Essays on Work and Retirement

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TILBURG UNIVERSITY

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Proefschrift ter verkrijging van de graad van doctor aan Tilburg University

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door

Adelbert Theodorus Gerardus Johannes Rutten,

geboren te Valkenswaard

Promotores:	prof. dr. D.J. van Vuuren (Tilburg University) prof. dr. M.G. Knoef (Tilburg University)
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Dankwoord

Deze dissertatie is het eindproduct van bijna negen jaar studie aan de Universiteit van Tilburg. Het begon met mijn bachelor Economie en Bedrijfseconomie (2014-2017) gevolgd door de Research Master Economics (2017-2019) en, uiteindelijk, mijn PhD (2019-2023). Het bereiken van deze opeenvolgende mijlpalen was niet mogelijk geweest zonder de hulp en steun van anderen. Vandaar dat ik op deze plek van de gelegenheid gebruik maak om alle mensen te bedanken die mij onderweg geholpen hebben.

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Al met al heeft deze samenwerking ervoor gezorgd dat ik de papers in dit proefschrift tijdens achttien academische sessies (workshops, seminars, conferenties) heb kunnen presenteren in drieënhalf jaar tijd. Maar goede PhD begeleiders doen meer dan het enkel geven van feedback op (nieuwe versies van) hoofdstukken uit het proefschrift. Want een PhD is noch een sprint, noch een marathon. Het is een tocht door de woestijn zonder überhaupt te weten waar het eindstation zich precies bevindt. Het is een woelige weg van wenselijkheid naar werkelijkheid. En het is dan uiteindelijk aan je begeleiders om de richtingaanwijzers zo neer te zetten dat het Beloofde Land bereikt kan worden. Dank dat jullie dat voor mij gedaan hebben.

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Eenzaam uw gangen en grauw uw gebouwen
Kantoren omsloten in een betonnen blok
Met alle tijd om alles nader te beschouwen
Maakt dit een plek waar mijn hart van kan houden

Ieder die u vormt is een waar van werk
Een curriculum gelijk een klok,
De chaos en tijdgeest te sterk
Geleerdheid als godsdienst en een netwerk als kerk

Blijf wat je was toen je blonk als een bloem
Zorg dat de gemotiveerde horde,
De Universiteit van Steenkamp, als zijn schuilplaats noem
Instituut als richtsnoer, voor ijver en fatsoen

Ongeacht wat je uit het verleden wil bewaren
En wat de toekomst ook mogen worden
Lauweren behoren enkel aan de hoogste normen en waarden
Aan een academie van kennis, over hemel en aarde.

Albert Rutten

Tilburg, 24 juni 2023

Content

Introductie (Nederlands)

Dit proefschrift is een verzameling van drie hoofdstukken over werk en pensioen. De eerste twee hoofdstukken zijn samen geschreven met Marike Knoef en Daniël van Vuuren en gaan over pensioenbeslissingen. In het laatste hoofdstuk staat de relatie tussen werk en gezondheid centraal. Alle drie de hoofdstukken maken gebruik van Nederlandse arbeidsmarkthervormingen en empirische econometrische methoden om inzicht te krijgen in de bovengenoemde relaties. In deze introductie beschrijf ik kort de beleidswijzigingen, de empirische methoden en de belangrijkste bevindingen van de drie hoofdstukken.

In de eerste twee hoofdstukken staan de arbeidsparticipatie en het aantal gewerkte uren van oudere werknemers centraal. De meeste OESO-landen zagen de afgelopen decennia een stijging van de levensverwachting en een daling van het vruchtbaarheidscijfer. Dit zet de betaalbaarheid van pensioenstelsels onder druk. Om het pensioenstelsel betaalbaar te houden, besloten de meeste landen om beleid te voeren met als doel de arbeidsparticipatie van oudere werknemers te verhogen. In de eerste twee hoofdstukken worden twee beleidsmaatregelen onderzocht die dit als doel hebben.

In het eerste hoofdstuk wordt gekeken naar het effect van een verhoging van de AOW-leeftijd op de arbeidsparticipatie van koppels. We onderzoeken hoe de arbeidsparticipatie van de jongste partner verandert als de oudste partner de AOW-gerechtigde leeftijd bereikt. Door de stapsgewijze verhoging van de AOW-leeftijd kunnen we het effect analyseren voor verschillende AOW-leeftijden van de oudere echtgenoot. Onze resultaten laten zien dat de netto arbeidsparticipatie van de jongste partner afneemt als de oudste partner de AOW-gerechtigde leeftijd bereikt. De omvang van het effect is vergelijkbaar voor verschillende AOW-cohorten, ongeacht de AOW-gerechtigde leeftijd van de oudste echtgenoot. Ook zien we dat in huishoudens met een hoog inkomen de jongere partner vaker met werken stopt als de oudste partner de AOW-leeftijd bereikt. Ten slotte vinden we enig bewijs dat de oorspronkelijke AOW-leeftijd van 65 jaar nog steeds een rol speelt bij de pensioenbeslissing. Dit houdt vermoedelijk verband met een sociale norm.

Het tweede hoofdstuk analyseert een beleidsmaatregel die erop gericht is om oudere werknemers langer aan het werk te houden: het Generatiepact (GRP). Het doel van GRPs is tweeledig. Ten eerste bieden GRPs oudere werknemers arbeidstijdverkorting aan die gepaard gaat met een geringe loonsverlaging en weinig tot geen korting op de pensioenopbouw. Op deze manier kunnen oudere werknemers op een gezonde manier de pensioengerechtigde leeftijd bereiken en kan worden voorkomen dat zij de arbeidsmarkt verlaten. Ten tweede, als oudere werknemers hun gewerkte uren verminderen, dan zouden volgens de beleidstheorie werkgevers meer nieuwe (jonge) werknemers

moeten aannemen. Om de werkgelegenheidseffecten van GRPs vast te stellen, analyseert dit hoofdstuk de werkgelegenheidsuitkomsten tussen Nederlandse gemeenten die wel en geen GRP hebben geïmplementeerd.

We vinden dat er een positief werkgelegenheidseffect is voor oudere werknemers (in termen van gewerkte uren alsmede de extensieve marge). Dit positieve effect concentreert zich vooral in de midden- en hoge inkomensgroepen. Voor jongere werknemers vinden we geen werkgelegenheidseffecten. We zien geen effect op het aannemen van jonge medewerkers. Daarnaast vinden we geen bewijs dat jongere werknemers door de invoering van GRPs sneller de carrièreladder beklimmen.

In het derde hoofdstuk staat het effect van werk op gezondheid centraal. Werklozen hebben om verschillende redenen (selectie-effecten, sociale normen) doorgaans een slechtere gezondheid dan werkenden. Hierdoor is het onmogelijk om de gezondheid van werkenden en werklozen met elkaar te vergelijken. Om de relatie tussen werk en gezondheid te onderzoeken, maak ik daarom gebruik van een hervorming in de werkloosheidswet (WW). Door deze hervorming werden sommige groepen geconfronteerd met een verlaging van de maximale WW-duur, terwijl deze voor anderen niet veranderde. Met behulp van een instrumentele variabele regressie wordt bepaald hoe het vinden van een baan het medicijngebruik beïnvloedt. De schattingsresultaten laten een vermindering van het medicijngebruik zien voor pijn en ontsteking, hyperlipidemie (hoog cholesterol) en psychische stoornissen (angst, depressie en spanning). Het vinden van werk lijkt daarmee een positief effect te hebben op gezondheid.

Vanuit een beleidsperspectief kunnen twee bredere conclusies worden getrokken uit dit proefschrift.

De eerste conclusie is de rol van financiële prikkels in het uittredingsgedrag in belangrijke mate kan verschillen tussen verschillende inkomensgroepen. De resultaten in hoofdstuk 1 laten zien dat jonge partners met een hoog inkomen meer flexibiliteit hebben bij hun pensioenbeslissing in vergelijking met huishoudens met een laag inkomen. Daarnaast laat hoofdstuk 2 zien dat vooral midden- en hoge inkomens gebruik maken van GRPs. De vraag doemt hierbij op of de opzet van GRPs doelmatig is, aangezien het geld vooral terechtkomt bij groepen die het waarschijnlijk niet nodig hebben om het langer doorwerken vol te kunnen houden.

Ten tweede laat dit proefschrift zien dat niet-financiële determinanten van arbeidsmarktgedrag belangrijk zijn. Hoofdstuk 1 laat zien dat de initiële pensioenleeftijd van 65 jaar belangrijk is bij de pensioenbeslissing, hetgeen suggereert dat sociale normen een rol spelen. De bevindingen van

hoofdstuk 3 impliceren dat het optimale ontwerp van een werkloosheidsverzekering anders is wanneer gezondheidseffecten worden meegenomen.

Al met al laat dit proefschrift zien dat zowel financiële als niet-financiële prikkels moeten worden meegenomen om de effecten van beleid goed te doorgronden.

Introduction

This dissertation is a collection of three chapters on employment and retirement. The first two chapters are joint work with Marike Knoef and Daniël van Vuuren and focus on retirement decisions. The last chapter focuses on the relationship between employment and health. All three chapters make use of Dutch labor market reforms and empirical econometric methods to gain insights into the aforementioned relationships. In this section, I will explain the policy reforms, the empirical methods, and the main findings of the papers in successive paragraphs.

The first two chapters focus on the labor force participation of older workers. Most OECD countries saw an increase in life expectancy and a decrease in the fertility rate during the last decades. This puts pressure on the sustainability of (pay-as-you-go) pension systems. To keep the pension system sustainable, most countries decided to implement policies that increase the labor force participation of older workers. The first two chapters investigate two policies that aim at keeping workers longer in the labor force.

The first chapter analyzes the effect of an increase in the first pillar statutory retirement age[1] on the labor force participation for couples. More precisely, we investigate how the younger spouse's labor force participation changes if the older partner reaches the pension eligibility age. Due to a stepwise increase in the first pillar pension eligibility age in the Netherlands, we are also able to analyze the effect for different retirement ages of the older spouse. Our results show that the net labor force participation of the younger partner decreases if the older spouse reaches the pension eligibility age. Moreover, the results indicate that the magnitude of the effect is similar for cohorts regardless of the oldest spouse's pension eligibility age. In addition, we find that younger partners more often stop working in high wage income households when the oldest spouse reaches the pension eligibility age. Lastly, we find some evidence that the initial retirement age of 65 still plays a role in the retirement decision (e.g., a social norm effect).

The second chapter analyzes a different policy that aims at keeping older workers longer in the labor force. More precisely, the second chapter investigates the employment effect of Incentivized Gradual Retirement Plans (GRPs)[2]. The goal of GRPS is twofold. First, GRPs offer older workers a reduction in work time with little reduction in salary, and little to no reduction in pension build-up. In this way, older workers should be able to reach the pension eligibility age healthily and prevent them from dropping out of the labor force. Second, as older workers reduce their number of hours worked, employers need to post vacancies to hire new (young) workers. Therefore, this chapter analyzes the

[1] In Dutch: verhoging van de AOW-leeftijd.
[2] In Dutch: Generatiepact.

employment effects of GRPs. To do so, this chapter compares employment outcomes between Dutch municipalities that did and did not implement a GRP.

We show that there is a positive employment effect for older workers (in terms of hours worked and the extensive margin). This positive effect is mainly concentrated in the middle- and high-wage income groups. For younger workers, however, there is no significant effect. We do not find any effect in terms of the hiring of young employees. In addition, we do not find any evidence that younger employees climb the career ladder faster due to the implementation of GRPs.

The third chapter analyzes the effect of employment on health. Unemployed workers tend to have worse health than employed workers for a variety of reasons (selection effects, social norms). This makes it impossible to compare the health of employed and unemployed workers with each other. To investigate the relationship between work and health, I make use of an unemployment insurance reform. Due to this reform, some groups faced a decrease in the maximum unemployment insurance duration while for others it did not change. Using an instrumental variable design, I determine how an increase in job finding affects health. I find a reduction in medication use for pain and inflammation, hyperlipidemia (high cholesterol), and mental diseases (e.g., anxiety, depression, and tension). Therefore, job finding seems to have a positive effect on health.

From a policy perspective, two broader conclusions can be drawn from this thesis.

First, financial incentives have different effects on the labor force participation decision for different wage income groups. The results in chapter 1 show that high-wage income households have more flexibility in determining their retirement decision when compared to low-wage income households. In addition, chapter 2 shows that mainly middle- and high-wage income workers make use of GRPs. The question arises whether the design of GRPs is effective, since the financial means mainly end up with groups that probably do not need it to remain active in the labor force.

Second, this thesis also shows that non-financial incentives are important. Chapter 1 shows that the initial statutory retirement age of 65 is important in the retirement decision, indicating that social norms play a role. In addition, the findings of Chapter 3 imply that the optimal unemployment insurance design is different once healthcare costs are considered.

All in all, this thesis shows that both financial and non-financial incentives should be considered to properly understand the effects of policies.

Chapter 1. The effect of the statutory retirement age on spousal labor force participation

A.T.G.J. Rutten[3], M.G. Knoef[4], D.J. Van Vuuren[5]

Abstract

We investigate the *direct* effect of the oldest spouse's statutory retirement age on the retirement behavior of couples. The Dutch statutory retirement age increased stepwise from 65 years and 3 months in 2015 to 65 years and 9 months in 2018. Using a regression discontinuity approach, we find a positive direct effect of the statutory retirement age on labor participation (extensive margin) and hours worked of both partners. More specifically, we find that about one third of the oldest spouses retire at the statutory retirement age. This has not changed much after the increase in the statutory retirement age. Moreover, we find that younger partners decrease their labor supply by up to almost 2 percentage points once the oldest spouse reaches the statutory retirement age. Male younger partners are twice as responsive as women. The responsiveness is also about twice as strong in high-income households as in low-income households. The responsiveness in terms of hours worked are somewhat smaller. Lastly, the original statutory retirement age of 65 still has a negative effect on the labor supply decision of the younger partner, especially when their older partner already reached the statutory retirement age. These results indicate that, in addition to the leisure complementarity of partners, social norms and reference points seem to affect retirement decisions.

Keywords: social security, joint retirement, spousal effect

JEL code: J26, H55, I38

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I Introduction

In light of an increasing life expectancy and decreasing fertility, many countries have made adjustments to their pension systems. A typical reform in many countries was – and still is – raising the statutory retirement age (OECD, 2011). An obvious objective of this reform is that older individuals retire from the labor force at a later moment. A higher pension age has many other potential effects: it may impact household behavior (e.g. saving and consumption decisions), firm behavior (e.g. human capital investments, hiring, retaining, and firing decisions), and worker behavior (e.g. educational and health-related choices). The relevance of such effects is often not yet known. In this paper, we focus at the effect of the oldest partner's statutory retirement age on both partners' retirement choices and hours worked. This household perspective has not received much attention yet in the earlier literature.

We distinguish three channels that may play a role in the retirement decisions of households. First, financial incentives of the pension program(s) affect spousal labor force participation. Cross-effects between financial incentives for the one spouse on retirement behavior of the other are likely in case of joint optimization within the household (Van der Klaauw and Wolpin, 2008). Second, leisure complementarity could play a role in the retirement decision. In case the older spouse serves as the reference point for the younger partner for the preferred amount of leisure time, retirement of the oldest spouse could result in a larger taste for leisure for the younger partner as well. As a result, leisure complementarity implies that later retirement by one spouse will also lead to later retirement of the other spouse (Coile, 2004; Schirle, 2008; and Atalay et al., 2019). Third, social norms and reference points may affect retirement decisions around the statutory retirement age (Van Erp et al., 2014). Results found by Behaghel and Blau (2012) imply that retirement behavior in the US cannot be explained by just financial incentives, and that reference dependence and loss aversion may play a role. Results of Mastrobuoni (2009) suggest that social norms play an important role in explaining retirement behavior. As mentioned by Seibold (2021), several studies estimate the effect of pension reforms involving statutory retirement ages, but evidence on the *direct* effect of statutory ages is scarce. We contribute to this scarce literature, and as far as we know we are the first to investigate the *direct* effect of an increased statutory retirement age in the context of couples.[6] That is, we investigate the *direct* effect of spouse's statutory retirement age on individual's labor supply (in addition to their own statutory retirement age) and estimate these effects for successive cohorts with increasing statutory retirement ages. Furthermore, we investigate the effect of the old "traditional" statutory retirement age of 65.

[6] This complements earlier papers that study how early retirement incentives for one of the partners reduced spousal labor supply (e.g. Bloemen, Hochguertel, & Zweerink, 2019 and Hospido & Zamarro, 2014).

To estimate the effects, we use high-quality monthly Dutch administrative data, which are available for the whole Dutch population for the period January 2015 – December 2018[7]. We exploit the discontinuity at the statutory retirement age and the stepwise increase in the statutory retirement age since 2013. In 2013, 2014, and 2015 the statutory retirement age increased by one month each year, and starting from 2016, it increased by 3 months per year. So, between 2015 and 2018, the statutory retirement age was raised by 6 months in total: from 65 years and 3 months to 65 years and 9 months. As a result of the gradual increase, cohorts face different statutory retirement ages.

Related to Deshpande, Fadlon, and Gray (2021), we use a regression discontinuity framework. Our double regression discontinuity design (Lalive and Parrotta, 2017) reveals how both spouses in a couple decide on their labor supply (in terms of hours worked and extensive margin) given the pension (in-)eligibility of their older partner. More precisely, we estimate the labor supply of the youngest partner as a function of their own and spousal age, their own and spousal statutory retirement age, and several control variables. Moreover, we run similar regressions to investigate hours worked (the intensive margin of labor supply).

In line with earlier findings, we find a direct effect of one's own statutory retirement age of almost 30%. The oldest spouse's statutory retirement age has a significant but small direct effect on the younger partner's net labor force participation: almost 1%-point of females and 2%-points of males retire when their older spouse reaches the statutory retirement age. The results suggest that leisure complementarity plays a role, which is more affordable for high wage households than for low wage households. In addition, we find that the "traditional" statutory retirement age still has an effect: when the older spouse already reached the retirement age, reaching the age of 65 by the younger female spouse increases retirement with 7%-points. For younger male spouses this effect is even 9.5%-points.[8]

The contribution to the literature is threefold. We contribute to the literature of household decision making regarding the retirement decision. First, we identify how different spousal labor supply responses evolve when the statutory retirement age increases. In addition to earlier studies, we also analyze labor supply responses for couples where the male partner is the younger partner (compare a.o. Zweimüller, Winter-Ebmer, and Falkinger, 1996; Lalive and Parrotta, 2017). Also, we contribute to the literature on partial and phased retirement by investigating effects on the extensive and

[7] We cannot take into account the first cohorts that faced a pension eligibility increase as before 2015 younger partners were entitled to partner pension. This means that younger partners received a fiscal payment when the older partner reached the public pension eligibility age. Limiting ourselves to the period after 2014, we can circumvent this possible bias in our result.

[8] These are the effect for the cohort 65 years and 9 months. For the cohorts 65 years and 3 months and 65 years and 6 months we find smaller effects.

intensive margin (i.e. a measurement for the amount of hours worked). Finally, we add to the literature by zooming in on different income groups. We analyze whether household retirement behavior differs between high- and low- wage income groups.

The setup of the rest of this paper is as follows. Section II provides a literature review. Section III describes the institutional setting. Section IV presents descriptive statistics and section V describes the estimation method and results. Section VI shows a sensitivity analysis of our results. Lastly, section VII provides a discussion of our findings and concludes.

II Literature Review

This section discusses the literature on household retirement. When considering household retirement decisions, the baseline models describe a problem of household coordination in which several channels play a role. In this review, we focus on three main channels, namely: financial incentives, leisure complementarity, and sociological and psychological channels. Thereafter we discuss some retirement research that has focused on the Netherlands.

II.A Main channels in household retirement decisions

Starting with financial incentives, Blau and Gilleskie (2006) and Van der Klaauw and Wolpin (2008) build theoretical models in which the effect of retirement runs through the household budget constraint. Both papers carefully explain how financial incentives of pension programs affect the labor participation decision of couples. Henretta and O'Rand (1983) show that financial characteristics of both partners play a role in their retirement decisions. They find that the age of both partners', their hourly wages, and pension entitlements affect the retirement decisions of each member in the household.

The second channel concerns leisure complementarities. Hurd (1990) studies joint retirement choices in models without uncertainty. Casanova (2010) builds a model taking uncertainty into account when explaining how leisure complementarities affect the retirement decision of both household members. Michaud and Vermeulen (2011) build a model in which they model household utility as the weighted sum of male and female utility. Using this specification and making use of the Health and Retirement Study, their estimates show that leisure complementarity plays an important role in the retirement decision. Zweimüller, Winter-Ebmer, and Falkinger (1996) draw a similar conclusion by examining how different statutory retirement ages for males and females in Austria affect spousal labor supply. They find that the female retirement age depends on the male's retirement age but not vice versa. Lalive and Parrotta (2017) confirm this finding by exploiting the difference in male and female statutory retirement ages in Switzerland. Coile (2004) finds similar results when examining dual-earner couples in the U.S. Schirle (2008) shows that – due to the increase in retirement age in

many G20 countries (see OECD (2011)) – the partner decided to work longer as well. More recently, Atalay et al. (2019) discuss how an increase or decrease in the retirement age affects household labor supply decisions. Exploiting reforms in Austria and Vietnam, they find that the partner adjusts his or her labor supply regardless of whether there is an increase (Austria) or decrease (Vietnam) in the statutory retirement age. More specifically, the Vietnam veteran pension fund induced veteran's wives to retire around 1.5 to 2.6 years earlier on average, while the estimates for Austria imply that a 5-year increase in female pension eligibility led husbands to retire later by 0.34 to 0.84 years on average.

Third, sociological and psychological effects may play a role in household retirement decision-making. Eismann, Henkens and Kalmijn (2019) discuss two possible channels of how the individual can influence the partner's labor supply decision. First, there is the channel of altruism. This channel states that, since retirement is generally associated with healthier behavior (Syse, 2017), an individual that cares about the partner's health might want that the partner to retire. Second, there is the channel of self-interest. Individuals want their partner to retire early if it benefits him or herself. This is for instance the case when the quality of the relationship is high or when long working days of the other person negatively affects the well-being of the other person. Another channel focuses on the importance of mental health. Picchio and Van Ours (2019) find that mental health differs between males and females after retirement. Single men tend to experience a drop in mental health. For males with a partner, the effect is positive: they experience a positive effect on their mental health as well as their partner's mental health. On the other hand, female retirement hardly has any effect on their mental health or the mental health of the partner. Moving away from sociological channels within the household, the initial age at which older workers were eligible for pension benefits may as well play a role in the retirement decision. More precisely, Behaghel and Blau (2012) argue that the initial age of 65 at which social security payments became available is still an important reference point for workers that are eligible at a higher age. The authors argue that a combination of the initial reference point combined with loss aversion of leisure due to an increase of the statutory retirement age may make workers less likely to work longer and instead retire at the age of 65. In a similar vein, Seibold (2021) shows that statutory retirement ages in Germany are an effective policy tool to influence retirement behavior. This is not the case for the US where an increase in the retirement age does not seem to result in an increase in labor supply (Deshpande, Fadlon, and Gray, 2021).

II.B Retirement research in the Netherlands

Having discussed the most important channels affecting joint retirement decisions, it is important to discuss what research regarding these channels has already been conducted for the Dutch pension

system. Considering financial incentives, Atav, Jongen, and Rabaté (2019) and Koning, Gelderblom, and Gravesteijn (2017) show that the gradual increase in the statutory retirement age as of 2013 increased the individual labor supply of older Dutch workers.

Focusing on spousal retirement, Deelen and Van Vuuren (2009) argue that an increase in the education levels resulted in a higher employment rate for both males and females, resulting in a higher earning capacity for both (i.e. higher opportunity costs for not working). Moreover, an increase in the female education level increased the likelihood of being employed at later ages, making it for the partner less attractive to retire early. The reason for this is that males/females postpone their (early) retirement decision due to leisure complementarity. Analyzing the female labor force participation, Euwals, Knoef, and van Vuuren (2011) argue that social norms influence the decision to participate and conclude that cohort effects are important for females born between 1935-1955. They postulate that the role of social norms and attitudes towards paid employment is important in explaining the development of female labor force participation over successive cohorts. Hospido and Zamarro (2014) make use of share data to investigate joint retirement decisions in several European countries including the Netherlands. Exploiting the early retirement and official retirement possibilities in those countries, they find a joint retirement effect for women, but not for males. García and van Soest (2022) discuss how the abolition of partner pension in the Netherlands changes the joint retirement decision. They point to a change in financial incentives as well as a change in the social norm that decreases the likelihood of retiring together. Lastly, Bloemen, Hochguertel, and Zweerink (2019) discuss how early retirement incentives affect the retirement behavior of the partner. To do so, they exploit an attractive early retirement policy for civil servants. They find that early retirement incentives for male civil servants induced their wives' probability to retire by ten percentage points.

III Institutional Setting

We describe the institutional setting in the Netherlands. We first discuss the Dutch pension system and thereafter we discuss other relevant programs that could be used as pathways into early retirement.

III.A Dutch Pension System: set-up

Like most modern pension systems, the Dutch pension system consists of three pillars, which allow workers to accumulate pension rights approximately equal to 70% of their average gross wage over their working life. The first pillar is the pay-as-you-go publicly funded pension benefits (in Dutch: AOW). Individuals start receiving these benefits from the statutory retirement age. Each individual that has lived for 50 years or more in the Netherlands receives an amount equal to 70% (50%) of the

minimum income after reaching the statutory retirement age[9] when he or she lives alone (with a partner).[10] A policy review of the Ministry of Social Affairs shows that the take-up rate of public pension benefits is very high, and it successfully eliminates poverty among older individuals.[11]

The second pillar pension is the pension that the employer and employee jointly save via a pension fund or insurance company. Unlike the first pillar, this pension pillar heavily depends upon work history and earnings per year. Another difference is that it is possible to early withdraw second pillar pension benefits before the (first pillar) statutory retirement age. Lastly, the third pillar consists of own individual savings on top of the first and second pillars. Under some conditions it is possible to make tax-favored pension savings.

III.B Reforms in the first pillar of the Dutch pension system

The Dutch first pillar pension scheme faced two major reforms in the past decade.[12] First, the first pillar partner pension was abolished. Before January 1st, 2015, individuals received partner pension from the statutory retirement age if their partner did not yet reach this age. The amount of first pillar partner pension depended on the partner's income (Van den Berg, et al., 2007). First pillar partner pension was abolished to keep the pension system sustainable. Moreover, it was deemed less necessary since the increase in the economic independence of female partners.

The second major reform is the gradual increase of the statutory retirement age. Up to January 1st, 2013, the first pillar statutory retirement age was 65 years. In 2013, 2014, and 2015, the statutory retirement age increased by one month each year. In 2016, 2017, and 2018, the statutory retirement age increased by three months per year. Table 1 provides a precise overview of the statutory retirement age per year and birth cohort.

Year	Statutory retirement age (in years)	Birth Cohort (dd-mm-yyyy)
<2013	65	< 01-01-1948
2013	65 + 1/12	01-01-1948 up to 01-12-1948
2014	65 + 2/12	01-12-1948 up to 01-11-1949
2015	65 + 3/12	01-11-1949 up to 01-10-1950

[9] The buildup rate is 2 percent per year.
[10] Kok, Kroon, Luiten, & Schwartz (2019) find that these different benefit schemes hardly affect the choice of the elderly to (de)register as a couple, live together, or separately.
[11] See Ministry of Social Affairs (2019). The chance of living in poverty is lower above the statutory retirement age than at any other age.
[12] Kapteyn et al. (2018) provide an overview of all the reforms that have been implemented since the 1990s to increase labor force participation rates of older workers.

2016	65 +6/12	01-10-1950 up to 01-07-1951
2017	65 + 9/12	01-07-1951 up to 01-04-1952
2018	66	01-04-1952 up to 01-01-1953

Table 1 The statutory retirement age for different birth cohorts. It is not possible to withdraw first pillar pension benefits prior reaching the statutory retirement age. Source: Rijksoverheid (2019).

III.C Reforms in the second pillar of the Dutch pension system

It is possible for workers to take up the second pillar pension before reaching the first-pillar statutory retirement age. However, the Dutch government made it less attractive to retire at an earlier age. For instance, pre-retirement pension arrangements between employers and employees were heavily restricted after 2006. Until 2006, the Dutch government subsidized early retirement routes. In 2006, this became gradually more restricted and a Life Cycle Saving Scheme (in Dutch: "Levensloopregeling")[13] was introduced. This arrangement was introduced to compensate individuals that reached the retirement age before January 1st, 2015. Although this arrangement was less attractive than the earlier arrangements, it was still financially attractive for younger partners to exit the labor force at a younger age, making it easier for couples to coordinate their joint retirement decision (i.e. when for instance one partner reaches the statutory retirement age). Moreover, this implies that cohorts after 2015 are not comparable to cohorts before 2015 as younger partners can no longer make use of this scheme (Van den Berg, et al. (2007)).

III.D Pathways into early retirement and legal changes

The increase of the statutory retirement age and the abolition of early retirement programs and lifecycle saving schemes may lead to an increased use of alternative social security programs. More precisely, alternative social security programs may serve as substitutes for the previously mentioned early retirement pathways. Over the last two decades, successive Dutch administrations tried to prevent this form of social support substitution.[14] At the beginning of the 21st century, the government reduced the attractiveness of disability insurance. As of 2002, they came up with stricter reintegration rules in case of sickness. In 2003, the sickness benefit became less generous for workers employed by small firms and in 2008 it was implemented for all firms.

[13] Grip, Lindeboom, and Montizaan (2012) Show that mental well-being was reduced for those that were ineligible for an early retirement plan.

[14] See Euwals et al. (2012) for a more elaborate overview of reforms implemented in the Netherlands regarding the labor force participation of older workers.

The maximum duration of unemployment insurance has been gradually decreased. From 2003 it is no longer possible to receive unemployment benefits up to retirement starting at the age of 57.5.[15] In 2006, the maximum benefit duration decreased from 5 years to 3 years and 2 months. As of 2015, the generosity of unemployment insurance was further reduced. Between January 1st, 2016, and January 1st, 2018, the benefit duration decreased gradually from 38 towards 30 months. Moreover, it takes more working years to get the full amount of benefit duration (de Pijper, et al., 2019).[16] However, this reform mostly affects workers with a large labor market history and therefore a large second pillar pensions benefit.[17] Nevertheless, all these measures seem to have limited alternative early retirement pathways via other social security programs (Ministry of Social Affairs, 2019).

Lastly, It is as important to analyze the conditions which allows workers to continue working beyond the statutory retirement age. Most sectors of industry can dismiss workers without any costs as soon as they reach the statutory retirement age.[18] As a consequence, workers in these sectors cannot continue in the job they had after reaching the statutory retirement age. A legal change in the Netherlands in the period 2014-2018 is the "Continuing to work Act[19]", which makes it more attractive for employers to retain workers after they reached the statutory retirement age. For instance, the notice period for dismissal for this group is reduced to 1 month[20] and the obligation to continue wage payment in case of illness is reduced to six weeks (instead of 2 years).

