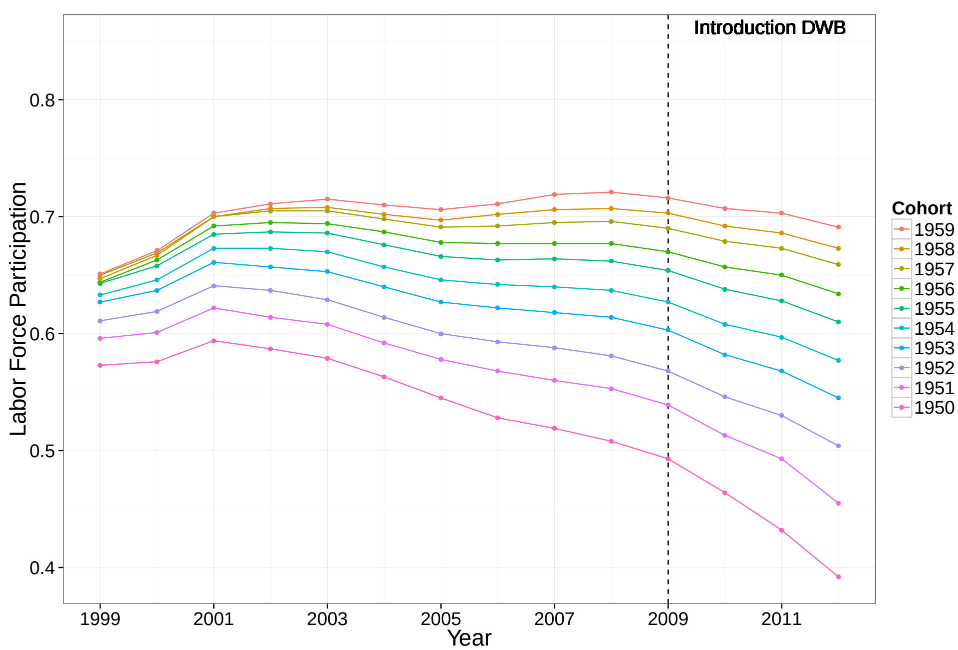
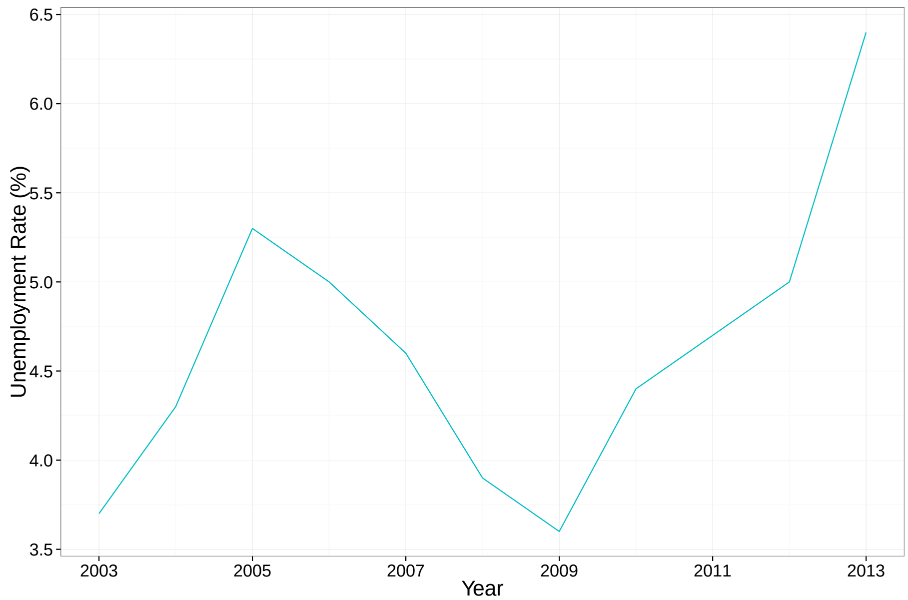
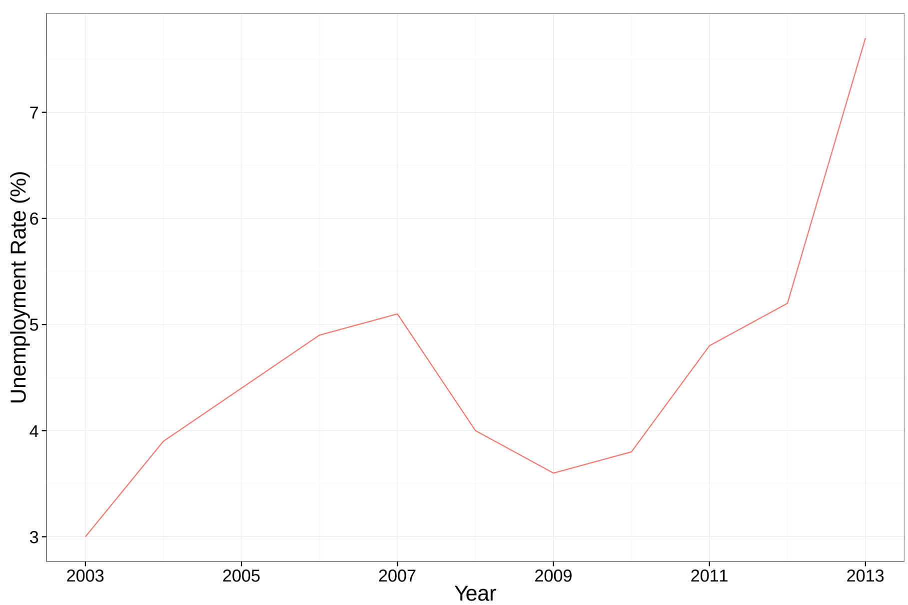


Figure 2.2a: Dutch Male Unemployment Rates (Age 55-60)



Source: Statistics Netherlands

Figure 2.2b: Dutch Female Unemployment Rates (Age 55-60)



Source: Statistics Netherlands

2.7 Tables

Table 2.1: Difference-in-Differences Model: Treatment and Control Groups

	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
					Control								
					"Before" Eligible Age			"After" Eligible Age					
1944	55	56	57	58	59	60	61	62	63	64			
1945	54	55	56	57	58	59	60	61	62	63			
1946	53	54	55	56	57	58	59	60	61	62			
								Treatment					
								"Before" Eligible Age			"After" Eligible Age		
1947	52	53	54	55	56	57	58	**59**	**60**	**61**	**62**	**63**	**64**
1948	51	52	53	54	55	56	57	**58**	**59**	**60**	**61**	**62**	**63**
1949	50	51	52	53	54	55	56	**57**	**58**	**59**	**60**	**61**	**62**

Table 2.2: Descriptive Statistics

Sample means (SD) and Proportions

	Husbands				Wives			
	Control		Treatment		Control		Treatment	
	Before	**After**	**Before**	**After**	**Before**	**After**	**Before**	**After**
Working	0.85	0.62	0.86	0.71	0.84	0.73	0.84	0.77
Age	58.7	61.7	58.8	61.8	54.5	57.5	54.7	57.7
	(1.1)	(1.1)	(1.1)	(1.1)	(2.7)	(2.7)	(2.3)	(2.3)
Pension	0.18	0.49	0.17	0.41	0.05	0.12	0.04	0.08
UI Benefits	0.06	0.07	0.06	0.04	0.03	0.04	0.04	0.03
DI Benefits	0.14	0.15	0.13	0.14	0.09	0.09	0.08	0.09
Welfare	0.001	0.001	0.001	0.002	0.001	0.002	0.001	0.002
Other Social Benefits	0.03	0.03	0.02	0.03	0.01	0.01	0.01	0.01
Couples	190,462	190,462	227,937	227,937	190,462	190,462	227,937	227,937

Note: This table shows the means of each variable by before and after period for the husbands' treatment and control groups. Means are three year averages. Age is a continues variable and all other variables are binary variables. The sample includes couples with husbands born between 1944 and 1955 and wives born between 1947 and 1959. Observations of couples in the control group, with husbands born between 1944 and 1946 are not included in the sample after 2009, when they are also eligible for the DWB. Observations of couples with wives born between 1947 and 1949 are also not included in the sample after 2009, when the wives are eligible for the DWB themselves.

Table 2.3: Difference-in-Differences Model: Husbands' LFP

Dependent Variable = Husband Working	(1)	(2)	(3)
Control Before Period	-0.032	-0.017	-0.016
	(0.004)	(0.003)	(0.003)
Control After Period	-0.084	-0.053	-0.052
	(0.008)	(0.006)	(0.006)
Treatment Before Period	-0.025	-0.012	-0.012
	(0.004)	(0.003)	(0.003)
Treatment After Period	0.003	0.005	0.005
	(0.007)	(0.005)	(0.005)
Husband Receiving Pension		-0.285	-0.284
		(0.010)	(0.010)
Husband Receiving Ul Benefits		-0.292	-0.292
		(0.007)	(0.007)
Husband Receiving Dl Benefits		-0.176	-0.175
		(0.003)	(0.003)
Husband Receiving Welfare		-0.461	-0.316
		(0.014)	(0.03)
Husband Receiving Other Social Benefits		-0.204	-0.200
		(0.007)	(0.006)
Wife Receiving Pension			-0.014
			(0.003)
Wife Receiving Ul Benefits			-0.002
			(0.001)
Wife Receiving Dl Benefits			-0.015
			(0.001)
Wife Receiving Welfare			-0.151
			(0.026)
Wife Receiving Other Social Benefits			-0.051
			(0.005)
Constant	1.007	1.039	1.040
	(0.003)	(0.004)	(0.004)
Year Dummies	Yes	Yes	Yes
Husband Age Dummies	Yes	Yes	Yes
Wife Age Dummies	Yes	Yes	Yes
Husband Sector Dummies	Yes	Yes	Yes
Wife Sector Dummies	No	No	No
Difference-in-Differences	0.079	0.054	0.053
	(0.004)	(0.003)	(0.003)
Couple-Years	4,255,909	4,255,909	4,255,909

Note: This table shows coefficients from linear probability models. The dependent variable is an indicator variable for whether or not the husband worked. Standard errors clustered at the husband-wife birth-cohort levels (114 in total) are in parentheses. The sample includes couples with husbands born between 1944 and 1955 and wives born between 1947 and 1959. Observations of couples in the control group, with husbands born between 1944 and 1946 are not included in the sample after 2009, when they are also eligible for the DWB. Observations of couples with wives born between 1947 and 1949 are also not included in the sample after 2009, when the wives are eligible for the DWB themselves.

Table 2.4: Uninstrumented Model: Joint Retirement

Dependent Variable = Wife Working

	(1)	(2)	(3)
Husband Working	0.130	0.130	0.119
	(0.003)	(0.003)	(0.003)
Husband Receiving Pension		-0.015	-0.008
		(0.002)	(0.001)
Husband Receiving Ul Benefits		0.034	0.036
		(0.002)	(0.002)
Husband Receiving Dl Benefits		0.013	0.026
		(0.002)	(0.001)
Husband Receiving Welfare		-0.329	-0.047
		(0.013)	(0.030)
Husband Receiving Other Social Benefits		-0.015	0.001
		(0.003)	(0.003)
Wife Receiving Pension			-0.140
			(0.011)
Wife Receiving Ul Benefits			-0.187
			(0.007)
Wife Receiving Dl Benefits			-0.382
			(0.004)
Wife Receiving Welfare			-0.308
			(0.031)
Wife Receiving Other Social Benefits			-0.189
			(0.007)
Constant	0.758	0.760	0.774
	(0.005)	(0.005)	(0.005)
Year Dummies	Yes	Yes	Yes
Husband Age Dummies	Yes	Yes	Yes
Wife Age Dummies	Yes	Yes	Yes
Husband Sector Dummies	Yes	Yes	Yes
Wife Sector Dummies	Yes	Yes	Yes
Couple-Years	4,355,909	4,355,909	4,355,909

Note: This table shows results from the linear probability model. The dependent variable is an indicator variable for whether or not the wife worked. Standard errors clustered at the husband-wife birth-cohort levels (114 in total) are in parentheses. The sample includes couples with husbands born between 1944 and 1955 and wives born between 1947 and 1959. Observations of couples in the control group, with husbands born between 1944 and 1946 are not included in the sample after 2009, when they are also eligible for the DWB. Observations of couples with wives born between 1947 and 1949 are also not included in the sample after 2009, when the wives are eligible for the DWB themselves.

Table 2.5: Two-Stage-Least-Squares Linear Probability Models: Second Stage

Dependent Variable = Wife Working

	(1)	(2)	(3)
$\widehat{\mathbf{Husband Working}}$	0.350	0.438	0.308
	(0.066)	(0.093)	(0.072)
Husband Receiving Pension		0.073	0.046
		(0.027)	(0.021)
Husband Receiving Ul Benefits		0.124	0.091
		(0.028)	(0.021)
Husband Receiving Dl Benefits		0.067	0.059
		(0.016)	(0.013)
Husband Receiving Welfare		-0.187	0.013
		(0.045)	(0.039)
Husband Receiving Other Social Benefits		0.048	0.038
		(0.019)	(0.015)
Wife Receiving Pension			-0.137
			(0.010)
Wife Receiving Ul Benefits			-0.187
			(0.007)
Wife Receiving Dl Benefits			-0.380
			(0.004)
Wife Receiving Welfare			-0.280
			(0.032)
Wife Receiving Other Social Benefits			-0.180
			(0.007)
Constant	0.537	0.439	0.577
	(0.068)	(0.098)	(0.076)
Year Dummies	Yes	Yes	Yes
Husband Age Dummies	Yes	Yes	Yes
Wife Age Dummies	Yes	Yes	Yes
Husband Sector Dummies	Yes	Yes	Yes
Wife Sector Dummies	Yes	Yes	Yes
Couple-Years	4,355,909	4,355,909	4,355,909
First Stage F-Statistic	62.8	74.8	74.7

Note: This table shows the full results from the second stage of the two-stage-least squares linear probability model. The full results from the first stage are shown in Appendix Table B.1. The dependent variable in the first stage is an indicator variable for whether or not the husband worked. The dependent variable in the second stage is an indicator variable for whether or not the wife worked. Standard errors clustered at the husband-wife birth-cohort levels (114 in total) are in parentheses. The sample includes couples with husbands born between 1944 and 1955 and wives born between 1947 and 1959. Observations of couples in the control group, with husbands born between 1944 and 1946 are not included in the sample after 2009, when they are also eligible for the DWB. Observations of couples with wives born between 1947 and 1949 are also not included in the sample after 2009, when the wives are eligible for the DWB themselves.

Table 2.6: Difference-in-Differences Model: Wife's LFP (Reduced Form Model)

Dependent Variable = Wife Working			
	(1)	**(2)**	**(3)**
Control Before Period	-0.007	-0.004	-0.003
	(0.003)	(0.002)	(0.002)
Control After Period	-0.025	-0.020	-0.017
	(0.005)	(0.005)	(0.004)
Treatment Before Period	-0.008	-0.006	-0.006
	(0.002)	(0.002)	(0.002)
Treatment After Period	0.004	0.004	0.002
	(0.005)	(0.004)	(0.004)
Husband Receiving Pension		-0.052	-0.041
		(0.003)	(0.002)
Husband Receiving Ul Benefits		-0.004	0.001
		(0.002)	(0.002)
Husband Receiving Dl Benefits		-0.010	0.005
		(0.002)	(0.001)
Husband Receiving Welfare		-0.388	-0.084
		(0.013)	(0.031)
Husband Receiving Other Social Benefits		-0.041	-0.023
		(0.004)	(0.003)
Wife Receiving Pension			-0.141
			(0.011)
Wife Receiving Ul Benefits			-0.188
			(0.007)
Wife Receiving Dl Benefits			-0.384
			(0.004)
Wife Receiving Welfare			-0.326
			(0.031)
Wife Receiving Other Social Benefits			-0.195
			(0.007)
Constant	0.890	0.895	0.897
	(0.004)	(0.004)	(0.004)
Year Dummies	Yes	Yes	Yes
Husband Age Dummies	Yes	Yes	Yes
Wife Age Dummies	Yes	Yes	Yes
Husband Sector Dummies	Yes	Yes	Yes
Wife Sector Dummies	Yes	Yes	Yes
Difference-in-Differences	0.030	0.026	0.021
	(0.004)	(0.004)	(0.003)
Couple-Years	4,355,909	4,355,909	4,355,909

Note: This table shows results from the linear probability model. The dependent variable is an indicator variable for whether or not the wife worked. Standard errors clustered at the husband-wife birth-cohort levels (114 in total) are in parentheses. The sample includes couples with husbands born between 1944 and 1955 and wives born between 1947 and 1959. Observations of couples in the control group, with husbands born between 1944 and 1946 are not included in the sample after 2009, when they are also eligible for the DWB. Observations of couples with wives born between 1947 and 1949 are also not included in the sample after 2009, when the wives are eligible for the DWB themselves.

Chapter 3

The Effect of Divorce on Health in Middle and Older Ages

(with S. Korenman)

3.1 Introduction

The prevalence and incidence of divorce has been rising among the middle-aged and elderly, doubling for those aged 50 and older between 1990 and 2010 (Brown and Lin 2012; Kennedy and Ruggles 2014). A substantial social science literature finds evidence of adverse impacts of divorce on mental and physical health (see Waite and Gallagher 2000; Hughes and Waite 2009; Bronselaer, De Koker and Van Peer 2008 for reviews); married persons have health advantages, and marital health advantages differ by gender, health outcome, and non-marital state. For example, marriage is related to longevity (Lillard and Waite 1995) and lower prevalence of cardiovascular disease and cancer (Goodwin et al. 1987).

Despite evidence linking marriage to ill-health, however, there are few studies linking health transitions to divorce at middle and older ages. As Hughes and Waite (2009) note (p.344): "Fewer studies have examined the effect of changes in marital status on either mental or physical well-being. Studies that do most often link these changes to shifts in mental health." They find significant associations between health status and marital histories. However, they estimate cross-sectional associations between marital histories and health status in the first wave of the HRS (Health and Retirement Study) but do not take advantage of its prospective design to track health transitions of respondents who undergo marital transitions in middle and older ages, the purpose of the present study.

We investigate whether divorcing later in life is associated with deterioration in health using HRS data that has followed subjects for up to 20 years. Moreover, the HRS follows couples longitudinally even if they are no longer married, which allows us to track spouses' health following divorce. To our knowledge, this is the first study to describe differences between spouses in health transitions following divorce.

We seek to answer the following questions: Following individuals, do people who divorce at middle and older ages experience greater declines in physical and mental health than their married same-sex counterparts? Following individuals, do changes in health associated with divorce differ between men and women? What mechanisms (social, behavioral, etc.) link divorce and health? Following couples, do physical and mental health changes associated with divorce at middle and older ages differ between wives and their husbands? In the next section, we summarize theories and evidence linking divorce to health. Section 3 describes the data and section 4 our empirical approach. Summary statistics and core results of multivariate models are presented in section 5. Section 6 describes robustness checks and section 7 concludes.