IV Descriptive Statistics

We make use of administrative microdata from Statistics Netherlands. Using these data[21], we investigate household retirement decisions for a large number of households. More precisely, we have data on monthly earnings of employees, whether they are native, first, or second-generation immigrants, and whether at least one child is living within the household. In our analysis, we only focus on heterosexual couples that either are married or have a registered partnership and stay together over the period 2014-2018.[22] Next to this, household members should not be in the same

[15] Although the IOW and IOAW are partially fulfilling this role nowadays, those programs are financially less attractive than the unemployment benefits.
[16] There will be no reduction in the months of unemployment benefits (WW) accumulated before the reform.
[17]There are several reasons for this. First, a reduction in the UI build-up only occurs for employees that have worked for more than 12 years. Earlier accrued rights are not affected. Second, a reduction in UI duration only occurs for workers with more than 30 years of labor market history. This groups is relatively small and also has very large second pillar pension benefits (given that they have accrued pension rights for at least 30 years).
[18] The Dutch terminology for this is "functioneel leeftijdsontslag".
[19] The Dutch name is "Wet doorwerken na AOW"
[20] This is the same notice period as for workers that are employed for less than 5 years. For workers that are longer employed, the notice period is in the range of 2 to 4 months, depending on the employment history.
[21] In particular, we make use of the datasets gbahuishoudensbus, spolisbus, gpapersoontab, and inpatab. The part-time factor is constructed with the variables svoltijddagen en sbaandagen from spolisbus.
[22] We take the first month of each year as a reference date to check whether each household is still together or not.

pension cohort as defined in Table 1. Moreover, we exclude couples in which the oldest partner does not work or is self-employed.[23] In other words, the oldest partner should be either an employee or should be retired. For the youngest partner in the couple, there is no restriction other than that he or she cannot be self-employed.[24]

We limit ourselves to the households in which the oldest spouse reaches the public statutory retirement age as of 2015. Prior 2015, early retirement schemes were still in place such as the Life Cycle Saving Scheme and the first pillar partner pension (see section III). Therefore, we focus ourselves on couples in which the oldest partner reached the statutory retirement age as of 2015. Table 2 (Table 3) provide summary statistics for Dutch households for couples in which the male (female) is the oldest spouse.

The upper part of Table 2 shows us the monthly mean male and female income, as well as the part-time factor. For male and female income, we report the mean monthly income per year provided that the income is larger than zero. Focusing on the income variables, we observe that average male income is in most cells higher when compared to average female income. This does not hold for all years for the first two cohorts. Moreover, we observe a decline in the average monthly male income over the years. The reason for this is that all male workers reach the statutory retirement age in the period 2015-2018. For the younger female partner, this is not necessarily the case as their statutory retirement age is at a later moment in time.

In brackets below the monthly mean annual labor income, we report the mean annual part-time factor. The part-time factor is defined as hours worked divided by full-time hours. For instance, if an individual worked 15 full-time[25] days (roughly 78 hours) and a full-time job in a particular month consists of 30 days (roughly 156 hours), the part-time factor for this person is equal to 0.5. In case an individual did not work in a particular month, we set the part-time factor equal to zero. The biggest drop in the part-time factor for males is observed one year after (the majority of) a particular cohort reaches the retirement age. For instance, the part-time factor drops from 0.32 in 2015 to 0.08 in 2016 for the male cohort with a statutory retirement age of 65 years and 3 months. For females, who are in a younger cohort than their male partner, we do not observe such a severe reduction. The

[23] To do so, we make use here of the inpatab dataset who indicates what the most important yearly source of income is for each individual. As we do not observe monthly data for self-employed workers we omit this category.
[24] More precisely, the younger partner may receive unemployment benefits, other forms of social assistance, and/or disability benefits. Lastly, it is as well possible for the younger partner to not receive any income at all. This information is stored in the variable inpsecj from the dataset inpatab.
[25] Full-time is defined according to the collective labor agreement. If there is none, Statistics Netherlands defines a full-time workweek as 35 hours a week (see the variable "svoltijddagen" in spolisbus for more information).

most likely reason for this is that the younger female partner does not have to become eligible for pension benefits in the period 2014-2018.

Next to average male and female labor income, Table 2 provides information on the age difference between the spouses. Across all cohorts, this is roughly equal to 3.8 years, indicating that the younger female partner is on average 3.8 years younger than the older male partner. Table also 2 provides information on first and second-generation immigrants. The share of first-generation female immigrants is approximately 6.7%. For second-generation female immigrants, this is equal to roughly 4.5%. It is important to take this into account as first-generation immigrants may not be entitled to the full public pension benefit.[26] The share of first- and second-generation male immigrants is respectively roughly equal to 6.1% and 5.3% for all cohorts. The percentage of households with children fluctuates between 13.8% and 18.3%, where the presence of children is more frequent when the older male partner has a higher retirement age (i.e. when the male partner is younger). Having children that still live at home (and the corresponding costs associated with it) may have the intention to retire relatively late when compared to couples where this is not the case.[27] In total, we have 61,037 unique household observations.

For couples where the female is the oldest partner, we observe roughly the same pattern (see Table 3). We observe here as well that the net labor force participation of the oldest partner declines faster when compared to the net labor force participation of the youngest partner. Moreover, the monthly average annual labor income is higher for males than for females, and the same holds for the part-time factor. Lastly, the drop in the part-time factor is as well present for females one year after they reached the statutory retirement age. However, there are three main differences between these two tables. First, the percentage of households with children is substantially lower in households where the female Is older than the male. Second, the mean age difference for couples where the female is the oldest partner Is approximately one year less when compared to couples where the male is the oldest partner. Third, the number of couples for which the female is the oldest spouse is substantially lower when compared to couples where the male is the older spouse.

[26] Each person living in the Netherlands accumulates two percent per year for old-age pension benefits (see section III). For instance, if a worker migrated to the Netherlands when he was 45 years old and retires at the age of 65.25, that person receives $20 * 2\% = 40\%$ of the total amount of public pension in the first year.
[27] See Damman, Henkens, and Kalmijn (2015).

Male = old / pension age male		65+3	65+6	65+9
Mean male labor income (€) (Part-time factor)	2014	3715 (0.50)	3889 (0.60)	4035 (0.70)
	2015	3656 (0.32)	3844 (0.53)	4028 (0.63)
	2016	2213 (0.08)	3780 (0.35)	3950 (0.56)
	2017	1849 (0.06)	2166 (0.08)	3775 (0.36)
	2018	1641 (0.05)	1837 (0.07)	2228 (0.09)
Mean female labor income (€) (Part-time factor)	2014	1907 (0.29)	1960 (0.32)	1970 (0.35)
	2015	1964 (0.26)	2017 (0.29)	2024 (0.32)
	2016	1998 (0.22)	2045 (0.26)	2061 (0.30)
	2017	2012 (0.18)	2055 (0.22)	2090 (0.27)
	2018	2029 (0.15)	2056 (0.18)	2096 (0.23)
Mean age difference (age male – age female)		3.84	3.82	3.85
% female immigrant 1st		6.5	6.8	6.7
% female immigrant 2nd		4.4	4.8	4.6
% male immigrant 1st		6.4	6.1	5.8
% male immigrant 2nd		5.0	5.3	5.6
% household with child		13.8	15.3	18.3
Households		21,148	20,224	19,665

Table 2 Summary statistics male (old), female (young) by public pension eligibility of the husband.

Female = old / pension age female		65+3	65+6	65+9
Mean male labor income (€) (Part-time factor)	2014	4282 (0.60)	4242 (0.65)	4247 (0.71)
	2015	4352 (0.53)	4261 (0.59)	4293 (0.66)
	2016	4396 (0.44)	4266 (0.53)	4296 (0.60)
	2017	4200 (0.32)	4135 (0.43)	4205 (0.53)
	2018	3890 (0.24)	3829 (0.33)	4166 (0.43)
Mean female labor income (€) (Part-time factor)	2014	1833 (0.34)	1927 (0.4)	1950 (0.46)
	2015	1877 (0.22)	1931 (0.34)	1953 (0.41)
	2016	1429 (0.04)	1976 (0.22)	1938 (0.36)
	2017	1326 (0.03)	1259 (0.04)	1974 (0.23)
	2018	1191 (0.02)	1139 (0.03)	1297 (0.04)
Mean age difference (age female – age male)		2.77	2.67	2.69
% female immigrant 1st		9.6	9.9	8.4
% female immigrant 2nd		5.5	5.1	6.7
% male immigrant 1st		6.2	6.0	6.0
% male immigrant 2nd		6.1	5.2	5.5
% household with child		8.9	9.5	12.3
Households		2663	2526	2473

Table 3 Summary statistics Female (old) and male (young) by public pension eligibility of the wife.

IV.A Graphical evidence

We plot the average net labor force participation of the youngest spouse 6 months prior, and after the older spouse reaches the statutory retirement age for all couples that are not in the same pension cohort. We do this for both types of couples where respectively males and females are the oldest spouse.

The graphs below visualize how the younger partner reacts to the statutory retirement age of their older spouse. Analyzing figures 1-3**,** we observe a small discontinuity in the labor supply of the younger partner when the older male spouse reaches her pension eligibility. More precisely, the drop in average labor force participation of the younger spouse one month prior and one month after the oldest spouse reaches her statutory retirement age is approximately 0.5 to 1 percentage points. In figures 4-6, we provide graphical evidence for couples where the female is the oldest spouse. We observe here a similar pattern as in figures 1-3.

The decrease in labor force participation is already visible before reaching the statutory retirement age. This could be due to early retirement, unemployment, and the unwillingness of employers to retain or hire older workers.[28]

Appendix A.1 shows graphs that visualize how males and females react to their own pension eligibility. Analyzing these graphs, we observe a strong decline in labor force participation at the moment someone is entitled to first pillar pension benefits, indicating that individuals react strongly to their own pension eligibility.

[28] Schippers and Vlasblom (2019) argue that the age of older workers is the most important reason why they cannot find a job. This is because their search intensity is not different when compared to younger workers and that reducing their wage standards does not have any effect on the chances of being hired.

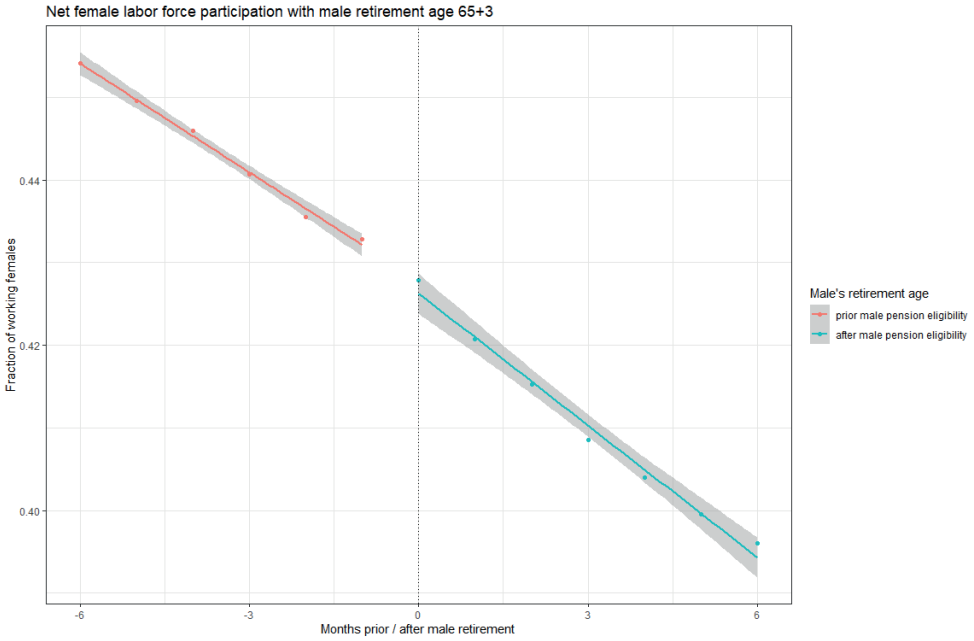

Figure 1 net labor force participation of the younger female spouse with male statutory retirement age of 65 years and 3 months. The red (blue) line indicates the net labor force participation of the younger female partner 6 months prior (after) retirement of the older spouse.

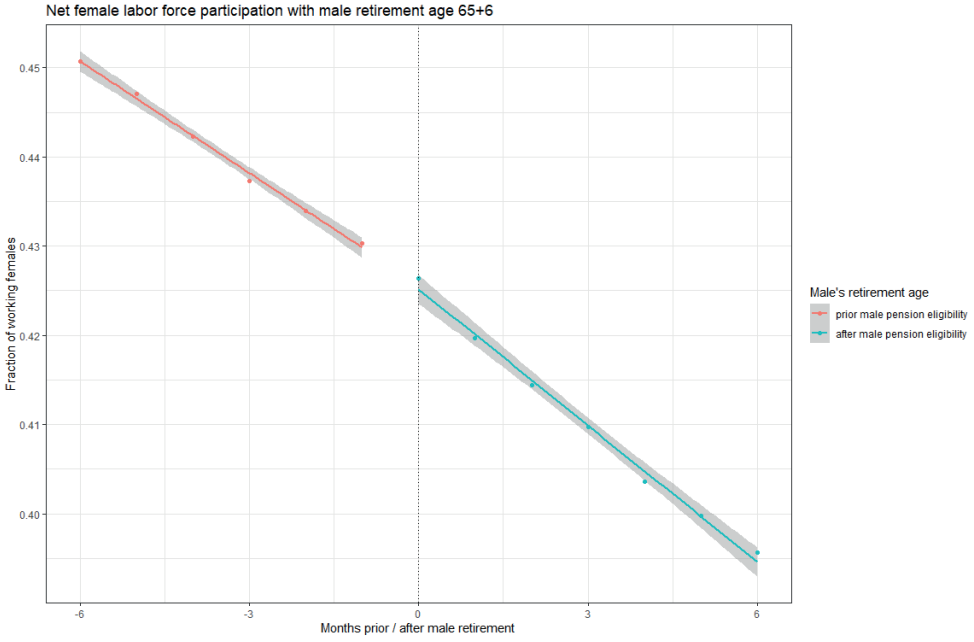

Figure 2 net labor force participation of the younger female spouse with male statutory retirement age of 65 years and 6 months. The red (blue) line indicates the net labor force participation of the younger female partner 6 months prior (after) retirement of the older spouse.

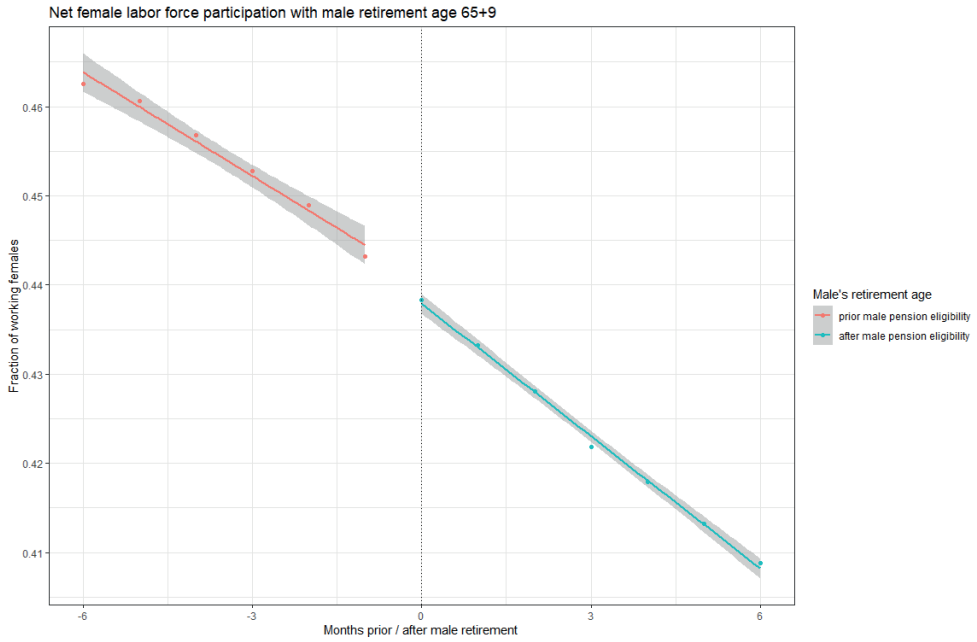

Figure 3 net labor force participation of the younger female spouse with male statutory retirement age of 65 years and 9 months. The red (blue) line indicates the net labor force participation of the younger female partner 6 months prior (after) retirement of the older spouse.

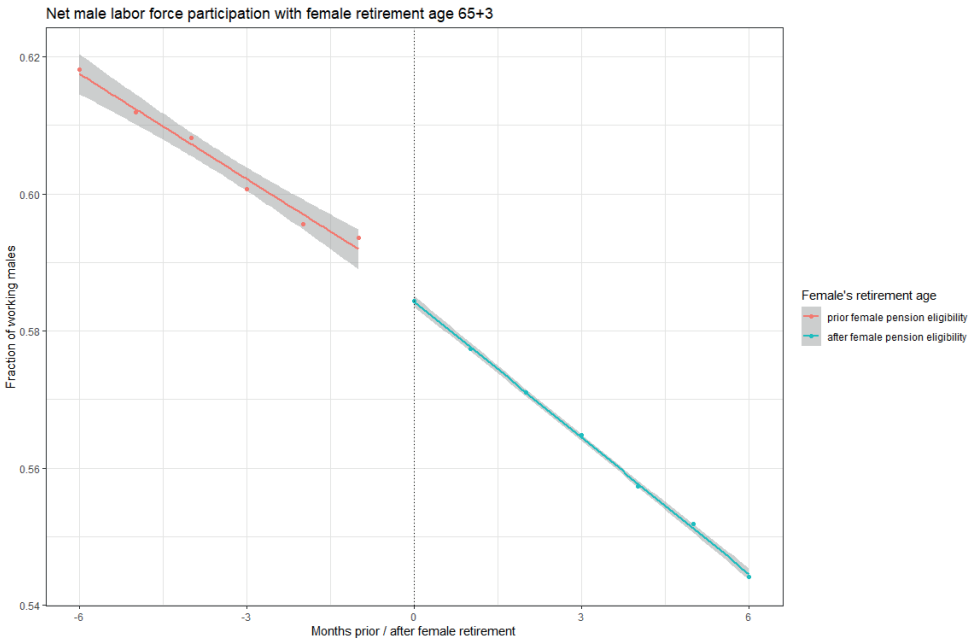

Figure 4 net labor force participation of the younger male spouse with female statutory retirement age of 65 years and 3 months. The red (blue) line indicates the net labor force participation of the younger male partner 6 months prior (after) retirement of the older spouse.

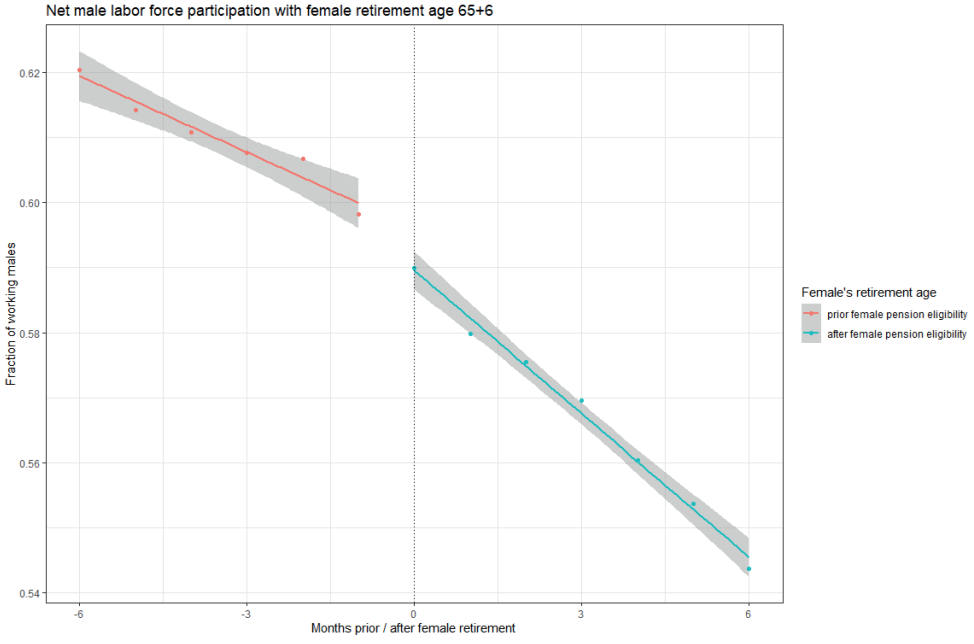

Figure 5 net labor force participation of the younger male spouse with female statutory retirement age of 65 years and 6 months. The red (blue) line indicates the net labor force participation of the younger male partner 6 months prior (after) retirement of the older spouse.

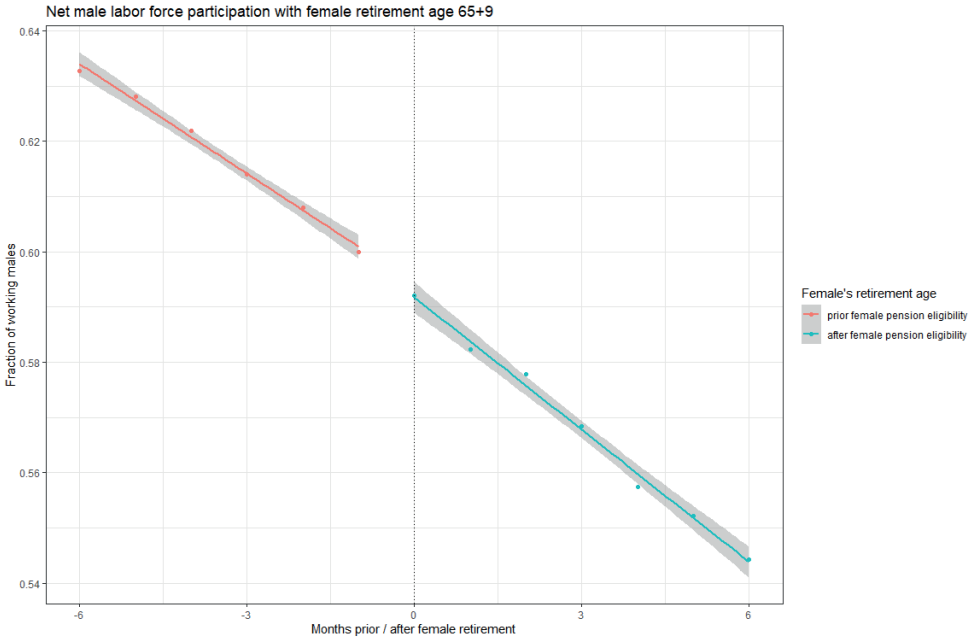

Figure 6 net labor force participation of the younger male spouse with female statutory retirement age of 65 years and 9 months. The red (blue) line indicates the net labor force participation of the younger male partner 6 months prior (after) retirement of the older spouse.

V Estimation Method & Results

We estimate the effect of the increase in the Dutch statutory retirement age on the partner's net labor force participation by using a double regression discontinuity design (D-RDD) as is advocated by Lalive and Parrotta (2017). Exploiting the fact that different pension cohorts have a different statutory retirement age, we can also determine whether spousal's net labor force participation changes with the increased statutory retirement age of the older partner. We as well use this regression output to explain whether leisure complementarity between partners increases or decreases. Thereafter, we analyze the part-time factor, which measures the labor-supply of the youngest partner at both the intensive and extensive margin. Lastly, we analyze whether social norms still may play a role. We do this by analyzing how the initial retirement age of 65 affects the net labor force participation.

V.A Labor Supply of the Youngest Spouse

We estimate the effect of reaching the statutory retirement age on the net labor force participation of the youngest partner. To do so, we estimate a linear probability model:

$$Q_y = \alpha + \beta_1 R^y + \beta_2 R^o + \beta_3\big(Age^y - Age(R^y)\big) +$$
$$\beta_4\big(Age^o - Age(R^o)\big) + \beta_6\big(Age^y - Age(R^y)\big) * R^y +$$
$$\beta_6\big(Age^o - Age(R^o)\big) * R^o + \beta_7 X + \epsilon \qquad (1)$$

The above regression measures how the net labor force participation of the youngest partner in the current month depends on the statutory retirement age of the older partner and his or her own pension eligibility. More precisely, Q_y denotes the labor supply of the youngest partner y, which is equal to unity if the partner works[29] and is equal to zero otherwise. α denotes a constant. R^o and R^y are dummy variables that indicate whether the oldest (o) and youngest (y) partner are eligible for public pension benefits in a particular month. If this is the case, the dummy is equal to unity. The terms $Age^o - Age(R^o)$ and $Age^y - Age(R^y)$ denote the difference in months between the age of the oldest and younger partner's age and their corresponding statutory retirement age. Age^o and Age^y are increasing each month as each person's age increases over time. β_5 and β_6 measure the interaction between the pension eligibility dummy and the difference between the current age and the statutory retirement age. We include these interaction terms, to allow for a different trend in labor participation before and after the statutory retirement age. Lastly, X denotes several control variables for the household members and ϵ denotes the error term. X includes variables that indicate whether one of the individuals is a first- or second-generation immigrant and whether any children are living in the household. Lastly, we as well include a set of year dummies and (pension) cohort dummies[30] for the younger partner as control variables. We run the above regression separately for each pension cohort of the older spouse, meaning that we examine the labor supply effect of the younger partner for different cohorts. More precisely, by analyzing the effect of spousal labor supply for individuals with different statutory retirement ages we can see whether spousal labor supply reacts stronger or weaker when the oldest partner has a higher statutory retirement age.

The main coefficient of interest is β_2. This coefficient captures how the youngest partner reacts to the statutory retirement age of the older partner. A negative sign indicates a reduction in the net labor force participation of the younger partner when the oldest spouse reaches the statutory retirement age. A positive sign would indicate an increase in the net labor force participation. Table 4 shows the β_1 and β_2 coefficients for the case where the male is the oldest partner and the female is

[29] We define an individual working when he or she either has a positive labor income or has a strictly positive part-time factor. Some individuals have a negative income during particular months (due to taxes payable for instance). To determine here whether that person works or does not work, we consider the part-time factor as discussed in the summary statistics.

[30] Younger workers that reach the pension eligibility age later than the year 2022 are pooled together in one cohort as this group is very small.

the oldest partner, respectively. The full regression output of regression (1) is displayed in Appendix B.1.

Table 4 shows the effect of pension eligibility of the oldest partner on the net labor force participation of the younger spouse. In addition, it shows how the pension eligibility age of the younger spouse affect the younger's spouse net labor force participation. The interpretation of the results is as follows. Focusing on couples where the male is the oldest spouse, we find that the effect of male public pension eligibility decreases female's net labor force participation by approximately 0.8 percentage point. When analyzing couples where the female is the oldest spouse, the estimates are in a range of minus 0.3 percentage points to minus 1.7 percentage points, although for the oldest cohort (with statutory retirement age of 65+3) the estimate is insignificant. Overall, the above results indicate that we find a consistently negative and significant effect across pension cohorts regardless of the gender of the oldest spouse. Using the net labor supply at the moment of pension eligibility of the older spouse, it is as well possible to calculate the percentage change at the extensive margin for the younger partner when the oldest spouse reaches the statutory retirement age[31]. For couples where the male is the oldest partner, we find that this percentage change is around 2 percent for all statutory retirement ages. For couples where the female is the oldest partner, the effect is approximately equal to minus 0.5 (insignificant) and minus 2.9 percent for the last two cohorts (65+6 and 65+9).

Estimates / Oldest spouse statutory retirement age	$65+3$		$65+6$		$65+9$	
Male = old/ Female = young	%-point	%-change	%-point	%-change	%-point	%-change
R^o (pension eligibility older spouse)	-0.9*** (0.1)	-2.1*** (0.2)	-0.8*** (0.1)	-1.9*** (0.2)	-0.8*** (0.1)	-1.8*** (0.2)
R^y (pension eligibility younger partner)	-14.0*** (0.4)	-32.6*** (0.9)	-13.8*** (0.4)	-32.1*** (0.9)	-9.0*** (0.6)	-20.5*** (1.4)
N (number of households)	$N = 21{,}148$		$N = 20{,}224$		$N = 19{,}665$	
Female = old / Male = young						
R^o(pension eligibility older spouse)	-0.3 (0.5)	-0.5 (0.9)	-1.7*** (0.5)	-2.9*** (0.8)	-1.7*** (0.5)	-2.9*** (0.8)
R^y (pension eligibility younger partner)	-24.4*** (1.1)	-42.1*** (1.9)	-22.4*** (1.1)	-38.0*** (1.9)	-13.7*** (1.4)	-23.2*** (2.4)
N (number of households)	$N = 2{,}663$		$N = 2{,}526$		$N = 2{,}473$	

[31] These numbers are for male is old (between brackets the pension eligibility age): 0.43 (65+3), 0.43 (65+6), and 0.44 (65+9). For the couples in which female is old: 0.58 (65+3), 0.59 (65+6), and 0.59 (65+9).

*Table 4 The effect of pension eligibility of the older spouse on the net labor supply of the younger partner. The regression formula is given by equation (1). We control for first- and second-generation immigrant status, the presence of children in the household, cohort dummies, and year effects. Clustered standard errors at the household level are between parentheses. * denotes significance level at 10%, ** denotes significance at 5%, and *** denotes significance at 1%. See Appendix B.1 for the full regression output.*

Lastly, the results show that younger spouses react much stronger to their own pension eligibility than to the pension eligibility of the older partner. Overall, this effect is negative and significant at the 1 percent level and ranges from minus 9.0 (13.7) percentage points to 14.0 (24.4) percentage points for couples where the male (female) is the oldest spouse. Analyzing the percentage change in net labor force participation, we find that the own pension eligibility decreases labor supply by 20 to approximately 33 percent for couples where the male is the oldest spouse. For couples where the female is the oldest spouse, the effect ranges from minus 23.2 to minus 42.1 percent. Interestingly, the reaction of the younger spouses on their own public pension eligibility is substantially lower for younger generations with higher public pension eligibility ages.

V.B Income effect and leisure complementarity

It is possible to determine how the retirement behavior of couples differs for different cohorts of the oldest spouse. To do so, we use the grey shaded results of Table 4. In addition, we run a similar regression as equation (1). However, we change the dependent variable into the net labor force participation of the *older* spouse (Q_o)[32]. The results of this regression are displayed in Appendix B.2. The main coefficient of interest is here (as well) β_2 as it indicates how the older partner changes his or her labor supply at the extensive margin after reaching his or her *own* statutory retirement age. The main results of this regression are summarized in Table 5 below.

Estimates / Oldest spouse pension cohort	$R = 65 + 3$	$R = 65 + 6$	$R = 65 + 9$
Male = old/ Female = young	%-point	%-point	%-point
R^O (pension eligibility older spouse)	-26.7*** (0.3)	-27.7*** (0.3)	-27.5*** (0.3)
N (number of households)	$N = 21{,}148$	$N = 20{,}224$	$N = 19{,}665$
Female = old / Male = young			
R^O (pension eligibility older spouse)	-29.8*** (0.8)	-29.0*** (0.8)	-28.4*** (0.8)
N (number of households)	$N = 2{,}663$	$N = 2{,}526$	$N = 2{,}473$

Table 5 The effect of pension eligibility of the older spouse on his/her own net labor supply. The regression formula is given by equation (1) with dependent variable labor supply of the older spouse. We control for first- and second-generation immigrant status, the presence of children in the household, and year effects. Clustered standard errors at the household level are between

[32] Hence, we replace Q_y by Q_o as our dependent variable.