3.2 Background

As noted, a vast literature documents relationships between marital status and health (see Waite and Gallagher 2000; Wilson and Oswald 2005; Wood, Goesling and Avelar, 2007; Bronselaer, De Koker and Van Peer 2008 for recent reviews). Divorce has been associated with increased risk of disability (Pienta, Hayward and Rahrig 2000), mental health problems (e.g., Aseltine and Kessler 1993; Simon 2002), deterioration in self-rated health (e.g. Williams and Umberson 2004), and mortality (e.g., Goldman, Korenman, Weinstein 1995). Although marital "health selection" explains part of the association between divorce and health (Lillard and Waite 1995; Hughes and Waite 2009; Bronselaer, De Koker and Van Peer 2008), the literature finds evidence of several protective mechanisms: direct emotional strain, economic strain and loss of social support. Evidence links short-term health effects of divorce to temporary uncertainty following divorce, and studies of longer-term consequences "consider divorce to be a process in which the dissolution of the partner relationship gives rise to all kinds of transitions (e.g. deteriorating financial situation, less social support, changing responsibilities, different regulation of health behaviors, ...) that are often perceived as stressful, and which have a long-term negative impact on individuals' health status." (Bronselaer, De Koker and Van Peer, 2008; p. 172).

Smock, Manning and Gupta (1999) estimated that divorced a woman's annual family income would average about \$47,000 (\$1994) had she remained married, compared to \$17,000 realized in the divorced state. Older divorced women are five times as likely to be poor than married women with the same education level (Haider, Jacknowitz and Schoeni 2003). Divorce may also result in loss of health insurance if coverage was provided by the ex-spouse's employer (Lavelle and Smock 2012; Peters, Simon and Taber 2014). All of these transitions associated with divorce could increase stress and health problems. Consistent with this "economic stress" hypothesis, data collected in the first wave of the HRS showed that 52% of divorced women are worried 'a lot' about their retirement income, compared to 31% of the married women, 32% of divorced men and 25% of married men.

While economic differences would predict more severe effects of divorce for women than men, differences in social support may favor women (Antonucci and Akiyama 1987). Married men may rely more on their wives for social and health support and care than the reverse and therefore experience a greater loss in social support and health following divorce (e.g., Berkman and Syme 1979; Sarason, Sarason and Gurung 1997; Umberson and Montez 2010).

Studies of divorce and health have tended to focus on younger age groups or pooled all ages, though a few have examined the relationship between marital status and health in middle and older age. Using HRS martial histories, Hughes and Waite (2009), find that, compared to continuously married people, those who experienced a marital disruption are in worse physical and mental health later in life, though they find no gender differences. They also report that the remarried are generally in better health than the currently divorced, but in worse health than the continuously married. Zhang and Hayward (2006) find, in HRS data, that, for women, marriage loss is associated with increased risk of cardiovascular disease. Liu (2012) finds that the adverse health effects of divorce decrease with age in four waves of the Americans' Changing Lives survey.

A burgeoning literature studies marital quality and health in mid- and later life. Lower or deteriorating marital quality has been associated with inflammation for middle-aged women but not for men (Donoho, Crimmins and Seeman 2013) and increased cardiovascular risks for older women, more so than men (Liu and Waite 2014). Since divorce is at least partly the outcome of low marital quality, this literature might suggest that divorce should be more strongly associated with bad health for women than men. On the other hand, ending a problematic marriage might improve health and well-being; the 'Escape Hypothesis.' Using data from two waves of the National Survey of Families and Households, Kalmijn and Monden (2006) found at best weak evidence for this hypothesis (at younger ages): "...at low levels of marital quality, there is indeed a smaller increase in depressive symptoms after divorce than at higher levels of quality. Even in poor marriages, however, the effect [of divorce] on depressive symptoms is positive, showing that people do not improve their well-being after divorce" (p. 1210).

The literature on marital status and health in mid- and later life has often taken a retrospective life-course approach, relating the number and timing of marital transitions, and durations spent in differing marital states, to health at a later age. Such an approach does not address selection into or out of marriage on unmeasured characteristics, including health, the subject of an emergent literature. Averett, Argys and Sorkin (2013), using models that include individual fixed effects, find that, for Canadian women, divorce reduces alcohol consumption but has no adverse effects on mental health. For men, divorce increases smoking and depression, but reduces drinking.

Kohn and Averett (2014) estimate a dynamic model relating health outcomes in one period to marital status and lagged health indicators. Using British data and a mixed logit model they estimate "health-related unobservable heterogeneity" for each individual in the sample, based on observed marital and health history. They find evidence of substantial (positive) health selection into marriage, both below and above age 45, for men and women (Kohn and Averett, 2014, Table 5, p. 76). They also find that, at older ages, divorce (relative to marriage) is more negatively health-selected for women than men.

Kohn and Averett (2014) next estimate and compare effects of marital status on an index of health across three models: OLS models; models with individual fixed effects; and models that include both a lagged health index and their controls for health-related unobservables. The first two models suggest significant adverse effects of divorce for women and men (especially under age 45). But in the third model, the effect of divorce on health falls by an order of magnitude, and, except for younger males, become statistically insignificant. Although results from these models suggest little effect of divorce on health, they also suggest little effect of age or education on health since their estimated effects are also far weaker in these models (though often statistically significant).

To our knowledge, no study has directly compared husbands and wives' health trajectories following divorce, including in middle and older ages. However, Mare and Palloni (1988) analyzed couple data for cross-spouse effects, controlling for shared but unmeasured traits in their study of socioeconomic differences in survival. They found that most of the variation in survival times is within couples (between husbands and wives) rather than between couples. Thus, we expect ample within-couple variation in health that can be used to estimate within-couple (i.e., husband-wife) differences in associations between divorce and health.

3.3 Empirical Methods

Data We use data from the HRS, a biennial national longitudinal study that focuses on older Americans, their health, retirement, and economic status. Since 1992, HRS has collected data on individuals born between 1931 and 1941, and their spouses (HRS cohort) and individuals born before 1924 (AHEAD cohort). In 1998, the study added a sample of individuals born between 1942 and 1947 (War-Baby cohort), 1924 to 1930 (CODA: Children of the Depression cohort), and, in 2004, individuals born 1948 to 1953 (Early Baby Boomers cohort).

We use the publicly available RAND HRS Data to construct two samples: individuals married or partnered at the baseline interview and linked "divorcing" couples who were married or partnered at the baseline interview and each interviewed at least once after divorce. Furthermore, we restrict the samples to respondents with complete information on our variables of interest (described below). Our individual sample includes 7,983 women (479 who divorce) and 7,883 men (403 who divorce), for a total of 96,961 person-year observations.

In all, 4,615 person-year observations were missing due to non-response (4%), 13,090 due to mortality attrition (10%), and 10,438 due to non-mortality attrition (including non-response leading to being dropped from the sample) (8%), for a person-year total retention rate of 78%. On average, women are observed in the divorced state at 2.74 waves, and men, 2.53 waves.

Our couple sample includes 388 divorcing couples, with 4,800 person-year observations. We dropped 413 couple-year observations due to mortality attrition of one spouse (13%), 179 couple-year observations were missing due to non-response of one spouse (5%), 310 couple-year observations were missing due to non-mortality attrition (9%), leaving 2,400 couple year observations (73%), though we explore the sensitivity of some of our results to mortality attrition. Most of our models treat divorce in older age as an absorbing state, but some models incorporate remarriage. On average, the couples are observed in the divorced state for 3.5 waves, 2.7 waves when we incorporate remarriage.

The HRS survey collects self-reported general health status for the respondents at each survey wave. Self-reported health is predictive of survival and regarded as a reliable measure of general health (Miilunpalo et al. 1997; McGee et al. 1998), though results in Dowd and Todd (2011) highlight the importance of adjustment for socio-economic status and race. Our primary physical health outcome is, therefore, an indicator of "bad" (i.e., fair or poor) health (versus good, very good or excellent). The HRS also collects information about whether a respondent has ever had any of several conditions diagnosed by a doctor: psychological problems, heart conditions, diabetes, arthritis, cancer and high blood pressure. We treat health condition indicators as outcomes as well as potential pathways through which divorce could affect general physical and mental health.

The HRS codes a mental health index, using an abbreviated 8- item version of the Center for Epidemiologic Studies Depression (CESD) scale, a standard measure considered highly reliable (Radloff 1977). Our clinical depression outcome is an indicator for a score of four or above on the abbreviated CESD scale (corresponding to a score of 16 or more on the full CESD scale; Steffick 2000). Information on imputation of missing information and other details of measure construction is available in our on-line appendix. We included a dummy variable in the models to indicate the use of imputed depression data.

Covariates include age (as a quadratic), years of education, census division, BMI (kilograms/meters squared), and dummy variables for black and Hispanic identification, smoking and HRS cohort. Since the survey asks income information of the household head and spouse only, we form a control for "adjusted household income", as the sum of the incomes of the household head and the spouse, divided by the square-root of the household size (OECD 2009). We top-code adjusted household income at $300,000 (inflation adjusted to 2010) to reduce the influence of imputation problems identified by Alwin, Zeiser and Gensimore (2014). We include a dummy variable for lacking health insurance, relevant for those younger than 65 years of age.

Regression Framework

We use regression analyses to describe how health changes with divorce at middle and older ages. Specifically, we use regression models with individual fixed effects to estimate (adjusted) differences in health associated with an individual's transition from the married to the divorced state. And we use regression models with couple fixed effects in a sample of married couples that divorce to compare changes in a woman's health with divorce to those of her husband. We also estimated couple models with both fixed effects and interactions between marital status and time; these models allow us to describe how changes in health over time differ between spouses, both leading up to and following divorce. The procedure is in the spirit of the distributed-fixed-effects models of Killewald and Lundberg (2014), who describe wage changes before and after marriage for men. Due to modest sample sizes, however, we constrain health trajectories to change linearly in the period before divorce and, with possibly a different slope, in the period after divorce, and allow a discrete change at the time of divorce. The models allow health trajectories of husbands and wives to differ both before and after divorce, and at the transition to divorce.

The models also vary in health outcomes and the covariates included. For each sample (individuals, couples), we began by estimating a basic model to estimate health differences associated with divorce, adjusting only for marital status and basic demographic characteristics such as age, education, race, Census region of residence and HRS cohort. We then further adjust for health behaviors and characteristics such as BMI (Body Mass Index) and smoking behavior, and economic status variables such, income, and health insurance status. (We provide details on the model covariates in the results section and in table notes.) We would like to adjust for these covariates if they are the basis of marital selection (e.g., if non-smokers or higher-income individuals are less likely to divorce or more likely to remarry). However, divorce-related differences in health behaviors and income could either be mechanisms by which marriage confers health advantages or additional marital-selection factors. Therefore, we present results from models with the basic and more detailed covariate adjustments throughout. We note that models with basic demographic covariates and fixed effects allow adjustment for fixed, unobservable characteristics that may be the basis of marital selection without also controlling for potential mechanisms by which marriage improves health.

For couples, since our focus is on health changes associated with divorce, we initially constrain the husband and wife to have the same marital status, treating divorce as an absorbing state (until death or loss to follow up). We do this because remarriage is likely to be highly selected on health status at older ages. However, to provide a more complete description, we also broke out “remarriage” as a marital state in some models.

We estimated all models using OLS regression (linear probability models), and cluster standard errors for individuals to address heteroskedasticity and possible correlation of the error terms for each individual. We report results from linear probability models to facilitate comparisons between models with and without (individual or couple) fixed effects since marginal effects are undefined in logit models with fixed effects, while odds ratios are difficult to compare across models (Norton 2012). Furthermore, in our couple models, we are particularly interested in the interaction between gender and divorce but interaction effects in non-linear models with fixed effects are easily misinterpreted (Ai and Norton 2003). Coefficients from linear probability model are easy to interpret and are the parameters of interest (probability derivatives). The corresponding results from logistic regression models available in Appendix Tables C.1b and C.5a show that statistical significance of marital status effects is not affected. Finally, we use unweighted regressions, but include controls for black and Hispanic identification and census region, the characteristics used for the HRS designed oversample (Solon, Haider, and Wooldridge, 2013).

3.4 Results

Table 3.1 reports weighted summary statistics by marital status, separately for all individuals married at baseline and the subsample of divorcing couples. Looking first at all individuals (the first four columns), divorced women are more likely than married women to report that their health is "bad" and are more likely to smoke, but BMI differs little by marital status. Divorced men are also more likely than married men to self-report bad health and to smoke. Divorced women are also more likely than married women to have been diagnosed with heart disease, psychological problems, stroke and lung disease. A similar relationship between marital status and health is found among men, although lung disease is equally likely among divorced and married men, while diabetes is more common among divorced men. Depression (CESD ≥ 4) is twice as likely among divorced people compared to their married counterparts.

Turning to demographic characteristics, we see that for men and women, age and education levels differ little between married and divorced persons. Income and race differ by marital status: for example, ten percent of divorced women are black compared to 6% of married women, 14% of divorced men, and 6% of married men. And divorced and widowed persons have lower adjusted household income than their married counterparts.

Columns (5) through (8) report summary statistics for the subsample of couples that divorce. Husbands and wives are more likely to report bad health after divorce, although the change for men is small. Husbands smoke less and are less depressed after divorce than before while wives are more likely to be depressed after divorce. Both husbands and wives are more likely to have been diagnosed with psychological problems or adverse health conditions after divorce though this reflects the cumulative nature of the variable and their more advanced ages in the divorced state. Finally, adjusted household income is lower for the wives after divorce. (Note that since summary statistics are shown for the same men and women in their married and divorced states, differences in means for time-constant variables result from an unbalanced panel.)

3.4.1 Regression Models, Individuals

Columns 1 and 5 of Table 3.2 show results from a basic model of health for women and men, respectively. As noted, the basic specification includes controls for marital status (dummy variables for divorced or separated; widowed; and partnered; the reference category is married) black and Hispanic identification (reference category is non-Hispanic white and other race/ethnicities, including Asian), a quadratic in age, years of education completed as well as dummy variables for the respondent's census division of residence and HRS cohort. Being divorced is associated with an increase in the likelihood of bad health of 10.5 percentage points for women and 8 percentage points for men. For women, being partnered rather than married is associated with a 7.6 percentage point increase in bad health, while widowhood is associated with about a four percentage point increase for both women and men. "Partnered" status is more similar to being divorced than married. Other covariates have expected signs (see Appendix Tables C.1a for the full model results.)

The models summarized in columns 2 and 6 adjust for health behavior and income: BMI, current smoking status, income, and a dummy for being both under age 65 and uninsured status to explore their roles as mechanisms or confounders of the association between marital status and health. After adding these covariates, divorce remains associated with substantially higher prevalence of bad health (8.2 percentage points for women and 6.9 percentage points for men).

When we add individual fixed effects (columns 3, 4, 7 and 8), for women, even after adjustment for health behaviors and income, the adverse association between divorce and health remains sizable (about 3.9 percentage points) and statistically significant. For men, the association between health and divorce is small and not statistically significantly.

If divorce worsens women's physical health, we might expect divorce to be associated with increased diagnoses of health conditions such as heart disease, although such effects may only appear over time. We estimated models in which one of each of several health conditions was the outcome: whether the respondent has ever been diagnosed with a heart or lung condition, diabetes, cancer, stroke, arthritis and high blood pressure. Table 3.3 reports coefficients of marital status dummies from these models, which include controls for race, age, education, BMI, smoking behavior, income as well as dummy variables for being under 65 and uninsured, census region, and HRS cohort, as well as individual fixed effects. (See Appendix Tables C.2a, C.2b and C.2c for the full model results.) There are no statistically significant or substantial associations between divorce and these physical health conditions. The sign of the divorce effect is negative for men for 5 of the 7 conditions (suggesting divorce is associated with improved health), but positive for women for 6 of the 7 conditions.

Although a longer-term follow-up might detect stronger associations between divorce and physical health conditions (since we follow people after divorce for only 4 to 6 years, on average), we do find that these conditions are associated with widowhood. Widowhood is associated with significant increases in the likelihood of diagnoses of lung conditions, diabetes and stroke for women and of high blood pressure and lung conditions for men. Widowhood reduces the likelihood of a diagnosis of arthritis for women and men.

Turning to mental health outcomes, columns 8 and 9 in Table 3.3 show results from models of psychiatric condition (ever diagnosed with emotional, nervous or psychiatric problem), and depression (CESD score of 4 or higher), controlling for individual fixed-effects. For women, divorce is associated with a five percentage point ($p<.05$) increase in both of these outcomes. For men, after controlling for health behavior, health insurance and income, divorce is associated with a 3.2 percentage point ($p=0.015$) increase in the probability of being diagnosed with a psychological condition and a 3 point (though not significant) increase in the likelihood of depression. The association between income and mental health, although at times statistically significant, is small and therefore it is unlikely that income plays an important mediating role in the relationship between divorce and mental health (See Appendix Table C.2c for full results.)

Since divorce appears to be associated with worse self-reported general health and worse mental health, we briefly explored the role of mental (and physical) health conditions in the association between divorce and general health. Table 3.4 summarizes these results. (The full results are reported in Appendix Tables C.3a and C.3b.) For reference, Table 3.4 shows the coefficients of the divorce variable from the fixed-effect models for women and men that exclude controls for mental health and physical health conditions. Row 1 corresponds to columns 4 and 8 from Table 3.2, with controls for demographic characteristics, health behaviors, income and health insurance. In row 2 and 3, we add controls, alternatively, for mental health and physical health conditions, and in row 4, we add both mental and physical health conditions.

After controlling for individual fixed-effects, mental and physical health conditions respectively explain 11 and 14 percent of the association between divorce and health for women. (For men, the fixed-effect estimate of the effect of divorce is zero even without controls for mental health.) The OLS results (Appendix Table C.3a) suggest that mental health conditions explain 60 percent of the association between divorce and women's health, while physical health condition explain about 30%.

In sum, when mental and physical health conditions are controlled, a modest adverse association of divorce of almost three percentage points remains unexplained for women in models with individual fixed effects, although the association is not statistically significant. Although mixed, our results suggest that mental rather than physical health accounts for much of the association between divorce and self-reported general health.

3.4.2 Regression Models, Couples

As noted, data on couples allow us to study differences between husbands and wives in health transitions leading up to and following divorce. These models implicitly adjust for all non-time-varying characteristics common to husbands and wives, for example, social class and the pre-divorce home environment. Table 3.5 shows the results for these models. (Although we treated 70 couples that were partnered but not married at baseline as married, coefficients of the divorce variable were not sensitive to this classification. Results are available from the corresponding author.)