*parentheses. * denotes significance level at 10%, ** denotes significance at 5%, and *** denotes significance at 1%. See Appendix B.2 for the full regression output.*

We observe that the coefficients range from minus 26.7 to minus 27.7 (minus 28.4 to minus 29.8) for couples where the male (female) is the oldest spouse (we do not find any significant effect of pension eligibility of the younger partner on the net labor force participation of the older spouse). So, although we find that for the youngest spouse the effect of one's own pension eligibility on net labor force participation declined for cohorts with a higher pension eligibility age, the effect for the oldest spouse remains relatively constant over the different cohorts. Appendix B.3 shows that this relatively constant effect is composed of an increasing effect among low wage income households and a decreasing effect among high income households. When analyzing the oldest spouses in low-income households, we find that younger cohorts with higher pension eligibility ages see a larger drop in net labor force participation at the statutory retirement age. For them, the liquidity effect at the pension eligibility age increases as early retirement routes have become more and more difficult and expensive. For high income households this is not the case. The liquidity effect will not drive their results, as high-income households have relatively high mandatory (second pillar pension) savings in the Netherlands. For them we see that younger cohorts with higher pension eligibility ages retire less often at the statutory retirement age, suggesting a decreasing social norm effect.

In addition to the above findings, we calculate the ratios between the estimated coefficients in Table 5 and the shaded coefficients in Table 4. These ratios indicate how sensitive the younger spouse's net labor force participation is with respect to the net labor force participation of the oldest spouse. Table 6 present these ratios (in appendix C, we discuss how these ratios relate to joint retirement).

	Male =old / female = young	Female = old / male =young
Cohort 1: $65+3$	0.035*** (0.005)	0.011 (0.016)
Cohort 2: $65+6$	0.029*** (0.005)	0.059*** (0.017)
Cohort 3: $65+9$	0.029*** (0.005)	0.059*** (0.018)

*Table 6 The ratio of the net labor force participation of the younger partner with respect to the net labor force participation of the older spouse. More formally, we calculate (dQ^y/dR^o) / (dQ^o/dR^o). To obtain the numerator (denominator) of this fraction, We regess equation (1) on the net labor supply of the younger (older) spouse. These regression results are presentered in Appendix B.2. Standard errors clustered at the household level are between parentheses. *** denotes significance at the 1% level.*

The results show that around 3% of younger female partners stops working (extensive margin) when the older male spouse stops working at the statutory retirement age. This is similar for the three different cohorts. For couples where the female is the oldest spouse, we observe that this ratio is

approximately equal to 6%. The exception is the oldest cohort, for which we only find an effect of 1% (not significantly different from zero).

Finally, we divide each pension eligibility cohort into two groups based on the total household wage income in January 2014. Thereafter we run the regression (1) on these different groups and calculate the above-mentioned ratio for low- and high wage income households. The regression output is available in Appendix B.3. Thes ratios for the different wage income groups per pension cohort are provided in Table 7 and Table 8. We find that these ratios is about twice as large for the high wage income group compared to the low wage income group. This pattern might be explained by leisure complementarity as this is more affordable for high wage households than for low wage households.

Male older than female	(1)	(2)
Pension cohort/ wage income group	Low wage income households	High wage income households
Cohort 1: 65+3	0.023* (0.012)	0.042*** (0.006)
Cohort 2: 65+6	0.015* (0.009)	0.041*** (0.006)
Cohort 3: 65+9	0.025*** (0.007)	0.035*** (0.008)

Table 7 The ratio of the net labor force participation of the younger partner with respect to the net labor force participation of the older spouse for different wage income groups. More formally, we calculate (dQ^y/dR^o) / (dQ^o/dR^o)*. To obtain the numerator (denominator) of this fraction, We regess equation (1) on the net labor supply of the younger (older) spouse for different income groups. These regression results are presentered in Appendix B.3. Standard errors clustered at the household level are between parentheses. *** denotes significance at the 1% level. * denotes significance at the 10%-level.*

Female older than male	(1)	(2)
Pension cohort/ wage income group	Low wage income households	High wage income households
Cohort 1: 65+3	0.007 (0.025)	0.020 (0.021)
Cohort 2: 65+6	0.051** (0.023)	0.069*** (0.024)
Cohort 3: 65+9	0.046* (0.024)	0.084*** (0.028)

Table 8 The ratio of the net labor force participation of the younger partner with respect to the net labor force participation of the older spouse for different wage income groups. More formally, we calculate (dQ^y/dR^o) / (dQ^o/dR^o)*. To obtain the numerator (denominator) of this fraction, We regess equation (1) on the net labor supply of the younger (older) spouse. These regression results are presentered in Appendix B.3. Standard errors clustered at the household level are between parentheses. *** denotes significance at the 1% level, ** denotes significance at the 5%-level, and * denotes significance at the 10%-level.*

V.C Part time factor

Using the part-time factor allows us to both examine the effect of the intensive and extensive margin as we can now consider whether the partner decides to decrease or increase the number of full-time days worked.

In Appendix A.2, we present graphs showing how the part-time factor changes before and after the older partner receive pension benefits for different cohorts for the older partner. They provide a similar image as the graphs we discussed in section IV. The regression we run is equal to regression (1), which we run again per pension cohort. However, now our left-hand-side variable is the part-time factor of the younger spouse (including zeros). The output is presented in Appendix B.4. Table 9 shows the percentage point change as well as the percentage change in the part-time factor of the younger partner after pension eligibility of the older spouse and for his or her own pension eligibility.

The results are as follows. For couples where the male is the oldest spouse, the part-time factor of the younger partner reduces by approximately 0.5% points when the male becomes eligible for pension benefits. This is equivalent to a decrease of 1.9 percent.[33] Analyzing the effect of own pension eligibility on the part-time factor, the result tends to be much stronger. In particular, the part-time factor decreases by 4.0 to 7.7 percentage points (15 to 30 percent) depending on the cohort the male belongs to. For couples where the female is the oldest partner, we observe a similar pattern as for the couples where the male is the oldest spouse. The biggest difference is that the estimate for couples with a statutory retirement age of 65+3 is not significant at the 5% level. Comparing Table 9 with Table 4, we find that the relative changes on the extensive and intensive margin follow approximately a similar pattern.

Estimates / Oldest spouse pension cohort	$R = 65 + 3$		$R = 65 + 6$		$R = 65 + 9$	
Male = old/ Female = young	%-point	%-change	%-point	%-change	%-point	%-change
R^o (pension eligibility older spouse)	-0.5*** (0.1)	-1.9*** (0.4)	-0.5*** (0.1)	-1.9*** (0.4)	-0.5*** (0.1)	-1.9*** (0.4)
R^y (pension eligibility younger partner)	-7.7*** (0.3)	-30.0*** (1.2)	-7.1*** (0.3)	-27.6*** (1.2)	-4.0*** (0.4)	-15.2*** (1.5)
N (number of households)	$N = 21{,}148$		$N = 20{,}224$		$N = 19{,}665$	
Female = old / Male = young						
R^o(pension eligibility older spouse)	-0.4 (0.4)	-0.8 (0.8)	-1.3*** (0.4)	-2.5*** (0.8)	-1.6*** (0.5)	-3.1*** (1.0)

[33] We use the average part time factor of the youngest spouse at the moment of pension eligibility for the older partner. For couples where the male is the older partner those values are: 0.26 (65+3), 0.26 (65+6), and 0.26 (65+9). For couples where the female is the older partner those values are: 0.52 (65+3), 0.52 (65+6), and 0.52 (65+9).

R^y (pension eligibility younger partner)	-23.0*** (1.0)	-43.9*** (1.9)	-21.8*** (0.9)	-41.7*** (1.7)	-14.4*** (1.1)	-27.5*** (2.1)
N (number of households)	$N = 2{,}663$		$N = 2{,}526$		$N = 2{,}473$	

*Table 9 The effect of pension eligibility on the part-time factor of the younger spouse. We control for first- and second-generation immigrant status, the presence of children in the household, and year effects. Clustered standard errors at the household level are between parentheses. * denotes significance level at 10%, ** denotes significance at 5%, and *** denotes significance at 1%. The full regression output is available in Appendix B.4.*

V.D Social norms

Since the introduction of the first pillar pension benefits in the Netherlands in 1956, the statutory retirement age was set at the age of 65. Therefore, this initial reference point could still play a role as former statutory retirement age in the labor force participation decision of the older partner (Behaghel and Blau, 2012). We are interested in the age of 65 for the net labor force participation for the younger partner. More precisely, as financial incentives are not likely to play a role at age 65 for the younger partner (e.g. no access to pension benefits), the main mechanisms that explain retirement behavior of the younger partner at this age are social norms and leisure complementarity. To check for this, we run the following regression:

$$Q^y = \alpha + \beta_1 R^y + \beta_2 R^o + \beta_3 D^y 65 + \beta_4 D^o 65 + \beta_5\big(Age^y - Age(R^y)\big) + \beta_6(Age^o - 65) + \beta_7\big(Age^y - Age(R^y)\big) * R^y + \beta_8(Age^o - 65) * R^o + \beta_9\big(Age^y - Age(R^y)\big) * D^y 65 + \beta_{10}(Age^o - 65) * D^o 65 + \beta_{11} D^y 65 * R^o + \beta_{12} X + \epsilon \qquad (2)$$

In the above regression, most of the variables have the same interpretation as in regression (1). However, we changed $(Age^o - Age(R^o))$ to $(Age^o - 65)$ as now the age of 65 is the main age of interest.[34] Besides, we added two dummy variables $D^y 65$ (and $D^o 65$) which are equal to unity when the younger partner (older partner) reaches the age of 65. If this is not the case, the variable equals zero. We as well add interaction terms between the age difference and the $D^y 65$ and $D^o 65$ variables. Lastly, we add the interaction term between the two dummy variables $D^y 65$ and R^o. This interaction term indicates whether the younger partner retires at the age of 65 when the older spouse is eligible for first pillar pension benefits. Given that the age of 65 still serves as a reference point, this is our main coefficient of interest as it indicates whether the reference point plays a role when the older partner is already eligible for first pillar pension benefits. The full results are displayed in Appendix B.5. Table 10 provides an overview of the main coefficient of interests.

[34] Note that we cannot add both terms $\big(Age^o - Age(R^o)\big)$ and $(Age^o - 65)$ because of multicollinearity. It does not matter which one we write down in the regression. We chose here to change one term to minus 65 to indicate that we analyze a social norm effect.

Estimates / Oldest spouse pension cohort	$R = 65 + 3$	$R = 65 + 6$	$R = 65 + 9$
Male = old/ Female = young	%-point	%-point	%-point
D^y65 (younger partner reaches age of 65)	-1.2 (4.9)	-4.1* (2.2)	-1.0 (1.7)
$D^y65 * R^o$ ((younger partner reaches age of 65 and older partner is eligible for pension benefits)	-2.3 (4.9)	-1.0 (2.2)	-6.0*** (1.5)
N (number of households)	$N = 21{,}148$	$N = 20{,}224$	$N = 19{,}665$
Female = old / Male = young			
D^y65 (younger partner reaches age of 65)	-2.2 (8.3)	-8.0* (4.0)	-9.9*** (3.2)
$D^y65 * R^o$ ((younger partner reaches age of 65 and older partner is eligible for pension benefits)	-4.7 (8.2)	-2.6 (3.8)	0.4 (2.8)
N (number of households)	$N = 2{,}663$	$N = 2{,}526$	$N = 2{,}473$

*Table 10 The effect of reaching the age of 65 by the younger partner on their labor supply. We control for first- and second-generation immigrant status, the presence of children in the household, and year effects. Clustered standard errors at the household level are between parentheses. * denotes significance level at 10%, ** denotes significance at 5%, and *** denotes significance at 1%. The full regression output is available in Appendix B.5.*

We observe that the net labor force participation of the younger partner decreases once the younger partner reaches the age of 65. For the oldest cohort with a statutory retirement age of 65+3 this effect is not significantly different from zero. For the youngest cohort the effect is the largest, when it also holds that the older partners reached the statutory retirement age. So, there is a social norm effect for the "old" statutory retirement age for the youngest partner, especially when the older partner already reached the (new) statutory retirement age.

VI Sensitivity analysis

The previous section described how the statutory retirement age of the older spouse affects the net labor force participation as well as the part time factor of the younger partner. In this section, we relax some of the assumptions we made in our data analysis. We still use regression (1) as our baseline estimation for both the net labor force participation and the part-time factor of the younger partner as the dependent variable. In Table 11 and Table 12 we show how our main coefficients of interest, R^o and R^y, change when we relax a number of assumptions. First, we relax the assumption regarding the main income category for the oldest spouse. More precisely, we now allow the older spouse to earn income as self-employed as well.[35] Although we do not observe their labor supply at

[35] These are the income categories 12-15 for the variable "inpsecj". Note that we are not able to determine monthly net labor supply for this group.

a monthly level, we can still see whether their younger partner reacts once they are eligible for pension benefits (both in terms of net labor supply and part-time factor).

For the baseline extended sample (column 1 of Table 9 and Table 10), we find that the R^o coefficient does not change in terms of sign or significance when analyzing net labor supply as the dependent variable. This does not depend on the gender of the older spouse. Adding cohort dummies (column 2) does not have a major impact in terms of sign, magnitude, or significance on our variables of interest. Analyzing the part-time factor (column (3) and column (4)), we observe as well that not much is changing when we add self-employed workers and cohort dummies, respectively.

%-point estimates	Net labor supply		Part time factor	
Male = old/ Female = young	(1)	(2)	(3)	(4)
Cohort 65+3				
R^o	-1.1*** (0.1)	-1.0*** (0.1)	-0.6*** (0.1)	-0.5*** (0.1)
R^y	-17.5*** (0.4)	-13.9*** (0.4)	-9.3*** (0.3)	-7.7*** (0.2)
Households	23,471		23,471	
Cohort 65+6				
R^o	-0.9*** (0.1)	-0.8*** (0.1)	-0.5*** (0.1)	-0.4*** (0.1)
R^y	-17.8*** (0.4)	-13.6*** (0.4)	-9.3*** (0.3)	-7.2*** (0.3)
Households	22,621		22,621	
Cohort 65+9				
R^o	-0.9*** (0.1)	-0.8*** (0.1)	-0.5*** (0.1)	-0.5*** (0.1)
R^y	-14.8*** (0.7)	-9.3*** (0.6)	-7.1*** (0.4)	-4.3*** (0.4)
Households	22,157		22,157	
Controls	YES	YES	YES	YES
Year dummies	YES	YES	YES	YES
Cohort dummies	NO	YES	NO	YES
Including self-employed	YES	YES	YES	YES

*Table 11 Sensitivity analysis for net labor supply (column (1) and (2)) and the part-time factor (column (3) and (4) where the male is the older spouse. Clustered standard errors at the household level are between parentheses. * denotes significance level at 10%, ** denotes significance at 5%, and *** denotes significance at 1%. Note that we cannot calculate the percentage change at the moment of retirement as we only have yearly data for self-employment.*

%-point estimates	Net labor supply		Part time factor	
Female = old / male = young	(1)	(2)	(3)	(4)
Cohort 65+3				
R^o	-0.5 (0.5)	-0.1 (0.5)	-0.7 (0.4)	-0.3 (0.4)
R^y	-28.5*** (1.1)	-23.5*** (1.0)	-27.0*** (1.0)	-22.2*** (0.9)
Households	2,944		2,944	
Cohort 65+6				
R^o	-1.9*** (0.5)	-1.4*** (0.5)	-1.6*** (0.4)	-1.2*** (0.4)
R^y	-27.1*** (1.2)	-21.5*** (1.0)	-26.1*** (1.0)	-20.9*** (0.9)
Households	2,805		2,805	
Cohort 65+9				
R^o	-2.1*** (0.5)	-1.8*** (0.5)	-2.0*** (0.4)	-1.6*** (0.4)
R^y	-18.6*** (1.5)	-14.1*** (1.3)	-19.3*** (1.2)	-14.6*** (1.1)
Households	2,763		2,763	
Controls	YES	YES	YES	YES
Year dummies	YES	YES	YES	YES
Cohort dummies	NO	YES	NO	YES
Including self-employed	YES	YES	YES	YES

*Table 12 Sensitivity analysis for net labor supply (column (1) and (2)) and the part-time factor (column (3) and (4) where the male is the older spouse. Clustered standard errors at the household level are between parentheses. * denotes significance level at 10%, ** denotes significance at 5%, and *** denotes significance at 1%. Note that we cannot calculate the percentage change at the moment of retirement as we only have yearly data for self-employment.*

In addition to the above relaxation, we also change the month in which the net labor force participation of the younger partner may change. More precisely, a reduction in net labor force participation of the younger partner in the month when the older spouse reaches the pension eligibility age might be too restrictive. Therefore, we analyze in Table 13 the effect on the net labor force participation of the younger spouse when using the net labor supply at time $t+1$, $t+2$, and $t+3$ as dependent variable. in regression (1). In case the size of the coefficient changes significantly, this may indicate that focusing on the month of retirement might be too restrictive.[36]

[36] Another interpretation of this sensitivity check is to analyze how the net labor force participation of the younger partner changes x month(s) after the oldest spouse reaches the pension eligibility age (where x equals 1, 2, or 3). It is possible to use regression (1) to calculate how the net labor force participation of the youngest spouse changes one month after pension eligibility of the oldest spouse. To do so, we use the coefficients on

We find that the coefficients remain relatively constant, indicating that the main reduction in net labor supply of the younger partner happens when the oldest spouse reaches the pension eligibility age.

R^o coefficient per Pension cohort of the oldest spouse (male) / dependent variable	Q_t^y	Q_{t+1}^y	Q_{t+2}^y	Q_{t+3}^y
65+3	-0.9*** (0.1)	-1.0*** (0.1)	-1.0*** (0.1)	-1.0*** (0.1)
65+6	-0.8*** (0.1)	-0.9*** (0.1)	-0.8*** (0.1)	-0.8*** (0.1)
65+9	-0.8*** (0.1)	-0.9*** (0.2)	0.9*** (0.2)	-0.8*** (0.2)

*Table 13 Sensitivity analysis for net labor supply for couples where the older spouse is male. The regression is given by equation (1) with a change of the dependent variable to Q_{t+1}^y, Q_{t+2}^y, and Q_{t+3}^y, respectively. We control for first- and second-generation immigrant status, the presence of children in the household, cohort dummies, and year effects. Column (1) represents the baseline estimate for the R^o coefficient as shown in section V.A. * denotes significance level at 10%, ** denotes significance at 5%, and *** denotes significance at 1%.*

R^o coefficient per Pension cohort of the oldest spouse (female) / dependent variable	Q_t^y	Q_{t+1}^y	Q_{t+2}^y	Q_{t+3}^y
65+3	-0.3 (0.5)	-0.3 (0.5)	-0.2 (0.5)	-0.2 (0.5)
65+6	-1.7*** (0.5)	-1.8*** (0.5)	-1.7*** (0.5)	-1.8*** (0.5)
65+9	-1.7*** (0.5)	-1.8*** (0.5)	-1.6*** (0.5)	-1.5*** (0.6)

*Table 14 Sensitivity analysis for net labor supply for couples where the older spouse is female. The regression is given by equation (1) with a change of the dependent variable to Q_{t+1}^y, Q_{t+2}^y, and Q_{t+3}^y, respectively. We control for first- and second-generation immigrant status, the presence of children in the household, cohort dummies, and year effects. Column (1) represents the baseline estimate for the R^o coefficient as shown in section V.A. * denotes significance level at 10%, ** denotes significance at 5%, and *** denotes significance at 1%.*

the following dependent variables: R^o, $Age - Age(R^o)$, and $(Age - Age(R^o) * R^o$. In case x=1, $Age - Age(R^o) = \frac{1}{12}$. This implies that the effect of the last two terms on the net labor force participation of the younger spouse will be close to zero when one looks at the size of the coefficients. In other words, if the linear model fits the data well, we should not expect to see a large change in the R^o coefficient once we shift the dependent variable by one month. A similar way of reasoning holds for shifting the net labor supply of the younger partner by two or three months.

VII Discussion & Conclusion

We analyzed how spousal labor supply is affected by the statutory retirement age of the oldest spouse. We investigate the *direct* effect of an increased statutory retirement age in the context of couples. We find that about one third of the oldest spouses retire at the statutory retirement age. This has not changed much after the increase in the statutory retirement age, although we do observe different trends between high and low-income households. With the increasing statutory retirement age, high-income households stick to the statutory retirement age less often (the direct effect for men declines from -44%-points to -32%-points), while low-income households stick more often to the statutory retirement age (from -14%-points to -24%-points for men).

The regression results also show a negative effect on the net labor participation of the younger spouse. Younger partners decrease their labor supply at the extensive margin up to 1.7 percentage points once the oldest spouse reaches the statutory retirement age. The responsiveness for younger men is twice as high than for younger female partners. The responsiveness is also about twice as strong in high-wage income households than in low-wage income households. The responsiveness in terms of hours worked are somewhat smaller. Lastly, we show evidence that for younger spouses the original statutory retirement age of 65 is still a reference point. This indicates that, in addition to the leisure complementarity, social norms also seem to impact retirement decisions.

In general, the negative participation effect we find can be caused by leisure complementarity, financial incentives and/or social norms. The ratio, which shows how sensitive the younger spouse's net labor force participation is with respect to the net labor force participation of the oldest spouse, is constant for different pension cohorts of the older spouse. The same holds as well when we investigate this ratio for different wage income groups. Therefore, leisure complementarity likely plays a role in the decision-making process.

On the other hand, we as well observe that these ratios are almost twice as high for couples where the male is the younger spouse. This might be explained by a smaller age difference for these couples. A smaller age difference means that the own statutory retirement age of both spouses are relatively close to each other. As a result, retiring prior to the own pension eligibility age has a less negative impact on lifetime income. More precisely, reducing the number of working hours today does not only affect current income, but also second pillar retirement income. If the younger partner is closer to the own retirement age, the reduction in the second pillar pension income will be limited. The importance of this mechanism is a question for future research.

In addition, the complementarity ratios are also 1.5 to 2 times higher for high wage income households. Therefore, it seems that the richer the household, the more likely both partners will

retire together. The first pillar pension benefits the older partner receives when retiring equals fifty percent of the minimum wage. This is most likely inadequate financial compensation to withdraw from the labor force for the younger partner unless there is sufficient second pillar pension available such that the younger partner can retire as well. High wage households often have mandatory and high second pillar pensions and are therefore more likely to retire jointly. Therefore, this suggests that leisure complementarity plays a larger role than liquidity constraints (i.e., access to public pension benefits) since high wage income households are less dependent on public pension benefits. The analysis on the initial retirement age of 65 also points in that direction.

Bibliography

Atalay, K., Barrett, G., & Siminski, P. (2019, 7 1). Pension incentives and the joint retirement of couples: evidence from two natural experiments. *Journal of Population Economics, 32*(3), 735-767.

Atav, T., Jongen, E., & Rabaté, S. (2019). *The Effects of Increasing the Normal Retirement Age: Evidence From the Netherlands.*

Behaghel, L., & Blau, D. M. (2012). Framing social security reform: Behavioral responses to changes in the full retirement age. *American Economic Journal: Economic Policy, 4(4)*, 41-67.

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

Bloemen, H., Hochguertel, S., & Zweerink, J. (2019). The Effect of Incentive-Induced Retirement on Spousal Retirement Rates: Evidence from a Natural Experiment. *Economic Inquiry*, 910-930.

Cammeraat, E., Jongen, E., & Koning, P. (2019). The Added Worker Effect in the Netherlands Before and During the Great Recession.

Casanova, M. (2010). Happy together: A structural model of couples' joint retirement choices. *Unpublished Manuscript, Department of Economics, UCLA*.

CBS. (2020, September 21). *CBS Statline* . Retrieved from https://opendata.cbs.nl/statline/#/CBS/nl/navigatieScherm/thema

Chiappori, P. A. (1988). Rational household labor supply. *Econometrica*, 63-90.

Coile, C. (2004). Retirement Incentives and Couples' Retirement Decisions. *Topics in Economic Analysis & Policy*, 1-30.

Damman, M., Henkens, K., & Kalmijn, M. (2015). Women's retirement intentions and behavior: The role of childbearing and marital histories. *European Journal of Population*, 339-363.

de Grip, A., Fouarge, D., & Montizaan, R. (2019). Redistribution of Individual Pension Wealth to Survivor Pensions: Evidence from a Stated Preferences Analysis. *Journal of Economic Behavior & Organization*.

de Pijper, B., Wildenburg, A., Montessori, R., van de Graaf, M., de Jong, M., Van der Zanden, R., & Ramaekers, H. (2019). *De Kleine Gids voor de Nederlandse sociale zekerheid 2019.1.* Alphen aan den Rijn: Wolters Kluwer Business.

Deelen, A., & van Vuuren, D. (2009). De Participatiegroei van Ouderen Ontrafeld. *ESB*, 10-12.

Doove, S., ter Haar, D., Schalken, N., & Span, T. (2019). *Inkomens- en arbeidsmarktpositie van de jongere partners van AOW-gerechtigden.* Den Haag.

Eerste Kamer der Staten-Generaal. (2012, Juli 18). *Wet verhoging AOW- en pensioenrichtleeftijd*. Retrieved from https://www.eerstekamer.nl/wetsvoorstel/33290_wet_verhoging_aow_en

Eismann, M., Henkens, K., & Kalmijn, M. (2019). Origins and mechanisms of social influences in couples: The case of retirement decisions. *European Sociological Review*, 1-17.

Euwals, R., Knoef, M., & van Vuuren, D. (2011). The trend in female labour force participation: what can be expected for the future? *Empirical Economics 40.3*, 729-753.

Euwals, R., van Vuren, A., & van Vuuren, D. (2012, 7). The decline of substitute pathways into retirement: Empirical evidence from the Dutch health care sector. *International Social Security Review, 65*(3), 101-122.

García, A. N., & Van Soest, A. (2018). How does an allowance for a non-working younger partner affect the retirement behaviour of couples? *Journal of Pension Economics & Finance*, 1-31.

García, A. N., & van Soest, A. (2022). Joint retirement behaviour and pension reform in the Netherlands. *The Journal of the Economics of Ageing, 23, 100401*.

Grip, A. D., Lindeboom, M., & Montizaan, R. (2012). Shattered dreams: the effects of changing the pension system late in the game. *The Economic Journal, 122(559)*, 1-25.

Gustman, A. L., & Steinmeier, T. L. (2000). Retirement in Dual-Career Families: A Structural Model. *Journal of Labor Economics*, 503-545.

Hanel, B., & Riphahn, R. (2012, 10). The timing of retirement - New evidence from Swiss female workers. *Labour Economics, 19*(5), 718-728.

Henretta, J. C., & O'Rand, A. M. (1983). Joint Retirement in the Dual Worker Family. *Social Forces*, 504-520.

Hospido, L., & Zamarro, G. (2014). Retirement patterns of couples in Europe. *IZA Journal of European Labor Studies*.

Hurd, M. D. (1990). The joint retirement decision of husbands and wives. *Issues in the Economics of Aging*, 231-258.

Jongen, E. (2016). Using Tax Credits to Postpone Retirement – A Panel Data Analysis of a Large Dutch Reform.

Jonneke Bolhaar, Dillingh, Rik, van Vuuren, D. (2017). Langer doorwerken: keuzes voor nu en later. *CPB Policy Brief*.

Kapteyn, A., Kalwij, A., Nl, S., & De Vos, K. (2018). *Network for Studies on Pensions, Aging and Retirement The Netherlands a Social security programs and employment at older ages in the Netherlands.*

Kok, L., Kroon, L., Luiten, W., & Schwartz, T. (2019). *Samen ouder worden? Beleidsopties voor leefvormnormen in de AOW.* Amsterdam: SEO Economisch Onderzoek.

Koning, J., Gelderblom, A., & Gravesteijn, J. (2017). Stijging AOW-leeftijd Leidt Vooralsnog tot Hogere Arbeidsparticipatie. *ESB*, 382-385.

Lalive, R., & Parrotta, P. (2017). How does pension eligibility affect labor supply in couples? *Labour Economics*, 177-188.

Michaud, P. C., & Vermeulen, F. (2011). A collective labor supply model with complementarities in leisure: Identification and estimation by means of panel data. *Labour Economics*, 159-167.

Ministry of Social Affairs. (2019). *Beleidsdoorlichting artikel 8 Oudedagsvoorziening.* Den Haag.

Nagore Garcia, A., Rossi, M. C., & van Soest, A. (2013). Labour Market Decisions of the Self-Employed in the Netherlands at the Statutory Retirement Age. *uxembourg Institute of Socio-Economic Research (LISER) Working Paper Series, 13*.

OECD. (2011). Pensions at a Glance 2011: Retirement-income Systems in OECD and G20 countries.

Picchio, M., & Van Ours, J. C. (2019). The Mental Health Effects of Retirement. *IZA Discussion Paper No. 12791*, 1-52.

Rijksoverheid. (2019, 11 6). *De Rijksoverheid. Voor Nederland.* Retrieved from Overzicht AOW-leeftijd Lange Termijn: https://www.rijksoverheid.nl/documenten/publicaties/2019/09/25/overzicht-aow-leeftijd-lange-termijn

Schippers, J. J., & Vlasblom, J. D. (2019). Werkloze ouderen weer aan het werk? Het effect van reserveringsloon en zoekintensiteit. *Tijdschrift voor Arbeidsvraagstukken*, 6-25.

Schirle, T. (2008, 10). Why have the labor force participation rates of older men increased since the mid-1990s? *Journal of Labor Economics, 26*(4), 549-594.

Seibold, A. (2021). Reference points for retirement behavior: Evidence from german pension discontinuities. *American Economic Review, 111(4)*, 1126-65.

Staubli, S., & Zweimüller, J. (2013, 12). Does raising the early retirement age increase employment of older workers? *Journal of Public Economics, 108*, 17-32.

Syse, A. e. (2017). Changes in health and health behavior associated with retirement. . *Journal of Aging and Health*, 99–127.

Van den Berg, C., Klabbers, G., de Pijper, B., Sens, I., Wildenburg, A., & Hop, A. (2007). *De Kleine Gids voor de Nederlandse Sociale Zekerheid 2007.2.* Deventer: Wolters Kluwer Business.

Van der Klaauw, W., & Wolpin, K. I. (2008). Social security and the retirement and savings behavior of low-income households. *Journal of econometrics*, 21-42.

van Ooijen, R., Mastrogiacomo, M., & Euwals, R. (2010). Private Wealth and Planne Early Retirement: A Panal Data Analysis for the Netherlands. *IZA Discussion Papaer No. 5339*, 1-32.

Vermeer, N. (2016). Age anchors and the expected retirement age: an experimental study. *De Economist*, 255-279.

Zweimüller, J., Winter-Ebmer, R., & Falkinger, J. (1996). Retirement of spouses and social security reform. *European Economic Review*, 449-472.

Appendix

A Additional graphs and figures

A.1 Effect of pension eligibility on own net labor force participation

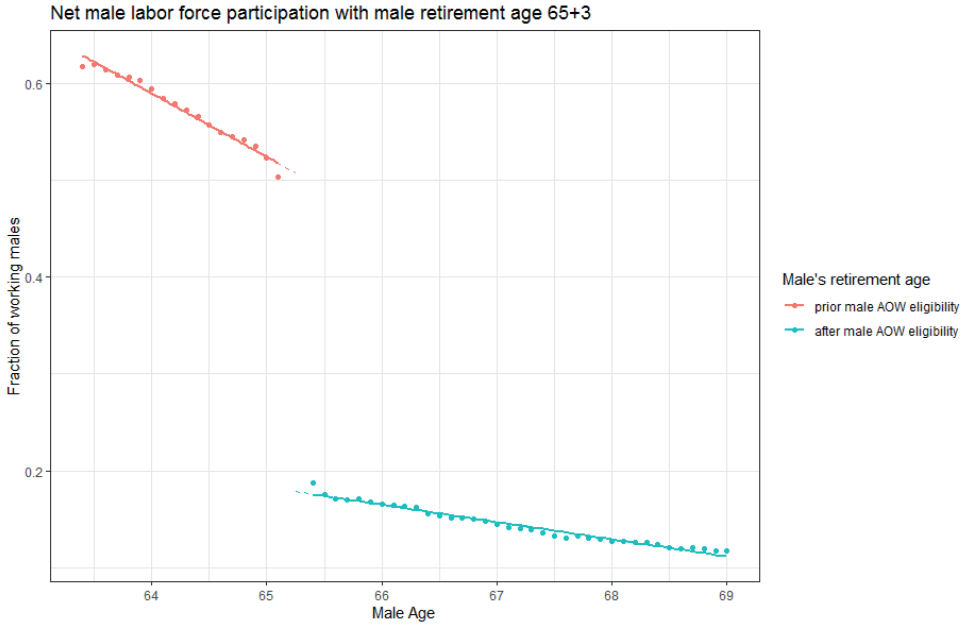

Figure 7 Average net labor force participation of the older male partner with male statutory retirement age of 65 years and 3 months. The red (blue) line indicates the average net labor force participation prior (after) the statutory retirement age.

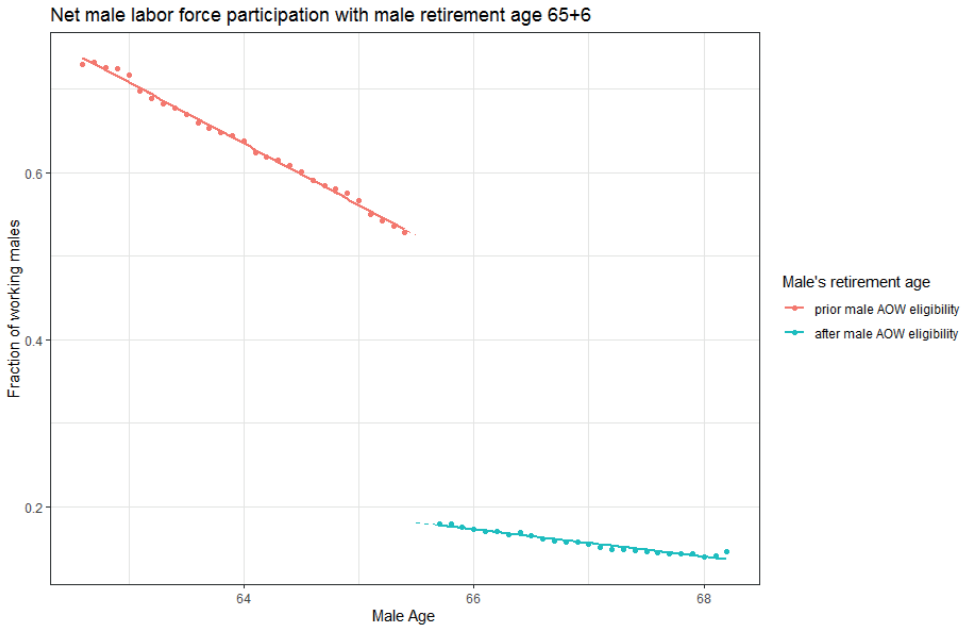

Figure 8 Average net labor force participation of the older male partner with male statutory retirement age of 65 years and 6 months. The red (blue) line indicates the average net labor force participation prior (after) the statutory retirement age.

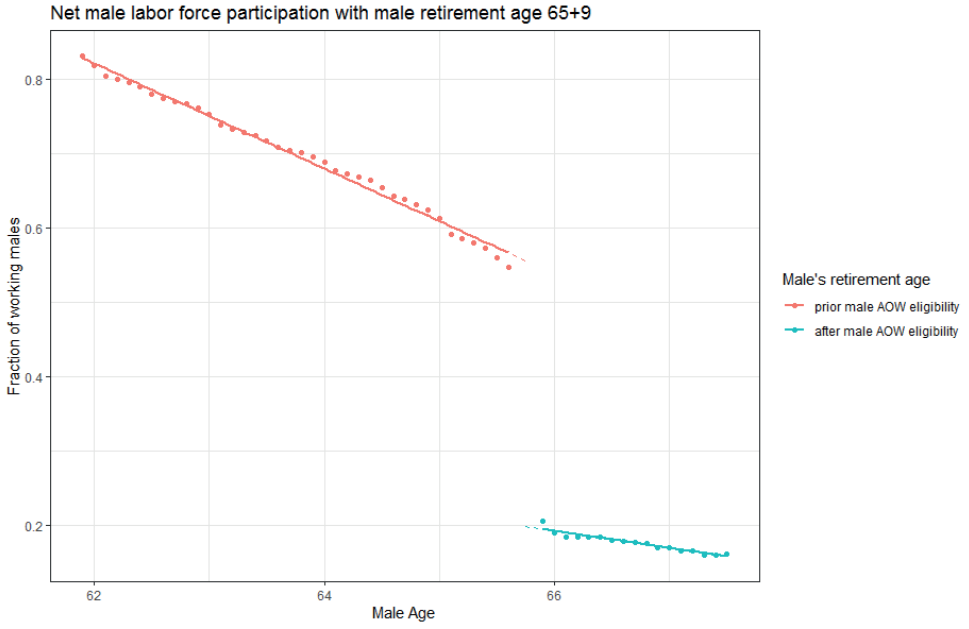

Figure 9 Average net labor force participation of the older male partner with male statutory retirement age of 65 years and 9 months. The red (blue) line indicates the average net labor force participation prior (after) the statutory retirement age.

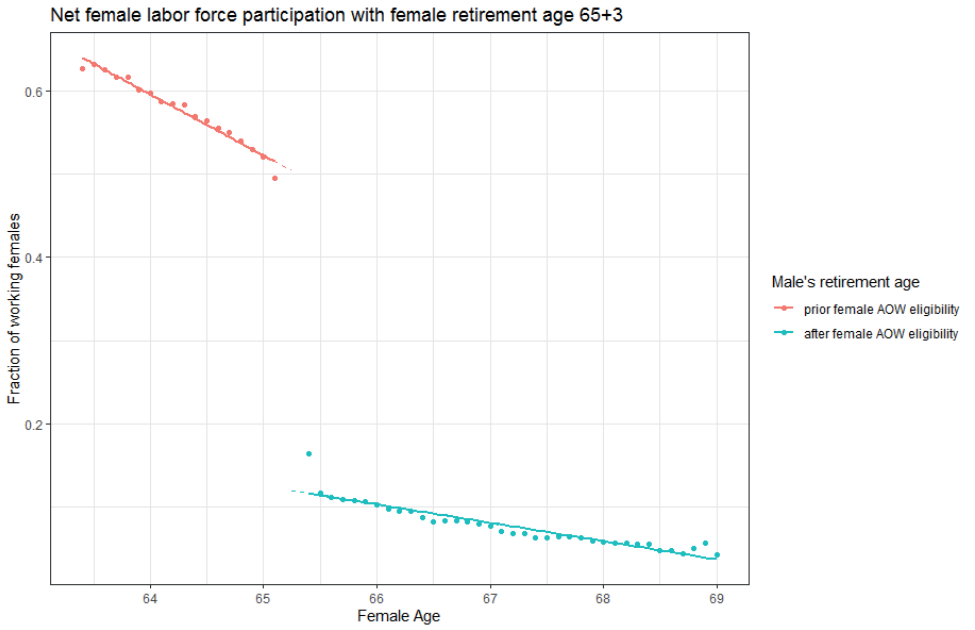

Figure 10 Average net labor force participation of the older female partner with female statutory retirement age of 65 years and 3 months. The red (blue) line indicates the average net labor force participation prior (after) the statutory retirement age.

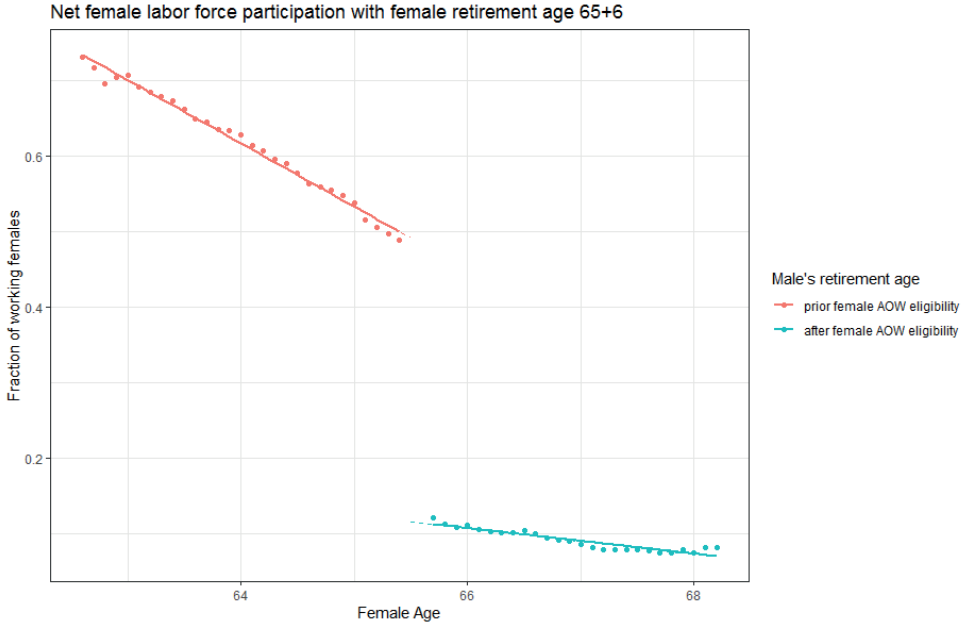

Figure 11 Average net labor force participation of the older female partner with female statutory retirement age of 65 years and 6 months. The red (blue) line indicates the average net labor force participation prior (after) the statutory retirement age.

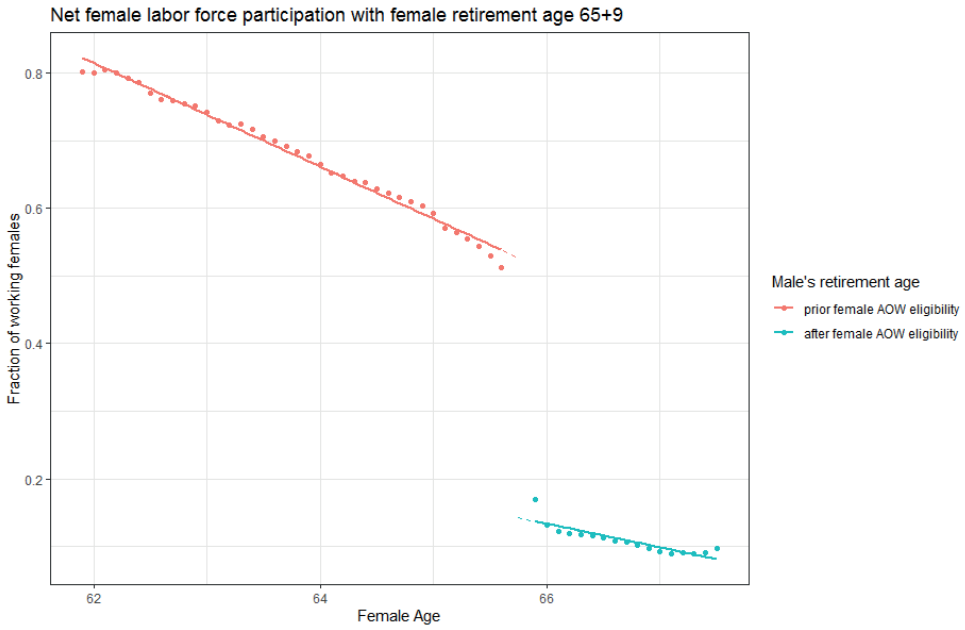

Figure 12 Average net labor force participation of the older female partner with female statutory retirement age of 65 years and 9 months. The red (blue) line indicates the average net labor force participation prior (after) the statutory retirement age.

A.2 Part time factor

We plot the part-time factor of the youngest person in a couple before and after the oldest person reaches the statutory retirement age. More precisely, we plot the average part-time factor of the youngest partner 6 months prior and after the oldest partners reaches the statutory retirement age.

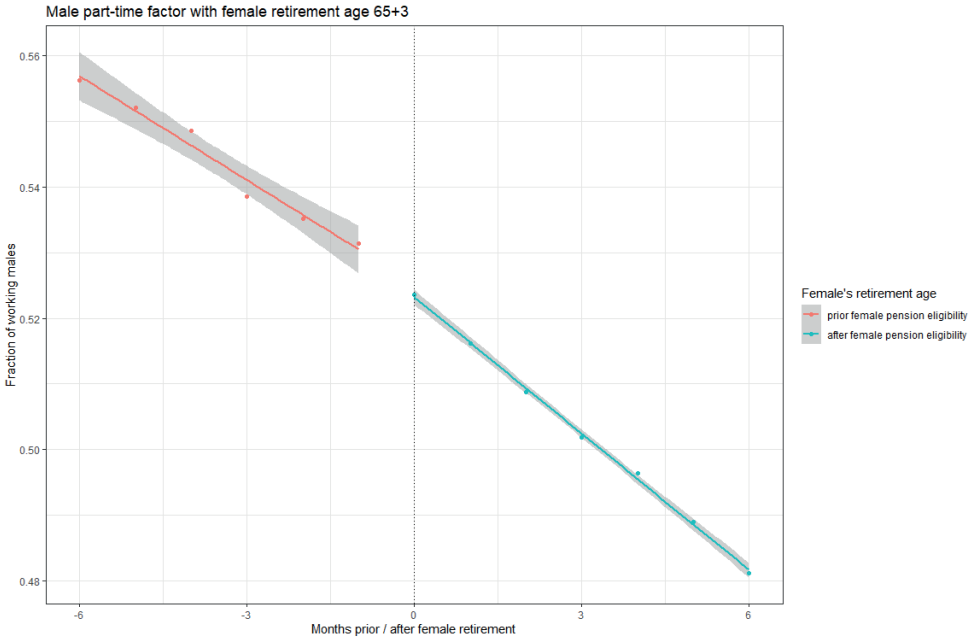

Figure 13 Average part-time factor of the younger male partner with female statutory retirement age of 65 years and 3 months. The red (blue) line indicates the average part-time factor of the younger male partner 6 months prior (after) the statutory retirement age of the older spouse.

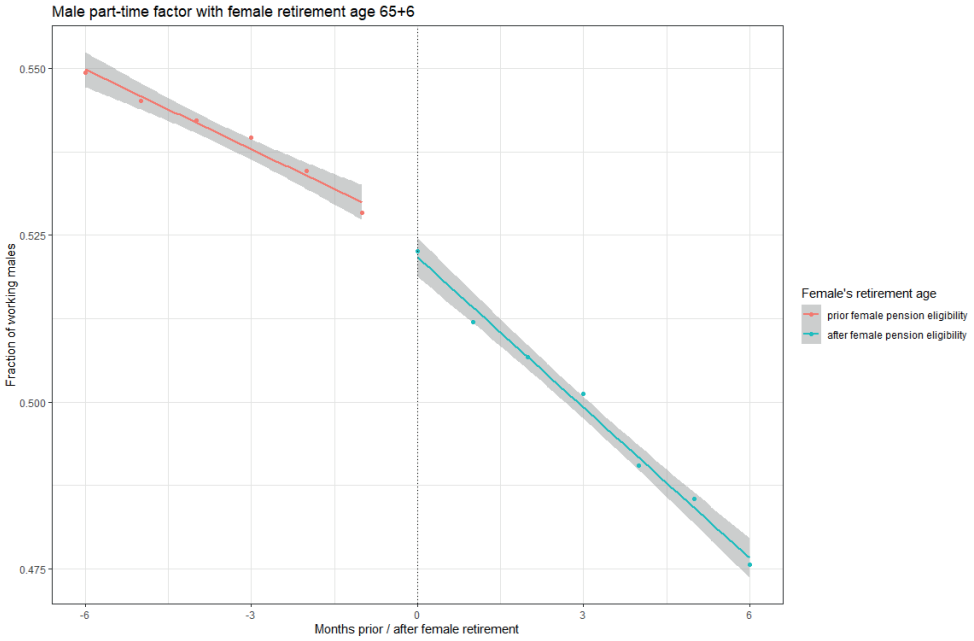

Figure 14 Average part-time factor of the younger male partner with female statutory retirement age of 65 years and 6 months. The red (blue) line indicates the average part-time factor of the younger male partner 6 months prior (after) the statutory retirement age of the older spouse.

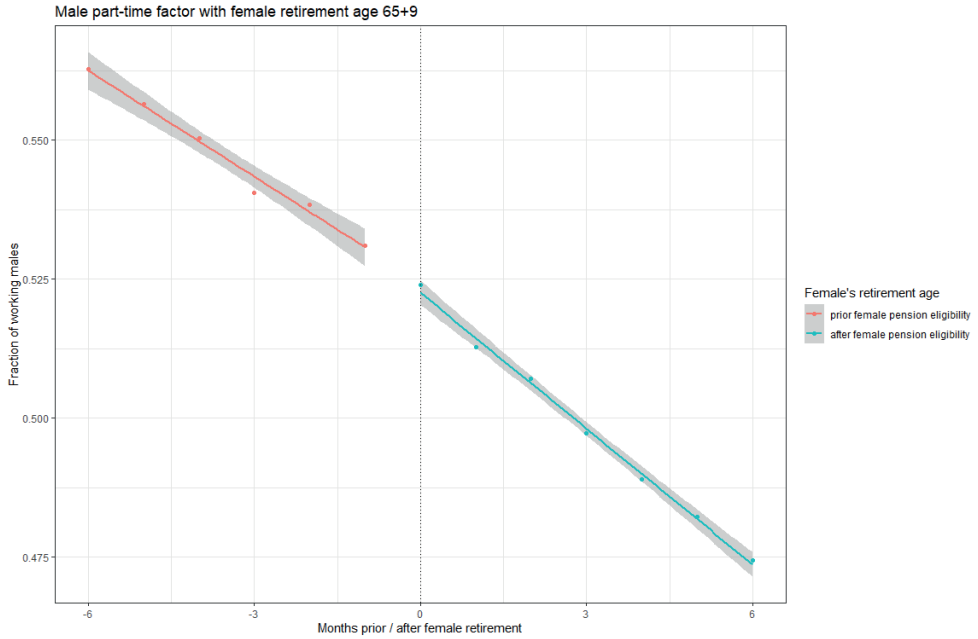

Figure 15 Average part-time factor of the younger male partner with female statutory retirement age of 65 years and 9 months. The red (blue) line indicates the average part-time factor of the male partner 6 months prior (after) the statutory retirement age of the older spouse.

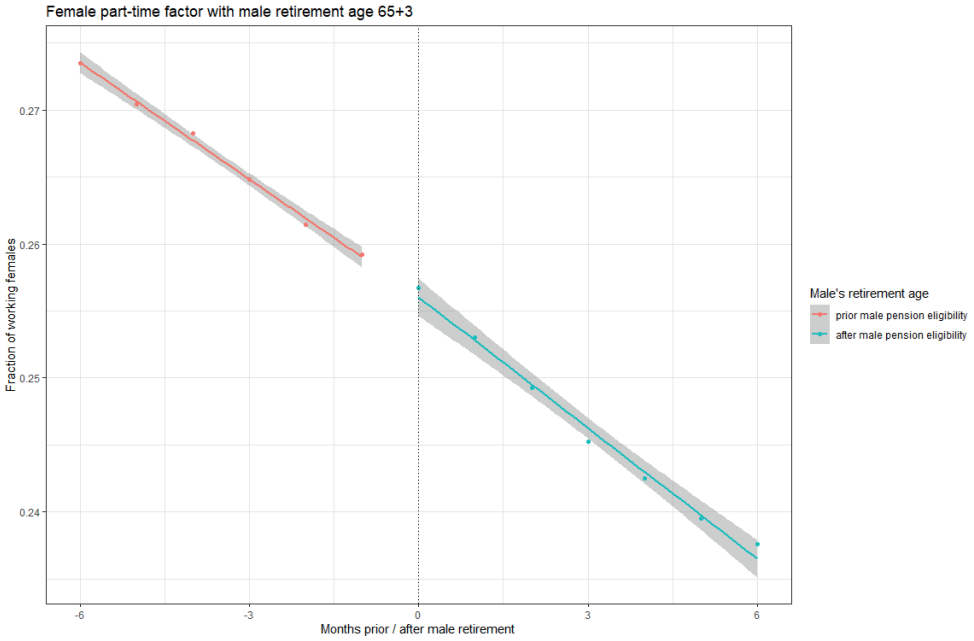

Figure 16 Average part-time factor of the younger female partner with male statutory retirement age of 65 years and 3 months. The red (blue) line indicates the average part-time factor of the female partner 6 months prior (after) the statutory retirement age of the older spouse.

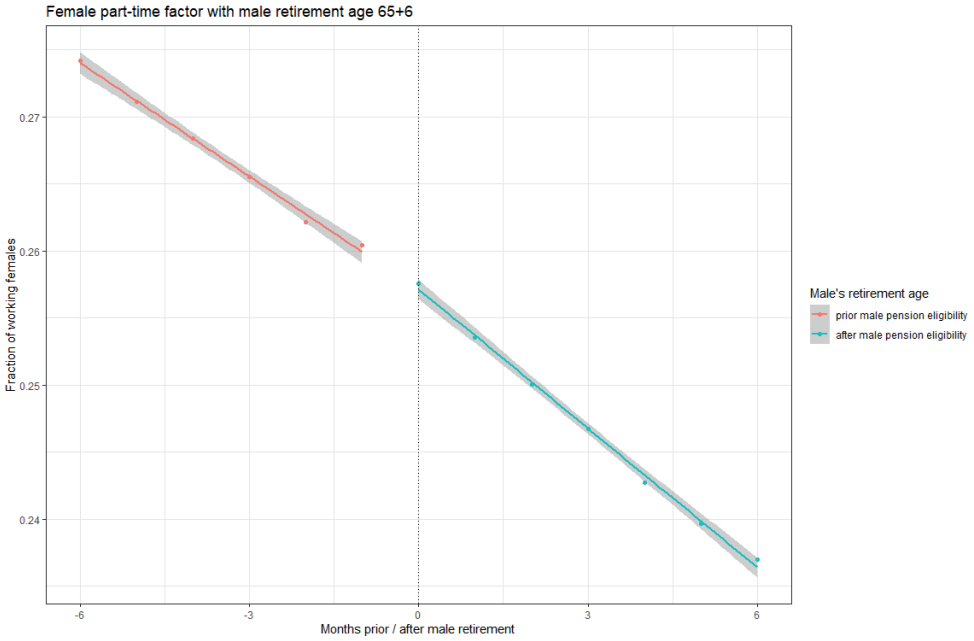

Figure 17 Average part-time factor of the younger female partner with male statutory retirement age of 65 years and 3 months. The red (blue) line indicates the average part-time factor of the female partner 6 months prior (after) the statutory retirement age of the older spouse.

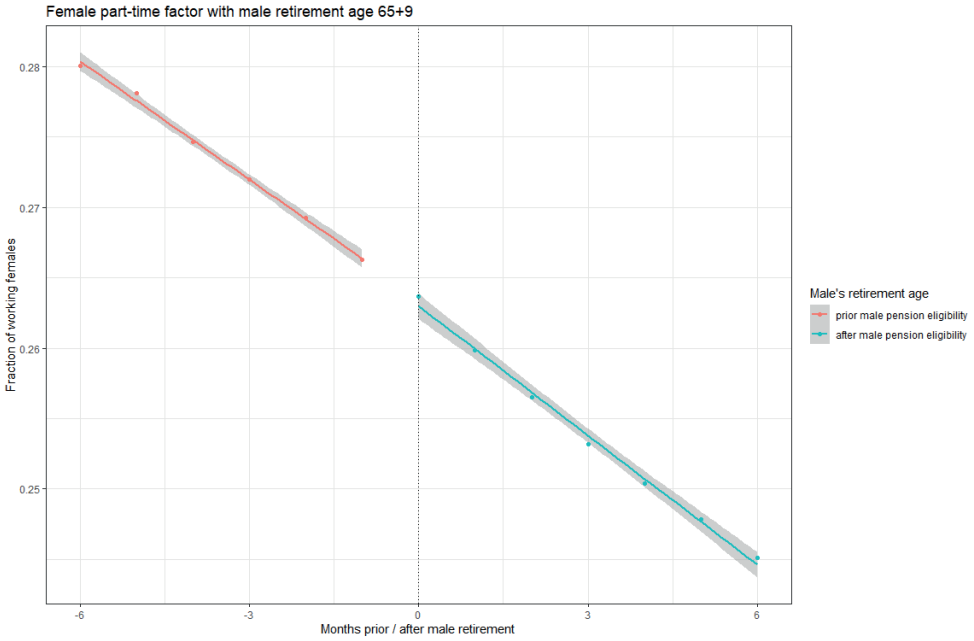

Figure 18 Average part-time factor of the younger female partner with male statutory retirement age of 65 years and 9 months. The red (blue) line indicates the average part-time factor of the female partner 6 months prior (after) the statutory retirement age of the older spouse.

B Additional regression output

In appendix B.1, we provide the regression output per regression cohort of equation (1). We provide the regression tables with clustered standard errors at the household level. In case we would change to robust standard errors, the results would not change (we omit them here to economize on space). The first tables provide the regression output with spousal labor supply of the youngest spouse as the dependent variable. In the upper left cell of each table we write down the gender of the oldest spouse as well as the pension cohort the oldest spouse belongs to. Cohort 1 refers to a pension eligibility age of 65 years and 3 months. Cohort 2 and cohort 3 refer to a pension eligibility age of 65 years and 6 months and 65 years and 9 months, respectively. The main variables we use from these tables are the coefficients for R^o and R^y.

In appendix B.2, show the regression output with the net labor supply of the oldest spouse as the dependent variable. Here we use the coefficient of R^o to calculate the ratios to determine whether joint retirement increases or decreases for different cohorts.

In appendix B.3, we show our regression results when we split the households into a low- and high wage income group. In appendix B.4 we show the regression results for the part-time factor of the younger spouse as the dependent variable. The references to the cohorts are the same as in appendix B1.

Lastly, in appendix B.5 we display the full regression output when we check for a social norm effect at the initial statutory retirement age of 65.