The first row of the table is the coefficient of greatest interest: the difference between husbands and their wives in the change in health following divorce. For example, the coefficient -0.043 in Column (1) indicates that the change in the probability of reporting "bad" health is 4.3 percentage points smaller for husbands than their wives, though the difference is not statistically significant. Divorce is associated with a (significant) 0.063 increase in proportion reporting bad health among wives (the coefficient of the divorce dummy variable). The change in health associated with divorce for husbands - the sum of the coefficients of the divorce x husband interaction term, the divorce dummy variable and husband dummy variable - is presented in the last row of the table and rounds to 0.02 (not statistically significant). In sum, with basic controls, we find a substantial adverse association of divorce with self-reported health for wives but not their husbands (The full results are reported in Appendix Table C.4.)

After adjustment for health behaviors, BMI, income and health insurance (Column (2)), the increase after divorce in bad health for wives falls to 5.2 percentage points (second row) but remains statistically significant; the difference between husbands and wives falls to -0.024, and the change for husbands grows slightly (to 0.028).

Columns (3) to (6) show results from models of mental health, controlling for couple fixed effects. Getting divorced is associated with a 12.7 percentage point increase in the likelihood of having been diagnosed with psychological problems for wives in the basic model and 11.9 percentage points when health behaviors and income are controlled (columns (3) and (4), respectively). The association between divorce and a diagnosis of psychological problems is smaller for their husbands, though still substantial: about 5.5 percentage points in the basic model and 4.8 percentage points in the model with health behavior controls. The associations are statistically significant for both husbands and wives, and the difference between husbands and wives of about 7 percentage points is also statistically significant ($p<0.05$ in both models). The association between psychological problems and income is very small

(See Appendix Table C.4.

For wives, divorce is associated with a 4.0 percentage point increase in the likelihood of depression ($p<0.10$; column (5)). Adjusting controlling for health behaviors and income, the differential falls to 3.2 percentage points and is not significant (column (6)). For husbands, the association between divorce and mental health is negligible in both models. Differences in these associations between husbands and wives are roughly -4.4 to -3.3 percentage points, but do not quite reach statistical significance. The point estimates suggest that wives experience an increase in depression following divorce while their husbands experience little change (or a small reduction). A $10,000 increase of adjusted household income is associated with a reduced likelihood of depression of 0.7 percentage point ($p<.05$) (see appendix table C.4).

In Table 3.6 we summarize results from couple models that explore the role of physical and mental health conditions in the relation between divorce and bad (general) health. (Appendix Table C.6 shows the full results.) For reference, Row (1) duplicates the results from column (2) of Table 3.5 for models that adjust for health behaviors and income. In Rows (2) and (3) of Table 3.6, we add controls for mental health and physical health conditions, respectively, and in Row (4) we include both sets of controls. For wives, controlling for couple fixed effects, adjusting for mental health conditions reduces the size of the coefficient by half, and it is no longer statistically significant (Row (2)). Adjusting for physical health conditions but not mental health conditions has a smaller effect, reducing the association between divorce and bad health by only 1.5 percentage points. This evidence suggests that the association between divorce and self-reported health for wives may reflect mental health conditions more than physical health conditions. There is little association between divorce and general health for husbands in any of these models.

We next estimated models to describe how associations between divorce and health evolve. To facilitate interpretation, we show the effects graphically in Figures 3.1, 3.2a and 3.2b (see

Appendix Table C.7 for the corresponding coefficient estimates). In Figure 3.1 we plotted the results from our model of "bad health." Wives' health deteriorates slightly immediately following divorce, while husbands' health improves slightly. After controlling for health behavior, health insurance, and income, the difference between husbands and wives disappears, suggesting a mediating role for these factors. Figure 3.2a, based on our model of psychological conditions, suggests that the likelihood of being diagnosed with a psychological condition increases for both husbands and wives as they approach divorce. Furthermore, wives appear to experience a greater increase in psychological conditions upon divorce than their husbands. Figure 3.2b shows the results from our model of depression (based on the CESD score) and again indicates that depression increases for husbands and wives as they approach divorce (slightly faster for husbands than for wives). Depression increases immediately following divorce for wives, but thereafter levels off, and changes little with time following divorce. Husbands appear to experience an abrupt decrease in depression upon divorce but a slight increase thereafter.

So far, our analyses of couples have treated divorce as an absorbing state. However, of 488 divorcing couples in our sample, 129 wives (33%) and 173 husbands (45%) remarry. Table 3.7 summarizes results from models with couple fixed effects in which we include a control for remarriage (see Appendix Table C.8 for the full models). When we allow for remarriage, divorce is associated with similar deteriorations in self-reported health for husbands and wives; the effect is 0.060 for wives and 0.045 for husbands, and both are significant in the model with basic controls (column 1). The divorce effect falls to about 0.015 for women and increases by slightly for men with controls for health behaviors and income.

Although there is little association between remarriage and physical health for wives, remarriage is associated with substantial improvements in husbands' health (a roughly seven percentage point decrease in reported bad health; bottom row of the table, Columns (1) and (2)). For psychological conditions, divorce is again associated with adverse outcomes for both husbands and wives: about 10 percentage points for wives (second row) and seven for their husbands (bottom row). Also, remarriage is associated with increases in the likelihood of being diagnosed with a psychological condition for wives (about nine percentage points), but not for husbands (bottom row).

The results for depression (Columns (5) and (6)) suggest that divorce is associated with worse outcomes for wives than for husbands: roughly five percentage points versus two and the difference is not statistically significant. Depression appears to improve about 5 to 6 percentage points upon remarriage for both husbands and wives. As a descriptive matter, therefore, many of the health advantages of divorce for husbands (relative to their wives) in couple models are accounted for by their greater remarriage rates and in the greater benefits they reap from remarriage in comparison to their ex-wives. However, remarriage is likely to be highly health selected at these ages so caution in interpretation is called for.

3.5 Robustness Checks and Supplemental Analyses

We conducted analyses to check the sensitivity of our results to: 1. functional form (linear versus logistic regression models); 2. measuring self-reported health as a binary outcome (bad/good) rather than the complete 5-category Likert scale; 3. measuring mental health on a 8-item CESD scale rather than as a binary outcome (depressed/ not depressed). The results (available in our Appendix) were not sensitive to these choices.

We also conducted an analysis to correct for selective mortality attrition. The results presented used outcome variables available only for survivors. Our finding of a more benign association between divorce and health for men than women, therefore, could be affected by the relatively higher male mortality rates at middle and older ages, especially among divorced men. To test the sensitivity of our results to selective mortality attrition, we restore the deceased to the sample for the first survey wave following their death. Rather than dropping them from this sample wave, their health status is classified as "bad." Using this procedure, we restored 882 person-year observations for women and 1644 person-year observations for men to our sample of individuals, and 38 person-year observations to our sample of couples. We also updated two time-varying covariates for these analyses: age and region of residence using age at death recorded by the HRS, and assigning region of residence to the region at the last recorded interview. Other covariates in the basic model are time-invariant.

In the sample of individuals, the results (see Appendix Table C.9a) adjusting for mortality attrition were quite similar to the corresponding unadjusted results in Table 3.2 for "bad" health, whether or not we controlled for individual fixed effects. For the sample of couples, results also suggest that selective mortality does not drive our conclusion that divorce is more strongly associated with adverse health outcomes for women than men (see Appendix Table C.9b).

We also explored further the role of income in the relationship between divorce and health. First, in our data, women suffer greater reductions to income after divorce than men as in Smock, Manning and Gupta (1999), Hurd and Wise (1989), and Hurd (1989). Second, gender-income interactions were not significant and their inclusion in the models did not affect the coefficient of the divorce dummy variable. Therefore, to the extent that income accounts for the gender difference in the association between divorce and health, it is because women's income falls more with divorce than men's. Similarly, including gender-age interactions did not change the estimated associations between divorce and health. (These and additional supplementary results are available from the corresponding author.)

3.6 Conclusion

Hughes and Waite (2009) wrote that few longitudinal studies have related changes in marital status to changes in mental and physical well-being at older ages. In response, we have sought to understand better the associations between divorce and physical and mental health, and differences between men and women in this age group. To our knowledge, this study is the first to estimate these associations in middle and later life in longitudinal data in the United States, comparing divorced individuals to their married counterparts, and comparing differences between spouses, using longitudinal data on the health of couples followed before and after divorce.

We found evidence of associations between divorce and poor health for women, but little evidence for men. On average, divorced women in our sample were about 10 percentage points, or over 50 percent, more likely to report being in bad (fair or poor) health than married women. Controlling for race, age, education, income, insurance status, weight (BMI) and smoking reduced that difference to about eight percentage points. After controlling for individual fixed effects, divorce is associated with a 3.5 percentage point increase in the probability of self-reported "bad" health. Divorce at middle and older ages appears to be more strongly associated with poor health for women than men, a finding at odds with the traditional finding in the literature that divorce is associated with greater declines in health for men than women. This difference may be due to our focus on middle and older ages. Previous studies either focused on younger ages or pooled all ages, perhaps because, until recently, there were few divorces at older ages. Our study is also based on more recent data and the relative health deficit for unmarried men may be shrinking; however, evidence on this point is mixed (Waite 2000; Liu and Umberson 2008). Finally, we note that our results are consistent with the results of other recent studies of health and marital status in older populations. For example, three recent studies have found that cardiovascular disease or inflammation are more strongly related to marital quality and marital status among older women than older men (Zhang and Hayward 2006; Donoho et al 2013; Liu and Waite 2014).

We found little evidence that divorce is associated with diagnoses of seven physical health conditions for men or women.(One exception is that our results without fixed effects are consistent with Zhang and Hayward (2006) in showing that divorce is associated with cardiovascular disease among women but not as much for men.) Divorce, however, is associated with deterioration in mental health for both men and women, with women experiencing a larger effect, consistent with findings for divorce at younger ages (Simon 2002).

Our results from within-couple comparisons also suggest that wives experience a deterioration of physical and mental health after divorce, but their husbands do not. Although many of the associations between divorce and wives' health are statistically significant, the difference between husbands and wives in the various divorce-health associations often is not. Wives experience substantial and significant worsening of mental health following divorce, both diagnoses of psychological conditions and depression, while their husbands experience a smaller (statistically significant) increase in diagnoses of psychological conditions, but not depression. The difference between husbands and wives in the association of divorce to diagnoses of psychological conditions is statistically significant. Interestingly, mental health conditions (depression and diagnoses) account for a substantial portion of the association between divorce and self-reported "bad" general health for wives, suggesting that mental health effects may underlie much of the effect of divorce on self-reported health.

Models that allow the effects of divorce to vary over time suggest that wives experience an abrupt deterioration in (self-reported) physical health at the time of divorce, while their ex-husbands experience slight improvements. Wives also appear to experience a greater "shock" in psychological conditions than their husbands. The results for depression indicate that husbands experience an improvement at the time of divorce, while wives do not. After these initial changes, wives' depression improves slowly with time-divorced, suggesting an adaptive response, while more husbands become depressed.

We also examined the role of remarriage in the association between divorce and health in models with couple fixed effects. Greater remarriage rates among men and the stronger association between remarriage and health for men than for their ex-wives can account for much of the generally more beneficial/less detrimental association of divorce for husbands than their wives. Although provocative, whether the results are evidence of an effect of remarriage rather than remarriage health selection merits further study.

Our approach has been descriptive and by no means establishes causal impacts of divorce. There are other plausible non-causal interpretations of these associations. First of all, although fixed effects control only for unmeasured time-invariant characteristics, they do not correct for bias induced by reverse causality or selection on unobserved time-varying characteristics. For instance, a traumatic experience (such as the death of a child) could both destabilize a marriage and adversely affect health, leading to a spurious correlation between changes in health and changes in marital status.

Although both divorced men and women are more likely to be in bad health than their married counterparts, our models with individual fixed effects more consistently show an adverse association between divorce and health for women than men. Taken together, these results suggest a more important role for marital selection for men than women. Since mortality rates are generally higher for men than women at older ages, we considered whether greater mortality attrition for men might influence our estimates. However, when we tested the sensitivity of the associations to differential mortality attrition by incorporating death in the "bad" health category, we continued to find that women experience more health deterioration following divorce than men (and some results suggested that men experience an improvement of health and mortality risk after divorce).

Theoretically, instrumental variables techniques could be used to support causal inferences, if valid instruments were available. For example, changes in divorce laws have been used as instruments for studies of the effects of divorce on socioeconomic status (e.g., Gruber 2004). The state-divorce-laws instruments could be implemented with the restricted HRS data. However, state divorce laws may or may not be valid instruments. States with strict divorce laws may also differ from other states in many respects, such as in the generosity of their Medicaid programs, which could be related to health so instrumental variable approaches may not convincingly establish a causal relationship between marital status and health (e.g., Moffitt 2005).

Measurement of divorce may also be an issue for studying the relationship between divorce and health. Divorces may drag on before they are finalized, for example, though we classify separated persons as divorced. In part, this is a philosophical question about the meaning of "divorce."

More research is needed to understand the pathways through which divorce in mid and later life becomes associated with health, and to understand why the associations are stronger for wives than their husbands. For example, a longstanding literature explores the importance of social networks and social support for explaining health effects of marital status, especially widowhood (Berkman and Syme 1979; Berkman 1984; House et al. 1992; Umberson, Wortman and Kessler 1992). Future work could use data available in the restricted HRS on the location of adult children (and other information) to explore social support as a mechanism or moderator.

Our results reinforce earlier findings of associations between divorce on mental health at older ages since these associations are large, generally robust, and because mental health accounts for a large portion of the effect of divorce on self-reported general health (especially for women). Therefore, our results provide further evidence of the potential importance of social, psychological or medical interventions that could address divorce as a risk factor for mental health in later life, especially among women, as populations age (Brown and Lin 2012; Kennedy and Ruggles 2014).

3.7 Figures

Figure 3.1: Divorce and General Health over Time

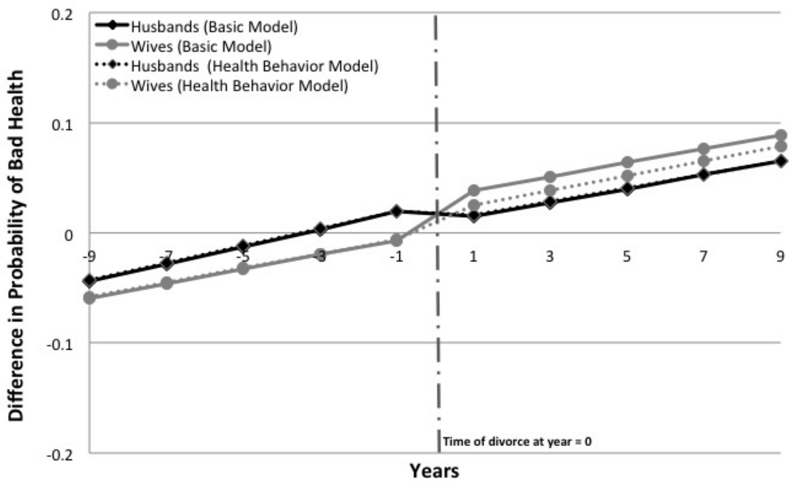


Figure 3.2a: Divorce and Psychological Conditions over Time

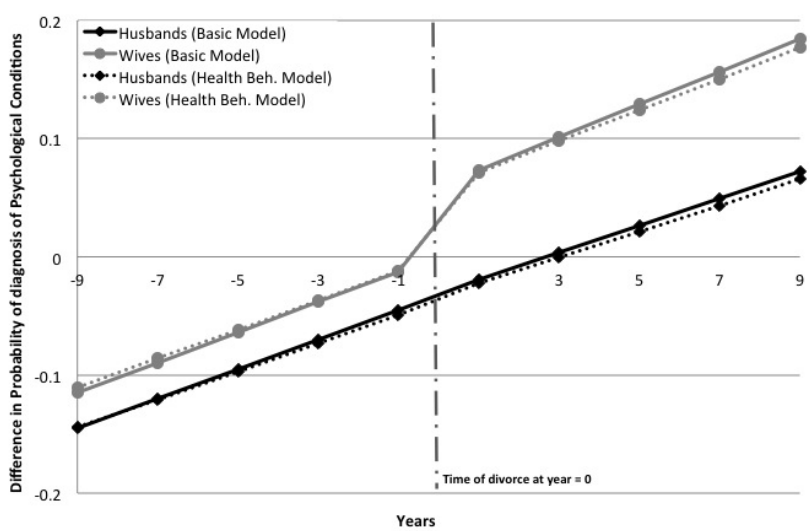
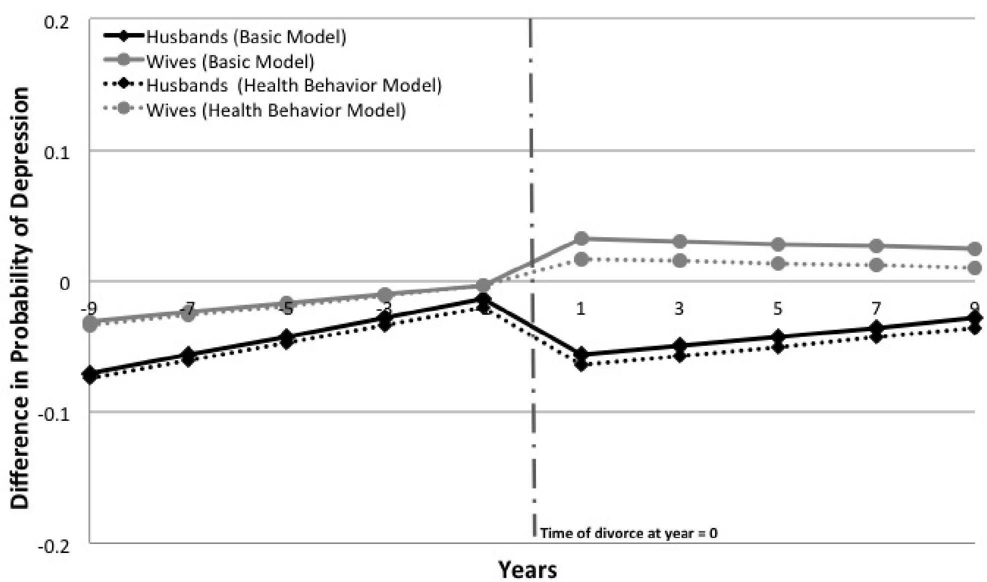


Figure 3.2b: Divorce and Depression over Time



3.8 Tables

Table 3.1: Summary Statistics

Sample means (SD) and Proportions (% unless indicated)