B.1 Net labor force participation for the youngest spouse

Male = old in cohort 1	(1)	(2)	(3)	(4)
α	0.278***	0.274***	0.247***	0.352***
	(0.005)	(0.005)	(0.014)	(0.051)
R^y	-0.178***	-0.178***	-0.175***	-0.140***
	(0.004)	(0.004)	(0.004)	(0.004)
R^o	-0.020***	-0.020***	-0.011***	-0.009***
	(0.002)	(0.002)	(0.001)	(0.001)
$Age^o - Age(R^o)$	-0.011***	-0.010***	-0.004	-0.009
	(0.002)	(0.002)	(0.006)	(0.006)
$Age^y - Age(R^y)$	-0.033***	-0.034***	-0.034***	-0.021***
	(0.001)	(0.001)	(0.001)	(0.003)
$(Age^y - Age(R^y)) * R^y$	0.006***	0.006***	0.004**	0.0185***
	(0.002)	(0.002)	(0.002)	(0.003)
$(Age^o - Age(R^o)) * R^o$	0.011***	0.010***	0.011***	0.004
	(0.002)	(0.002)	(0.004)	(0.004)
Controls	NO	YES	YES	YES
Year dummies	NO	NO	YES	YES
Cohort dummies	NO	NO	NO	YES
Adj. R^2	12.6%	12.8%	12.8%	13.3%
Households	21,148	21,148	21,148	21,148

*Table 15 The effect of male pension eligibility (male = oldest spouse) on female net labor supply. Clustered standard errors at the household level are between parentheses. ***denotes significance at the 1%-level, ** denotes significance at the 5% level, and * denotes significance at the10% level.*

Male = old in cohort 2	(1)	(2)	(3)	(4)
α	0.293***	0.293***	0.286***	0.354***
	(0.005)	(0.005)	(0.011)	(0.044)
R^y	-0.178***	-0.177***	-0.176***	-0.138***
	(0.005)	(0.005)	(0.005)	(0.004)
R^o	-0.014***	-0.014***	-0.010***	-0.008***
	(0.002)	(0.002)	(0.001)	(0.001)
$Age^o - Age(R^o)$	-0.016***	-0.016***	-0.017***	-0.022***
	(0.001)	(0.001)	(0.006)	(0.006)
$Age^y - Age(R^y)$	-0.030***	-0.030***	-0.030***	-0.021***
	(0.0001)	(0.001)	(0.001)	(0.003)
$(Age^y - Age(R^y)) * R^y$	-0.023***	-0.023***	-0.024***	-0.0121**
	(0.004)	(0.004)	(0.004)	(0.005)
$(Age^o - Age(R^o)) * R^o$	0.012***	0.012***	0.015***	0.009**
	(0.003)	(0.002)	(0.004)	(0.004)
Controls	NO	YES	YES	YES
Year dummies	NO	NO	YES	YES
Cohort dummies	NO	NO	NO	YES
Adj. R^2	8.9%	9.0%	9.0%	9.5%
Households	20,224	20,224	20,224	20,224

*Table 16 The effect of male pension eligibility (male = oldest spouse) on female net labor supply. Clustered standard errors at the household level are between parentheses. ***denotes significance at the 1%-level, ** denotes significance at the 5% level, and * denotes significance at the10% level.*

Male = old in cohort 3	(1)	(2)	(3)	(4)
α	0.32***	0.315***	0.315***	0.4678***
	(0.005)	(0.005)	(0.003)	(0.0368)
R^y	-0.150***	-0.148***	-0.148***	-0.0904***
	(0.007)	(0.007)	(0.007)	(0.006)
R^o	-0.010***	-0.010***	-0.009***	-0.008***
	(0.002)	(0.002)	(0.001)	(0.001)
$Age^o - Age(R^o)$	-0.012***	-0.011***	-0.006	-0.012**
	(0.001)	(0.001)	(0.006)	(0.006)
$Age^y - Age(R^y)$	-0.028***	-0.029***	-0.029***	-0.015***
	(0.001)	(0.001)	(0.001)	(0.004)
$(Age^y - Age(R^y)) * R^y$	-0.163***	-0.161***	-0.161***	-0.169***
	(0.02)	(0.015)	(0.016)	(0.016)
$(Age^o - Age(R^o)) * R^o$	0.001	0.00001	-0.006	-0.012***
	(0.003)	(0.003)	(0.004)	(0.004)
Controls	NO	YES	YES	YES
Year dummies	NO	NO	YES	YES
Cohort dummies	NO	NO	NO	YES
Adj. R^2	6.4%	6.8%	6.8%	7.3%
Households	19,665	19,665	19,665	19,665

*Table 17 The effect of male pension eligibility (male = oldest spouse) on female net labor supply. Clustered standard errors at the household level are between parentheses. ***denotes significance at the 1%-level, ** denotes significance at the 5% level, and * denotes significance at the10% level.*

Female = old in cohort 1	(1)	(2)	(3)	(4)
α	0.464***	0.466***	0.410***	0.475***
	(0.013)	(0.013)	(0.037)	(0.118)
R^y	-0.294***	-0.293***	-0.288***	-0.244***
	(0.011)	(0.011)	(0.011)	(0.011)
R^o	-0.021***	-0.020***	-0.007	-0.003
	(0.006)	(0.006)	(0.005)	(0.005)
$Age^o - Age(R^o)$	-0.024***	-0.023***	-0.0002	-0.008
	(0.006)	(0.006)	(0.015)	(0.016)
$Age^y - Age(R^y)$	-0.038***	-0.038***	-0.038***	-0.026***
	(0.002)	(0.002)	(0.002)	(0.007)
$(Age^y - Age(R^y)) * R^y$	0.006	0.005	0.001	0.021***
	(0.006)	(0.006)	(0.007)	(0.008)
$(Age^o - Age(R^o)) * R^o$	0.0216**	0.0216***	0.014	0.003
	(0.008)	(0.008)	(0.013)	(0.013)
Controls	NO	YES	YES	YES
Year dummies	NO	NO	YES	YES
Cohort dummies	NO	NO	NO	YES
Adj. R^2	22.2%	22.5%	22.6%	23.3%
Households	2,663	2,663	2,663	2,663

*Table 18 The effect of female pension eligibility (female = oldest spouse) on male net labor supply. Clustered standard errors at the household level are between parentheses. ***denotes significance at the 1%-level, ** denotes significance at the 5% level, and * denotes significance at the10% level.*

Female = old in cohort 2	(1)	(2)	(3)	(4)
α	0.493***	0.493***	0.484***	0.599***
	(0.014)	(0.014)	(0.030)	(0.137)
R^y	-0.287***	-0.287***	-0.283***	-0.224***
	(0.012)	(0.012)	(0.012)	(0.011)
R^o	-0.031***	-0.031***	-0.022***	-0.017***
	(0.006)	(0.006)	(0.005)	(0.005)
$Age^o - Age(R^o)$	-0.024***	-0.024***	-0.016	-0.029*
	(0.005)	(0.005)	(0.0014)	(0.016)
$Age^y - Age(R^y)$	-0.032***	-0.032***	-0.032***	-0.011
	(0.0003)	(0.0003)	(0.003)	(0.009)
$(Age^y - Age(R^y)) * R^y$	-0.049***	-0.049***	-0.052***	-0.024*
	(0.011)	(0.011)	(0.011)	(0.012)
$(Age^o - Age(R^o)) * R^o$	0.042***	0.042***	0.031***	0.015
	(0.007)	(0.007)	(0.012)	(0.013)
Controls	NO	YES	YES	YES
Year dummies	NO	NO	YES	YES
Cohort dummies	NO	NO	NO	YES
Adj. R^2	14.7%	15.3%	15.3%	16.9%
Households	2,526	2,526	2,526	2,526

*Table 19 The effect of female pension eligibility (female = oldest spouse) on male net labor supply. Clustered standard errors at the household level are between parentheses. ***denotes significance at the 1%-level, ** denotes significance at the 5% level, and * denotes significance at the10% level.*

Female = old in cohort 3	(1)	(2)	(3)	(4)
α	0.515***	0.513***	0.497***	0.618***
	(0.013)	(0.014)	(0.020)	(0.104)
R^y	-0.186***	-0.187***	-0.185***	-0.137***
	(0.016)	(0.016)	(0.016)	(0.014)
R^o	-0.026***	-0.026***	-0.020***	-0.017***
	(0.007)	(0.007)	(0.005)	(0.005)
$Age^o - Age(R^o)$	-0.024***	-0.023***	-0.029**	-0.039***
	(0.003)	(0.003)	(0.014)	(0.015)
$Age^y - Age(R^y)$	-0.030***	-0.030***	-0.030***	-0.014*
	(0.002)	(0.002)	(0.002)	(0.007)
$(Age^y - Age(R^y)) * R^y$	-0.274***	-0.275***	-0.280***	-0.284***
	(0.034)	(0.034)	(0.035)	(0.035)
$(Age^o - Age(R^o)) * R^o$	0.006	0.006	0.021	0.010
	(0.010)	(0.010)	(0.013)	(0.014)
Controls	NO	YES	YES	YES
Year dummies	NO	NO	YES	YES
Cohort dummies	NO	NO	NO	YES
Adj. R^2	9.9%	10.4%	10.4%	11.5%
Households	2,473	2,473	2,473	2,473

*Table 20 The effect of female pension eligibility (female = oldest spouse) on male net labor supply. Clustered standard errors at the household level are between parentheses. ***denotes significance at the 1%-level, ** denotes significance at the 5% level, and * denotes significance at the10% level.*

B.2 Labor supply of the oldest spouse

Male = old in cohort 1 (own labor supply)	(1)	(2)	(3)	(4)
α	0.469*** (0.005)	0.468*** (0.005)	0.451*** (0.011)	0.433*** (0.036)
R^y	0.002 (0.004)	0.0002 (0.004)	0.005 (0.004)	0.009*** (0.003)
R^o	-0.301*** (0.003)	-0.301*** (0.003)	-0.267*** (0.003)	-0.267*** (0.003)
$Age^o - Age(R^o)$	-0.063*** (0.002)	-0.063*** (0.002)	-0.063*** (0.006)	-0.062*** (0.006)
$Age^y - Age(R^y)$	-0.008*** (0.001)	-0.006*** (0.001)	-0.006*** (0.001)	-0.007*** (0.002)
$(Age^y - Age(R^y)) * R^y$	0.005* (0.003)	0.004 (0.003)	-0.003 (0.003)	0.007** (0.003)
$(Age^o - Age(R^o)) * R^o$	0.040*** (0.002)	0.040*** (0.002)	0.037*** (0.006)	0.035*** (0.006)
Controls	NO	YES	YES	YES
Year dummies	NO	NO	YES	YES
Cohort dummies	NO	NO	NO	YES
Adj. R^2	18.6%	18.8%	18.9%	18.9%
Households	21,148	21,148	21,148	21,148

*Table 21 The effect of male pension eligibility (male = oldest spouse) on male net labor supply. Clustered standard errors at the household level are between parentheses. ***denotes significance at the 1%-level, ** denotes significance at the 5% level, and * denotes significance at the10% level.*

Male = old in cohort 2 (own labor supply)	(1)	(2)	(3)	(4)
α	0.488*** (0.005)	0.484*** (0.005)	0.452*** (0.009)	0.4865*** (0.032)
R^y	0.001 (0.005)	-0.001 (0.005)	0.004 (0.005)	0.019*** (0.005)
R^o	-0.304*** (0.003)	-0.304*** (0.003)	-0.278*** (0.003)	-0.277*** (0.003)
$Age^o - Age(R^o)$	-0.064*** (0.001)	-0.065*** (0.001)	-0.083*** (0.005)	-0.084*** (0.006)
$Age^y - Age(R^y)$	-0.010*** (0.001)	-0.008*** (0.001)	-0.008*** (0.001)	-0.005** (0.002)
$(Age^y - Age(R^y)) * R^y$	0.00002 (0.005)	-0.001 (0.005)	-0.011** (0.005)	-0.002 (0.006)
$(Age^o - Age(R^o)) * R^o$	0.032*** (0.002)	0.032*** (0.002)	0.055*** (0.006)	0.053*** (0.006)
Controls	NO	YES	YES	YES
Year dummies	NO	NO	YES	YES
Cohort dummies	NO	NO	NO	YES
Adj. R^2	22.3%	22.5%	22.6%	22.6%
Households	20,224	20,224	20,224	20,224

*Table 22 The effect of male pension eligibility (male = oldest spouse) on male net labor supply. Clustered standard errors at the household level are between parentheses. ***denotes significance at the 1%-level, ** denotes significance at the 5% level, and * denotes significance at the 10% level.*

Male = old in cohort 3 (own labor supply)	(1)	(2)	(3)	(4)
α	0.509***	0.507***	0.469***	0.487***
	(0.005)	(0.005)	(0.006)	(0.026)
R^y	0.004	-0.0003	0.002	0.016*
	(0.008)	(0.008)	(0.008)	(0.009)
R^o	-0.288***	-0.289***	-0.276***	-0.275***
	(0.003)	(0.003)	(0.003)	(0.003)
$Age^o - Age(R^o)$	-0.061***	-0.062***	-0.076***	-0.077***
	(0.001)	(0.001)	(0.005)	(0.001)
$Age^y - Age(R^y)$	-0.011***	-0.009***	-0.009***	-0.006***
	(0.001)	(0.001)	(0.001)	(0.002)
$(Age^y - Age(R^y)) * R^y$	0.030	0.029	0.018	0.016
	(0.02)	(0.019)	(0.019)	(0.019)
$(Age^o - Age(R^o)) * R^o$	-0.018***	-0.018***	0.017***	0.016***
	(0.003)	(0.003)	(0.006)	(0.006)
Controls	NO	YES	YES	YES
Year dummies	NO	NO	YES	YES
Cohort dummies	NO	NO	NO	YES
Adj. R^2	21.6%	21.9%	21.9%	22.0%
Households	19,665	19,665	19,665	19,665

*Table 23 The effect of male pension eligibility (male = oldest spouse) on male net labor supply. Clustered standard errors at the household level are between parentheses. ***denotes significance at the 1%-level, ** denotes significance at the 5% level, and * denotes significance at the10% level.*

Female = old in cohort 1 (own labor supply)	(1)	(2)	(3)	(4)
α	0.505***	0.498***	0.482***	0.388***
	(0.012)	(0.012)	(0.025)	(0.112)
R^y	-0.014***	-0.013*	-0.002	-0.010
	(0.007)	(0.007)	(0.007)	(0.007)
R^o	-0.346***	-0.346***	-0.298***	-0.298***
	(0.009)	(0.009)	(0.008)	(0.008)
$Age^o - Age(R^o)$	-0.079***	-0.079***	-0.069***	-0.065***
	(0.006)	(0.006)	(0.016)	(0.017)
$Age^y - Age(R^y)$	-0.0003	0.0002	0.0003	-0.005
	(0.002)	(0.002)	(0.002)	(0.007)
$(Age^y - Age(R^y)) * R^y$	0.020***	0.020***	0.008	0.009
	(0.005)	(0.005)	(0.016)	(0.006)
$(Age^o - Age(R^o)) * R^o$	0.038***	0.037***	0.022	0.023
	(0.007)	(0.007)	(0.023)	(0.016)
Controls	NO	YES	YES	YES
Year dummies	NO	NO	YES	YES
Cohort dummies	NO	NO	NO	YES
Adj. R^2	27.7%	27.9%	28.1	28.2%
Households	2,663	2,663	2,663	2,663

*Table 24 The effect of female pension eligibility (female = oldest spouse) on female net labor supply. Clustered standard errors at the household level are between parentheses. ***denotes significance at the 1%-level, ** denotes significance at the 5% level, and * denotes significance at the10% level.*

Female = old in cohort 2 (own labor supply)	(1)	(2)	(3)	(4)
α	0.492***	0.484***	0.427***	0.362***
	(0.012)	(0.013)	(0.021)	(0.115)
R^y	-0.023**	-0.023**	-0.015*	-0.005
	(0.008)	(0.008)	(0.009)	(0.009)
R^o	-0.323***	-0.324***	-0.291***	-0.290***
	(0.009)	(0.009)	(0.008)	(0.008)
$Age^o - Age(R^o)$	-0.086***	-0.084***	-0.066***	-0.066***
	(0.004)	(0.004)	(0.015)	(0.016)
$Age^y - Age(R^y)$	-0.001**	-0.0005	-0.0004	-0.002
	(0.002)	(0.002)	(0.002)	(0.008)
$(Age^y - Age(R^y)) * R^y$	0.018**	0.018**	0.005	0.016*
	(0.007)	(0.008)	(0.008)	(0.009)
$(Age^o - Age(R^o)) * R^o$	0.040***	0.039***	0.036**	0.032**
	(0.006)	(0.006)	(0.016)	(0.016)
Controls	NO	YES	YES	YES
Year dummies	NO	NO	YES	YES
Cohort dummies	NO	NO	NO	YES
Adj. R^2	27.5%	28.0%	28.1%	28.2%
Households	2,526	2,526	2,526	2,526

*Table 25 The effect of female pension eligibility (female = oldest spouse) on female net labor supply. Clustered standard errors at the household level are between parentheses. ***denotes significance at the 1%-level, ** denotes significance at the 5% level, and * denotes significance at the10% level.*

Female = old in cohort 3 (own labor supply)	(1)	(2)	(3)	(4)
α	0.522***	0.516***	0.471***	0.596***
	(0.012)	(0.013)	(0.016)	(0.019)
R^y	-0.022*	-0.023*	-0.018	-0.004
	(0.012)	(0.012)	(0.012)	(0.014)
R^o	-0.301***	-0.302***	-0.284***	-0.284***
	(0.009)	(0.009)	(0.008)	(0.008)
$Age^o - Age(R^o)$	-0.077***	-0.076***	-0.086***	-0.092***
	(0.004)	(0.004)	(0.014)	(0.015)
$Age^y - Age(R^y)$	-0.003	-0.002	-0.002	0.008
	(0.002)	(0.002)	(0.002)	(0.007)
$(Age^y - Age(R^y)) * R^y$	0.076***	0.075***	0.063**	0.057**
	(0.026)	(0.026)	(0.027)	(0.027)
$(Age^o - Age(R^o)) * R^o$	-0.038***	-0.038***	-0.006	-0.008
	(0.008)	(0.008)	(0.02)	(0.017)
Controls	NO	YES	YES	YES
Year dummies	NO	NO	YES	YES
Cohort dummies	NO	NO	NO	YES
Adj. R^2	24.9%	25.2%	25.3%	25.4%
Households	2,473	2,473	2,473	2,473

*Table 26 The effect of female pension eligibility (female = oldest spouse) on female net labor supply. Clustered standard errors at the household level are between parentheses. ***denotes significance at the 1%-level, ** denotes significance at the 5% level, and * denotes significance at the10% level.*

B.3 Regression tables for low wage and high wage income households

In the regression tables below, we run the same regression as equation (1) after splitting our data into rich and poor households for each pension cohort of the older spouse. To do so, we use the household wage income in January 2014. The results are presented below.

Male = old in cohort 1 (female labor supply)	Low wage income	High wage income
α	0.220***	0.488***
	(0.074)	(0.066)
R^y	-0.094***	-0.221***
	(0.004)	(0.007)
R^o	-0.003*	-0.018***
	(0.002)	(0.002)
$Age^o - Age(R^o)$	0.002	-0.015*
	(0.008)	(0.009)
$Age^y - Age(R^y)$	-0.022***	-0.017***
	(0.004)	(0.004)
$\left(Age^y - Age(R^y)\right) * R^y$	0.019***	0.007
	(0.003)	(0.005)
$(Age^o - Age(R^o) * R^o)$	-0.003	0.011*
	(0.005)	(0.006)
Controls	YES	YES
Year Dummies	YES	YES
Cohort dummies	YES	YES
Adj. R^2	9.2%	17.2%
Households	11,936	9,212

*Table 27 The effect of male pension eligibility (male = oldest spouse) on female net labor supply for different wage income groups. Clustered standard errors at the household level are between parentheses. ***denotes significance at the 1%-level, ** denotes significance at the 5% level, and * denotes significance at the 10% level.*

Male = old in cohort 2 (female labor supply)	Low wage income	High wage income
α	0.175**	0.497***
	(0.072)	(0.048)
R^y	-0.097***	-0.205***
	(0.005)	(0.007)
R^o	-0.003*	-0.016***
	(0.002)	(0.002)
$Age^o - Age(R^o)$	-0.004	-0.020**
	(0.008)	(0.008)
$Age^y - Age(R^y)$	-0.018***	-0.018***
	(0.005)	(0.003)
$\left(Age^y - Age(R^y)\right) * R^y$	-0.008	-0.025***
	(0.006)	(0.009)
$(Age^o - Age(R^o) * R^o)$	0.002	0.010
	(0.005)	(0.006)
Controls	YES	YES
Year Dummies	YES	YES
Cohort dummies	YES	YES
Adj. R^2	5.6%	14.1%
Households	11,036	9,188

*Table 28 The effect of male pension eligibility (male = oldest spouse) on female net labor supply for different wage income groups. Clustered standard errors at the household level are between parentheses. ***denotes significance at the 1%-level, ** denotes significance at the 5% level, and * denotes significance at the10% level.*

Male = old in cohort 3 (female labor supply)	Low wage income	High wage income
α	0.385***	0.553***
	(0.054)	(0.041)
R^y	-0.059***	-0.143***
	(0.007)	(0.011)
R^o	-0.006***	-0.011***
	(0.002)	(0.003)
$Age^o - Age(R^o)$	0.002	-0.019**
	(0.008)	(0.008)
$Age^y - Age(R^y)$	-0.012***	-0.016***
	(0.003)	(0.003)
$\left(Age^y - Age(R^y)\right) * R^y$	-0.144***	-0.216***
	(0.018)	(0.029)
$(Age^o - Age(R^o) * R^o)$	-0.013***	-0.014**
	(0.005)	(0.007)
Controls	YES	YES
Year Dummies	YES	YES
Cohort dummies	YES	YES
Adj. R^2	4.8%	10.8%
Households	11,037	8,628

*Table 29 The effect of male pension eligibility (male = oldest spouse) on female net labor supply for different wage income groups. Clustered standard errors at the household level are between parentheses. ***denotes significance at the 1%-level, ** denotes significance at the 5% level, and * denotes significance at the10% level.*

Male = old in cohort 1 (male own labor supply)	Low wage income	High wage income
α	0.234*** (0.051)	0.692*** (0.046)
R^y	-0.000 (0.004)	-0.014*** (0.005)
R^o	-0.138*** (0.003)	-0.436*** (0.005)
$Age^o - Age(R^o)$	-0.021** (0.003)	-0.096*** (0.006)
$Age^y - Age(R^y)$	-0.004 (0.003)	-0.005** (0.003)
$\left(Age^y - Age(R^y)\right) * R^y$	0.005* (0.003)	-0.009* (0.005)
$(Age^o - Age(R^o) * R^o)$	0.012* (0.007)	0.050*** (0.007)
Controls	YES	YES
Year Dummies	YES	YES
Cohort dummies	YES	YES
Adj. R^2	6.7%	41.3%
Households	11,936	9,212

*Table 30 The effect of male pension eligibility (male = oldest spouse) on male net labor supply for different wage income groups. Clustered standard errors at the household level are between parentheses. ***denotes significance at the 1%-level, ** denotes significance at the 5% level, and * denotes significance at the10% level.*

Male = old in cohort 2 (male own labor supply)	Low wage income	High wage income
α	0.376*** (0.053)	0.593*** (0.037)
R^y	0.019*** (0.006)	-0.006 (0.007)
R^o	-0.193*** (0.004)	-0.380*** (0.005)
$Age^o - Age(R^o)$	-0.061*** (0.008)	-0.078*** (0.005)
$Age^y - Age(R^y)$	-0.004 (0.003)	-0.003 (0.002)
$\left(Age^y - Age(R^y)\right) * R^y$	-0.003 (0.007)	-0.010 (0.008)
$(Age^o - Age(R^o) * R^o)$	0.037*** (0.008)	0.042*** (0.007)
Controls	YES	YES
Year Dummies	YES	YES
Cohort dummies	YES	YES
Adj. R^2	11.2%	43.2%
Households	11,036	9,188

*Table 31 The effect of male pension eligibility (male = oldest spouse) on male net labor supply for different wage income groups. Clustered standard errors at the household level are between parentheses. ***denotes significance at the 1%-level, ** denotes significance at the 5% level, and * denotes significance at the10% level.*

Male = old in cohort 3 (male own labor supply)	Low wage income	High wage income
α	0.408***	0.570***
	(0.040)	(0.029)
R^y	0.015	0.002
	(0.011)	(0.012)
R^o	-0.240***	-0.322***
	(0.004)	(0.005)
$Age^o - Age(R^o)$	-0.069***	-0.075***
	(0.008)	(0.005)
$Age^y - Age(R^y)$	-0.007***	-0.003*
	(0.003)	(0.002)
$\left(Age^y - Age(R^y)\right) * R^y$	0.031	-0.010
	(0.025)	(0.030)
$(Age^o - Age(R^o) * R^o)$	0.016**	0.004
	(0.008)	(0.008)
Controls	YES	YES
Year Dummies	YES	YES
Cohort dummies	YES	YES
Adj. R^2	14.0%	38.1%
Households	11,037	8,628

*Table 32 The effect of male pension eligibility (male = oldest spouse) on male net labor supply for different wage income groups. Clustered standard errors at the household level are between parentheses. ***denotes significance at the 1%-level, ** denotes significance at the 5% level, and * denotes significance at the10% level.*

Female = old in cohort 1 (male labor supply)	Low wage income	High wage income
α	0.315	0.775***
	(0.201)	(0.100)
R^y	-0.146***	-0.382***
	(0.013)	(0.016)
R^o	-0.002	-0.007
	(0.006)	(0.008)
$Age^o - Age(R^o)$	0.024	-0.045***
	(0.023)	(0.012)
$Age^y - Age(R^y)$	-0.034***	-0.008
	(0.012)	(0.005)
$\left(Age^y - Age(R^y)\right) * R^y$	0.010	0.002
	(0.010)	(0.012)
$(Age^o - Age(R^o) * R^o)$	-0.014	0.026
	(0.016)	(0.018)
Controls	YES	YES
Year Dummies	YES	YES
Cohort dummies	YES	YES
Adj. R^2	15.2%	38.4%
Households	1,451	1,212

*Table 33 The effect of female pension eligibility (female = oldest spouse) on male net labor supply for different wage income groups. Clustered standard errors at the household level are between parentheses. ***denotes significance at the 1%-level, ** denotes significance at the 5% level, and * denotes significance at the10% level.*

Female = old in cohort 2 (male labor supply)	Low wage income	High wage income
α	0.435**	0.509***
	(0.199)	(0.133)
R^y	-0.152***	-0.337***
	(0.013)	(0.017)
R^o	-0.013**	-0.023***
	(0.006)	(0.008)
$Age^o - Age(R^o)$	-0.027	-0.024*
	(0.023)	(0.014)
$Age^y - Age(R^y)$	-0.013	-0.030***
	(0.013)	(0.009)
$\left(Age^y - Age(R^y)\right) * R^y$	0.003	-0.074***
	(0.016)	(0.018)
$(Age^o - Age(R^o) * R^o)$	0.022	0.016
	(0.016)	(0.018)
Controls	YES	YES
Year Dummies	YES	YES
Cohort dummies	YES	YES
Adj. R^2	12.6%	27.6%
Households	1,374	1,152

*Table 34 The effect of female pension eligibility (female = oldest spouse) on male net labor supply for different wage income groups. Clustered standard errors at the household level are between parentheses. ***denotes significance at the 1%-level, ** denotes significance at the 5% level, and * denotes significance at the10% level.*

Female = old in cohort 3 (male labor supply)	Low wage income	High wage income
α	0.626***	0.544***
	(0.148)	(0.111)
R^y	-0.085***	-0.212***
	(0.018)	(0.020)
R^o	-0.012*	-0.026***
	(0.006)	(0.008)
$Age^o - Age(R^o)$	-0.008	-0.045***
	(0.021)	(0.015)
$Age^y - Age(R^y)$	-0.013	-0.020**
	(0.010)	(0.008)
$\left(Age^y - Age(R^y)\right) * R^y$	-0.244***	-0.344***
	(0.049)	(0.051)
$(Age^o - Age(R^o) * R^o)$	-0.011	0.025
	(0.017)	(0.022)
Controls	YES	YES
Year Dummies	YES	YES
Cohort dummies	YES	YES
Adj. R^2	9.2%	19.2%
Households	1,339	1,134

*Table 35 The effect of female pension eligibility (female = oldest spouse) on male net labor supply for different wage income groups. Clustered standard errors at the household level are between parentheses. ***denotes significance at the 1%-level, ** denotes significance at the 5% level, and * denotes significance at the10% level.*

Female = old in cohort 1 (female own labor supply)	Low wage income	High wage income
α	0.395*** (0.130)	0.449*** (0.169)
R^y	-0.021** (0.009)	-0.013 (0.011)
R^o	-0.244*** (0.010)	-0.366*** (0.012)
$Age^o - Age(R^o)$	-0.050** (0.023)	-0.091*** (0.023)
$Age^y - Age(R^y)$	0.006 (0.008)	-0.011 (0.010)
$\left(Age^y - Age(R^y)\right) * R^y$	-0.005 (0.008)	0.015 (0.010)
$(Age^o - Age(R^o) * R^o)$	0.013 (0.021)	0.039* (0.023)
Controls	YES	YES
Year Dummies	YES	YES
Cohort dummies	YES	YES
Adj. R^2	21.9%	37.4%
Households	1,451	1,212

*Table 36 The effect of female pension eligibility (female = oldest spouse) on female net labor supply for different wage income groups. Clustered standard errors at the household level are between parentheses. ***denotes significance at the 1%-level, ** denotes significance at the 5% level, and * denotes significance at the10% level.*

Female = old in cohort 2 (female own labor supply)	Low wage income	High wage income
α	0.246* (0.145)	0.463*** (0.167)
R^y	-0.007 (0.012)	-0.019 (0.014)
R^o	-0.253*** (0.011)	-0.335*** (0.013)
$Age^o - Age(R^o)$	-0.046** (0.023)	-0.088*** (0.022)
$Age^y - Age(R^y)$	-0.009 (0.009)	0.004 (0.011)
$\left(Age^y - Age(R^y)\right) * R^y$	0.011 (0.013)	0.017 (0.014)
$(Age^o - Age(R^o) * R^o)$	0.019 (0.022)	0.051** (0.022)
Controls	YES	YES
Year Dummies	YES	YES
Cohort dummies	YES	YES
Adj. R^2	22.1%	37.0%
Households	1,374	1,152

*Table 37 The effect of female pension eligibility (female = oldest spouse) on female net labor supply for different wage income groups. Clustered standard errors at the household level are between parentheses. ***denotes significance at the 1%-level, ** denotes significance at the 5% level, and * denotes significance at the10% level.*

Female = old in cohort 3 (female own labor supply)	Low wage income	High wage income
α	0.627*** (0.137)	0.462*** (0.149)
R^y	0.005 (0.019)	-0.020 (0.019)
R^o	-0.271*** (0.011)	-0.301*** (0.019)
$Age^o - Age(R^o)$	-0.099*** (0.022)	-0.057*** (0.020)
$Age^y - Age(R^y)$	0.013 (0.009)	-0.005 (0.011)
$\left(Age^y - Age(R^y)\right) * R^y$	0.044 (0.037)	0.071* (0.040)
$(Age^o - Age(R^o) * R^o)$	-0.007 (0.023)	-0.021 (0.023)
Controls	YES	YES
Year Dummies	YES	YES
Cohort dummies	YES	YES
Adj. R^2	20.9%	33.0%
Households	1,339	1,134

*Table 38 The effect of female pension eligibility (female = oldest spouse) on female net labor supply for different wage income groups. Clustered standard errors at the household level are between parentheses. ***denotes significance at the 1%-level, ** denotes significance at the 5% level, and * denotes significance at the10% level.*

B.4 Part-time factor

Male = old in cohort 1	(1)	(2)	(3)	(4)
α	0.139***	0.136***	0.122***	0.200***
	(0.004)	(0.003)	(0.010)	(0.040)
R^y	-0.095***	-0.094***	-0.093***	-0.077***
	(0.003)	(0.003)	(0.003)	(0.002)
R^o	-0.010***	-0.010***	-0.006***	-0.005***
	(0.001)	(0.001)	(0.001)	(0.001)
$Age^o - Age(R^o)$	-0.003**	-0.002*	0.001	-0.003
	(0.002)	(0.002)	(0.004)	(0.004)
$Age^y - Age(R^y)$	-0.026***	-0.026***	-0.026***	-0.018***
	(0.001)	(0.001)	(0.001)	(0.002)
$(Age^y - Age(R^y)) * R^y$	0.009***	0.010***	0.008***	0.014***
	(0.001)	(0.001)	(0.001)	(0.002)
$(Age^o - Age(R^o)) * R^o$	0.004***	0.004**	0.005*	0.002
	(0.001)	(0.001)	(0.003)	(0.003)
Controls	NO	YES	YES	YES
Year dummies	NO	NO	YES	YES
Cohort dummies	NO	NO	NO	YES
Adj. R^2	13.4%	13.5%	13.5%	13.8%
Households	21,148	21,148	21,148	21,148

*Table 39 The effect of male pension eligibility (male = oldest spouse) on female's part-time factor. Clustered standard errors at the household level are between parentheses. ***denotes significance at the 1%-level, ** denotes significance at the 5% level, and * denotes significance at the10% level.*

Male = old in cohort 2	(1)	(2)	(3)	(4)
α	0.149***	0.147***	0.133***	0.167***
	(0.004)	(0.004)	(0.007)	(0.034)
R^y	-0.092***	-0.091***	-0.090***	-0.071***
	(0.003)	(0.003)	(0.003)	(0.003)
R^o	-0.010***	-0.010***	-0.005***	-0.005***
	(0.001)	(0.001)	(0.001)	(0.001)
$Age^o - Age(R^o)$	-0.005***	-0.005***	-0.002	-0.005***
	(0.001)	(0.001)	(0.003)	(0.004)
$Age^y - Age(R^y)$	-0.024***	-0.025***	-0.024***	-0.019***
	(0.001)	(0.001)	(0.001)	(0.002)
$(Age^y - Age(R^y)) * R^y$	-0.008***	-0.008***	-0.009***	-0.005***
	(0.002)	(0.002)	(0.002)	(0.003)
$(Age^o - Age(R^o)) * R^o$	0.004***	0.004***	0.007***	0.004**
	(0.001)	(0.001)	(0.003)	(0.003)
Controls	NO	YES	YES	YES
Year dummies	NO	NO	YES	YES
Cohort dummies	NO	NO	NO	YES
Adj. R^2	10.1%	10.3%	10.3%	10.6%
Households	20,224	20,224	20,224	20,224

*Table 40 The effect of male pension eligibility (male = oldest spouse) female's part-time factor. Clustered standard errors at the household level are between parentheses. ***denotes significance at the 1%-level, ** denotes significance at the 5% level, and * denotes significance at the10% level.*