	Individuals				**Couples**			
	Women		**Men**		**Women**		**Men**	
	Divorced	**Married**	**Divorced**	**Married**	**Divorced**	**Married**	**Divorced**	**Married**
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Bad Health	0.29	0.19	0.31	0.20	0.29	0.23	0.29	0.28
Psychological Condition	0.26	0.14	0.20	0.08	0.28	0.17	0.21	0.17
Depressed	0.26	0.12	0.20	0.08	0.25	0.23	0.17	0.22
CESD score	2.24	1.27	1.84	0.99	2.15	1.94	1.57	1.82
	(2.4)	(1.8)	(2.1)	(1.6)	(2.4)	(2.3)	(2.0)	(2.3)
BMI (kg/m^2)	27.98	27.56	27.97	28.28	28.02	27.59	27.98	27.81
	(7.0)	(5.8)	(5.9)	(4.8)	(6.9)	(6.3)	(5.3)	(4.8)
Current Smoker	0.24	0.13	0.28	0.15	0.25	0.25	0.26	0.33
Uninsured	0.12	0.06	0.13	0.05	0.10	0.12	0.13	0.12
Adj. HH. Income	0.29	0.49	0.40	0.52	0.33	0.47	0.44	0.44
	(0.3)	(0.4)	(0.4)	(0.4)	(0.3)	(0.4)	(0.4)	(0.4)
Heart Condition	0.16	0.13	0.27	0.22	0.16	0.14	0.30	0.18
Lung Condition	0.13	0.06	0.09	0.07	0.12	0.07	0.10	0.08
Diabetes	0.13	0.12	0.20	0.17	0.13	0.13	0.19	0.16
Cancer	0.08	0.10	0.09	0.10	0.10	0.07	0.10	0.04
Stroke	0.07	0.04	0.08	0.05	0.09	0.06	0.08	0.05
Arthritis	0.55	0.54	0.48	0.43	0.56	0.42	0.47	0.37
High Blood Pressure	0.46	0.43	0.53	0.46	0.45	0.36	0.53	0.44
Age (years)	60.95	61.42	62.81	62.52	60.84	56.73	62.93	58.03
	(6.2)	(7.0)	(6.8)	(7.8)	(6.2)	(5.2)	(6.6)	(6.5)
Education (years)	13.07	12.85	12.81	13.28	13.03	13.01	12.8	12.55
	(2.4)	(2.7)	(3.1)	(3.0)	(2.5)	(2.7)	(3.1)	(3.3)
Black	0.10	0.06	0.14	0.06	0.09	0.09	0.12	0.14
Hispanic	0.06	0.06	0.08	0.06	0.06	0.08	0.07	0.09
Person-Years	1,310	4,416	1,006	4,117	1,358	1,042	1,356	1,044

Note: This table shows weighted summary statistics, using HRS person-level weights. The sample of individuals includes 7983 females and 7883 males (unweighted). The sample of couples includes 388 linked couples married or partnered at the baseline interview. The couple sample is restricted to couples whose marriage ends in divorce and for which both spouses were interviewed at least once while married and at least once after divorce. The sample of individuals includes "partnered" persons and married persons who become widowed, but due to space constraints means for the married and "partnered" states are not shown separately. Income in $100,000 of head and spouse/partner, if present, divided by the square root of the household size.

Table 3.2: Divorce and General Health, Individuals

	Women				**Men**			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Divorced	0.105**	0.082**	0.039**	0.035**	0.080**	0.069**	-0.017	-0.020
	(0.019)	(0.018)	(0.016)	(0.016)	(0.022)	(0.021)	(0.018)	(0.018)
Widowed	0.042**	0.025**	0.008	0.007	0.038**	0.031*	-0.016	-0.017
	(0.011)	(0.011)	(0.008)	(0.008)	(0.018)	(0.018)	(0.014)	(0.014)
Partnered	0.076**	0.061**	-0.015	-0.011	0.034*	0.028	-0.010	-0.009
	(0.022)	(0.020)	(0.018)	(0.018)	(0.019)	(0.019)	(0.017)	(0.017)
Controls for Health Behavior and Income	No	Yes	No	Yes	No	Yes	No	Yes
Individual Fixed Effects	No	No	Yes	Yes	No	No	Yes	Yes
Person-Years	51,980	51,980	51,980	51,980	44,981	44,981	44,981	44,981
Persons	7,983	7,983	7,983	7,983	7,883	7,883	7,883	7,883

Note: This table shows the main results from linear probability models with and without individual fixed effects. Full results are shown in Appendix Table C.1a. The dependent variable is an indicator variable for “bad” health, defined as self-reported poor or fair health versus good, very good or excellent health. All models include controls for age, age (as a quadratic), education, dummies for black, Hispanic, Census region (9) and HRS cohort (2). Models in even-numbered columns also include controls for BMI, smoking behavior, income, age (as a quadratic) fully interacted with a dummy for age 65 and older as well as an indicator for missing health insurance information. Standard errors clustered at the individual level are in parentheses. Significance levels are indicated by * <0.1, ** <0.05.

Table 3.3: Divorce and Diagnosed Health Conditions, Individuals

		Physical Health							***Mental Health***	
		High Blood P.	Lung Cond.	Heart Cond.	Diabetes	Cancer	Stroke	Arthritis	Psych. Cond.	Depression
Women	**Divorced**	0.014	0.016	0.013	0.006	0.001	0.011	-0.008	0.050**	0.054**
	Widowed	0.005	0.010*	-0.002	0.015**	-0.007	0.009*	-0.017**	0.030**	0.083**
Men	**Divorced**	-0.011	0.006	-0.007	-0.006	-0.005	0.002	-0.022	0.032**	0.030
	Widowed	0.029**	0.017*	0.015	-0.011	-0.004	-0.002	-0.022*	0.026**	0.115**

Note: This table shows the main results from linear probability models with individual fixed effects. The full results can be found in Appendix Tables C.2a, C.2b and C.2c. The physical health dependent variables are indicator variables for whether or not a person has been diagnosed with the indicated conditions. Psychological Condition is an indicator for a diagnosis of emotional, nervous or psychiatric condition. Depression is an indicator for depression according to the CESD scale. CESD information was imputed for 27 person-years so the model for depression includes a variable to indicate whether depression status was imputed from partial information. Models also include controls for age (as a quadratic) fully interacted with dummy for age 65 and older, education, BMI, smoking behavior, income, dummies for black, Hispanic, and an indicator for missing health insurance information, Census region (9) and HRS cohort (2). Standard errors clustered at the individual level (not reported). Significance levels are indicated by * <0.1, ** <0.05.

Table 3.4: Divorce and General Health, Individuals: The Role of Physical & Mental Health Conditions

	Women	**Men**
(1) No controls for Mental or Physical Health Conditions	0.035**	-0.017
	(0.016)	(0.018)
(2) Model (1) plus Mental Health Conditions	0.031*	-0.017
	(0.017)	(0.019)
(3) Model (1) plus Physical Health Conditions	0.030*	-0.018
	(0.016)	(0.018)
(4) Model (1) plus Mental and Physical Health Conditions	0.028	-0.017
	(0.017)	(0.019)

Note: This table shows the main results from linear probability models with individual fixed effects. Full results are shown in Appendix Tables C.3a and C.3b. The dependent variable is an indicator variable for "bad" health, defined as self-reported poor or fair health versus good, very good or excellent health. Models in row (1) correspond to columns (4) and (8) from Table 3.2. Controls for mental health conditions are a dummy for a diagnosis of any of three psychological conditions and a dummy variable for depression according to the CESD scale. CESD information was imputed for 27 person-years. Model includes a dummy variable for depression status imputed from partial CESD information. Controls for physical health conditions include seven physical health conditions (heart condition, lung condition, diabetes, cancer, stroke, arthritis, High Blood Pressure). All models include controls for age (as a quadratic) fully interacted with dummy for age 65 and older, education, BMI, smoking behavior, income, dummies for black, Hispanic, and an indicator for missing health insurance information, Census region (9) and HRS cohort (2). Standard errors clustered at the individual level are in parentheses. Significance levels are indicated by * <0.1, ** <0.05.

Table 3.5: Divorce and Health, Couples

	"Bad" General Health		**Psychological Condition**		**Depression**	
	(1)	(2)	(3)	(4)	(5)	(6)
Divorced x Husband	-0.043	-0.024	-0.071**	-0.071**	-0.044	-0.033
	(0.027)	(0.027)	(0.029)	(0.029)	(0.029)	(0.029)
Divorced	0.063**	0.052**	0.127**	0.119**	0.040*	0.032
	(0.020)	(0.020)	(0.022)	(0.022)	(0.024)	(0.024)
Husband	0.005	0.003	-0.056**	-0.059**	-0.037	-0.037
	(0.022)	(0.022)	(0.026)	(0.026)	(0.025)	(0.025)
Controls for Health Behavior and Income	No	Yes	No	Yes	No	Yes
Person-Years	4,790	4,790	4,790	4,790	3,965	3,965
Couples	388	388	388	388	388	388
Effect of Divorce on Husband	0.020	0.028	0.055	0.048	-0.003	-0.002
	(0.023)	(0.023)	(0.019)	(0.019)	(0.023)	(0.024)

Note: This table shows results from linear probability models with couple fixed effects. The dependent variables are: "Bad" health an indicator variable for self-reported poor or fair health versus good, very good or excellent health; Psychological condition is an indicator for a diagnosis of emotional, nervous or psychiatric condition; Depression is an indicator for depression according to the CESD scale. All models include controls for age, age (as a quadratic), education, dummies for black, Hispanic, Census region (9) and HRS cohort (2). Models in even-numbered columns also include controls for BMI, smoking behavior, income, age (as a quadratic) fully interacted with a dummy for age 65 and older as well as an indicator for missing health insurance information. Standard errors are clustered at the individual level are in parentheses. Significance levels are indicated by * <0.1, ** <0.05.

Table 3.6: Divorce and General Health, Couples: The Role of Physical & Mental Health Conditions

	Wives	**Husbands**	**Difference**
(1) No controls for Mental or Physical Health Conditions	0.052**	0.028	-0.024
	(0.020)	(0.023)	(0.027)
(2) Model (1) plus Mental Health Conditions	0.026	0.016	-0.010
	(0.023)	(0.026)	(0.029)
(3) Model (1) plus Physical Health Conditions	0.037*	-0.001	-0.039
	(0.019)	(0.022)	(0.025)
(4) Model (1) plus Mental and Physical Health Conditions	0.022	-0.005	-0.026
	(0.022)	(0.025)	(0.028)

Note: This table shows the main results from linear probability models with couple fixed effects. Full results are shown in Appendix Table C.6. The dependent variable is an indicator variable for "bad" health, defined as self-reported poor or fair health versus good, very good or excellent health. Models in row (1) correspond to columns (2) from Table 3.5. Controls for mental health conditions are a dummy for a diagnosis of any of three psychological conditions and a dummy variable for depression according to the CESD scale. Model includes a dummy variable for depression status imputed from partial CESD information. Controls for physical health conditions include seven physical health conditions (heart condition, lung condition, diabetes, cancer, stroke, arthritis, High Blood Pressure). All models include controls for age (as a quadratic) fully interacted with dummy for age 65 and older, education, BMI, smoking behavior, income, dummies for black, Hispanic, and an indicator for missing health insurance information, Census region (9) and HRS cohort (2). Standard errors clustered at the individual level are in parentheses. Significance levels are indicated by * <0.1, ** <0.05.

Table 3.7: Divorce, Remarriage and Health, Couples

	"Bad" General Health		Psychological Condition		Depression	
	(1)	(2)	(3)	(4)	(5)	(6)
Divorced x Husband	-0.016	0.006	-0.030	-0.028	-0.033	-0.021
	(0.031)	(0.031)	(0.030)	(0.030)	(0.032)	(0.032)
Divorced	0.060**	0.044**	0.099**	0.092**	0.052**	0.041
	(0.021)	(0.021)	(0.023)	(0.023)	(0.025)	(0.025)
Husband	0.005	0.003	-0.055**	-0.059**	-0.039	-0.039
	(0.022)	(0.022)	(0.026)	(0.026)	(0.025)	(0.025)
Divorced x Remarried x Husband	-0.066	-0.078*	-0.122**	-0.124**	-0.010	-0.020
	(0.041)	(0.041)	(0.047)	(0.046)	(0.039)	(0.039)
Divorced x Remarried	-0.001	0.018	0.093**	0.091**	-0.059**	-0.045
	(0.030)	(0.030)	(0.036)	(0.036)	(0.029)	(0.029)
Controls for Health Behavior and Income	No	Yes	No	Yes	No	Yes
Person-Years	4,790	4,790	4,790	4,790	3,965	3,965
Couples	388	388	388	388	388	388
Effect of Divorce on Husband	0.045	0.050	0.070	0.064	0.019	0.019
	(0.025)	(0.025)	(0.020)	(0.020)	(0.025)	(0.026)
Effect of Remarriage on Husband	-0.068	-0.060	-0.029	-0.032	-0.068	-0.065
	(0.029)	(0.029)	(0.031)	(0.031)	(0.026)	(0.026)

Note: This table shows the main results from linear probability models with couple fixed effects. Full results are shown in Appendix Table C.4 The dependent variables are: "Bad" health an indicator variable for self-reported poor or fair health versus good, very good or excellent health; Psychological condition is an indicator for a diagnosis of emotional, nervous or psychiatric condition; Depression is an indicator for depression according to the CESD scale. The husband's effect of divorce is the sum of the coefficients in row 1 and 2. The husband's effect of remarriage is the sum of the coefficients in row 4 and 5. All models include controls for age, age (as a quadratic), education, dummies for black, Hispanic, Census region (9) and HRS cohort (2). Models in even-numbered columns also include controls for BMI, smoking behavior, income, age (as a quadratic) fully interacted with a dummy for age 65 and older as well as an indicator for missing health insurance information. Standard errors are clustered at the individual level are in parentheses. Significance levels are indicated by * <0.1, ** <0.05.

Appendix A

Appendix Tables for Chapter I

Table A.1: Eligibility Model: Full results

	(1)	(2)
Cohort 1939 : Years 2003-2005	0.032	0.017
	(0.019)	(0.014)
Cohort 1939 : Years 2006-2008	0.061	0.036
	(0.021)	(0.016)
Cohort 1940 : Years 2003-2005	0.000	0.000
	(0.019)	(0.014)
Cohort 1940 : Years 2006-2008	0.029	0.016
	(0.020)	(0.016)
Cohort 1941 : Years 2003-2005	-0.028	-0.014
	(0.020)	(0.014)
Cohort 1941 : Years 2006-2008	0.004	0.004
	(0.020)	(0.015)
Cohort 1942 : Years 2003-2005	-0.028	-0.009
	(0.021)	(0.015)
Cohort 1942 : Years 2006-2008	-0.010	0.004
	(0.021)	(0.015)
Cohort 1942 : Years 2009-2011	-0.003	0.008
	(0.022)	(0.016)
Cohort 1943 : Years 2003-2005	-0.023	-0.004
	(0.020)	(0.014)
Cohort 1943 : Years 2006-2008	-0.027	-0.008
	(0.020)	(0.015)
Cohort 1943 : Years 2009-2011	-0.018	-0.001
	(0.021)	(0.016)
Cohort 1944 : Years 2003-2005	-0.016	0.000
	(0.017)	(0.011)
Cohort 1944 : Years 2006-2008	-0.031	-0.011
	(0.021)	(0.015)
Cohort 1944 : Years 2009-2011	-0.028	-0.007
	(0.021)	(0.016)
Cohort 1945 : Years 2003-2005	-0.011	0.001
	(0.011)	(0.007)
Cohort 1945 : Years 2006-2008	-0.024	-0.006
	(0.022)	(0.015)
Cohort 1945 : Years 2009-2011	-0.022	-0.002
	(0.021)	(0.016)
Cohort 1946 : Years 2003-2005	-0.004	0.000
	(0.006)	(0.004)
Cohort 1946 : Years 2006-2008	-0.032	-0.015
	(0.028)	(0.020)
Cohort 1946 : Years 2009-2011	-0.039	-0.017
	(0.036)	(0.026)
Cohort 1947 : Years 2006-2008	0.008	0.011
	(0.017)	(0.011)
Cohort 1947 : Years 2009-2011	0.041	0.038
	(0.022)	(0.015)
Cohort 1948 : Years 2006-2008	0.009	0.009
	(0.012)	(0.007)
Cohort 1948 : Years 2009-2011	0.070	0.056
	(0.023)	(0.016)
Cohort 1949 : Years 2006-2008	0.008	0.008
	(0.007)	(0.004)
Cohort 1949 : Years 2009-2011	0.072	0.053
	(0.023)	(0.015)

Table A.1 (Continued). Eligibility Model: Full results

	(1)	**(2)**
Married or partnered	0.150	0.093
	(0.002)	(0.004)
Widowed	0.091	0.155
	(0.003)	(0.006)
Divorced or separated	0.055	0.040
	(0.003)	(0.004)
Pension Receiver		-0.297
		(0.020)
Ul Benefits		-0.282
		(0.012)
Dl Benefits		-0.330
		(0.005)
Welfare		-0.573
		(0.011)
Other Social Benefits		-0.275
		(0.008)
Constant	0.861	0.976
	(0.007)	(0.007)
Pool 1 Treatment Effect	-0.022	-0.015
	(0.006)	(0.004)
Pool 2 Treatment Effect	-0.020	-0.010
	(0.006)	(0.005)
Pool 3 Treatment Effect	-0.030	-0.014
	(0.006)	(0.004)
Pool 4 Treatment Effect	-0.016	-0.009
	(0.006)	(0.004)
Pool 5 Treatment Effect	0.003	0.007
	(0.006)	(0.004)
Pool 6 Treatment Effect	0.048	0.038
	(0.006)	(0.005)
Pool 7 Treatment Effect	0.074	0.054
	(0.006)	(0.005)
Pool 8 Treatment Effect	0.063	0.042
	(0.006)	(0.005)
Person - Years	29,500,000	28,500,000
Age Dummies	Yes	Yes
Year Dummies	Yes	Yes
Sector Dummies	Yes	Yes

Note: This table shows the full results from the eligibility model, specified as a linear probability model. The dependent variable is an indicator variable for whether or not a person worked. The standard errors are clustered at the cohort level, 21 clusters in total. The sample includes men born between 1939 and 1959 the period from 1999 through 2011. For the cohorts that only serve as controls (cohorts 1939, 1940, 1941) the observations after 2008 are not included in the sample.