Male = old in cohort 3	(1)	(2)	(3)	(4)
α	0.167***	0.164***	0.164***	0.311***
	(0.004)	(0.004)	(0.005)	(0.029)
R^y	-0.072***	-0.071***	-0.071***	-0.040***
	(0.005)	(0.005)	(0.005)	(0.004)
R^o	-0.006***	-0.006***	-0.005***	-0.005***
	(0.001)	(0.001)	(0.001)	(0.001)
$Age^o - Age(R^o)$	-0.004***	-0.003***	0.0002	-0.005***
	(0.001)	(0.001)	(0.004)	(0.004)
$Age^y - Age(R^y)$	-0.023***	-0.023***	-0.023***	-0.012***
	(0.001)	(0.001)	(0.001)	(0.002)
$(Age^y - Age(R^y)) * R^y$	-0.103***	-0.101***	-0.100***	-0.108***
	(0.009)	(0.009)	(0.010)	(0.010)
$(Age^o - Age(R^o)) * R^o$	-0.001	-0.002	-0.007***	-0.010***
	(0.002)	(0.002)	(0.003)	(0.003)
Controls	NO	YES	YES	YES
Year dummies	NO	NO	YES	YES
Cohort dummies	NO	NO	NO	YES
Adj. R^2	7.3%	7.5%	7.5%	8.0%
Households	19,665	19,665	19,665	19,665

*Table 41 The effect of male pension eligibility (male = oldest spouse) on female's part-time factor. Clustered standard errors at the household level are between parentheses. ***denotes significance at the 1%-level, ** denotes significance at the 5% level, and * denotes significance at the10% level.*

Female = old in cohort 1	(1)	(2)	(3)	(4)
α	0.40***	0.396***	0.336***	0.369***
	(0.011)	(0.012)	(0.032)	(0.117)
R^y	-0.279***	-0.278***	-0.273*	-0.230***
	(0.010)	(0.010)	(0.010)	(0.010)
R^o	-0.021***	-0.021***	-0.008*	-0.004
	(0.005)	(0.005)	(0.004)	(0.004)
$Age^o - Age(R^o)$	-0.022***	-0.021***	0.002	-0.005
	(0.006)	(0.006)	(0.015)	(0.015)
$Age^y - Age(R^y)$	-0.040***	-0.040***	-0.040***	-0.030***
	(0.002)	(0.002)	(0.002)	(0.007)
$(Age^y - Age(R^y)) * R^y$	0.007	0.006	0.002	0.023***
	(0.007)	(0.004)	(0.004)	(0.007)
$(Age^o - Age(R^o)) * R^o$	0.022***	0.021***	0.015**	0.004
	(0.007)	(0.007)	(0.012)	(0.012)
Controls	NO	YES	YES	YES
Year dummies	NO	NO	YES	YES
Cohort dummies	NO	NO	YES	YES
Adj. R^2	25.4%	25.7%	25.7%	26.6%
Households	2,663	2,663	2,663	2,663

*Table 42 The effect of female pension eligibility (female = oldest spouse) on male's part-time factor. Clustered standard errors at the household level are between parentheses. ***denotes significance at the 1%-level, ** denotes significance at the 5% level, and * denotes significance at the10% level.*

Female = old in cohort 2	(1)	(2)	(3)	(4)
α	0.418***	0.412***	0.393***	0.476***
	(0.013)	(0.013)	(0.027)	(0.136)
R^y	-0.277***	-0.276***	-0.273***	-0.218***
	(0.011)	(0.011)	(0.010)	(0.009)
R^o	-0.026***	-0.026***	-0.018***	-0.013***
	(0.005)	(0.005)	(0.004)	(0.004)
$Age^o - Age(R^o)$	-0.023***	-0.021***	-0.010	-0.022
	(0.004)	(0.004)	(0.014)	(0.016)
$Age^y - Age(R^y)$	-0.034***	-0.034***	-0.034***	-0.015
	(0.003)	(0.003)	(0.003)	(0.009)
$(Age^y - Age(R^y)) * R^y$	-0.041***	-0.041***	-0.044***	-0.017*
	(0.007)	(0.007)	(0.007)	(0.009)
$(Age^o - Age(R^o)) * R^o$	0.033***	0.031***	0.026**	0.011
	(0.006)	(0.006)	(0.012)	(0.012)
Controls	NO	YES	YES	YES
Year dummies	NO	NO	YES	YES
Cohort dummies	NO	NO	YES	YES
Adj. R^2	16.8%	17.5%	17.5%	19.1%
Households	2,526	2,526	2,526	2,526

*Table 43 The effect of female pension eligibility (female = oldest spouse) on male's part-time factor. Clustered standard errors at the household level are between parentheses. ***denotes significance at the 1%-level, ** denotes significance at the 5% level, and * denotes significance at the10% level.*

Female = old in cohort 3	(1)	(2)	(3)	(4)
α	0.441***	0.439***	0.417***	0.521***
	(0.013)	(0.013)	(0.018)	(0.108)
R^y	-0.197***	-0.197***	-0.195***	-0.144***
	(0.013)	(0.013)	(0.012)	(0.011)
R^o	-0.027***	-0.027***	-0.020***	-0.016***
	(0.006)	(0.006)	(0.005)	(0.005)
$Age^o - Age(R^o)$	-0.026***	-0.025***	-0.022	-0.031**
	(0.003)	(0.003)	(0.013)	(0.015)
$Age^y - Age(R^y)$	-0.031***	-0.031***	-0.031***	-0.016**
	(0.002)	(0.002)	(0.002)	(0.008)
$(Age^y - Age(R^y)) * R^y$	-0.230***	-0.232***	-0.238***	-0.241***
	(0.025)	(0.025)	(0.026)	(0.027)
$(Age^o - Age(R^o)) * R^o$	0.012	0.012	0.021	0.010
	(0.009)	(0.008)	(0.013)	(0.013)
Controls	NO	YES	YES	YES
Year dummies	NO	NO	YES	YES
Cohort dummies	NO	NO	YES	YES
Adj. R^2	11.2%	11.5%	11.5%	12.7%
Households	2,473	2,473	2,473	2,473

*Table 44 The effect of female pension eligibility (female = oldest spouse) on male's part-time factor. Clustered standard errors at the household level are between parentheses. ***denotes significance at the 1%-level, ** denotes significance at the 5% level, and * denotes significance at the10% level.*

B.5 Initial statutory retirement age of 65

We first examine whether there is any discontinuity at the age of 65. The reason for doing this is that the age of 65 has been the initial age at which older workers receive first pillar pension benefits. In line with Behaghel and Blau (2012), this point could still serve as a reference point for workers. To do so, we run the following regression:

$$Q^y = \alpha + \beta_1 R^y + \beta_2 D^y 65 + \beta_3 R^o + \beta_4 D^o 65 + \beta_5\left(Age^y - Age(R^y)\right) + \beta_6(Age^o - 65) + \beta_7\left(Age^y - Age(R^y)\right) * R^y + \beta_8\left(Age^y - Age(R^y)\right) * D^y 65 + \beta_9(Age^o - 65) * D^o 65 + \beta_{10}(Age^o - 65) * R^o + \beta_{11} D^y 65 * R^o + \beta_{11} X + \epsilon \quad (3)$$

The regression results are displayed in Table 47 and Table 48. We observe that the coefficient $D^y 65 * R^o$ is insignificant for all cohorts except for the cohort with statutory retirement age 65+9 and the male is the oldest spouse (column 3 of Table). Therefore, we conclude that the age of 65 does not serve as a reference point for the younger partner to leave the labor force.

Male = old / female = young	(1) 65+3	(2) 65+6	(3) 65+9
α	0.370*** (0.051)	0.383*** (0.045)	0.493*** (0.039)
R^y	-0.122*** (0.004)	-0.111*** (0.004)	-0.051*** (0.005)
$D^y 65$	-0.012 (0.049)	-0.041* (0.022)	-0.010 (0.017)
R^o	-0.012*** (0.002)	-0.013*** (0.003)	-0.002 (0.003)
$D^o 65$	-0.000 (0.001)	-0.001 (0.002)	-0.001 (0.001)
$Age^o - 65$	-0.009 (0.006)	-0.022*** (0.006)	-0.012** (0.006)
$Age^y - Age(R^y)$	-0.021*** (0.003)	-0.019*** (0.003)	-0.014*** (0.002)
$(Age^y - Age(R^y)) * R^y$	-0.011 (0.007)	-0.039** (0.008)	-0.196*** (0.018)
$(Age^y - Age(R^y)) * D^y 65$	0.025*** (0.006)	0.023*** (0.006)	0.022** (0.008)
$(Age^o - 65) * D^o 65$	-0.016** (0.008)	-0.001 (0.004)	-0.001 (0.004)
$(Age^o - 65) * R^o$	0.023*** (0.007)	0.015*** (0.005)	-0.002 (0.005)
$D^y 65 * R^o$	-0.023 (0.049)	-0.010 (0.022)	-0.060*** (0.015)
Controls	YES	YES	YES
Year dummies	YES	YES	YES
Cohort dummies	YES	YES	YES
Adj. R^2	13.4%	9.6%	7.4%
Households	21,148	20,224	19,665

*Table 45 The effect of spousal labor supply (male = old) when younger partner reaches the age of 65. Clustered standard errors at the household level are between parentheses. ***denotes significance at the 1%-level, ** denotes significance at the 5% level, and * denotes significance at the10% level.*

Female = old / male = young	65+3	65+6	65+9
α	0.511***	0.650***	0.696***
	(0.117)	(0.140)	(0.109)
R^y	-0.210***	-0.169***	-0.096***
	(0.010)	(0.011)	(0.012)
$D^y 65$	-0.022	-0.080*	-0.099***
	(0.083)	(0.040)	(0.032)
R^o	-0.006	-0.011	-0.005
	(0.006)	(0.008)	(0.012)
$D^o 65$	0.003	0.001	-0.004
	(0.004)	(0.005)	(0.005)
$Age^o - 65$	-0.009	-0.031*	-0.038***
	(0.016)	(0.016)	(0.015)
$Age^y - Age(R^y)$	-0.024***	-0.009	-0.011
	(0.006)	(0.009)	(0.007)
$(Age^y - Age(R^y)) * R^y$	-0.027	-0.014	-0.295***
	(0.020)	(0.021)	(0.041)
$(Age^y - Age(R^y)) * D^y 65$	0.040**	-0.018	0.008
	(0.017)	(0.017)	(0.019)
$(Age^o - 65) * D^o 65$	-0.010	0.021	0.008
	(0.023)	(0.014)	(0.011)
$(Age^o - 65) * R^o$	0.019	-0.000	0.001
	(0.022)	(0.017)	(0.017)
$D^y 65 * R^o$	-0.047	-0.026	0.004
	(0.082)	(0.038)	(0.028)
Controls	YES	YES	YES
Year dummies	YES	YES	YES
Cohort dummies	YES	YES	YES
Adj. R^2	23.4%	17.8%	11.7%
Households	2,663	2,526	2,473

*Table 46 The effect of spousal labor supply (female = old) when younger partner reaches the age of 65. Clustered standard errors at the household level are between parentheses. ***denotes significance at the 1%-level, ** denotes significance at the 5% level, and * denotes significance at the10% level.*

C Relation of ratios with respect to joint retirement

In section V.B, we discuss the ratio indicating how sensitive the younger spouse's net labor force participation is with respect to the net labor force participation of the oldest spouse. In this section, we discuss how this relates to the fraction of couples that stop working[37] in the same month, which is almost equivalent to retirement. To determine the fraction of couples that stop working in the same month, we determine the fraction of couples in which both spouses worked in the previous month and did not work in the current month. Table 47 shows the fraction of couples for which this is the case.

	Male =old/female =young	Female =old/ male = young
65+3	0.013	0.016
65+6	0.014	0.020
65+9	0.012	0.021

Table 47 Fraction of couples that stops working in the same month

We observe that the fraction of couples that stop working together is around 0.013 for couples where the male is the older spouse and around 0.019 four couples where the female is the older spouse.

These numbers are lower than the ratios we find in section V.B. A possible reason why the numbers in the initial tables are higher than the numbers above is that the ratio is less restrictive. More precisely, the ratio above only indicates the fraction of couples that retire jointly in the same month whereas my initial ratios allow also younger partners to stop working (i.e. their net labor force participation equals zero) while the older spouse still continues working. If these events occur, the numerator of the ratio becomes bigger while the denominator becomes smaller.

[37] This means that the dummy variable for net labor force participation of both spouses is equal to zero.

Chapter 2. Employment effects of Incentivized Gradual Retirement Plans

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Abstract

We investigate the effect of Incentivized Gradual Retirement plans (GRPs). GRPs encourage later retirement of older workers by offering a reduction in working hours with only a limited decrease in net earnings and pension accrual. A second policy aim is that municipalities use this freed up capacity to hire more young employees. We exploit variation in the availability of GRPs between Dutch municipalities to identify its employment effects. We find that GRPs increase labor supply for older civil servants by 6.9 full time weeks on a yearly basis. We do not find an increase in the hiring of young workers.

Keywords: Retirement behavior, financial incentives, administrative data, actual behavior

JEL codes: J14, J26, J38, J45

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I Introduction

Most western countries are confronted with an increasing life expectancy and a decreasing fertility rate. Because of these developments, most countries implemented numerous reforms to increase the labor force participation rate among older workers (OECD, 2011). However, the implementation of these reforms raised questions about whether older workers are able to work longer. Therefore, different countries proposed different solutions. For instance, Austria implemented an early retirement scheme for workers in heavy occupations. In the Netherlands, several sectors chose to implement an incentivized gradual retirement plan[4] (hereafter referred to as GRP, or the plural GRPs).

GRPs have been introduced in multiple sectors in the Netherlands such as construction, education, and various governmental organizations via collective labor agreements. The first goal of GRPs is to help older workers to reach the statutory retirement age healthily. This became especially important as the statutory retirement age has increased since 2013 and substitution pathways into early retirement have been reduced during the last two decades (de Vos, et al., 2018). From an employer's perspective, there are also reasons to introduce a GRP. For instance, an employer benefits from healthy and motivated employees (Veth & Van Vuuren, 2020). A GRP tries to achieve these goals by giving older employees a strong reduction in working hours, a small reduction in salary, and little to no reduction in pension accrual. For example, the most often offered GRP plan in our data gives older workers the possibility to work 60% of their initial working hours while getting 80% paid and no discount on pension accrual. In other words, a GRP aims at creating an attractive package for older workers to reduce their working hours and increase their retirement age.

Goldin and Katz (2007) find that the labor force participation of older workers is partially determined by their skill compositions whereas Van Soest and Vonkova (2014) find that financial incentives play an important role. Euwals, Van Vuuren & Wolthoff (2010) find that individuals are more sensitive to the price of leisure than to changes in individual's pension wealth, indicating that the price of leisure is more important in the retirement decision. The introduction of GRPs reduce these opportunity costs. Lastly, the health of individuals (Weir, 2007) and social norms regarding labor force participation (Euwals, Knoef, & Van Vuuren, 2011) play as well an important role in labor force participation at higher ages.

The second goal of GRPs focus on the reduction of youth unemployment. As older workers reduce their labor supply, this could potentially create vacancies for younger workers and reduce youth

[4] The Dutch name for those plans is "Generatiepact".

unemployment in particular regions of the Netherlands. Therefore, the GRP is meant to be an effective tool to create a good mix between young and old workers.[5]

Regarding the second goal, previous studies analyzed the lump of labor fallacy, which concerns the substitutability of younger and older workers. They found that in the long-run these two groups are not substitutes when observing macro-economic data (Gruber & Wise, 2010). This means that youth and elderly unemployment tend to move in the same direction rather than the opposite, hinting at skill complementarity between those two groups (Kalwij, et al., 2010).

In the short run, however, younger and older workers could be substitutable. Vestad (2013) analyzes how an early retirement program for older Norwegian workers affects youth labor force participation. He finds that substitution between younger and older workers is almost one-to-one. In a similar vein, Boeri, et al. (2016) find that employers with a high number of senior workers were less likely to hire younger workers because of an increase in the retirement age.

We test whether GRPs in the Netherlands affected the labor supply of older workers and increased the number of younger workers working at municipalities. We do so by making use of monthly Dutch administrative data for the period 2013-2018. We focus on municipalities with more than 100,000 citizens. As of January 2014, nineteen municipalities (out of 32 with more than 100,000 citizens) adopted a GRP. Our rich administrative dataset provides us with monthly data on income and monthly hours worked on the individual level, as well as a large number of socio-economic characteristics including birth year[6] and gender. This makes it possible for us to exactly pinpoint the effects of the GRPs.

Using the municipalities that did not adopt a GRP as the control group, we make use of a difference-in-differences framework to establish the causal effects of GRPs.[7] To make sure that the municipalities that did not adopt a GRP are a valid control group, we check for any significant differences between treatment and control group regarding financial solvency, voting outcomes, and youth unemployment.[8] Since no significant differences occur, we are confident that the adoption of

[5] For local government institutions (that is municipalities), there are two other minor reasons to implement a GRP. First, municipalities should integrate workers with a distance from the labor market. Second, the GRP can provide additional opportunities for the disadvantaged group(s) (de Pijper, et al., 2019).
[6] We select older workers, who were born after 1950. Individuals born before 1950 were eligible for an attractive early retirement arrangement for older civil servants.
[7] Because the four largest municipalities in the Netherlands are atypical municipalities in terms of size, we exclude them from the main analysis. The regression results, however, do not differ much when we include them. These results are presented in Appendix IV.
[8] It is important to test for financial solvency, youth unemployment, and voting preferences as these may affect the adoption of GRPs in different ways. First, as GRPs could be financially costly, it could be the case that municipalities that are financially more solvent are more likely to adopt a GRP. Regarding youth unemployment it could be the case that muncipalites with a high unemployment level are more likely to adopt a GRP to create

GRPs between treatment and control group can be considered as good as random allocation. This also gives us confidence that we have a valid control group. This is also confirmed when analyzing the common trend assumption for older civil servants.

Our contribution to the literature is threefold. First, we contribute to the retirement literature on revealed preferences. As gradual retirement plans are often offered via informal agreements, only very few papers have been able to study revealed preferences (Elsayed, et al., 2018). In our research design, however, it is perfectly clear how the gradual retirement plan looks like and who is eligible. This makes it possible to examine revealed preferences regarding retirement behavior. This as well helps us to identify the effect of gradual retirement plans on labor supply at higher ages (Gielen (2009), Albanese, et al., (2020), Börsch-Supan, et al., (2018)). With these results, we add to the broader discussion on the employment of older employees (Bolhaar, et al., 2017).

Second, we add to the literature regarding the substitutability between younger and older workers. Gruber and Wise (2010) and Bertoni & Brunello (2017) focus respectively on several countries and a region to analyze short-term substitution effects. We focus on a particular sector instead, yielding results at the firm level. Moreover, we address whether the job prospects of young civil servants are positively or negatively affected by the introduction of a GRP. In particular, when older civil servants enroll in a GRP it may provide younger workers the opportunity to climb the career ladder and obtain a higher wage (Mohnen, 2019).

Third, we add to the already small existing literature on GRPs. Van Dalen and Henkens (2019) argue that especially older wealthy individuals would be interested in participating in a GRP. Veth and Van Vuuren (2020) conduct interviews with older workers that participate in a GRP (both government and non-government employers). They found that gradual retirement plans could reduce the burden of work, resulting in a decrease of work-related stress and the motivation of employees, which is in line with Kantarci and Van Soest (2008). Our paper is, to our knowledge, the first paper that quantifies the effect of a GRP on a larger scale by looking at the employment of older workers and the hiring of young employees within the local government sector.

Analyzing the labor supply of older civil servants, we find that the treatment group increases their labor supply by on average 2.8 hours a month, which is almost equal to a full-time workweek per year.[9] There is however large heterogeneity for different ages. Moreover, we find that this increase

jobs. Suppose left wing parties are more in favor of GRPs than right wing parties. If municipalities in the treatment group are more likely to vote for left wing than right wing parties, this may drive the adoption of GRPs. In appendix I we show that there are no significant differences between treated and control group in these fields.

[9] A full time workweek for civil servants in the Netherlands equals 36 hours per week.

in labor supply is particularly present in the middle- and high- wage income groups. In other words, the GRPs in the low wage income group, which is most likely the group that needed the most help to reach the pension eligibility age healthily, is the group that does not face a significant increase in hours worked after GRPs are implemented.

Examining the second goal of a GRP, we use again a difference-in-differences framework to estimate whether municipalities with a GRP hire more young workers when compared to municipalities without this program. Since older workers remain longer employed, it is questionable whether municipalities still need to hire young workers to fill up vacancies. We indeed find that the number of younger workers does not significantly increase due to the introduction of GRPs. In addition, we barely find an effect on wage growth for young civil servants.

The setup of the rest of this paper is as follows. Section II provides a literature review. Section III describes the institutional setting. Section IV discusses the descriptive statistics and section V describes the estimation method and the results. Lastly, section VI discusses and concludes.

II Literature Review

The aim of a GRP is twofold. The first aim of a GRP is to make sure that older workers can reach the pension eligibility age healthily and, hence, to prevent older workers from dropping out of the labor force. The second aim of a GRP is to increase the employment rate of younger workers. To start with the already existing literature on the former, most OECD countries see an increase in the labor force participation of older workers. The Netherlands is no exception to this (Verkooijen, 2017). The first subsection provides an overview of the policies that may already have contributed to the increased labor force participation of older workers. In general, three types of policy measures affect the employment levels of older workers: supply-side policies, demand-side policies, and policies that influence institutional factors. For the latter factor, we limit ourselves to the Netherlands in this review. In the second subsection we discuss the substitutability between young and old workers.

II.A. Employment of older workers

To start with, the skill composition of workers is an important component for explaining the supply-side factor. Especially education plays an important role (Goldin & Katz, 2007). Their paper argues that an increase in education level increased labor force participation as the opportunity cost of not working is higher. Second, on the job training seems to have a positive effect on employment prospects for older workers in the Netherlands (Picchio & Van Ours, 2013). In particular, if workers know that they need to work longer, they have an incentive to maintain their skill level and therefore take up additional training (Montizaan, et al., 2010). In a similar vein, the increase in health at older

ages and the fact that higher educated jobs are less physically demanding makes it possible for workers to work at higher ages. Although health does on average decline with age, Weir (2007) shows that a large part of workers in their 60s and 70s are still physically capable of working.[10]

In addition, financial incentives play an important role for older workers to leave the labor force. For instance, it seems that during recession older workers are more likely to leave the labor force and retire. These effects are particularly strong for the lower educated workers who depend heavily on their first pillar pension benefits and therefore have lower opportunity costs to retire (Coile & Levine, 2011). On the other hand, lower income workers are more liquidity constraint. Therefore, they are more likely to work until higher ages (Bolhaar, et al., 2017). The question how flexible labor supply at higher ages affect retirement decision and total labor supply is still an open question (Gielen, (2009); Börsch-Supan, et al., (2018) Machado & Portela, (2014); Hernæs, et al., (2020)). A paper by van Soest & Vonkova (2014) use stated preferences to investigate whether older workers like to retire earlier with actuarially fair adjusted replacement rates. They find that retirement behavior is very sensitive to financial incentives. If the rewards for retiring later and the penalties for retiring earlier were reduced by 50%, this would result in a fall of the average retirement age by about 10 months. Analyzing the labor supply of older workers using vignettes, Elsayed et al. (2018) find that the full-time retirement age is on average one year later. However, the total labor supply decreases over the period by 3.4 months. This indicates that gradual retirement plans do not contribute to an increase in the aggregate labor supply of workers close to retirement. Analyzing revealed preferences, Euwals, et al. (2010) exploit the variation in the starting dates of the transitional arrangements from actuarially unfair schemes to more actuarially fair schemes for older workers. They find that the individuals are more sensitive to the price of leisure (substitution effect) than to changes in an individual's pension wealth (wealth effect). This indicates that foregone wages are a more important opportunity cost than foregone pension accumulation. In a similar vein, Albanese et al. (2020) study the effect of a gradual retirement scheme in Belgium. They find that gradual retirement increases labor force participation at younger ages (below 60), but it decreases thereafter. This could be explained by employers who view enrollment into gradual retirement as a preference for early retirement.

Lastly, the increase in the labor supply of older workers could also be explained by social norms (Euwals, et al., 2011). More precisely, the role of social norms and attitudes towards paid

[10]Damman & van Solinge (2017) use Dutch data to show that paid work is substitutable for unpaid (voluntary) work, indicating that older workers are not necessarily longer active in the labor force.

employment at higher ages could affect the retirement decision. In a similar vein, reference points regarding retirement could also play a role. For instance, Behaghel and Blau (2012) find that the intitial retirement age in the US still plays a role in the retirement decision.

Having discussed the supply side, there are as well several demand-side factors that could explain an increase in the labor force participation of older workers. As the education gap between younger and older cohorts decreases, younger and older workers become closer substitutes. An analysis of US data shows that the oldest generation had on average 2.6 years less education when compared to the youngest generation in 1990. In 2030, it is projected to be only 0.5 years. The increase in substitutability is particularly the case in jobs where experience plays a dominant role, making it more attractive for employees to hire older workers (Goldin & Katz, 2007). On the other hand, age discrimination makes it more difficult for older workers to remain employed (Lahey (2008); Schippers & Vlasblom (2019)).

Lastly, several institutional changes increased the labor force participation of older workers. Limiting ourselves to changes in the Netherlands, the increase of the statutory retirement age as of 2013 and the abolition of publicly funded partner pension in 2015 provided a financial incentive for workers to work longer (Atav, et al., (2019); Doove, et al., (2019)). Focusing on GRPs, one study shows that older workers with a high level of equity are particularly interested in a GRP (van Dalen & Henkens, 2019). Another interview-based study concluded that both employers and older employees are satisfied with the introduction of a GRP (Veth & van Vuuren, 2020). In particular, they find that the motivation and energy level of older workers increase when they participate in a GRP-arrangement, contributing to a positive effect on overall well-being. Kantarci and Van Soest (2008) find similar results for gradual retirement plans in general.

II.B. Substitution between younger and older workers

Having discussed the literature on the employment levels of older workers, we now describe the existing literature on the substitutability between younger and older workers. Starting at long-run macroeconomic effects, Kapteyn, et al. (2010) examine the VUT arrangement in the Netherlands. This program was originally implemented in 1975. This arrangement aimed at reducing youth unemployment by letting older workers retire earlier. By analyzing time series data, they conclude that this program did not succeed in its goal. Instead, they found that there is a positive relationship between youth employment and the employment of older workers, indicating that younger and older workers compete in different segments of the labor market. These findings are in line with various other OECD countries (Gruber & Wise, (2010); Kapteyn, et al., (2010)).

However, these estimates are based on long-run macro-data. Several studies find that substitution is still possible in the short-run. Vestad (2013) analyzes how a national early retirement program in Norway affected youth employment. He found that there is a one-to-one substitution between an older worker that retires early and every young new labor entrant. When focusing on micro-level data, Boeri, et al. (2016) analyze how an increase in the statutory retirement age in Italy affected youth employment. By making use of a database from the Italian social security administration, they can identify which private firms have a large share of workers that are exposed to this increase. They find that firms with a high number of senior workers significantly reduce youth hirings. More precisely, they find that out of 150 thousand youth jobs lost during the Great Recession, 36 thousand job losses can be attributed to the increase in the statutory retirement age. Bertoni & Brunello (2017) find similar results when analyzing the same reform while focusing on regional employment. However, Carta & Von Wachter (2021) find there does exist complementarity between the hiring of younger and older workers. In particular, they find that that an increase in the number of older workers by 10%, increases in the number of young workers by 1.8%.[11]

III Institutional Framework

Before focusing on the GRPs in municipalities, it is important to know that other sectors in the Netherlands offer as well GRPs. For instance, the education sector, the engineering sector, and the construction sector offer similar plans. Also, some other governmental bodies, such as the provinces[12], have implemented GRPs. This shows that GRPs are becoming a widely implemented program in the Netherlands. Therefore a large-scale economic analysis of its effects important.

However, the municipality sector differs in several ways of other sectors in the Netherlands. For instance, the percentage of female workers tend to be slightly higher (2%-points) for civil servants when compared to the overall labor force.[13] Next to this, civil servants work more often full-time compared to the labor force (A+O fonds Gemeenten, 2018). In addition, the share of civil servants that are highly educated is also high when compared to other sectors.[14] Besides, civil servants tend to be older than workers in other sectors. In particular, the group of workers above the age of 55 is

[11] The differences in the studies can most likely be explained by the use of different datasets. In particular, Boeri, Garibaldi, and Moen (2016) have data for the years 2008, 2011, and 2014 whereas Carta & Von Wachter (2021) have data for the period 2010-2014 for every year.
[12] The Dutch name for this governmental body is the “Provinciale Staten”.
[13] In 2013, the percentage of female civil servants was 48% where in the overall labor force this percentage was equal to 46. In 2017, the percentage of female civil servants was 50% compared to 47% in the total labor force.
[14] More precisely, in 2014, 55.5% of all civil servants have obtained a form of higher education (Walstra, 2017).

almost twice as large in the municipality sector compared to the overall labor force (A+O fonds Gemeenten, 2014). Lastly, the sickness leave is as well higher when compared to other national organizations (A+O fonds Gemeenten, 2018).

In this section we first analyze why both demand and supply of labor are in favor of GRPs. Thereafter we discuss how GRPs were implemented in municipalities.[15] Lastly, we mention other potential municipality programs that may affect the take-up rate of GRPs.

III.A Reasons for implementing a GRP

Both employers (labor demand) and employees (labor supply) could benefit from GRPs. In this paragraph, we discuss why each of these groups could be in favor of a GRP. Analyzing the employer's side, it is important to distinguish the two roles for local government bodies, namely the municipality as an employer and the municipality as a government institution. Both of these roles can play a role in implementing GRPs. From a government perspective, one of the main reasons is to be able to reduce youth unemployment. This is in line with the local government's task regarding labor market integration. This states that it is the task of municipalities to help workers find a job if they are unlikely to succeed in this task by themselves[16] (de Pijper, et al., 2019). Another reason for offering GRPs is to help disadvantaged young individuals with a migration background.

The municipality as an employer may as well have several reasons for implementing a GRP. First, a GRP could reduce personnel cost for older employees. Although their hourly wage will increase, their total wage will go down. Second, it may contribute to a better mix of younger and older civil servants. Across all Dutch municipalities, one out of every six employees is older than 60 in 2018. Besides, the average age of civil servants is two years higher when compared than the average age of the labor force (48.1 vs 46.3). Lastly, the amount of young civil servants below the age of 35 is on average 24 percentage points lower when compared to the average of the labor force (Bekkers, 2019). The implementation of a GRP could therefore be used to create a better mix of young and old workers. Ilmakunnas & Ilmakunnas (2011) show that a good mix of old and young workers increase output.

Another reason to implement a GRP is to keep older workers healthy and productive. This may also explain the large interest in GRPs. For instance, Van Dalen and Henkens (2019) found that 60% of workers between the ages 40-60 would be potentially interested in participating in a GRP. A reduction in working hours may for example reduce stress levels for older employees and/or increase

[15] The reason we limit our scope to municipalities is that for this group we can exactly determine at which municipality people work. We do not have data for private sector firms at the local level.
[16] In case the municipality thinks it is highly unlikely this person finds a paid job, then the focus will shift towards any form of participation within the society.

a better work-life balance. Several older civil servants that participated in the GRP already indicated that they feel more energized when compared to the time they worked full-time (Veth & Van Vuuren, 2020). Besides, letting older workers work part-time until their pension eligibility age may have positive side effects. It could for instance lead to less days of sick leave and, hence, decrease labor costs. Second, it may lead to more motivated workers due to a better work-life balance. This could result in more satisfied employees and an increase in labor productivity (A&O fonds Gemeenten, 2020).