Table A.2: Decomposing the Treatment Effect by Age

		Pool 1	Pool 2	Pool 3	Pool 4	Pool 5	Pool 6	Pool 7	Pool 8	
	Ages	**67, 68, 69**	**66, 67, 68**	**65, 66, 67**	**64, 65, 66**	**63, 64, 65**	**62, 63, 64**	**61, 62, 63**	**60, 61, 62**	
Treatment	**Cohort**	**1942**	**1943**	**1944**	**1945**	**1946**	**1947**	**1948**	**1949**	
DWBp	**Age**									$\overline{\Delta LPF_a}$
0	60								.	.
0	61							.	.	.
5	62						0.026	0.045	0.042	0.038
7	63					0.008	0.036	0.063		0.036
10	64				-0.019	0.011	0.052			0.015
2	65			-0.017	-0.004	0.002				-0.006
2	66		-0.015	-0.017	-0.004					-0.012
1	67	-0.015	-0.008	-0.008						-0.010
1	68	-0.015	-0.008							-0.011
1	69	-0.015								-0.015
		$\overline{\Delta LPF_{Pool1}}$	$\overline{\Delta LPF_{Pool2}}$	$\overline{\Delta LPF_{Pool3}}$	$\overline{\Delta LPF_{Pool4}}$	$\overline{\Delta LPF_{Pool5}}$	$\overline{\Delta LPF_{Pool6}}$	$\overline{\Delta LPF_{Pool7}}$	$\overline{\Delta LPF_{Pool8}}$	
		-0.015	-0.010	-0.014	-0.009	0.007	0.038	0.054	0.042	

Note: This table shows results from a decomposition of the treatment effects from the eligibility model that includes controls for pension receipt and social benefits (Row 2 in Table **??**nd column 2 in Appendix Table A.1), also shown in the bottom row. The cells show the change in LFP, the treatment effect, at age a in age pool m, calculated as $\Delta LFP_{ma} = DWBp_{ma}\frac{\overline{\Delta LFP_m}}{\overline{DWB_{p_m}}}$, where $DWBp_{ma}$ is the DWB percentage that people are eligible for at age a in age pool m, and $\overline{DWP_{p_m}}$is the (arithmetic) mean DWB percentage of age pool m. The decomposition results for pool 7 and 8 treats the treatment effect as two and one year averages. This gives more conservative decomposition results than treating it as a 3-year average with a 0% DWB at the ages before 62.

Table A.3: Eligibility Model - Falsification Test: Full results

	(1)	**(2)**
Cohort 1950 : Years 2003-2005	-0.003	0.002
	(0.003)	(0.001)
Cohort 1950 : Years 2006-2008	-0.019	-0.012
	(0.003)	(0.001)
Cohort 1951 : Years 2003-2005	0.002	0.004
	(0.002)	(0.001)
Cohort 1951 : Years 2006-2008	-0.005	-0.002
	(0.003)	(0.001)
Cohort 1952 : Years 2003-2005	0.003	0.003
	(0.002)	(0.001)
Cohort 1952 : Years 2006-2008	-0.003	-0.003
	(0.003)	(0.001)
Cohort 1953 : Years 2003-2005	0.003	0.003
	(0.002)	(0.001)
Cohort 1953 : Years 2006-2008	0.000	-0.001
	(0.003)	(0.001)
Cohort 1953 : Years 2009-2011	0.003	-0.001
	(0.003)	(0.001)
Cohort 1954 : Years 2003-2005	0.002	0.003
	(0.002)	(0.001)
Cohort 1954 : Years 2006-2008	-0.001	-0.002
	(0.002)	(0.001)
Cohort 1954 : Years 2009-2011	0.003	-0.002
	(0.003)	(0.001)
Cohort 1955 : Years 2003-2005	0.002	0.003
	(0.002)	(0.001)
Cohort 1955 : Years 2006-2008	0.001	-0.002
	(0.002)	(0.001)
Cohort 1955 : Years 2009-2011	0.005	-0.002
	(0.003)	(0.001)
Cohort 1956 : Years 2003-2005	0.001	0.001
	(0.001)	(0.001)
Cohort 1956 : Years 2006-2008	0.000	-0.004
	(0.002)	(0.001)
Cohort 1956 : Years 2009-2011	0.002	-0.005
	(0.002)	(0.001)
Cohort 1957 : Years 2003-2005	0.004	0.004
	(0.001)	(0.001)
Cohort 1957 : Years 2006-2008	0.003	-0.001
	(0.002)	(0.001)
Cohort 1957 : Years 2009-2011	0.005	-0.003
	(0.002)	(0.001)
Cohort 1958 : Years 2006-2008	0.002	0.000
	(0.001)	(0.001)
Cohort 1958 : Years 2009-2011	0.004	-0.003
	(0.002)	(0.001)
Cohort 1959 : Years 2006-2008	0.003	-0.001
	(0.001)	(0.001)
Cohort 1959 : Years 2009-2011	0.006	-0.003
	(0.002)	(0.001)
Cohort 1960 : Years 2006-2008	-0.003	-0.002
	(0.001)	(0.000)
Cohort 1960 : Years 2009-2011	-0.001	-0.005
	(0.002)	(0.001)

Table A.3 (Continued). Eligibility Model - Falsification Test: Full results

	(1)	(2)
Married or partnered	0.126	0.063
	(0.004)	(0.003)
Divorced or separated	0.073	0.073
	(0.006)	(0.007)
Widowed	0.039	0.016
	(0.002)	(0.002)
Pension Receiver		-0.086
		(0.007)
Ul Benefits		-0.184
		(0.010)
Dl Benefits		-0.367
		(0.003)
Welfare		-0.565
		(0.008)
Other Social Benefits		-0.315
		(0.004)
Constant		0.973
		(0.001)
Pool 1 Treatment Effect	0.019	0.014
	(0.001)	(0.000)
Pool 2 Treatment Effect	0.010	0.007
	(0.001)	(0.000)
Pool 3 Treatment Effect	0.009	0.006
	(0.001)	(0.000)
Pool 4 Treatment Effect	0.004	0.002
	(0.001)	(0.000)
Pool 5 Treatment Effect	0.005	0.003
	(0.001)	(0.000)
Pool 6 Treatment Effect	0.003	0.002
	(0.001)	(0.000)
Pool 7 Treatment Effect	0.003	0.002
	(0.001)	(0.000)
Pool 8 Treatment Effect	0.003	0.002
	(0.001)	(0.000)
Person - Years	34,300,000	32,000,000
Age Dummies	Yes	Yes
Year Dummies	Yes	Yes
Sector Dummies	Yes	Yes

Note: This table shows the full results from the falsification test for the eligibility model, specified as a linear probability model. The dependent variable is an indicator variable for whether or not a person worked. The standard errors are clustered at the cohort level, 20 clusters in total. The sample includes men born between 1950 through 1969 the period from 1999 through 2011. For the cohorts that only serve as controls (cohorts 1950, 1951, 1952) the observations after 2008 are not included in the sample.

Appendix B

Appendix Tables for Chapter II

Table B.1: Full Results from 2SLS - Linear Probability Models: First Stage

First Stage **Dependent Variable = Husband Working**			
	(1)	**(2)**	**(3)**
Husband Eligible for DWB	0.051	0.036	0.035
	(0.006)	(0.004)	(0.004)
Husband Receiving Pension		-0.286	-0.285
		(0.010)	(0.010)
Husband Receiving Ul Benefits		-0.292	-0.292
		(0.007)	(0.007)
Husband Receiving Dl Benefits		-0.176	-0.175
		(0.003)	(0.003)
Husband Receiving Welfare		-0.461	-0.317
		(0.014)	(0.030)
Husband Receiving Other Social Benefits		-0.204	-0.200
		(0.007)	(0.006)
Wife Receiving Pension			-0.015
			(0.003)
Wife Receiving Ul Benefits			-0.001
			(0.001)
Wife Receiving Dl Benefits			-0.014
			(0.001)
Wife Receiving Welfare			-0.150
			(0.026)
Wife Receiving Other Social Benefits			-0.050
			(0.005)
Constant	1.008	1.040	1.040
	(0.004)	(0.004)	(0.004)
Year Dummies	Yes	Yes	Yes
Husband Age Dummies	Yes	Yes	Yes
Wife Age Dummies	Yes	Yes	Yes
Husband Sector Dummies	Yes	Yes	Yes
Wife Sector Dummies	Yes	Yes	Yes
Difference-in-Differences	0.079	0.054	0.053
	(0.004)	(0.003)	(0.003)
F-Statistic	62.8	74.8	74.7
Couple-Years	4,355,909	4,355,909	4,355,909

Note: This table shows the full results from the first stage of the two-stage-least-squares linear probability model. The dependent variable in the first stage is an indicator variable for whether or not the husband worked. The dependent variable in the second stage is an indicator variable for whether or not the wife worked. The standard errors are clustered at the husband-wife birth-cohort levels, 114 in total. The sample includes couples with with husbands born between 1944 and 1955 and wives born between 1947 and 1959. Observations of couples in the control group, with husbands born between 1944 and 1946 are not included in the sample after 2009, when they are also eligible for the DWB. Observations of couples with wives born between 1947 and 1949 are also not included in the sample after 2009, when they are eligible for the DWB.

Appendix C

Appendix Tables for Chapter III

Table C.1a: Divorce and General Health, Individuals

	Women				Men			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Divorced	0.105**	0.082**	0.039**	0.035**	0.080**	0.069**	-0.017	-0.020
	(0.019)	(0.018)	(0.016)	(0.016)	(0.022)	(0.021)	(0.018)	(0.018)
Widowed	0.042**	0.025**	0.008	0.007	0.038**	0.031*	-0.016	-0.017
	(0.011)	(0.011)	(0.008)	(0.008)	(0.018)	(0.018)	(0.014)	(0.014)
Partnered	0.076**	0.061**	-0.015	-0.011	0.034*	0.028	-0.010	-0.009
	(0.022)	(0.020)	(0.018)	(0.018)	(0.019)	(0.019)	(0.017)	(0.017)
Education	-0.036**	-0.029**			-0.029**	-0.023**		
	(0.001)	(0.001)			(0.001)	(0.001)		
Black	0.096**	0.063**			0.078**	0.068**		
	(0.013)	(0.013)			(0.013)	(0.013)		
Hispanic	0.094**	0.097**			0.068**	0.065**		
	(0.016)	(0.015)			(0.016)	(0.016)		
BMI		0.009**		0.002*		0.007**		-0.001
		(0.001)		(0.001)		(0.001)		(0.001)
Current Smoker		0.082**		-0.061**		0.078**		-0.069**
		(0.009)		(0.010)		(0.009)		(0.011)
Adj. HH. Income		-0.075**		-0.015**		-0.101**		-0.020**
		(0.006)		(0.004)		(0.006)		(0.005)
Under 65 - Uninsured		0.008		-0.018**		-0.007		-0.007
		(0.010)		(0.009)		(0.012)		(0.011)
Individual Fixed Effects	No	No	Yes	Yes	No	No	Yes	Yes
Person-Years	51,980	51,980	51,980	51,980	44,981	44,981	44,981	44,981
Persons	7,983	7,983	7,983	7,983	7,883	7,883	7,883	7,883

Note: This table shows the coefficients from linear probability models with and without individual fixed effects. The dependent variable is an indicator variable for "bad" health, defined as self-reported poor or fair health versus good, very good or excellent health. All models include controls for age, age (as a quadratic), education, dummies for black, Hispanic, Census region (9) and HRS cohort (2). Models in even-numbered columns also include controls for BMI, smoking behavior, income, age (as a quadratic) fully interacted with a dummy for age 65 and older as well as an indicator for missing health insurance information. Adjusted household income is in $100,000 of head and spouse/partner, if present, and divided by the square root of the household size. Standard errors clustered at the individual level are in parentheses. Significance levels are indicated by * <0.1, ** <0.05.

Table C.1b: Divorce and General Health, Individuals (Logistic Model)

	Women				Men			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Divorced	0.622**	0.422**	0.260*	0.187	0.447**	0.346**	-0.339**	-0.358**
	(0.1)	(0.098)	(0.148)	(0.15)	(0.111)	(0.106)	(0.157)	(0.158)
Widowed	0.250**	0.093	-0.020	-0.021	0.198**	0.136	-0.325**	-0.311**
	(0.062)	(0.061)	(0.078)	(0.079)	(0.091)	(0.091)	(0.115)	(0.116)
Partnered	0.449**	0.358**	-0.165	-0.150	0.189*	0.166	-0.131	-0.124
	(0.117)	(0.11)	(0.170)	(0.173)	(0.106)	(0.107)	(0.177)	(0.179)
Education	-0.212**	-0.162**			-0.162**	-0.116**		
	(0.009)	(0.009)			(0.007)	(0.007)		
Black	0.533**	0.307**			0.411**	0.335**		
	(0.069)	(0.069)			(0.069)	(0.068)		
Hispanic	0.353**	0.367**			0.291**	0.227**		
	(0.086)	(0.082)			(0.086)	(0.084)		
BMI		0.056**		0.023**		0.044**		-0.001
		(0.004)		(0.007)		(0.004)		(0.009)
Current Smoker		0.545**		-0.520**		0.457**		-0.468**
		(0.053)		(0.093)		(0.051)		(0.086)
Adj. HH. Income		-1.145**		-0.203**		-1.312**		-0.267**
		(0.103)		(0.079)		(0.091)		(0.084)
Under 65 - Uninsured		-0.023		-0.039		-0.078		0.101
		(0.059)		(0.074)		(0.064)		(0.089)
Individual Fixed Effects	No	No	Yes	Yes	No	No	Yes	Yes
Person-Years	51,980	51,980	20,413	20,413	44,981	44,981	19,265	19,265
Persons	7,983	7,983	2,783	2,783	7,883	7,883	2,859	2,859

Note: This table shows the coefficients from logistic models with and without individual fixed effects. The dependent variable is an indicator variable for "bad" health, defined as self-reported poor or fair health versus good, very good or excellent health. All models include controls for age, age (as a quadratic), education, dummies for black, Hispanic, Census region (9) and HRS cohort (2). Models in even-numbered columns also include controls for BMI, smoking behavior, income, age (as a quadratic) fully interacted with a dummy for age 65 and older as well as an indicator for missing health insurance information. Adjusted household income is in $100,000 of head and spouse/partner, if present, and divided by the square root of the household size. Standard errors clustered at the individual level are in parentheses. Significance levels are indicated by * <0.1, ** <0.05.

Table C.1c: Divorce and General Health, Individuals (5-point Likert scale)

	Women				Men			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Divorced	0.264**	0.178**	0.078**	0.075**	0.146**	0.106*	-0.103**	-0.107**
	(0.056)	(0.053)	(0.038)	(0.037)	(0.059)	(0.055)	(0.045)	(0.045)
Widowed	0.085**	0.021	-0.061**	-0.060**	0.049	0.027	-0.131**	-0.130**
	(0.028)	(0.027)	(0.019)	(0.019)	(0.045)	(0.045)	(0.031)	(0.031)
Partnered	0.193**	0.135**	-0.025	-0.016	0.090*	0.067	-0.005	-0.005
	(0.057)	(0.050)	(0.043)	(0.043)	(0.054)	(0.052)	(0.047)	(0.047)
Education	-0.106**	-0.078**			-0.088**	-0.067**		
	(0.004)	(0.004)			(0.003)	(0.004)		
Black	0.368**	0.231**			0.207**	0.169**		
	(0.031)	(0.030)			(0.034)	(0.033)		
Hispanic	0.234**	0.239**			0.116**	0.106**		
	(0.039)	(0.037)			(0.042)	(0.041)		
BMI		0.036**		0.010**		0.031**		0.005**
		(0.002)		(0.002)		(0.002)		(0.003)
Current Smoker		0.287**		-0.152**		0.283**		-0.132**
		(0.024)		(0.024)		(0.025)		(0.024)
Adj. HH. Income		-0.286**		-0.020*		-0.333**		-0.021
		(0.019)		(0.012)		(0.019)		(0.014)
Under 65 - Uninsured		0.055**		-0.006		-0.016		0.002
		(0.026)		(0.019)		(0.031)		(0.025)
Individual Fixed Effects	No	No	Yes	Yes	No	No	Yes	Yes
Person-Years	51,954	51,954	51,954	51,954	44,969	44,969	44,969	44,969
Persons	7,983	7,983	7,983	7,983	7,883	7,883	7,883	7,883

Note: This table shows the coefficients from OLS models with and without individual fixed effects. The dependent variable is a self-reported health status on a 5-point Likert scale. All models include controls for age, age (as a quadratic), education, dummies for black, Hispanic, Census region (9) and HRS cohort (2). Models in even-numbered columns also include controls for BMI, smoking behavior, income, age (as a quadratic) fully interacted with a dummy for age 65 and older as well as an indicator for missing health insurance information. Adjusted household income is in $100,000 of head and spouse/partner, if present, and divided by the square root of the household size. Standard errors clustered at the individual level are in parentheses. Significance levels are indicated by * <0.1, ** <0.05.

Table C.2a: The Effect of Divorce on Physical Health Conditions of Individuals (Women)

	High Blood P.	**Lung**	**Heart**	**Diabetes**	**Cancer**	**Stroke**	**Arthritis**
Divorced	0.014	0.016	0.013	0.006	0.001	0.011	-0.008
	(0.016)	(0.010)	(0.011)	(0.011)	(0.009)	(0.009)	(0.015)
Widowed	0.005	0.010*	-0.002	0.015**	-0.007	0.009*	-0.017**
	(0.009)	(0.006)	(0.007)	(0.007)	(0.005)	(0.005)	(0.009)
Partnered	0.005	0.000	0.009	0.003	0.010	0.006	-0.011
	(0.018)	(0.011)	(0.014)	(0.013)	(0.014)	(0.009)	(0.018)
BMI	0.003**	0.001	0.000	-0.002**	-0.001	-0.002**	0.002**
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.000)	(0.001)
Current Smoker	-0.021*	-0.048**	-0.059**	-0.012*	-0.036**	-0.014**	-0.004
	(0.010)	(0.008)	(0.010)	(0.007)	(0.007)	(0.006)	(0.010)
Adj. HH. Income	-0.005	-0.002	-0.002	-0.002	-0.009**	-0.007**	0.004
	(0.005)	(0.003)	(0.003)	(0.003)	(0.003)	(0.002)	(0.005)
Under 65 - Uninsured	-0.005	-0.012**	-0.012**	-0.025**	-0.004	-0.011**	-0.006
	(0.008)	(0.005)	(0.006)	(0.006)	(0.004)	(0.004)	(0.008)
Person-Years	51,980	51,980	51,980	51,980	51,980	51,980	51,980
Persons	7,983	7,983	7,983	7,983	7,983	7,983	7,983

Note: This table shows coefficients from linear probability models with individual fixed effects. The dependent variables are indicator variables reflecting the answer to the question “Has a doctor ever told you that you have ...?”. All models include controls for age (as a quadratic) fully interacted with dummy for age 65 and older, education, BMI, smoking behavior, income, dummies for black, Hispanic, and an indicator for missing health insurance information, Census region (9) and HRS cohort (2). Adjusted household income is in \$100,000 of head and spouse/partner, if present, and divided by the square root of the household size. Standard errors clustered at the individual level. Significance levels are indicated by * <0.1, ** <0.05.

Table C.2b: The Effect of Divorce on Physical Health Conditions of Individuals (Men)

	High Blood P.	Lung	Heart	Diabetes	Cancer	Stroke	Arthritis
Divorced	-0.011	0.006	-0.007	-0.006	-0.005	0.002	-0.022
	(0.016)	(0.011)	(0.014)	(0.014)	(0.013)	(0.009)	(0.017)
Widowed	0.029**	0.017*	0.015	-0.011	-0.004	-0.002	-0.022*
	(0.014)	(0.010)	(0.014)	(0.011)	(0.012)	(0.009)	(0.013)
Partnered	-0.026	0.006	0.007	-0.009	-0.019	0.001	-0.034**
	(0.020)	(0.014)	(0.015)	(0.014)	(0.016)	(0.012)	(0.017)
BMI	0.004**	0.000	-0.001	-0.005**	-0.002**	-0.002**	0.002**
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Current Smoker	-0.056**	-0.072**	-0.069**	-0.031**	-0.035**	-0.020**	-0.020**
	(0.010)	(0.009)	(0.010)	(0.008)	(0.008)	(0.006)	(0.009)
Adj. HH. Income	-0.003	-0.005*	0.001	-0.003	-0.003	-0.008**	-0.013**
	(0.005)	(0.003)	(0.005)	(0.004)	(0.004)	(0.003)	(0.005)
Under 65 - Uninsured	-0.025**	0.000	0.000	-0.026**	0.011*	-0.004	-0.003
	(0.010)	(0.005)	(0.007)	(0.008)	(0.006)	(0.005)	(0.009)
Person-Years	44,981	44,981	44,981	44,981	44,981	44,981	44,981
Persons	7,883	7,883	7,883	7,883	7,883	7,883	7,883

Note: This table shows coefficients from linear probability models with individual fixed effects. The dependent variables are indicator variables reflecting the answer to the question "Has a doctor ever told you that you have ...?". All models include controls for age (as a quadratic) fully interacted with dummy for age 65 and older, education, BMI, smoking behavior, income, dummies for black, Hispanic, and an indicator for missing health insurance information, Census region (9) and HRS cohort (2). Adjusted household income is in \$100,000 of head and spouse/partner, if present, and divided by the square root of the household size. Standard errors clustered at the individual level. Significance levels are indicated by * <0.1, ** <0.05.

Table C.2c: The Effect of Divorce on Mental Health, Individuals

	Women				Men			
	Psych. Cond		Depression		Psych. Cond		Depression	
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**
Divorced	0.052**	0.050**	0.057**	0.054**	0.034**	0.032**	0.033*	0.03
	(0.014)	(0.014)	(0.019)	(0.019)	(0.013)	(0.013)	(0.019)	(0.019)
Widowed	0.031**	0.030**	0.084**	0.083**	0.027**	0.026**	0.116**	0.115**
	(0.007)	(0.007)	(0.009)	(0.009)	(0.009)	(0.009)	(0.014)	(0.014)
Partnered	0.051**	0.052**	0.035	0.035	0.013	0.013	-0.003	-0.004
	(0.015)	(0.015)	(0.022)	(0.022)	(0.013)	(0.013)	(0.019)	(0.019)
BMI		0.000		-0.001		0.000		-0.003**
		(0.001)		(0.001)		(0.001)		(0.001)
Current Smoker		-0.012		-0.029**		-0.009		-0.015*
		(0.008)		(0.011)		(0.006)		(0.009)
Adj. HH. Income		-0.002		-0.011**		-0.010**		-0.001
		(0.003)		(0.005)		(0.003)		(0.004)
Under 65 - Uninsured		-0.006		0.031**		-0.004		0.018*
		(0.006)		(0.009)		(0.005)		(0.011)
Person-Years	51,980	51,980	46,862	46,862	44,981	44,981	39,888	39,888
Persons	7,983	7,983	7,707	7,707	7,883	7,883	7,334	7,334

Note: This table shows coefficients from linear probability models with individual fixed effects. The dependent variables psychological condition is an indicator for a diagnosis of emotional, nervous or psychiatric condition. The dependent variable depression is an indicator for depression according to the CESD scale. CESD information was imputed for 27 person-years so the model for depression includes a variable to indicate whether depression status was imputed from partial information. All models include controls for age, age (as a quadratic), education, dummies for black, Hispanic, Census region (9) and HRS cohort (2). Models in even-numbered columns also include controls for BMI, smoking behavior, income, age (as a quadratic) fully interacted with a dummy for age 65 and older as well as an indicator for missing health insurance information. Adjusted household income is in $100,000 of head and spouse/partner, if present, and divided by the square root of the household size. Standard errors clustered at the individual level. Significance levels are indicated by * <0.1, ** <0.05.

Table C.2d: The Effect of Divorce on CESD index of Individuals (Men and Women)

	Women		Men	
	(1)	(2)	(3)	(4)
Divorced	0.396**	0.377**	0.332**	0.317**
	(0.091)	(0.091)	(0.095)	(0.095)
Widowed	0.551**	0.546**	0.795**	0.790**
	(0.044)	(0.045)	(0.072)	(0.072)
Partnered	0.143	0.149	-0.074	-0.085
	(0.117)	(0.116)	(0.089)	(0.089)
BMI		0.000		-0.005
		(0.004)		(0.005)
Current Smoker		-0.185**		-0.066
		(0.058)		(0.046)
Adj. HH. Income		-0.070**		-0.020
		(0.025)		(0.023)
Under 65 - Uninsured		0.142**		0.148**
		(0.046)		(0.051)
Person-Years	46,846	46,846	39,878	39,878
Persons	7,707	7,707	7,333	7,333

Note: This table shows coefficients from OLS models with individual fixed effects. The dependent variable is the abbreviated version of the Center for Epidemiologic Studies Depression (CESD) scale and ranges between 0 and 8, and is the sum of indicators of whether the respondent experienced each of several sentiments/conditions, such as “everything is an effort” and “felt sad”, all or most of the time during the week before the interview. CESD information was imputed for 27 person-years so the model for depression includes a variable to indicate whether depression status was imputed from partial information. All models include controls for age, age (as a quadratic), education, dummies for black, Hispanic, Census region (9) and HRS cohort (2). Models in even-numbered columns also include controls for BMI, smoking behavior, income, age (as a quadratic) fully interacted with a dummy for age 65 and older as well as an indicator for missing health insurance information. Adjusted household income is in $100,000 of head and spouse/partner, if present, and divided by the square root of the household size. Standard errors clustered at the individual level. Significance levels are indicated by * <0.1, ** <0.05.

Table C.3a: Divorce and General Health, Individuals: The Role of Physical & Mental Health Conditions (Women)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Divorced	0.082**	0.032*	0.056**	0.023	0.035**	0.031*	0.030*	0.028
	(0.018)	(0.016)	(0.016)	(0.015)	(0.016)	(0.017)	(0.016)	(0.017)
Widowed	0.025**	-0.007	0.007	-0.016*	0.007	-0.007	0.004	-0.007
	(0.011)	(0.010)	(0.009)	(0.009)	(0.008)	(0.008)	(0.008)	(0.008)
Partnered	0.061**	0.032	0.035*	0.018	-0.011	-0.014	-0.013	-0.015
	(0.020)	(0.020)	(0.018)	(0.018)	(0.018)	(0.019)	(0.018)	(0.019)
Education	-0.029**	-0.023**	-0.024**	-0.020**				
	(0.001)	(0.001)	(0.001)	(0.001)				
Black	0.063**	0.067**	0.057**	0.057**				
	(0.013)	(0.012)	(0.011)	(0.011)				
Hispanic	0.097**	0.087**	0.130**	0.114**				
	(0.015)	(0.014)	(0.013)	(0.013)				
BMI	0.009**	0.008**	0.003**	0.003**	0.002*	0.002*	0.002**	0.002**
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Smoking Now	0.082**	0.055**	0.055**	0.038**	-0.061**	-0.066**	-0.043**	-0.050**
	(0.009)	(0.009)	(0.008)	(0.008)	(0.010)	(0.011)	(0.010)	(0.011)
Adj. HH. Income	-0.075**	-0.057**	-0.053**	-0.041**	-0.015**	-0.012**	-0.013**	-0.011**
	(0.006)	(0.006)	(0.006)	(0.005)	(0.004)	(0.004)	(0.004)	(0.004)
Under 65 - Uninsured	0.008	0.004	0.025**	0.020**	-0.018**	-0.014	-0.012	-0.008
	(0.010)	(0.010)	(0.009)	(0.010)	(0.009)	(0.009)	(0.009)	(0.009)
Psych. Cond		0.146**		0.088**		0.080**		0.063**
		(0.010)		(0.009)		(0.012)		(0.012)
Clinical Depression Likely		0.275**		0.238**		0.103**		0.099**
		(0.008)		(0.008)		(0.007)		(0.007)
Heart Condition			0.164**	0.136**			0.083**	0.077**
			(0.010)	(0.010)			(0.011)	(0.011)
Lung Condition			0.231**	0.191**			0.114**	0.102**
			(0.014)	(0.014)			(0.015)	(0.015)
Diabetes			0.156**	0.145**			0.082**	0.073**
			(0.010)	(0.010)			(0.011)	(0.011)
Cancer			0.067**	0.057**			0.103**	0.105**
			(0.010)	(0.010)			(0.013)	(0.013)
Stroke			0.178**	0.154**			0.136**	0.126**
			(0.017)	(0.016)			(0.018)	(0.018)
Arthritis			0.099**	0.079**			0.046**	0.040**
			(0.006)	(0.006)			(0.006)	(0.007)
High Blood Pressure			0.052**	0.042**			0.038**	0.037**
			(0.006)	(0.006)			(0.007)	(0.007)
Individual Fixed Effects	No	No	No	No	Yes	Yes	Yes	Yes
Person-Years	51,980	46,862	51,980	46,862	51,980	46,862	51,980	46,862
Persons	7,333	7,333	7,333	7,333	7,983	7,707	7,983	7,707

Note: This table shows coefficients from linear probability models with and without individual fixed effects. The dependent variable is an indicator variable for "bad" health, defined as self-reported poor or fair health versus good, very good or excellent health. Psychological condition is an indicator for a diagnosis of emotional, nervous or psychiatric condition. Depression is an indicator for depression according to the CESD scale. CESD information was imputed for 27 person-years. Models include a dummy variable for depression status imputed from partial CESD information. All models include controls for age (as a quadratic) fully interacted with dummy for age 65 and older, and an indicator for missing health insurance information, Census region (9) and HRS cohort (2). Adjusted household income is in $100,000 of head and spouse/partner, if present, and divided by the square root of the household size. Standard errors clustered at the individual level are in parentheses. Significance levels are indicated by * <0.1, ** <0.05.

Table C.3b: Divorce and General Health, Individuals: The Role of Physical & Mental Health Conditions (Men)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Divorced	0.069**	0.016	0.043**	0.009	-0.020	-0.017	-0.018	-0.017
	(0.021)	(0.018)	(0.018)	(0.016)	(0.018)	(0.019)	(0.018)	(0.019)
Widowed	0.031*	-0.015	0.013	-0.020	-0.017	-0.036**	-0.020	-0.037**
	(0.018)	(0.017)	(0.016)	(0.015)	(0.014)	(0.014)	(0.013)	(0.014)
Partnered	0.028	0.002	0.022	0.003	-0.009	-0.001	-0.006	0.002
	(0.019)	(0.019)	(0.018)	(0.018)	(0.017)	(0.019)	(0.017)	(0.019)
Education	-0.023**	-0.020**	-0.020**	-0.018**				
	(0.001)	(0.001)	(0.001)	(0.001)				
Black	0.068**	0.071**	0.070**	0.070**				
	(0.013)	(0.013)	(0.011)	(0.012)				
Hispanic	0.065**	0.065**	0.110**	0.105**				
	(0.016)	(0.015)	(0.014)	(0.014)				
BMI	0.007**	0.006**	0.001	0.001	-0.001	-0.001	-0.001	-0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Smoking Now	0.078**	0.065**	0.063**	0.057**	-0.069**	-0.058**	-0.043**	-0.036**
	(0.009)	(0.009)	(0.008)	(0.008)	(0.011)	(0.011)	(0.010)	(0.011)
Adj. HH. Income	-0.101**	-0.084**	-0.070**	-0.061**	-0.020**	-0.017**	-0.018**	-0.016**
	(0.006)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)
Under 65 - Uninsured	-0.007	-0.016	0.021**	0.011	-0.007	-0.009	-0.005	-0.007
	(0.012)	(0.012)	(0.010)	(0.011)	(0.011)	(0.012)	(0.011)	(0.012)
Psych. Cond		0.201**		0.124**		0.090**		0.070**
		(0.014)		(0.013)		(0.017)		(0.016)
Clinical Depression Likely		0.282**		0.231**		0.111**		0.104**
		(0.010)		(0.010)		(0.009)		(0.009)
Heart Condition			0.162**	0.138**			0.095**	0.086**
			(0.008)	(0.008)			(0.010)	(0.010)
Lung Condition			0.243**	0.212**			0.125**	0.110**
			(0.014)	(0.014)			(0.016)	(0.017)
Diabetes			0.151**	0.133**			0.058**	0.049**
			(0.009)	(0.009)			(0.010)	(0.011)
Cancer			0.092**	0.081**			0.110**	0.107**
			(0.010)	(0.010)			(0.012)	(0.012)
Stroke			0.159**	0.133**			0.094**	0.086**
			(0.014)	(0.014)			(0.016)	(0.017)
Arthritis			0.080**	0.066**			0.034**	0.028**
			(0.006)	(0.006)			(0.008)	(0.008)
High Blood Pressure			0.044**	0.035**			0.036**	0.035**
			(0.006)	(0.006)			(0.008)	(0.008)
Individual Fixed Effects	No	No	No	No	Yes	Yes	Yes	Yes
Person-Years	44,981	39,888	44,981	39,888	44,981	39,888	44,981	39,888
Persons	7,707	7,707	7,707	7,707	7,883	7,334	7,883	7,334

Note: This table shows coefficients from linear probability models with and without individual fixed effects. The dependent variable is an indicator variable for "bad" health, defined as self-reported poor or fair health versus good, very good or excellent health. Psychological condition is an indicator for a diagnosis of emotional, nervous or psychiatric condition. Depression is an indicator for depression according to the CESD scale. CESD information was imputed for 27 person-years. Models include a dummy variable for depression status imputed from partial CESD information. All models include controls for age (as a quadratic) fully interacted with dummy for age 65 and older, and an indicator for missing health insurance information, Census region (9) and HRS cohort (2). Adjusted household income is in $100,000 of head and spouse/partner, if present, and divided by the square root of the household size. Standard errors clustered at the individual level are in parentheses. Significance levels are indicated by * <0.1, ** <0.05.

Table C.4: Divorce and Health, Couples

	(1)	(2)	(3)	(4)	(5)	(6)
	General Health		Psych. Cond.		Depression	
Divorced x Husband	-0.043	-0.024	-0.071**	-0.071**	-0.044	-0.033
	(0.027)	(0.027)	(0.029)	(0.029)	(0.029)	(0.029)
Divorced	0.063**	0.052**	0.127**	0.119**	0.040*	0.032
	(0.020)	(0.020)	(0.022)	(0.022)	(0.024)	(0.024)
Husband	0.005	0.003	-0.056**	-0.059**	-0.037	-0.037
	(0.022)	(0.022)	(0.026)	(0.026)	(0.025)	(0.025)
Education	-0.006	-0.007	-0.013**	-0.014**	-0.019**	-0.019**
	(0.005)	(0.005)	(0.006)	(0.006)	(0.005)	(0.005)
Black	-0.152	-0.168*	0.246**	0.231**	0.042	0.005
	(0.107)	(0.102)	(0.111)	(0.114)	(0.080)	(0.081)
Hispanic	-0.089	-0.109	-0.007	0.011	0.141**	0.145**
	(0.094)	(0.092)	(0.052)	(0.053)		(0.070)
BMI		0.004**		0.004*		0.002
		(0.002)		(0.002)		(0.002)
Current Smoker		-0.008		0.060**		0.072**
		(0.025)		(0.024)		(0.025)
Adj. HH. Income		-0.109**		-0.001		-0.071**
		(0.021)		(0.020)		(0.021)
Under 65 - Uninsured		-0.038*		0.027		0.033
		(0.022)		(0.019)		(0.024)
Person-Years	4,790	4,790	4,790	4,790	3,965	3,965
Couples	388	388	388	388	388	388
Effect of Divorce on Husband	0.020	0.028	0.055	0.048	-0.003	-0.002
SE	(0.023)	(0.023)	(0.019)	(0.019)	(0.023)	(0.024)

Note: This table shows results from linear probability models with couple fixed effects. The dependent variables are: "Bad" health an indicator variable for self-reported poor or fair health versus good, very good or excellent health; Psychological condition is an indicator for a diagnosis of emotional, nervous or psychiatric condition; Depression is an indicator for depression according to the CESD scale. All models include controls for age (as a quadratic), Census region (9) and HRS cohort (2). Models in even-numbered columns also include controls for age (as a quadratic) fully interacted with a dummy for age 65 and older as well as an indicator for missing health insurance information. Standard errors are clustered at the individual level are in parentheses. Adjusted household income is in $100,000 of head and spouse/partner, if present, and divided by the square root of the household size. Significance levels are indicated by * <0.1, ** <0.05.

Table C.5a: Divorce and General Health, Couples (Logistic Model)

	(1)	**(2)**	**(3)**	**(4)**
Divorced x Husband	-0.177	0.007	-0.312	-0.154
	(0.173)	(0.177)	(0.211)	(0.211)
Divorced	0.177	0.028	0.548**	0.406**
	(0.141)	(0.145)	(0.162)	(0.162)
Husband	-0.033	-0.025	0.012	0.008
	(0.164)	(0.167)	(0.178)	(0.178)
Education	-0.192**	-0.130**	-0.038	-0.040
	(0.023)	(0.023)	(0.035)	(0.036)
Black	0.172	0.046	-0.797	-0.947*
	(0.168)	(0.157)	(0.573)	(0.538)
Hispanic	-0.294	-0.275	-0.497	-0.623
	(0.278)	(0.266)	(0.629)	(0.633)
BMI		0.044**		0.032**
		(0.010)		(0.012)
Current Smoker		0.551**		0.002
		(0.129)		(0.179)
Adj. HH. Income		-2.195**		-1.368**
		(0.411)		(0.348)
Under 65 - Uninsured		-0.227*		-0.236
		(0.135)		(0.155)
Couple Fixed Effects	No	No	Yes	Yes
Person-Years	4,789	4,789	3,570	3,570
Couples	388	388	544	544
Effect of Divorce on Husband	-0.002	-0.002	-0.002	-0.002
SE	(0.024)	(0.024)	(0.024)	(0.024)

Note: This table shows the coefficients from logistic models with and without couple fixed effects. The dependent variable is an indicator variable for "bad" health, defined as self-reported poor or fair health versus good, very good or excellent health. All models include controls for age (as a quadratic), Census region (9) and HRS cohort (2). Models in even-numbered columns also include controls for age (as a quadratic) fully interacted with a dummy for age 65 and older as well as an indicator for missing health insurance information. Adjusted household income is in $100,000 of head and spouse/partner, if present, and divided by the square root of the household size. Standard errors clustered at the couple level in logit models without couple fixed effects and clustered at the individual level in models with couple fixed effects are in parentheses. Significance levels are indicated by * <0.1, ** <0.05.