From the employee's side, Labor unions are in favor of GRPs for two reasons. First, it spares older workers and gives them more time to recover from their work. It is as well possible to see this as a claim for higher wages for the effective time worked. Second, the Dutch labor unions support this plan as they see it as a way to increase the employment chances of younger workers (although this argument is disputable when examining the literature (see section II.B)). They argue that if, for instance, two older workers decrease their labor supply by 40% in a full-time contract, a young worker can receive a contract of 0.8 FTE. Apart from reducing youth unemployment, they as well claim that the quality of the jobs for younger workers may improve (FNV, sd).

III.B The Incentivized Gradual Retirement Plans

As of 2014, municipalities started adopting a GRP. It is important to know that municipalities can decide on their own whether they adopt a GRP or not. More precisely, the option of offering a GRP can be part of a collective labor agreement when this is the outcome of the negotiations between the social partners. However, this does not mean that every municipality is obliged to offer a GRP once it is part of the collective labor agreement. Investigating the aims of GRPs, the goal of this plan is twofold. First, it should prevent older civil servants working at municipalities to drop out before reaching the statutory retirement age. Second, as older employees start to reduce their labor supply, local municipalities need to hire new workers. Municipalities aim to fill these vacancies with young employees, thereby reducing local youth unemployment.

Focusing on the first goal, due to the increase of the Dutch statutory retirement age to 66 in 2018, it is unknown how many workers can work full-time at higher ages. Therefore, Dutch municipalities offer their older employees different forms of GRPs that allows them to work less with a small reduction in salary and no (or little) reduction in pension accrual. These programs are, for instance, abbreviated in the form of 60-80-100. This means that a civil servant works 60 percent of his initial working hours against 80 percent of his original salary while maintaining a 100 percent pension

accrual when participating in a GRP.[17] Other arrangements such as 50-75-100 or 80-88-88 have a similar meaning. Once a civil servant participates in a GRP, the decision cannot be reversed. More precisely, provided that the civil servant does not switch to another sector, he or she will be paid according to what is agreed upon in that particular GRP up to reaching the statutory retirement age. Moreover, in the case of disability, only the employee can decide to end the participation in a GRP. Lastly, the employer may decide in some cases that a particular person is not allowed to enroll in a GRP. This could be the case when a certain department already has a large number of civil servants enrolled in a GRP and the head of that department fears that a further reduction of experienced workers may negatively affect the department's productivity.

It is important to note that each municipality decides on its own 1) whether it offers a GRP for its older employees and 2) in what form, which creates heterogeneity between GRPs across municipalities. Niemeijer (2017) shows that smaller municipalities are often not willing to introduce a GRP. This is because smaller municipalities are not able to free-up sufficient capacity to hire younger employees. However, also when looking at larger municipalities with more than 100,000 citizens, there is considerable variation between municipalities that introduce a GRP and those that do not. Table 1 below provides an overview of which municipalities did and did not introduce a GRP over the period 2012-2018.[18] The treatment group consists of all municipalities that adopted a GRP in the period 2012-2018 and have more than 100,000 citizens. The control group consists of municipalities that did not adopt a GRP in the period 2013-2018 and have more than 100,000 citizens. The four biggest municipalities, Amsterdam, Rotterdam, the Hague, and Utrecht (hereafter referred to as G4) have a large proportion of civil servants above the age of 60.[19] Therefore, we provide the graphs and the estimation results in the next section excluding the civil servants of these G4 municipalities. However, in Appendix IV we show the graphs and estimation results including the biggest four municipalities as a robustness check.[20]

Treatment Group (municipalities with GRP)	Control group (municipalities without GRP)
Den Haag	Amsterdam
Utrecht	Rotterdam
Eindhoven	Almere

[17] Note that the Netherlands has a progressive income tax, meaning that the net differences before participating in the municipalities GRP and thereafter is smaller than a decrease in salary of 20 percent.
[18] The cutoff is determined by data availability (see section IV).
[19] in total, they make up for 43% of the total amount of civil servants in this group.
[20] The estimation results do not change much in terms of sign, significance, and magnitude.

Groningen	Breda
Tilburg	Apeldoorn
Nijmegen	Zaanstad
Haarlem	Arnhem
Enschede	`s-Hertogenbosch
Amersfoort	Zoetermeer
Haarlemmermeer	Maastricht
Zwolle	Dordrecht
Leiden	Venlo
Leeuwarden	Ede
Alphen aan den Rijn	
Westland	
Alkmaar	
Emmen	
Delft	
Deventer	
Total: 19	Total: 13

Table 1 Overview of treatment and control group

Table 2 shows an overview of the type of GRP that each municipality in the treatment group offered. In particular, Table 2 shows that there are several dimensions in which GRPs differ across municipalities. To start with, the age at which a civil servant can enroll differs. Most municipalities allow civil servants to enter the program when they reach the age of 60. Deventer, Alkmaar, and Zwolle, however, allow people to enter earlier as of age 55, 57, and 58, respectively. There are as well some municipalities that only allow workers to enroll in the program after they reach the age of 60. More precisely, Westland, Eindhoven, and Amersfoort have an eligibility age of 61, 62, and 63, respectively.

Analyzing the contractual details, some municipalities require civil servants to have a minimum number of service years at that municipality, while others require them to have a permanent contract. Municipalities like Tilburg and Alphen aan den Rijn require both a minimum number of service years and a permanent contract. Focusing on the minimum hours that an employee needs to work after participating in a GRP, there is as well variation between municipalities. Most municipalities do not require a minimum number of hours that need to be worked after participating.

However, Deventer and Amersfoort require a minimum amount of working hours of at least 21.6 hours, the highest of all municipalities that adopted a GRP. When examining the options regarding payment, most municipalities offer a GRP in which there is no discount on pension accrual. However, some municipalities like Enschede, Zwolle, Emmen, and Deventer offer a discount on pension accrual once participating. In case the program has the word "different" as an option it means that there is the possibility to tailor a GRP for each civil servant that wants to participate. Lastly, the starting dates of a GRP across all municipalities are somewhere between January 2014 and July 2018.

III.C Other programs & limitations

Having discussed the GRPs and its details for multiple municipalities, it is also important to discuss other programs that may affect the willingness of civil servants to participate in a GRP. For instance, civil servants born before 1950 could make use of the FPU-arrangement. This arrangement made it attractive for workers to retire earlier than the statutory retirement age. Other programs that make it less likely for participants to participate in a GRP are the "55-years arrangement" and the "60-years arrangement"[21]. The content of these arrangements differs per municipality and are therefore often informal arrangements between the municipality and their employees (that is, they are not the same for all municipalities in the Netherlands). For instance, in the municipality of Alkmaar, it is possible to work fewer hours a week (up to 2.5 hours) without receiving any discount in salary. In Amsterdam, however, it "only" states that a civil servant does no longer has to work night shifts and overtime after reaching a particular age. It is important to note that these arrangements exist in municipalities regardless of whether they adopted a GRP or not, indicating that these arrangements are not a substitute for GRPs.

Moreover, several financial incentives for older civil servants changed over the period 2013-2018. Considering the labor supply side, the work bonus[22] was abolished for workers born after 1953. The work bonus consisted of an income-dependent tax credit for older workers, which made it more attractive to continue working (Ambtenarensalaris.nl, 2020). This both affected civil servants in the treatment and control group. Considering the labor demand side, the premium discount for younger and older workers was replaced by a wage cost-benefit[23] scheme as of January 2018. The latter is as well a premium discount for workers with a distance from the labor market, but the new discounts are less generous when compared to the previous premium discounts (Rijksoverheid, sd). This

[21] The implementation of these programs does not coincide with the adoption of a GRP.
[22] In Dutch: werk bonus.
[23] In Dutch: Loonkostenvoordelen (LKV).

reduction affects both the treatment and control group. However, we are unfortunately not able to determine whether one group is affected more or less by this measure.

Lastly, when analyzing the effect of GRPs on hiring younger workers, municipalities could receive a subsidy via the A&O fund[24] (when hiring young employees). This concerns the period 2015-2018. Research by the Ministry of Internal Affairs shows that municipalities seemed unresponsive to incentive changes to remain eligible for the subsidy.[25] Therefore, they concluded that this subsidy seems not to have a large impact on the hiring decisions by municipalities (Ministry of Internal Affairs, 2019). Just like with the previous measure we cannot rule out that either the control or treatment group made more use of the subsidy than the other group. However, it is not the case that either of these financial arrangements was particularly targeted at either the treatment or the control group. In other words, we do know that all the above-mentioned financial incentives affect both the treatment and control group.

[24] In Dutch: A&O fonds gemeenten.
[25] In 2018, municipalities had to offer young employees a two-year contract instead of one. However, rarely did municipalities deviate from the standard one-year contract they regularly offered.

Municipality	Minimal age	Minimal service years	Option(s)	Start-date (dd-mm-yyyy)	Permanent contract	Minimum hours after GRP
Den Haag	60	2	60-80-100	01-10-2015	YES	-
Utrecht	60	-	60-75-100	01-03-2016	YES	-
Eindhoven	62	-	60-75-100 60-80-100	01-04-2017	NO	-
Groningen	60	1	Different[a]	01-01-2014	NO	-
Tilburg	60	5	80-90-100	01-07-2018	YES	14.4
Nijmegen	60	-	50-75-100 60-80-100 80-90-100	01-09-2017	YES	-
Haarlem	62 (60)	-	60-80-100 (80-90-100)[b]	01-04-2017 (01-04-2018)	NO	18
Enschede	60	-	80-80-90 60-70-85	01-02-2016	NO	16
Amersfoort	63	-	60-70-100	01-10-2017	YES	21.6
Haarlemmermeer	60	-	60-80-100	01-07-2018	NO	-
Zwolle	60 (58)[1]	-	80-90-90 (80-95-95)	01-07-2017 (01-10-2017)	YES	18
Leiden	60	5	Different[c]	01-05-2016	NO	-
Leeuwarden	60	3	80-90-100	01-05-2016	NO	18
Alphen aan den Rijn	60	2	70-85-100	01-04-2017	YES	18
Westland	61[2]	-	60-80-100 80-90-100	01-01-2017	NO	-
Alkmaar	57[3]	5	50-75-100 65-80-100 80-85-100	04-01-2018	NO	-
Emmen	60	1	80-90-90	01-03-2015	NO	18
Delft	60[4]	0	60-80-100 80-90-100 50-70-100	01-01-2017	NO	-
Deventer	55	1	80-88-88 60-76-76	01-10-2015	YES	21.6

Table 2: Overview of GRP across municipalities. 1: The municipality of Zwolle changed their GRP in October 2017, 3 months after the initial implementation. Another option became available (80-95-95) as well as a decrease in the eligibility age. 2: 5 years prior to pension eligibility age, 3: 10 years prior to pension

eligibility age, 4: 7 years prior to pension eligibility age. a: their GRP was here part of a social arrangement, b: that option became one year later available, c: An employee can ask for a reduction of working hours up to 40%.

Sources: Gemeente Alkmaar (2018), Alphen aan den Rijn (2017), Gemeente Amersfoort (2017), Gemeente Delft (2016), Gemeente Den Haag (2015), A+O fonds Gemeenten (2015), Gemeente Eindhoven (2017), Gemeente Emmen, A+O fonds Gemeenten (2016), Gemeente Groningen (2013), Gemeente Haarlem (2017), Gemeente Haarlem (2018), Gemeente Haarlemmermeer (2019), Gemeente Leeuwarden (2016), Gemeente Leiden (2018), Gemeente Nijmegen (2017), Gemeente Tilburg (2018), Gemeente Utrecht (2015), Gemeente Westland (2016), and Gemeente Zwolle (2015), and Gemeente Zwolle (sd).

IV Descriptive statistics

Having discussed the institutional framework, this section describes the data we use. We focus on municipalities with more than 100,000 citizens as these are also big municipalities in terms of civil servants. We focus on big municipalities as smaller municipalities may be less likely to introduce a GRP (Niemeijer, 2017). We will implement in section V a difference-in-differences strategy to analyze the effect of GRPs. Therefore, we will order the data in this section into a treatment and control group. The treatment group consist of those municipalities that obtain a GRP in the period 2012-2018. The control group consist of municipalities that do not introduce a GRP (see Table 1 for an overview of treated and non-treated municipalities) in this period.

In Appendix I, we discuss whether endogenous adoption could have played a role in the adoption of GRPs by comparing the youth unemployment rates (25-45), the difference in political orientation between the treatment and control group before the GRPs were implemented, and the financial position of municipalities. Regarding the voting behavior we only observe small differences, but none are significant at the 5% level when focusing on the p-value. The same holds as well for the financial position when comparing solvency ratios between the treatment and control group. Therefore, we conclude that this does not seem to be the case.

In this section, we provide an additional check whether the common trend assumption holds. We verify the common trend assumption between treatment and control group for the labor supply of older civil servants (both intensive and extensive margin). We do the same for young civil servants by analyzing the percentage of young civil servants employed in the treatment and control group. We show this common trend in the subsection Graphical evidence. All of the tests above make us believe that we have a good control group that allows us to use a difference-in-differences framework to determine the employment effects of GRPs.

We use administrative microdata from Statistics Netherlands to analyze the effects of GRPs. Using these data[26], we construct the number of old and young civil servants that work at a particular municipality in a particular month over the period 2012-2018.[27]

We select civil servants who have worked for the same municipality since 2010. All civil servants remain are part of the sample until they reach the pension eligibility age. Older workers are 60 years

[26] We will make use of the following files: gbahuishoudensbus, spolisbus, gbapersoontab, gemeentestpltab. The latter file is used to pinpoint in which municipality a civil servant works. More precisely, when using the "rinpersoons", "rinpersoon", and "ikvid" number from spolisbus after determining that individuals have the "scaosector" of a municipality, we can match the likewise named variables with the variables in gemeentestpltab.

[27] See section III Other programs & limitations.

or older and should be born after 1949. By selecting older civil servants in this way, we make sure that the FPU-early retirement arrangement does not play a role in determining the effect of a GRP. Moreover, we drop civil servants that are employed by more than one employer in the period 2012-2018.[28] Besides, we omit observations for civil servants that are employed after the statutory retirement age.[29] We define younger workers when they are older than 18 and younger than 30. For younger workers, we do not impose any restrictions. More precisely, this means that younger workers are allowed to have multiple employers. The reason we do this is that the introduction of a GRP does not necessarily mean that younger workers get a full-time contract at a municipality.[30]

In our dataset, we have several socioeconomic variables on each civil servant as well as work-related variables. Regarding the socioeconomic variables, we observe the civil servants' gender, birthdate, age, the presence of children in the household, and their marital status. Regarding the economic variables, we observe the monthly salary, the monthly hours worked, the number of full-time days per month as well as the number of days a civil servant was employed in a particular month. These last two variables allow us to create a part-time factor for each civil servant in a particular month. This part-time factor is defined as hours worked divided by full-time hours. The part-time factor allows us to measure how the labor supply of civil servants increases (or decreases) at the intensive margin. Therefore, we expect the part-time factor for older workers to decrease at municipalities after a GRP is introduced. Tables 2-5 below provide summary statistics of older and younger workers based on the adoption of a GRP. In other words, we divide our statistics into a treatment and control group. We omit the G4 municipalities from our main analysis as they are a large proportion of the total amount of civil servants and therefore may affect the common trend disproportionally. In Appendix II, we provide graphs including the largest four municipalities as a robustness check. The results do not differ much once we include the G4 municipalities.

[28] The reason for this is twofold. First, we do this to drop older civil servants that select into GRPs to increase their labor supply in another sector. In particular, if older workers use the municipalities' GRP to increase their labor supply in another sector, then a GRP does not help workers to remain employable at a higher age. As we want to test the latter, it does not make much sense to have workers in our sample that use the municipalities' GRP for other reasons. Second, it is impossible to determine the effect of the introduction of GRP for civil servants that are employed by multiple or switch between municipalities. In particular, consider a civil servant to increase his or her labor supply in a municipality without a GRP and decreases their labor supply in a municipality with a GRP. This pattern can arise because 1) one municipality has an increase in demand and the other one a decrease or 2) the civil servant participated in the municipalities' GRP and, as a result of this, decrease in his or her labor supply in one municipality and increases his or her labor supply in the other one. For all municipalities in the Netherlands, this means that we drop 40% of all our observations over the period 2010-2018.

[29] The main aim of GRPs are to let older civil servants reach the pension eligibility age. If civil servants decide to continue working after the pension eligibility age, this can be due to other institutional factors as well such as the Continuing to Work Act (in Dutch: "Wet langer doorwerken na AOW").

[30] This is approximately 5% of our sample.

Tables 3 and 4 provide summary statistics for older civil servants at municipalities (with more than 100,000 citizens) that did and did not adopt a GRP in the period 2012-2018. Observing the monthly income of civil servants at municipalities that did and did not adopt a GRP, we see that the income of civil servants working in a municipality without GRP increases over time. In 2012, the difference between those groups was €426, - and in 2018 this has decreased to €323, -. This decreasing wage gap is associated with a smaller decrease in the part-time factor as well as working hours for municipalities that introduced a GRP. For municipalities without a GRP, this decrease is larger.

	Municipalities without GRP – older workers (60+) Excl. G4						
Variable/year	2012	2013	2014	2015	2016	2017	2018
Labor income	3206	2625	2467	2279	2289	2338	2258
Working Hours (month) (Part-time factor)	121.1 (0.78)	100.7 (0.64)	92.8 (0.59)	83.4 (0.53)	81.6 (0.52)	79.4 (0.50)	78.0 (0.49)
% male	67.5	66.4	65.7	64.3	63.2	62.3	60.4
% 1st immigrant	6.6	6.2	5.7	5.8	5.7	5.8	5.8
% 2nd immigrant	6.1	6.3	6.3	6.5	6.7	6.5	6.4
%married/ cohabiting	79.5	78.7	78.8	78.4	77.7	77.2	76.5
% with child	19.9	17.6	17.2	16.8	16.2	16.7	17.5
Mean age	61.2	61.7	62.2	62.5	62.7	62.9	63.0
Number of observations	18,237	27,039	36,134	42,821	46,500	50,061	53,069
Number of municipalities	11	11	11	11	11	11	11
Civil servants	5,982						

Table 3: Summary statistics for older workers working at municipalities that did not adopt a GRP.

	Municipalities with GRP – older workers (60+) Excl. G4						
Variable/year	2012	2013	2014	2015	2016	2017	2018
Labor income	2780	2267	2142	2012	2029	2056	1935
Working Hours (month) (Part-time factor)	101.1 (0.65)	87.3 (0.56)	80.4 (0.51)	73.4 (0.47)	71.6 (0.46)	68.9 (0.44)	66.3 (0.42)
% male	63.7	63.7	63.0	62.5	60.6	59.3	57.9
% 1st immigrant	5.4	5.3	5.2	5.1	5.0	5.0	4.9
% 2nd immigrant	4.9	5.2	5.1	5.4	5.5	5.5	5.7
%married/ cohabiting	79.3	79.0	78.7	78.4	78.0	78.1	77.3
% with child	18.5	16.8	16.6	16.3	16.1	16.2	16.9
Mean age	61.2	61.7	62.2	62.5	62.7	62.8	63.0
Number of observations	28,885	42,585	57,740	70,318	78,305	84,491	90,612
Number of municipalities	17	17	17	17	17	17	17
Civil servants	8,407						

Table 4: Summary statistics for older workers working at municipalities that adopted a GRP.

Discussing the economic characteristics, we observe that labor income and the number of hours worked are higher in municipalities that do not introduce a GRP. This can most likely be explained by the difference in gender composition between the treatment- and control group. In general, older females tend to work more part-time when compared to males (CBS, 2022). This may explain the

observed gap in income as well as hours worked. Analyzing the other socioeconomic characteristics, we observe that the percentage of married / cohabiting civil servants is approximately the same. When considering immigrant status, municipalities without a GRP tend to have both a higher rate of first and second-generation immigrants. More precisely, municipalities with a GRP have 4.9-6.6% first or second-generation immigrants whereas municipalities without GRP have 5.7-6.7% of immigrants working as civil servants. Lastly, the mean age is the same in each year for both groups when rounded to one decimal. In total, we have 14,389 unique observations of which 5,982 are working for municipalities without a GRP, and 8,407 are employed for municipalities that introduce a GRP over the period 2014-2018.[31]

Tables 5 and 6 show the summary statistics for younger civil servants aging from 18-30. We show the summary statistics separately for workers that work for municipalities with and without a GRP, respectively. The differences between those two groups are again small. We observe that the mean monthly income, the part-time factor, and the mean of working hours per month are approximately equal. The percentage married / cohabiting and the percentage with child is approximately 2-6%points higher for municipalities without a GRP.

Lastly, the age difference between younger civil servants that work at municipalities with and without a GRP is almost negligible. In total, we have 6,184 young civil servants that work for municipalities without a GRP and 8,274 civil servants that work for municipalities that introduce a GRP over the period 2012-2018.

[31] We allow workers to work for another municipality for the period 2013-2018. This means as well for instance civil servants could be employed for a municipality that did not have a GRP in the period 2013-2015 and thereafter switch to a municipality with a GRP. However, we find the number of civil servants switching between those groups (and switching to both sides) to be very small (less than 25. The amount is 25 when we include G4 municipalities). Therefore, we do not believe that self-selection plays an important role.

	Municipalities without GRP – younger workers (18-30) Excl. G4						
Variable/year	2012	2013	2014	2015	2016	2017	2018
Income	2181	2092	1736	1989	2022	2126	2215
Working Hours (month) (Part-time factor)	132.6 (0.86)	134.4 (0.86)	133.2 (0.86)	137.4 (0.87)	138.6 (0.85)	153.9 (0.87)	135.3 (0.87)
% male	47.8	48.7	58.7	51.1	51.4	49.9	47.7
% permanent contract	74.1	73.0	73.3	61.5	61.8	60.4	61.6
% 1st immigrant	4.3	3.8	3.1	3.7	3.8	4.8	4.2
% 2nd immigrant	12.6	12.7	10.4	12.6	12.2	12.2	11.8
%married/ cohabiting	74.4	75.8	76.9	74.2	73.8	73.3	71.3
% with child	42.7	44.1	49.5	43.9	42.3	42.6	40.0
Mean age	26.3	26.6	26.3	26.5	26.4	26.4	26.5
Number of observations	18,391	14,900	16,624	13,370	14,446	15,295	16,976
Number of municipalities	11	11	11	11	11	11	11
Civil servants	6,184						

Table 5: Summary statistics for younger workers working at municipalities that did not adopt a GRP.

	Municipalities with GRP – younger workers (18-30) Excl. G4						
Variable/year	2012	2013	2014	2015	2016	2017	2018
Income	2439	2137	2054	1982	1984	2167	2309
Working Hours (month) (Part-time factor)	137.2 (0.88)	137.7 (0.89)	130.8 (0.84)	126.6 (0.82)	124.7 (0.80)	127.0 (0.82)	130.4 (0.84)
% male	47.0	47.4	48.0	47.3	47.6	45.5	44.6
% permanent contract	65.6	66.8	63.5	56.5	49.3	48.4	53.2
% 1st immigrant	4.0	3.2	3.3	3.2	3.0	3.3	3.2
% 2nd immigrant	11.7	11.3	11.3	11.6	11.4	12.2	13.1
%married/ cohabiting	72.3	73.1	72.6	71.7	70.6	68.0	67.6
% with child	37.6	37.6	37.4	38.9	39.0	37.9	34.6
Mean age	26.6	26.6	26.6	26.4	26.3	26.4	26.4
Number of observations	21,415	17,641	15,940	15,706	17,703	20,005	22,298
Number of municipalities	17	17	17	17	17	17	17
Civil servants	8,274						

Table 6: Summary statistics for younger workers working at municipalities that adopted a GRP.

IV.A Graphical evidence

Having discussed the differences between municipalities with and without a GRP, it is important to analyze whether there is a common trend between those two groups of municipalities as it is the key identifying assumption in a difference-in-differences framework. Figure 1 shows the monthly average hours worked of civil servants above 60 at municipalities with and without a GRP. We observe that in the years 2012 and 2013 there is a common trend between the (treated) municipalities with a GRP and the (non-treated) municipalities that did not adopt a GRP. After 2014, the monthly average hours worked starts to decline while the gap between the treatment and control group slightly decreases over time. In Appendix II, we plot the same graph but include the G4 municipalities. We observe that there is a spike around January 2015. Overall, however, the pattern does not change compared to the graph shown in Figure 1.

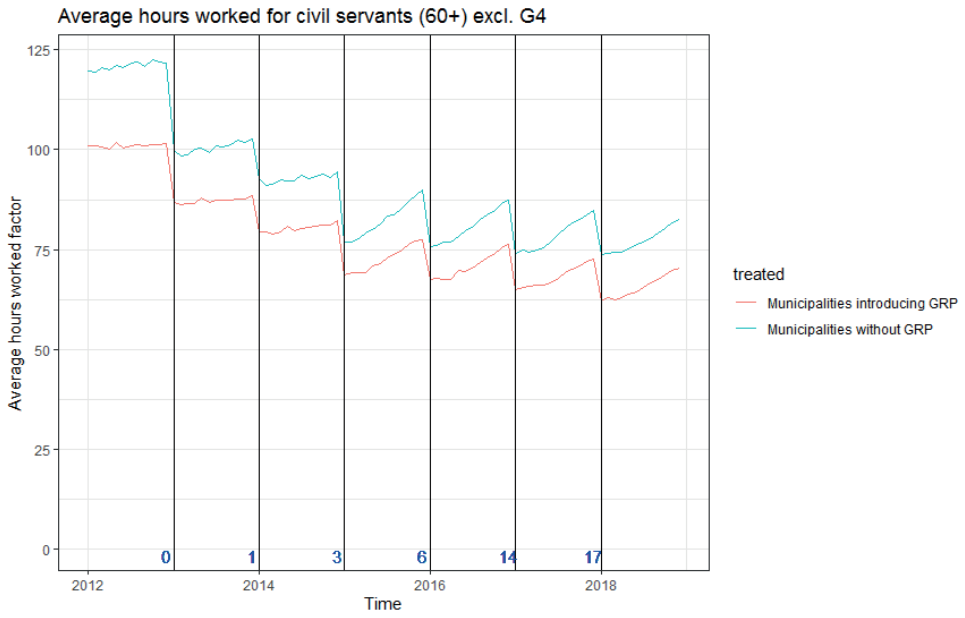

Figure 1: Average hours worked for civil servants (60+) for municipalities that did and did not adopt a GRP. The vertical lines accompanied by a blue number indicate how many municipalities adopted a GRP in that year or earlier (that means there was one municipality in 2014, there were 3 municipalities in 2015, etc.). In Appendix II, we show a similar graph including the G4 municipalities. As the G4 municipalities are relatively large, we decided to omit them from the main analysis.

Figure 2 shows the extensive margin for the (treated) municipalities with a GRP and the (non-treated) municipalities that did not adopt a GRP. More precisely, we create an intensive margin variable that is equal to unity in case a civil servant works at least one hour in a particular month. If the civil servant does not work, this variable is equal to zero. We observe that there is a large decline in the

intensive margin between the treatment and control group. More precisely, in 2012 there is a difference of approximately 0.2 between the treatment and control group. At the end 2018, this is gap decreased by approximately 0.1. This may indicate that under the GRP workers are better able to work longer.[32]

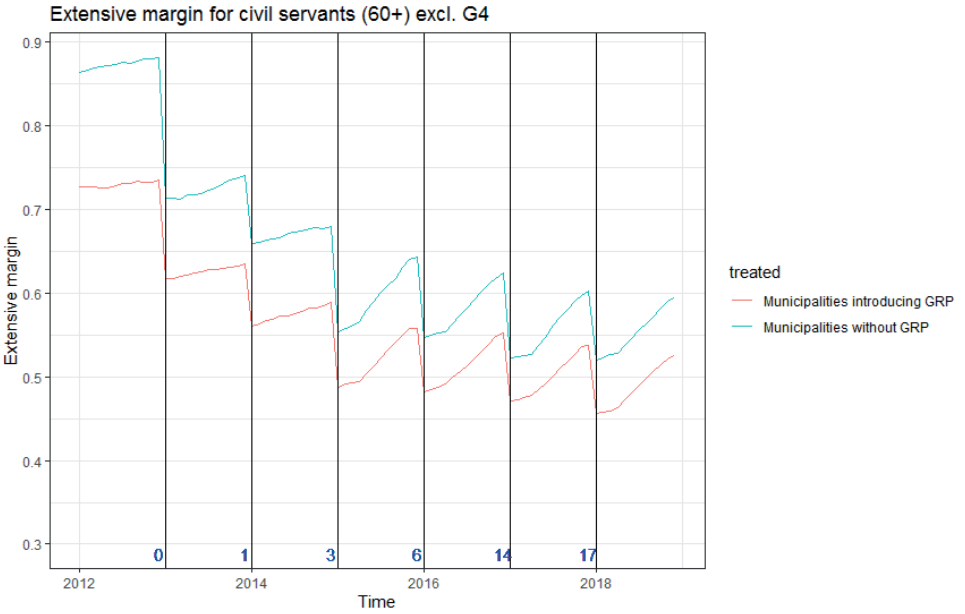

Figure 2: Extensive margin for older workers (60+) for municipalities with and without a GRP. The vertical lines accompanied by a blue number indicate how many municipalities adopted a GRP in that year or earlier (that means there was one municipality in 2014, there were 3 municipalities in 2015, etc.). In Appendix II we show a similar graph including the G4 municipalities. As the G4 municipalities are relatively large, we decided to omit them from the main analysis.

Figure 3 shows the monthly percentage of young civil servants employed at municipalities with and without a GRP. More precisely, we divide the number of young civil servants (18-30) by the total amount[33] of active civil servants for the treatment and control group separately. After multiplying this number by 100, we get the percentage of young civil servants working at municipalities for each month. In the years 2012-2013, we again observe a common trend between municipalities that adopted and did not adopt a GRP. We as well observe that for both the treatment and control group the percentage of young civil servants increase over time. Lastly, we observe an increase in the number of young civil servants in the last quarter of each year followed by a drop in the number of civil servants in January. This is probably due to the inflow and outflow of traineeships. The sharp

[32] Note, that despite our dataset ends at 2018, we still have data that indicates whether civil servants are still employed in January 2019. Therefore, we do not have to exclude December 2018 from our analysis.
[33] All civil servants are defined as all civil servants born after 1950. In this way, we prevent that the FPU-arrangement may affect the percentage of young workers employed in a particular month.

decrease is in line with a large group of young civil servants that leave the municipality within one year.[34]

Unlike the previous figure, it is hard to observe any increasing or decreasing trend for the treated and non-treated municipalities. We observe a similar pattern. We as well plot the absolute number of young workers between the treatment and control group in Appendix II.