Table C.5b: Divorce and General Health, Couples (5-point Likert scale)

	(1)	(2)	(3)	(4)
Divorced x Husband	-0.115	-0.027	-0.137*	-0.077
	(0.088)	(0.083)	(0.073)	(0.071)
Divorced	0.145**	0.073	0.235**	0.176**
	(0.070)	(0.065)	(0.053)	(0.052)
Husband	0.001	-0.016	0.035	0.025
	(0.082)	(0.078)	(0.061)	(0.060)
Education	-0.115**	-0.079**	-0.011	-0.019
	(0.012)	(0.011)	(0.014)	(0.014)
Black	0.080	0.018	-0.278	-0.345
	(0.087)	(0.078)	(0.260)	(0.246)
Hispanic	-0.111	-0.067	-0.125	-0.157
	(0.134)	(0.128)	(0.245)	(0.239)
BMI		0.034**		0.024**
		(0.005)		(0.005)
Current Smoker		0.407**		0.073
		(0.064)		(0.065)
Adj. HH. Income		-0.605**		-0.395**
		(0.073)		(0.057)
Under 65 - Uninsured		-0.014		-0.043
		(0.066)		(0.054)
Couple Fixed Effects	No	No	Yes	Yes
Person-Years	4,786	4,786	4,786	4,786
Couples	388	388	388	388
Row 1 + Row 2	0.030	0.046	0.097	0.099
SE	(0.073)	(0.069)	(0.059)	(0.059)

Note: This table shows the coefficients from OLS models with and without couple fixed effects. The dependent variable is a self-reported health status on a 5-point Likert scale. All models include controls for age (as a quadratic), Census region (9) and HRS cohort (2). Models in even-numbered columns also include controls for age (as a quadratic) fully interacted with a dummy for age 65 and older as well as an indicator for missing health insurance information. Adjusted household income is in $100,000 of head and spouse/partner, if present, and divided by the square root of the household size. Standard errors clustered at the couple level in OLS models without couple fixed effects and clustered at the individual level in models with couple fixed effects are in parentheses. Significance levels are indicated by * <0.1, ** <0.05.

Table C.6: Divorce and General Health, Couples: The Role of Physical & Mental Health Conditions

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Divorced x Husband	-0.004	0.008	-0.026	-0.015	-0.024	-0.010	-0.039	-0.026
	(0.031)	(0.035)	(0.028)	(0.033)	(0.027)	(0.029)	(0.025)	(0.028)
Divorced	0.012	-0.011	0.005	-0.004	0.052**	0.026	0.037*	0.022
	(0.025)	(0.028)	(0.023)	(0.026)	(0.020)	(0.023)	(0.019)	(0.022)
Husband	-0.009	0.012	0.015	0.025	0.003	0.024	0.026	0.036
	(0.028)	(0.031)	(0.026)	(0.030)	(0.022)	(0.025)	(0.021)	(0.025)
Education	-0.028**	-0.022**	-0.020**	-0.018**				
	(0.004)	(0.004)	(0.003)	(0.004)				
Black	0.022	0.046	0.034	0.046*				
	(0.031)	(0.028)	(0.027)	(0.026)				
Hispanic	-0.036	-0.001	0.044	0.054				
	(0.051)	(0.045)	(0.042)	(0.040)				
BMI	0.008**	0.007**	0.000	0.000	0.004**	0.002	-0.001	-0.002
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Current Smoker	0.107**	0.071**	0.077**	0.054**	-0.008	-0.010	0.002	-0.004
	(0.025)	(0.024)	(0.021)	(0.022)	(0.025)	(0.026)	(0.023)	(0.025)
Adj. HH. Income	-0.190**	-0.155**	-0.145**	-0.122**	-0.109**	-0.091**	-0.091**	-0.079**
	(0.028)	(0.023)	(0.023)	(0.021)	(0.021)	(0.021)	(0.020)	(0.020)
Under 65 - Uninsured	-0.031				-0.038*			
	(0.026)				(0.022)			
Psych. Cond		0.188**		0.113**		0.163**		0.110**
		(0.028)		(0.026)		(0.025)		(0.025)
Clinical Depression Likely		0.271**		0.234**		0.205**		0.183**
		(0.023)		(0.023)		(0.021)		(0.021)
Heart Condition			0.133**	0.110**			0.106**	0.082**
			(0.030)	(0.030)			(0.025)	(0.026)
Lung Condition			0.233**	0.186**			0.171**	0.159**
			(0.040)	(0.038)			(0.031)	(0.033)
Diabetes			0.153**	0.139**			0.116**	0.119**
			(0.031)	(0.031)			(0.025)	(0.026)
Cancer			0.071*	0.051			0.086**	0.072**
			(0.038)	(0.038)			(0.032)	(0.033)
Stroke			0.203**	0.142**			0.121**	0.07
			(0.041)	(0.044)			(0.041)	(0.047)
Arthritis			0.151**	0.117**			0.132**	0.099**
			(0.021)	(0.020)			(0.019)	(0.019)
High Blood Pressure			0.045**	0.027			0.048**	0.037**
			(0.020)	(0.019)			(0.017)	(0.018)
Couple Fixed Effects	No	No	No	No	Yes	Yes	Yes	Yes
Person-Years	4,790	3,965	4,790	3,965	4,790	3,965	4,790	3,965
Couples	388	387	388	387	387	387	387	387
Effect of Divorce on Husband	0.008	-0.003	-0.020	-0.019	0.028	0.016	-0.001	-0.005
SE	(0.027)	(0.028)	(0.023)	(0.025)	(0.023)	(0.026)	(0.022)	(0.025)

Note: This table shows coefficients from linear probability models with and without couple fixed effects. The dependent variable is an indicator variable for "bad" health, defined as self-reported poor or fair health versus good, very good or excellent health. Psychological condition is an indicator for a diagnosis of emotional, nervous or psychiatric condition. Depression is an indicator for depression according to the CESD scale. CESD information was imputed for 27 person-years. Models include a dummy variable for depression status imputed from partial CESD information. All models include controls for age (as a quadratic) fully interacted with dummy for age 65 and older, and an indicator for missing health insurance information, Census region (9) and HRS cohort (2). Adjusted household income is in $100,000 of head and spouse/partner, if present, and divided by the square root of the household size. Standard errors clustered at the couple level in OLS models and clustered at the individual level in models with couple fixed effects are in parentheses. Significance levels are indicated by * <0.1, ** <0.05.

Table C.7: Divorce and Health of Couples over Time

	(1)	(2)	(3)	(4)	(5)	(6)
	General Health		**Psych. Cond.**		**Depression**	
Divorced x Husband	-0.048	-0.026	-0.018	-0.019	-0.065	-0.054
	(0.035)	(0.035)	(0.026)	(0.026)	(0.041)	(0.041)
Divorced	0.032	0.013	0.036*	0.034*	0.024	0.009
	(0.024)	(0.024)	(0.019)	(0.020)	(0.031)	(0.031)
Husband	0.035	0.036	-0.041	-0.047*	-0.031	-0.033
	(0.029)	(0.029)	(0.028)	(0.028)	(0.036)	(0.035)
Time	0.007*	0.009**	0.016**	0.016**	0.011*	0.012**
	(0.004)	(0.004)	(0.005)	(0.005)	(0.006)	(0.006)
Time x Divorce	-0.001	-0.001	-0.001	-0.001	-0.014**	-0.014**
	(0.005)	(0.005)	(0.005)	(0.005)	(0.006)	(0.006)
Time x Husband	0.004	0.004	-0.002	-0.003	0.001	0.000
	(0.005)	(0.005)	(0.005)	(0.005)		(0.007)
Time x Divorce x Husband	-0.006	-0.006	-0.004	-0.003	0.002	0.004
	(0.007)	(0.007)	(0.007)	(0.007)	(0.008)	(0.008)
Education	-0.006	-0.006	-0.013**	-0.014**	-0.019**	-0.019**
	(0.005)	(0.005)	(0.006)	(0.006)	(0.005)	(0.005)
Black	-0.156	-0.174*	0.242**	0.225**	0.043	0.004
	(0.109)	(0.104)	(0.112)	(0.114)	(0.080)	(0.082)
Hispanic	-0.096	-0.119	-0.017	-0.002	0.138**	0.139**
	(0.093)	(0.092)	(0.053)	(0.054)	(0.070)	(0.070)
BMI		0.003*		0.003		0.001
		(0.002)		(0.002)		(0.002)
Current Smoker		-0.010		0.056**		0.071**
		(0.025)		(0.024)		(0.025)
Adj. HH. Income		-0.114**		-0.010		-0.071**
		(0.021)		(0.020)		(0.021)
Under 65 - Uninsured		-0.040*		0.024		0.033
		(0.022)		(0.019)		(0.024)
P-value t-test: Row 5 = Row 7	0.704	0.666	0.749	0.872	0.204	0.204
Person-Years	4,790	4,790	4,790	4,790	3,965	3,965
Couples	388	388	388	388	387	387

Note: This table shows coefficients from linear probability models with couple fixed effects. The dependent variables are: "Bad" health an indicator variable for self-reported poor or fair health versus good, very good or excellent health; Psychological condition is an indicator for a diagnosis of emotional, nervous or psychiatric condition; Depression is an indicator for depression according to the CESD scale. All models include controls for age (as a quadratic), Census region (9) and HRS cohort (2). Models in even-numbered columns also include controls for age (as a quadratic) fully interacted with a dummy for age 65 and older as well as an indicator for missing health insurance information. Time is measured as years since divorce. Date of divorce is assumed to be at the midpoint between the last interview date the respondent reports being married and the first interview date the respondent reports being divorced or separated.Standard errors are clustered at the individual level are in parentheses. Adjusted household income is in $100,000 of head and spouse/partner, if present, and divided by the square root of the household size. Significance levels are indicated by * <0.1, ** <0.05.

Table C.8: Divorce, Remarriage and Health, Couples

	(1)	(2)	(3)	(4)	(5)	(6)
	General Health		Psych. Cond.		Depression	
Divorced x Husband	-0.016	0.006	-0.030	-0.028	-0.033	-0.021
	(0.031)	(0.031)	(0.030)	(0.030)	(0.032)	(0.032)
Divorced	0.060**	0.044**	0.099**	0.092**	0.052**	0.041
	(0.021)	(0.021)	(0.023)	(0.023)	(0.025)	(0.025)
Husband	0.005	0.003	-0.055**	-0.059**	-0.039	-0.039
	(0.022)	(0.022)	(0.026)	(0.026)	(0.025)	(0.025)
Divorced x Remarried x Husband	-0.066	-0.078*	-0.122**	-0.124**	-0.010	-0.020
	(0.041)	(0.041)	(0.047)	(0.046)	(0.039)	(0.039)
Divorced x Remarried	-0.001	0.018	0.093**	0.091**	-0.059**	-0.045
	(0.030)	(0.030)	(0.036)	(0.036)	(0.029)	(0.029)
Education	-0.006	-0.007	-0.012**	-0.014**	-0.019**	-0.019**
	(0.005)	(0.005)	(0.006)	(0.006)	(0.005)	(0.005)
Black	-0.151	-0.168*	0.241**	0.226**	0.052	0.014
	(0.107)	(0.101)	(0.107)	(0.11)	(0.078)	(0.080)
Hispanic	-0.087	-0.108	-0.016	0.002	0.152**	0.155**
	(0.093)	(0.092)	(0.052)	(0.053)	(0.070)	(0.070)
BMI		0.004**		0.004*		0.002
		(0.002)		(0.002)		(0.002)
Current Smoker		-0.007		0.060**		0.073**
		(0.025)		(0.024)		(0.025)
Adj. HH. Income		-0.108**		-0.011		-0.063**
		(0.021)		(0.020)		(0.021)
Under 65 - Uninsured		-0.037*		0.025		0.037
		(0.022)		(0.019)		(0.024)
Person-Years	4,790	4,790	4,790	4,790	3,965	3,965
Couples	388	388	388	388	388	388
Effect of Divorce on Husband	0.045	0.050	0.070	0.064	0.019	0.019
	(0.025)	(0.025)	(0.020)	(0.020)	(0.025)	(0.026)
Effect of Remarriage on Husband	-0.068	-0.060	-0.029	-0.032	-0.068	-0.065
	(0.029)	(0.029)	(0.031)	(0.031)	(0.026)	(0.026)

Note: This table shows coefficients from linear probability models with couple fixed effects. The dependent variables are: "Bad" health an indicator variable for self-reported poor or fair health versus good, very good or excellent health; Psychological condition is an indicator for a diagnosis of emotional, nervous or psychiatric condition; Depression is an indicator for depression according to the CESD scale. All models include controls for age (as a quadratic), Census region (9) and HRS cohort (2). Models in even-numbered columns also include controls for age (as a quadratic) fully interacted with a dummy for age 65 and older as well as an indicator for missing health insurance information. The husband's effect of divorce is the sum of the coefficients in row 1 and 2, remarriage is the sum of the coefficients in row 4 and 5. Standard errors are clustered at the individual level are in parentheses. Adjusted household income is in \$100,000 of head and spouse/partner, if present, and divided by the square root of the household size. Significance levels are indicated by * <0.1, ** <0.05.

Table C.9a: Divorce and General Health, Individuals: Incorporating Death as “Bad” Health

	Women		**Men**	
	(1)	(2)	(3)	(4)
Divorced	0.105**	0.040**	0.075**	-0.027
	(0.020)	(0.016)	(0.022)	(0.018)
Widowed	0.043**	0.005	0.035**	-0.026*
	(0.011)	(0.008)	(0.017)	(0.014)
Partnered	0.077**	-0.014	0.038*	-0.014
	(0.022)	(0.018)	(0.020)	(0.017)
Age	0.001	-0.006**	-0.005	-0.022**
	(0.003)	(0.003)	(0.004)	(0.004)
Age Squared/100	0.003	0.012**	0.009**	0.027**
	(0.002)	(0.002)	(0.003)	(0.003)
Education	-0.036**		-0.030**	
	(0.001)		(0.001)	
Black	0.099**		0.081**	
	(0.013)		(0.013)	
Hispanic	0.089**		0.060**	
	(0.016)		(0.016)	
Individual Fixed Effects	No	Yes	No	Yes
Person-Years	52,862	52,862	46,625	46,625
Persons	7,998	7,998	7,921	7,921

Note: This table shows the coefficients from linear probability models with and without individual fixed effects. The dependent variable is an indicator variable for “bad” health, defined as self-reported poor or fair health versus good, very good or excellent health. All models include controls for Census region (9) and HRS cohort (2). Observations of first survey wave following the death of the deceased were restored, and their health status was classified as “bad.” 882 person-year observations for women and 1644 person-year observations for men were restored. Age was updated to age at death recorded by the HRS and region of residence was set to the region at the last recorded interview. Other covariates in the basic model are time-invariant. Standard errors clustered at the individual level are in parentheses. Significance levels are indicated by * <0.1, ** <0.05.

Table C.9b: Divorce and General Health, Couples: Incorporating Death as "Bad" Health

	(1)	(2)
Divorced x Husband	-0.044	-0.054*
	(0.032)	(0.027)
Divorced	0.039	0.069**
	(0.026)	(0.020)
Husband	-0.005	0.005
	(0.029)	(0.022)
Age	-0.003	-0.007
	(0.009)	(0.008)
Age Squared/100	0.008	0.012*
	(0.008)	(0.007)
Education	-0.038**	-0.007
	(0.004)	(0.005)
Black	0.036	-0.179
	(0.034)	(0.11)
Hispanic	-0.049	-0.094
	(0.052)	(0.095)
Couple Fixed Effects	No	Yes
Person-Years	4,828	4,828
Couples	388	388
Effect of Divorce on Husband	-0.005	0.015
SE	(0.027)	(0.023)

Note: This table shows the coefficients from linear probability models with and without couple fixed effects. The dependent variable is an indicator variable for "bad" health, defined as self-reported poor or fair health versus good, very good or excellent health. All models include controls for Census region (9) and HRS cohort (2). Observations of first survey wave following the death of the deceased were restored, and their health status was classified as "bad." 38 person-year observations were restored. Age was updated to age at death recorded by the HRS and region of residence was set to the region at the last recorded interview. Other covariates in the basic model are time-invariant. Standard errors clustered at the couple level in OLS models and clustered at the individual level in models with couple fixed effects are in parentheses. Significance levels are indicated by * <0.1, ** <0.05.

Imputation of missing CESD data

In 346 person-years, data are missing for at least one item used to construct the CESD scale. In 293 of these 346 cases, enough information was available to determine depression status with certainty no matter the responses to the missing items. In 53 cases, classification was indeterminate. For 27 of these 53 cases, we imputed values based on interpolation of item responses from surrounding interview waves. The remaining 26 cases were dropped from the analysis of depression.

Bibliography

Ai, C., and E. C. Norton (2003): "Interaction terms in logit and probit models," *Economics Letters*, 80, 123-29.

Alwin, D. F., K. Zeiser, and D. Gensimore (2014): "Reliability of Self-reports of Financial Data in Surveys, Results from the Health and Retirement Study," *Sociological Methods Research*, 43, 98-136.

Antonucci, T. C., and H. Akiyama (1987): "An examination of sex differences in social support among older men and women," *Sex Roles*, 17, 737-49.

Aseltine R. H., Jr., and R. Kessler (1993): "Marital disruption and depression in a community sample," *Journal of Health and Social Behavior*, 34, 237-51.

Averett, S. L., L. M. Argys, and J. Sorkin (2013): "In sickness and in health: An examination of relationship status and health using data from the Canadian national Public Health Survey," *Review of Economics of the Household*, 11, 599-633.

Baker, M. (2002): "The retirement behavior of married couples: Evidence from the spouse's allowance," *Journal of Human Resources*, 37, 1-34.

Banks J., R. Blundell, and M. M. Casanova. (2010): "The dynamics of retirement behavior in couples: reduced-form evidence from England and the US," http://www.econ.ucla.edu/casanova/Files/Main_ELSA_HRS.pdf

Benitez-Silva, H., and F. Heiland (2008): "Early Retirement, Labor Supply, and Benefit Withholding: The Role of the Social Security Earnings Test," *Michigan Retirement Research Center*, Working Paper 2008-183.

Berkman, L. F. (1984): "Assessing the physical health effects of social networks and social support," *Annual Review of Public Health* 5, 413-32.

Berkman, L. F., and S. Leonard Syme (1979): "Social networks, host resistance, and mortality: a nine-year follow-up of Alameda county residents," *American Journal of Epidemiology*, 109: 186-204.

Bertrand, M., E. Duflo, and S. Mullainathan (2004): "How Much Should We Trust Differences-in-Differences Estimates?," *The Quarterly Journal of Economics*, 119, 249-275.

Blau, D. M. (1998): "Labor force dynamics of older married couples," *Journal of Labor Economics*, 16, 595-629.

Blau, D. M., and D. B. Gilleskie (2006): "Health insurance and retirement of married couples," *Journal of Applied Econometrics*, 21, 935-953.

Bloemen, H., J. Hochguertel, and J. Zweerink (2014): "Joint Retirement of Couples: Evidence from a Natural Experiment," *IZA Working paper 8861.*

Bovenberg, A., and A. Meijdam (2001): "The Dutch Pension System," in *Pension Reform in Six Countries: What Can We Learn from Each Other?* ed. by A.H. Borsch-Supan and M. Miegel, Berlin, Springer.

Bosch, N., A. Deelen, and R. Euwals (2008): "Is part-time employment here to stay? Evidence from the Dutch Labour Force Survey 1992-2005," *IZA discussion paper 3367.*

Bronselaer, J. L. J., B. S. M. De Koker and C. M. A. Van Peer (2008): "The impact of divorce on the health status of ex-partners," *Archives of Public Health*, 66,168-186.

Brown, S. L., and I. Lin (2012): "The Gray Divorce Revolution: Rising Divorce among Middle-aged and Older Adults, 1990-2009," *National Center for Family & Marriage Research, Bowling Green State University, Working Paper Series, WP-12-04.*

Burkhauser, R. V., and M. Daly (2011): "The declining work and welfare of people with disabilities: What went wrong and a strategy for change," Washington, DC: AEI Press.

Cameron, A. C., J. B. Gelbach, and D. L. Miller (2008): "Bootstrap-Based Improvements for Inference with Clustered Errors," *The Review of Economics and Statistics*, 90, 414-427.

Chai, J., R. Maurer, O. S. Mitchel and R. Rogalla (2013): "Exchanging Delayed Social Security Benefits for Lump Sums: Could This incentivize longer Work Careers?," *NBER Working Paper Series, Working Paper No. 19032.*

Coile, C. (2004): "Retirement Incentives and Couples' Retirement Decisions," *Topics in Economic Analysis & Policy*, 4(1).

Da Silva Soca, M.L (2013): "Tax Incentives to Promote Active Aging- The Introduction of the Doorwerkbonus," *Netspar-Masters Thesis-Tilburg University.*

De Vos, K., and A. Kapteyn (2004): "Incentives and exit routes to retirement in the Netherlands," in *Social security programs and retirement around the world - micro estimation* ed. by J. Gruber and D. Wise, Chicago: National Bureau of Economic Research, 461 - 498.

De Jong, P. (2008): "Recent changes in Dutch disability policy," *Working paper, Amsterdam: University of Amsterdam.*

Diamond, P., and J. Gruber (1999): "Social Security and retirement in the United States," in *Social Security and retirement around the world* ed. by Jonathan Gruber and David A. Wise, Chicago: University of Chicago Press, 437 - 73.

Donoho, C. J., E. M. Crimmins, and T. E. Seeman (2013): "Marital Quality, Gender, and Markers of Inflammation in the MIDUS Cohort," *Journal of Marriage and Family*, 75, 127-41.

Dowd, J. B., and M. A. Todd (2011): "Does self-reported health bias the measurement of health inequalities in U.S. adults? Evidence using anchoring vignettes from the Health and Retirement Study," *The Journals of Gerontology, Series B: Psychological Sciences and Social Sciences*, 66, 478-89.

Dutch Association of Industry-wide Pension Funds (VB) and Dutch Association of Company Pension Funds (2010): "The Dutch Pension System an overview of the key aspects," Den Haag, The Netherlands.

Evers, M., R. de Mooij, and D. van Vuuren (2008): "The Wage Elasticity Of Labour Supply: A Synthesis Of Empirical Estimates," *De Economist*, 156, 25-43.

Euwals, R., D. van Vuuren, and R. Wolthoff (2010): "Early retirement behaviour in the Netherlands; Evidence from a policy reform," *De Economist*, 158, 209-236.

Feldstein, M., and J. Liebman (2002): "Social Security," in *The Handbook of Public Economics* ed. by A. J. Auerback, and M. Feldstein, vol. 4. Chapter 32. Elsevier.

Fernandes, M., E. Meijer, and G. Zamarro (2008): "Labor Force Participation and Retirement," in *First Results from the Survey of Health, Ageing and Retirement in Europe (2004 - 2007): Starting the Longitudinal Dimension* ed. by Brsch-Supan et al., Mannheim, Germany: Mannheim Research Institute for the Economics of Aging (MEA), 48 - 55.

Friedberg, L. (2000): "The Labor Supply Effects of the Social Security Earnings Test," *Review of Economics and Statistics*, 82, 48 - 63.

Goldman, N., S. Korenman, and R. Weinstein (1995): "Marital Status and Health among the Elderly," *Social Science and Medicine*, 40, 1717-30.

GOODWIN, J. S., W. C. HUNT, C. R. KEY, AND J. M. SMAET (1987): "The Effect of Marital Status on Stage, Treatment, and Survival of Cancer Patients," *Journal of the American Medical Association*, 258, 3125-30.

GRUBER, J. (2004): "Is Making Divorce Easier Bad for Children? The Long-Run Implications of Unilateral Divorce," *Journal of Labor Economics*, 22, 799-833.

GRUBER J., AND P. ORSZAG (2000): "Does the Social Security Earnings Test affect labor supply and benefits receipt?," *National Bureau of Economic Research, Working Paper 7923*.

GRUBER, J., AND J. POTERBA (1994): "Tax Incentives and the Decision to Purchase Health Insurance: Evidence from the Self-Employed," *Quarterly Journal of Economics*, 109, 701-733.

GRUBER, J., AND D. A. WISE (1999): "Social Security and Retirement around the World," Published in January 1999 by University of Chicago Press ©1999 by the National Bureau of Economic Research.

GRUBER, J., AND K. MILLIGAN, AND W. A. WISE (2009): "Social Security Programs and Retirement Around the World: The Relationship to Youth Employment, Introduction and Summary," *NBER Working Papers 14647*.

GRUBER, J., AND D. A. WISE (2005): "Social Security Programs and Retirement around the World: Fiscal Implications, Introduction and Summary," *NBER Working Papers 11290*.

GRUBER, J., AND D. A. WISE (2004): "Social Security Programs and Retirement around the World: Micro-Estimation," NBER Books, National Bureau of Economic Research, Inc, number grub04-1.

GRUBER, J., AND D. A. WISE (1997): "Social Security Programs and Retirement Around the World: Introduction and Summary of Papers," *NBER Working Papers 6134*.

GUSTMAN, A.L., AND T. L. STEINMEIER (1985): "The 1983 Social Security Reforms and Labor Supply Adjustments of Older Individuals in the Long Run," *Journal of Labor Economics*, 3, 237-253.

GUSTMAN, A. L., AND T. L. STEINMEIER (2004): "Social Security, Pensions And Retirement Behavior Within The Family," *Journal of Applied Econometrics*, 2004, 723-737.

HAIDER, S. J., A. JACKNOWITZ, AND R. F. SCHOENI (2003): "The economic status of elderly divorced women," *Michigan Retirement Research Center, Working paper WP 2003-046*.

HAIDER S. J., AND D. S. LOUGHRAN (2008): "The effect of the Social Security Earnings Test on male labor supply: New evidence from survey and administrative data," *The Journal of Human Resources*, 43, 57-87.

Health and Retirement Study, (HRS Public Data and RAND Contributions) public use dataset. Produced and distributed by the University of Michigan with funding from the National Institute on Aging (grant number NIA U01AG009740). Ann Arbor, MI, (2011).

HECKMAN, J.J. (1993): "What Has Been Learned About Labor Supply In The Past Twenty Years," *Papers and Proceedings of the Hundred and Fifth Annual Meeting of the American Economic Association, The American Economic Review*, 83, 116-121.

HOSPIDO, L. (2015): "Pension Reform and Couples? Joint Retirement Decisions," *IZA World of Labor 2015*, 142

HOUSE, J. S., C. ROBBINS, AND H. L. METZNER (1982): "The association of social relationships and activities with mortality: prospective evidence from the Tecumseh Community Health Study," *American Journal of Epidemiology*, 116, 123-140.

HUGHES, M. E., AND L. J. WAITE (2009): "Marital Biography and Health at Mid-Life," *Journal of Health and Social Behavior*, 50, 344-358.

HURD, M. D., AND M. BOSKIN (1984): "The effect of social security on retirement in the early 1970s', *Quarterly Journal of Economics*, 99, 767-790.

HURD, M. D., AND D. A. WISE (1989): The Wealth and Poverty of Widows: Assets Before and After the Husband's Death," in *The Economics of Aging*, University of Chicago Press.

HURD, M. D. (1989): "The Poverty of Widows: Future Prospects," in *NBER Chapters: The Economics of Aging* National Bureau of Economic Research, Inc.

HURD, M. D. (1990): "Research on the elderly: Economic status, retirement, and consumption and savings," *Journal of Economic Literature*, 28, 565-637. Online at: http://www.jstor.org/stable/2727265

IMBENS, G.W., AND J. M. WOOLDRIDGE (2009): "Econometrics of Program Evaluation," *Journal of Economic Literature*, 47, 5-86.

JOHNSON, R.W., AND M.M. FAVREAULT (2009): "Retireing Together or Working Alone: The Impact of Spousal Employment and Disability on Retirement Decisions," *Working Paper 2001-01*, Chestnut Hill, MA: Center for Retirement Research at Boston College

SONG J., AND J. MANCHESTER (2007): "Have people delayed claiming retirement benefits? Responses to changes in social security rules," *Social Security Bulletin*, 67(2).

KALMIJN, M., AND C. W. S. MONDEN (2006): "Are the negative effects of divorce on well-being dependent on marital quality?," *Journal of Marriage and Family*, 68, 1197-1213.

Kapteyn, A., and K. de Vos (1999): "Social Security and Retirement in the Netherlands," in *Social Security Programs and Retirement Around the World* ed. by J. Gruber and D. Wise, Chicago, University of Chicago Press, 269-303.

Kennedy, S., and S. Ruggles (2014): "Breaking Up is Hard to Count: The Rise of Divorce in the United States, 1980-2010," *Demography*, 51, 587-598.

Kerkhofs, M., M. Lindeboom and J. Theeuwes (1999): "Retirement, Financial Incentives and Health," *Labour Economics*, 6, 203-227

Killewald, A., and I. Lundberg (2014): "Men's labor market outcomes: Is there a case for marriage?," Department of Sociology, Harvard University. Revised version of paper presented to the 2014 meetings of the Population Association of America.

Kohn, J., and S. L. Averett (2014): "The effect of relationship status on health with dynamic health and persistent relationships," *Journal of Health Economics*, 36, 69-83

Krueger, A., and J. Pischke (1992): "The Effect of Social Security on Labor Supply: A Cohort Analysis of the Notch Generation," *Journal of Labor Economics*, 10, 412-437.

Lavelle, B., and P. J. Smock (2012): "Divorce and Women's Risk of Health Insurance Loss," *Journal of Health and Social Behavior*, 54, 413-431

Laitner, J., and D. Silverman (2012): "Consumption, retirement and social security: Evaluating the efficiency of reform that encourages longer careers," *Journal of Public Economics*, 96, 615 - 634.

Lillard, L. A., and L. J. Waite (1995): "Til Death Do Us Part: Marital Disruption and Mortality," *American Journal of Sociology*, 100, 1131-56.

Lindeboom, M. (1998): "Microeconometric analysis of the retirement decision: The Netherlands," OECD Economics Department Working Paper 107, Paris, OECD.

Liu, H. (2012): "Marital Dissolution and Self-rated Health: Age Trajectories and Birth Cohort Variations," *Social Science and Medicine*, 74,1107-16.

Liu, H., and L. J. Waite (2014): "Bad Marriage, Broken Heart? Age and Gender Differences in the Link between Marital Quality and Cardiovascular Risks among Older Adults," *Journal of Health and Social Behavior*, 55, 403-423.

Mare, R. D., and A. Palloni (1988): "Couple Models for Socioeconomic Effects on the Mortality of Older Persons," *CDE Working Paper 88-7*. Madison, WI: Center for Demography and Ecology, University of Wisconsin-Madison.

Mastrogiacomo, M., Bosch, N., Gielen, M. and E. L. W. Jongen (2011): "Estimating labour supply responses in the Netherlands using structural models," *Working Paper*. The Hague: CPB.

McGee, D. L., Y. Liao, G. Cao, and R. S. Cooper (1999): "Self-reported Health Status and Mortality in a Multiethnic US Cohort," *American Journal of Epidemiology*, 149, 41-46.

Miilunpalo, S., I. Vuori, P. Oja, M. Pasanen, and H. Urponen (1997): "Self-rated health status as a health measure: The predictive value of self-reported health status on the use of physician services and on mortality in the working-age population," *Journal of Clinical Epidemiology*, 50, 517-528.

Mitchell, O. (1987): "Social Security Reforms And Poverty Among Older Dual-Earner Couples," *NBER Working Paper Series, Working Paper No. 2382.*

Moffitt, R. (2005): "Remarks on the Analysis of Causal Relationships in Population Research," *Demography*, 42, 91-108.

Myers, R.J., and B. D. Schobel (1990): "Early-Retirement Reduction and delayed-Retirement Increase Factors under U.S. Social Security Law," *Transactions, Society of Actuaries*, 42, 295-320.

Norton, E. C. (2012): "Log Odds and Ends," *NBER Working Paper 18252.*

Novella, M.L. (2012): "Analysing the impact of eligibility and financial measures aiming at delaying early retirement in Belgium: a "difference-in-differences" approach using panel data," *Federal Planning Bureau, Working Paper 14-12.*

OECD (2009): What are equivalence scales?www.oecd.org/dataoecd/61/52/35411111.pdf

OECD (2015): OECD Stat. LFS by sex and age - indicators Retrieved April 10, 2015 from `https://stats.oecd.org/Index.aspx?DataSetCode=LFS_SEXAGE_I_R#`

Orszag, P. R. (2001): "Should a Lump-Sum Payment Replace Social Security Delayed Retirement Credit?," *Issue Brief 2001-06*, Center for Retirement Research at Boston College.

Peters, H. E., K. Simon, and J. R. Taber (2014): "Marital Disruption and Health Insurance," *NBER Working Paper 20233.*

Pienta, A. M., M. D. Hayward, and K. R. Jenkins (2000): "Health Consequences of Marriage for the Retirement Years," *Journal of Family Issues*, 21, 559-86.

Pingle, J.F. (2006): "Social Security's Delayed Retirement Credit and the Labor Supply of Older Men," *Finance and Economics Discussion Series*, Divisions of Research & Statistics and Monetary Affairs Federal Reserve Board, Washington, D.C.

Pozzoli, D., and M. Ranzani (2009): "Old European Couples' Retirement Decisions: the Role of Love and Money," *Working Papers, Department of Economics, Aarhus School of Business, University of Aarhus, 09-2.*

Radloff, L. S. (1977): "The CES-D Scale: A self-report depression scale for research in the general population," *Applied Psychological Measurement*, 1, 385-401.

RAND HRS Data, Version L. Produced by the RAND Center for the Study of Aging, with funding from the National Institute on Aging and the Social Security Administration. Santa Monica, CA (December 2011).

Sarason, B. R., I. G. Sarason, and R. A.R. Gurung (1997): "Close personal relationships and health outcomes: a key to the role of social support," in *Handbook of personal relationships* ed. by S. Duck.

Solon, G., S. J. Haider, and J. Woolridge (2013): "What are we weighting for?," *NBER working paper 18859*.

Smock, P. J., W. D. Manning, and S. Gupta (1999): "The Effect of Marriage and Divorce on Women's Economic Well-Being," *American Sociological Review*, 64, 794-812.

Steffick, D. E. (2000): "Documentation of affective functioning measures in the Health and Retirement Study," Survey Research Center, University of Michigan: Ann Arbor, MI.

Simon, R. W. (2002): "Revisiting the Relationships Among Gender, Marital Status, and Mental Health." *American Journal of Sociology*, 4, 1065-1096.

Umberson, D., and J. K. Montez (2010): "Social Relationships and Health: A Flashpoint for Health Policy," *Journal of health and Social Behavior*, 51, S54-S66.

Umberson, D., C. B. Wortman, and R. C. Kessler (1992): "Widowhood and depression: Explaining long-term gender differences in vulnerability," *Journal of Health and Social Behavior*, 33, 10-24.

United Nations (2013): Department of Economic and Social Affairs, Population Division, World Population Prospects: The 2012 Revision, New York, (2013): Retrieved April 10, 2015, from `http://data.un.org/Data.aspx?d=PopDiv&f=variableID%3A44`

United Nations (2013): Department of Economic and Social Affairs, Population Division (2013). World Population Ageing 2013. ST/ESA/SER.A/348.

Van Sonsbeek, J.M. (2010): "Estimating the effect of recent disability reforms in the Netherlands," *Working paper Amsterdam: University of Amsterdam*.

Waite, L. J. (2000): "Trends in Men's and Women?s Well-Being in Marriage" in *The Ties that Bind: Perspectives on Marriage and Cohabitation* ed. by L. J. Waite, Hawthorne, NY: Aldine de Gruyter, 368-392.

Waite, L. J., and M. Gallagher (2000): "The case for marriage: Why married people are happier, healthier, and better off financially," New York: Doubleday.

Williams, K., and D. Umberson (2004): "Marital Status, Marital Transitions, and Health: A Gendered Life Course Perspective," *Journal of Health and Social Behavior*, 45, 81-98.

Wilson, C. M., and Oswald, A. J. (2005): "How does marriage affect physical and psychological health? A survey of the longitudinal evidence," *Working Paper. Coventry: University of Warwick, Department of Economics.*

Wise, D. A. (2016): "Social Security Programs and Retirement Around the World: The Capacity to Work at Older Ages," David A. Wise, editor Forthcoming from University of Chicago Press in NBER Book Series - International Social Security).

Wood, R.G., B. Goesling, and S. Avellar (2007): "The effects of marriage on health: a synthesis of recent research evidence," Mathematica Policy Research. http://aspe.hhs.gov/_topic/subtopic.cfm?subtopic=377.

World Bank (2015): World Development Indicators. Age dependency ratio, old (% of working-age population). Retrieved April 10, 2015 from `http://data.worldbank.org/indicator/SP.POP.DPND.OL`

Zhang, Z, and M. D. Hayward (2006): "Gender, the Marital Life Course, and Cardiovascular Disease in Late Midlife," *Journal of Marriage and Family*, 68, 639-657.