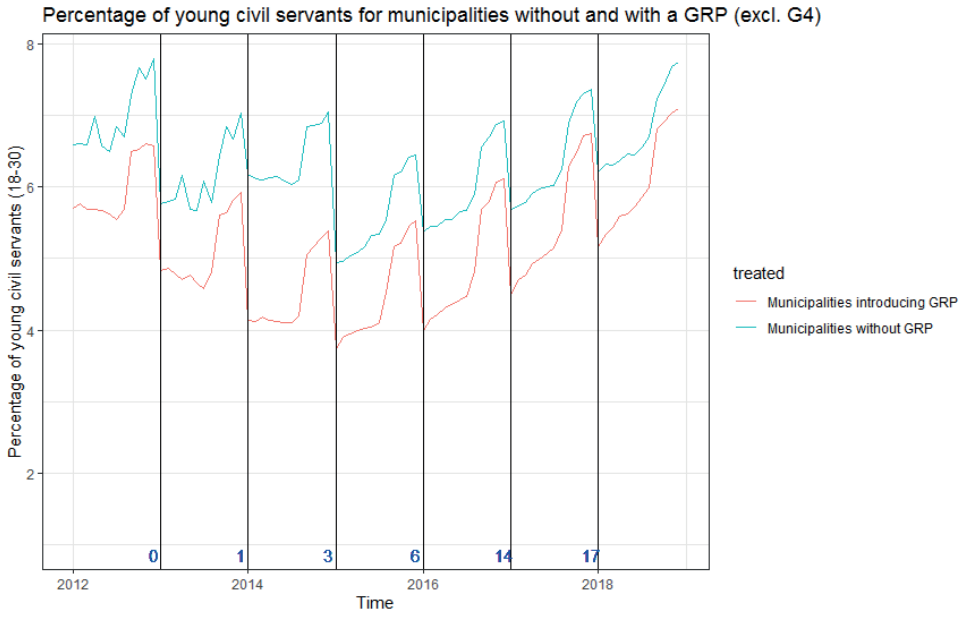

Figure 3: The number of young civil servants working at municipalities that did and did not adopt a GRP. The vertical lines accompanied by a blue number indicate how many municipalities adopted a GRP in that year or earlier (there was one municipality 2014, there were 3 municipalities in 2015, etc.). In Appendix II, we show a similar graph including the G4 municipalities. As the G4 municipalities are relatively large, we decided to omit them from the main analysis.

IV.B Formal test of the common trend assumption

To check for the common trend assumption for older workers we run the following regression:

$$y_{imt} = \alpha + \gamma_t + \lambda_m + +\delta_1 A_{imt} + \delta_2 X_{it} + \delta_3 D_{imt-6} + \delta_4 D_{imt-4} + \delta_5 D_{imt-2} + \delta_6 D_{imt} + \delta_7 D_{imt+2} + \delta_8 D_{imt+4} + \delta_9 D_{imt+6} + \epsilon_{imt} \quad (1)$$

[34] For all young starting civil servants, approximately 11% leave within one year. Reasons for leaving are a large amount of bureaucracy. More than 50% of young workers indicates that this is their main reason to leave. The second reason is the difficulty to climb the career ladder (Bekkers, 2020).

Here y_{imt} denotes the labor supply of individual i at municipality m in month t in terms of monthly hours worked (intensive and extensive margin)[35] or the net participation rate (extensive margin). α is a constant. γ_t and λ_m denote time dummies for each year-month combination and municipality dummies, respectively. The variable D_{imt} is a dummy variable equal to unity when an individual works at a municipality that has a GRP available in that month. Apart from this variable, we introduce several lead and lag variables to check for a common trend assumption. For instance, the variable D_{imt-6} is equal to unity in case a civil servant works for a municipality that will introduce a GRP six months before a GRP is implemented. These coefficients help us to formally test for pre trends. In particular, we expect not to find any effect prior a GRP is introduced. The results are displayed in Figure 4 and Figure 5.[36]

Figure 4 checks for pre trends in terms of monthly hours worked. We observe that there is no significant effect prior the implementation of a GRP. Figure 5 checks for pre trends when only analyzing the extensive margin. Here we find one significant pre trend two months prior a GRP is implemented. However, We do not think that this is a major problem. More precisely, we expect workers to postpone the retirement decisions once they know an attractive retirement program is in the making. Therefore, it is possible that we observe a significant coefficient two months prior the implementation of a GRP.

[35] Since it is possible that civil servants work zero hours per month, this regression estimates the effect on both the intensive and extensive margin

[36] Different specification with different number of leads and lags lead to a similar result in terms of sign and significance.

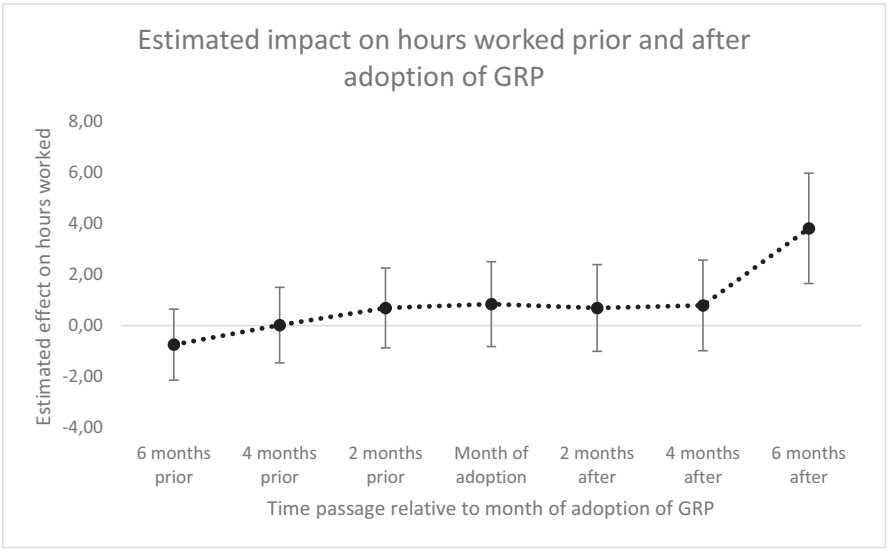

Figure 4: Test for pre-trends in hours workers between the treatment- and control group. We display the point estimates with a 5% confidence interval. The coefficient for six month after implementation of a GRP is positive and significantly different from zero. All other coefficients are not significantly different from zero.

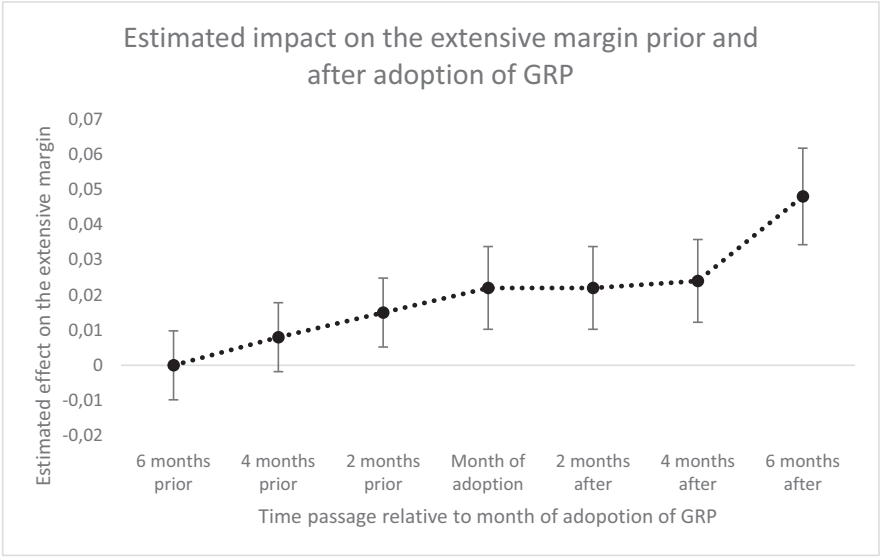

Figure 5 Test for pre-trends at the extensive margin between the treatment- and control group. We display the point estimates with a 5% confidence interval. The coefficient becomes significantly different form zero two months prior the implementation of a GRP. Before that time, the coefficients are not significantly different from zero.

V Estimation method & results

We analyze the effect of GRPs on the labor supply of older workers and the hiring of younger workers. We use a difference-in-differences approach, comparing civil servants in municipalities with and without GRPs, before and after the GRPs become available. Generally, we estimate a regression of the form:

$$y_{imt} = \alpha + \gamma_t + \lambda_m + \beta_1 D_{imt} + \beta_2 A_{imt} + \beta_4 X_{it} + \epsilon_{imt} \qquad (2)$$

Here y_{imt} denotes the labor supply of individual i at municipality m in month t, in terms of monthly hours worked (intensive and extensive margin) or the participation rate (only extensive margin). α is a constant. γ_t and λ_m denote time dummies for each year-month combination and municipality dummies, respectively. The variable D_{imt} is a dummy variable equal to unity when an individual works at a municipality that has a GRP available in that month. Its coefficient captures the effect of a GRP on labor supply. The vector X_{it} contains control variables and A_{imt} denotes a set of dummies for the ages 60 to 65. We control for gender, first- and second-generation immigrant, marital status, and whether the civil servant has children living at home. In addition to the basic specification, we also run a regression where we add an interaction term of age and GRP: $A_{imt} * D_{imt}$. Lastly, ϵ_{imt} denotes the error term.

We first analyze the effect of a GRP on monthly hours worked for older civil servants. We restrict our estimation to civil servants born after 1949. We do this to prevent any interference with attractive early retirement arrangements (FPU) for which older civil servants may still have been eligible (see section III). Second, we analyze the effect of GRPs on the participation (extensive margin) of older civil servants. We also perform this analysis for different wage income groups. Finally, we estimate the effect of GRPs on the hiring of young civil servants (18-30) and whether GRPs affect the wage growth of these younger workers. Given our limited sample size it is not possible to exploit differences in policy parameters in the municipalities that adopt a GRP.[37]

Borusyak, et al. (2021) indicate that it is necessary to check for heterogenous effect. Apart from the age interaction terms, mentioned above, we as well check for differences between gender in Appendix III. In Appendix IV, we display the results when we include the G4 municipalities as a robustness check. The results do not change much in terms of sign, significance, and magnitude.

V.A. Labor supply of older civil servants: total hours worked

We first analyze the number of monthly hours worked of older workers (age 60+), which is available on a monthly basis. Since it is possible that civil servants work zero hours per month, this regression

[37] For instance, it would be interesting to observe whether different packages (60-80-100 vs 80-88-88) would lead to different results.

estimates the effect on both the intensive and extensive margin. Our main coefficient of interest is the difference-in-differences estimator β_1 in regression (2) and the coefficient for the interaction of age and GRP. In casa a GRP increases (decreases) total labor supply, we expect these coefficients to be positive (negative) (see section IV).

We observe that a GRP increases the number of monthly hours worked by 2.8-3.1 hours (see Table 7, column 1 and 2). This increase is significant at the 1% level. In other words, civil servants that can enroll in a GRP work on average two hours more per month when compared to municipalities where a GRP is unavailable[38]. This equals roughly one full-time work week per year.[39]

We compare the effect of GRPs at a particular age by adding interaction terms (columns 3). We observe a significant negative baseline effect of nearly minus four hours per month. Moreover, we observe significantly positive interaction effects between the ages of 62 and 65. At those ages civil servants work significantly more hours per month when compared to the control group. For instance, at the age of 65 civil servants in the treatment group work on average $-3.9 + 16.8 = 12.9$ more hours per month when compared to civil servants who are not able to make use of a GRP.[40]

The results that we find are in line with the aims of GRPs. First, GRPs decrease the number of hours worked for younger age groups. Since civil servants in the control group receive an attractive option to work part-time, we expect that some will make use of this offer. As a result, this leads to a decrease in the number of hours worked at younger ages. At the same time, GRPs should succeed in retaining older workers at higher ages (i.e. prevent them from dropping out before reaching the pension eligibility age). As a result, there should be a positive coefficient at higher ages. Both these effects explain the observed pattern in column (3) of Table 7.

[38] In Appendix III, we show that the results of a GRP are not much different between male and female civil servants.
[39] A full-time workweek for civil servants working at municipalities is equal to 36 hours.
[40] In case we include the G4 municipalities, the sign and significance of the coefficient does not change much. The magnitude is approximately the same. See Appendix IV.

EXCL. G4 Older civil servants (60+): total hours worked			
D_{imt}	3.133*** (0.864)	2.765*** (0.828)	-3.859*** (1.348)
$D_{imt} * age(61)$			0.024 (0.938)
$D_{imt} * age(62)$			4.579*** (1.342)
$D_{imt} * age(63)$			9.884*** (1.579)
$D_{imt} * age(64)$			13.298*** (1.747)
$D_{imt} * age(65)$			16.817*** (1.697)
Male		18.389*** (0.896)	18.406*** (0.896)
1st generation immigrant		3.797* (1.978)	3.783* (1.981)
2nd generation immigrant		4.516** (1.838)	4.502** (1.835)
Kidsdummy		5.488*** (1.066)	5.486*** (1.066)
Married		-6.488*** (1.053)	-6.503*** (1.054)
Age dummies			
61		-3.823*** (0.309)	-3.819*** (0.380)
62		-10.246*** (0.506)	-11.395*** (0.626)
63		-18.962*** (0.694)	-21.789*** (0.876)
64		-32.132*** (0.872)	-36.402*** (1.106)
65		-62.997*** (0.962)	-69.614*** (1.189)
α	126.293*** (4.579)	118.821*** (4.481)	118.718*** (4.479)
Controls	NO	YES	YES
Municipality FE	YES	YES	YES
Time FE	YES	YES	YES
Adj. R^2	8.8%	15.4%	15.5%
Civil servants	14,389	14,389	14,389

*Table 7 The effect of adopting a GRP on the number of monthly hours worked for older civil servants. Clustered standard errors at the civil servant level between parentheses. *** denotes significance at the 1% level, ** denotes significance at the 5% level, and * denotes significance at the 10% level. For the interaction effects between the GRP dummy D_{imt} and age. The age of 60 is the reference category.*

In addition, we estimate which wage income group especially has an interest in GRPs. We calculate the hourly wage income by using the work history in the years 2010-2013. This allows us to define a low-, middle-, and high wage income group based on the wage income boundaries of the treatment

group. The low wage income group is the group with wages in the bottom 25% of the wage income distribution, and the highest wage income group are the wages in the top 25% of the wage income distribution[41]. In-between is the middle wage income group. Based on these cut-offs, we divide the control group into the same wage income categories. Then we run regression (2) for different wage income groups. We present the results here with the number of monthly hours work as our dependent variable.

The effect of a GRP on monthly hours worked is overall positive for the low-, middle- and high wage income group (see table 8). Using the results from Table 8, it is possible to calculate the net effect of a GRP over the ages 60-65[42]. For the low wage income group, we find a positive effect of 184.5 (115.8) hours over the years 60-65. For the middle- and high wage income group these numbers are equal to 212.5*** (81.8) and 395.6*** (122.2) hours, respectively. So, we find a positive and significant effect for the middle- and high-wage income group that roughly corresponds to 6 and 11 full time work weeks, respectively, over a period of six years. Calculating the weighted average for all wage income groups, we find that total labor supply increases with approximately 6.9 full time work weeks on average.

[41] This means that that the salaries benchmark is at €19.70 and €30.65 per hour, respectively. Moreover, as not everyone worked already for the municipality in the period 2010-2013, we lose 6.5% of our observations.
[42] To do so, we use the estimation results from column (3) regarding the baseline coefficient D_{imt} and the age-interaction terms. For example, for the low wage income group the effect of a GRP at age 60 equals $1.906 * 12 = 22.9$ hours per year. For age 61 this is equal to $(1.906 + 0.411) * 12 = 27.8$ hours per year. Doing this for all ages and all wage income groups yield the results mentioned in the text. We use the delta method to calculate the corresponding standard error.

EXCL. G4: Older civil servants (60+): total hours worked									
	Low wage income			Middle wage income			High wage income		
	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)
D_{imt}	2.396	2.544	1.906	2.285*	1.654	-7.487***	5.293***	4.399***	-5.790**
	(1.0708)	(1.633)	(2.789)	(1.224)	(1.177)	(1.912)	(1.840)	(1.728)	(2.692)
$D_{imt} * age(61)$			0.411			0.113			0.481
			(2.023)			(1.315)			(1.809)
$D_{imt} * age(62)$			2.244			5.632***			7.056***
			(2.889)			(1.883)			(2.648)
$D_{imt} * age(63)$			1.618			13.715***			13.724***
			(3.231)			(2.252)			(3.187)
$D_{imt} * age(64)$			-1.344			20.186***			18.621***
			(3.464)			(2.513)			(3.557)
$D_{imt} * age(65)$			1.010			22.986***			27.825***
			(3.372)			(2.420)			(3.469)
Male		16.503***	16.505***		18.071***	18.174***		17.487***	17.504***
		(1.765)	(1.765)		(1.289)	(1.288)		(2.194)	(2.198)
1st generation immigrant		9.739***	9.746***		4.152	4.394		3.152	2.979
		(2.949)	(2.950)		(2.912)	(2.921)		(5.732)	(5.754)
2nd generation immigrant		4.082	4.093		7.167***	7.159***		-2.289	-2.174
		(3.515)	(3.514)		(2.505)	(2.490)		(3.997)	(3.976)
kids dummy		4.959**	4.952**		5.741***	5.701***		4.360**	4.380**
		(2.321)	(2.320)		(1.512)	(1.513)		(1.979)	(1.973)
married		-9.641***	-9.627***		-11.208***	-11.201***		1.550	1.623
		(1.893)	(1.894)		(1.516)	(1.516)		(2.316)	(2.319)
Age dummies									
61		-3.274***	-3.349***		-3.751***	-3.731***		-4.267***	-4.427***
		(0.596)	(0.708)		(0.441)	(0.548)		(0.607)	(0.776)
62		-8.973***	-9.410***		-10.098***	-11.521***		-11.712***	-13.616***
		(0.959)	(1.141)		(0.728)	(0.907)		(1.030)	(1.312)
63		-14.318***	-14.662***		-19.238***	-23.299***		-23.073***	-27.261***
		(1.282)	(1.534)		(1.004)	(1.279)		(1.458)	(1.892)

64		-23.388***	-22.912***		-33.615***	-40.303***		-39.422***	-45.807***
		(1.615)	(1.954)		(1.265)	(1.613)		(1.841)	(2.395)
65		-48.921***	-49.170***		-66.049***	-75.317***		-71.844***	-83.626***
		(1.787)	(2.135)		(1.383)	(1.721)		(2.054)	(2.525)
α	115.433***	111.900***	112.022***	130.065***	128.778***	128.441***	135.413***	118.666***	119.058***
	(10.033)	(9.492)	(9.487)	(6.327)	(6.300)	(6.303)	(8.465)	(8.405)	(8.307)
Controls	NO	YES	YES	NO	YES	YES	NO	YES	YES
Municipality FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
Time FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
Adj. R^2	13.6%	18.7%	18.7%	8.6%	15.7%	16.0%	11.1%	18.2%	18.5%
Civil servants	3,719	3,719	3,719	6,484	6,484	6,484	3,253	3,253	3,253

*Table 8 The effect of adopting a GRP on monthly hours worked for different wage income groups of older civil servants. Clustered standard errors at the civil servant level between parentheses. *** denotes significance at the 1% level, ** denotes significance at the 5% level, and * denotes significance at the 10% level. Age 60 is the reference category in the above regression.*

V.B. Labor supply of older civil servants: extensive margin

Having established that GRPs positively affect the number of hours worked, we now investigate the effect at the extensive margin. In particular, we are interested at which age civil servants leave the municipality, which is almost equivalent to retirement.

The main goal of the extensive margin analysis is to analyze whether municipalities can retain older workers. In particular, we would expect significantly positive coefficients at higher ages relative to the control group.

To test this, we construct a dummy variable which is equal to one if the civil servant works at least one hour at the municipality of employment during a particular month. If this is not the case, this variable is equal to zero. We use the same independent variables as in equation (2) only now we estimate a linear probability model. If the D_{imt} coefficient is positive, it indicates that civil servants that are employed at a municipality with a GRP are more likely to remain active for a municipality with a GRP. In other words, a positive sign means a positive effect of GRPs on the retirement of older civil servants.

In the baseline regression without controls, the presence of a GRP positively and significantly affects the labor supply at the extensive by on average 4%-points (Table 9). Once we add control variables, this effect reduces to 3.7%-points.

Once we introduce interaction terms between age and the difference-in-differences estimator we find a positive significant effect of being employed at the ages of 62-65. More precisely, a GRP increases the probability of being employed at age 65 by $0.111 - 0.005 = 10.6$%-points. The introduction of GRPs do not have an extensive margin effect at the ages of 60 and 61. Since we focus in this analysis on the extensive margin, we do not expect to find a significant effect as the extensive margin analysis does not take into account a decrease in the number of hours worked.[43]

[43] In Appendix III we show that the results of a GRP are not much different between male and female civil servants. In Appendix IV we display the results including the G4 municipalities. The results are the same in terms of sign, magnitude, and significance.

EXCL. G4 Older civil servants (60+): extensive margin			
D_{imt}	0.040*** (0.006)	0.037*** (0.006)	-0.005 (0.009)
$D_{imt} * age(61)$			-0.001 (0.006)
$D_{imt} * age(62)$			0.028*** (0.009)
$D_{imt} * age(63)$			0.063*** (0.011)
$D_{imt} * age(64)$			0.087*** (0.012)
$D_{imt} * age(65)$			0.111*** (0.012)
Male		0.018*** (0.006)	0.018*** (0.006)
1st generation immigrant		0.003 (0.013)	0.003 (0.013)
2nd generation immigrant		0.025** (0.012)	0.025** (0.012)
Kidsdummy		0.032*** (0.007)	0.032*** (0.007)
married		-0.019*** (0.007)	-0.019*** (0.007)
Age dummies			
61		-0.024*** (0.002)	-0.024*** (0.003)
62		-0.064*** (0.003)	-0.071*** (0.004)
63		-0.122*** (0.005)	-0.140*** (0.006)
64		-0.212*** (0.006)	-0.240*** (0.008)
65		-0.436*** (0.007)	-0.480*** (0.008)
α	0.907*** (0.029)	0.912*** (0.029)	0.912*** (0.029)
Controls	NO	YES	YES
Municipality FE	YES	YES	YES
Time FE	YES	YES	YES
Adj. R^2	9.7%	14.9%	15.0%
Civil servants	14,389	14,389	14,389

*Table 9 The effect of adopting a GRP on being employed (extensive margin). Clustered standard errors at the civil servant level between parentheses. *** denotes significance at the 1% level, ** denotes significance at the 5% level, and * denotes significance at the 10% level. Age 60 is the reference category in the above regression.*

We run the same regression for different wage income groups as we did in the previous section (see Table 10). We observe that a GRP has a positive effect on extensive margin for the low-, middle-, and high wage income group. Once we add age-interaction terms, the positive sign disappears for the low-wage income group[44]. For the other income groups, we find positive and significant age-interaction effects effect at the ages 62 to 65. Moreover, the effect is stronger at higher ages. For instance, for the middle-wage income group we find a positive effect at age 62 that equals 1.2%-points, while at age 65 this equals 12.2%-points. The same holds as well for the high-wage income group. Thus, the availability of a GRP increases the labor force participation at the extensive margin mainly at higher ages.

[44] This is probably due to overfitting. When analyzing the (sum) of the age interaction effects and the baseline effect, we observe most are roughly equal to the coefficient in column (2).

EXCL. G4: Older civil servants (60+): extensive margin									
	Low wage income			Middle wage income			High wage income		
	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)
D_{imt}	0.026**	0.024**	0.013	0.036***	0.034***	-0.025*	0.050***	0.045***	-0.014
	(0.012)	(0.012)	(0.020)	(0.008)	(0.008)	(0.013)	(0.012)	(0.011)	(0.017)
$D_{imt} * age(61)$			0.008			0.001			-0.004
			(0.014)			(0.009)			(0.012)
$D_{imt} * age(62)$			0.015			0.037***			0.038**
			(0.021)			(0.013)			(0.017)
$D_{imt} * age(63)$			0.017			0.087***			0.083***
			(0.023)			(0.015)			(0.021)
$D_{imt} * age(64)$			0.005			0.129***			0.112***
			(0.025)			(0.017)			(0.024)
$D_{imt} * age(65)$			0.031			0.147***			0.169***
			(0.025)			(0.017)			(0.023)
Male		-0.015	-0.015		0.032***	0.032***		0.056***	0.056***
		(0.012)	(0.012)		(0.009)	(0.009)		(0.015)	(0.015)
1st generation immigrant		0.029	0.029		0.006	0.006		0.011	0.009
		(0.019)	(0.019)		(0.019)	(0.019)		(0.038)	(0.039)
2nd generation immigrant		0.010	0.010		0.054***	0.054***		-0.020	-0.019
		(0.024)	(0.024)		(0.017)	(0.017)		(0.025)	(0.025)
kids dummy		0.023	0.023		0.036***	0.036***		0.028**	0.028**
		(0.015)	(0.015)		(0.010)	(0.010)		(0.013)	(0.013)
married		-0.029**	-0.029**		-0.049***	-0.049***		0.018	0.012
		(0.013)	(0.013)		(0.010)	(0.010)		(0.015)	(0.015)
Age dummies									
61		-0.024***	-0.025***		-0.025***	-0.025***		-0.022***	-0.021***
		(0.004)	(0.005)		(0.003)	(0.004)		(0.004)	(0.005)
62		-0.064***	-0.067***		-0.065***	-0.075***		-0.064***	-0.074***
		(0.007)	(0.008)		(0.005)	(0.006)		(0.007)	(0.009)
63		-0.104***	-0.108***		-0.127***	-0.153***		-0.133***	-0.159***
		(0.009)	(0.011)		(0.007)	(0.009)		(0.010)	(0.012)

64		-0.173***	-0.173***		-0.224***	-0.267***		-0.242***	-0.280***
		(0.012)	(0.014)		(0.009)	(0.011)		(0.012)	(0.016)
65		-0.368***	-0.378***		-0.457***	-0.516***		-0.464***	-0.536***
		(0.013)	(0.015)		(0.010)	(0.012)		(0.014)	(0.017)
α	0.878***	0.906***	0.907***	0.940***	0.964***	0.962***	0.926***	0.870***	0.871***
	(0.063)	(0.062)	(0.062)	(0.041)	(0.041)	(0.041)	(0.052)	(0.052)	(0.052)
Controls	NO	YES	YES	NO	YES	YES	NO	YES	YES
Municipality FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
Time FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
Adj. R^2	15.6%	19.2%	19.2%	9.5%	15.4%	15.6%	11.7%	18.0%	18.3%
Civil servants	3,719	3,719	3,719	6,484	6,484	6,484	3,253	3,253	3,253

*Table 10 The effect of adopting a GRP on being employed (extensive margin) for different wage income groups of older civil servants. Clustered standard errors at the civil servant level between parentheses. *** denotes significance at the 1% level, ** denotes significance at the 5% level, and * denotes significance at the 10% level. Age 60 is the reference category in the above regression.*

V.C. Medication use of older civil servants

The main goal of this paper is to analyze the employment effects of GRPs. However, another goal of GRPs is to make sure that older civil servants reach the pension eligibility age healthily. Therefore, we analyze in Appendix V the effect of GRPs on medication use. We have yearly medication data for hypertension, high cholesterol (hyperlipidemia), mental diseases (anxiety, tension, depression), and pain and inflammation. Using a difference-in-differences design we find that the introduction of GRPs do not have a significant effect on medication use.

We would like to stress that in this analysis we only analyze four health indicators. Other indicators could possibly show an effect. For example, Veth & van Vuuren (2020) show that positive effects of GRPS have been achieved when focusing on work-life balance, feeling more energized, and motivation (see also section II). A drawback of this study is that it is based on interviews. As a result, it produces less hard evidence than the data analysis described in the previous paragraph.

V.D. Hiring decision of young civil servants

Having discussed whether GRPs affect the labor supply of older civil servants, we now examine whether municipalities with a GRP hire more young workers when compared to municipalities that did not adopt a GRP[45]. We estimate the following regression equation:

$$\log(L_{ymt}) = \zeta + \eta_{yt} + \mu_{mt} + \lambda_m + \beta_3 D_{mt} + \rho_{ymt} \qquad (3)$$

The dependent variable is the natural logarithm of young workers y at municipality m at time t. The variable ζ indicates the intercept. The variables η_{yt} and μ_{mt} denote year and month dummies, respectively[46]. The variables λ_m have the same interpretation as in regression (2) and the variable D_{mt} denotes a dummy variable whether municipality m at time t has implemented a GRP. If this is the case, the variable is equal to unity and otherwise it equals zero. This is our main coefficient of interest. As GRPs aim at making it possible for municipalities to increase the number of younger workers, we expect this coefficient to be positive. Lastly, ρ_{mt} denotes the error term.

[45] To do this, we use the aggregate command from package Stats in R to transform our dataset. This command allows us to sum the total amount of young employees per month and per municipality. This provides us with 2352 observations (= 84 months (=seven years) multiplied by 28 municipalities).

[46] The main reason for creating year and month dummies separately is to prevent overfitting. More precisely, when including for each year-month combination a separate dummy, we would include 84 dummies (83 because of perfect multicollinearity). Now we only include seventeen time dummies (six year dummies and eleven month dummies), reducing our amount of independent variables by more than 80%.

	Age group (18-30)	
	Log (young civil servants)	% of young civil servants
D_{mt}	0.011 (0.076)	-0.114 (0.301)
Municipality FE	YES	YES
Time FE	YES	YES
Adj. R^2	81.6%	72.7%
Number of observations	2,352	2,352

*Table 11 The effect of adopting a GRP on the number of younger workers hired. Clustered standard errors at the municipality level between parentheses. *** denotes significance at the 1% level, ** denotes significance at the 5% level, and * denotes significance at the 10% level.*

Table 11 provides us with the difference-in-differences estimator for equation (3). Next to the natural logarithm of young workers, we as well run a regression with the percentage of young workers as our dependent variable. We observe that for the entire group 18-30 the estimator is positive, yet insignificant at the 5%-level. The difference-in-differences estimator is insignificant for both dependent variables. In other words, the introduction of GRPs seems not to have a positive and significant effect on the hiring rate of young workers.

Lastly, it is as well possible to analyze the wage growth of young civil servants. A faster wage growth of young civil servants may indicate that they are able to climb the career ladder faster and end up in better paying jobs. Therefore, it is interesting to analyze how the introduction of GRPS affect the career opportunities of young civil servants. We construct the wage growth as a variable that is equal to the current wage at time t divided by the wage of that same young civil servant at time $t - 12$ (that is, the wage one year ago). For instance, we divide the wage individual i at municipality m earned in January 2017 by the wage he earned in January 2016.[47] We plot the average wage growth for young civil servants (see Appendix II.D) and we run the same regression as in equation (2) with our dependent variable now equal to the wage growth of young civil servants. We only focus on young civil servants that remain employed by the same municipality.[48] We assume that young civil servants that stay are most likely the ones that are the most capable in their job and have the highest chance of climbing the career ladder faster. As a result, this means that the interpretation of the above regression can be interpreted as an upper bound for the wage growth of young civil servants caused by the introduction of GRPs.

The results are displayed in Table 12 below. We observe that there is a negative significant effect of GRPs on the wage growth for young civil servants. This effect remains the same when adding control variables. The effect, however, is rather small. As an example, suppose a civil servant in the control

[47] We drop young workers whose are at the top and bottom 5% of the wage growth distribution to prevent that outliers have an effect on our estimation.
[48] In case we include young civil servants that leave the municipality the results do not change in terms of sign, significance, or magnitude.

group earns a monthly income of €2000, - gross in this year and the year thereafter. According to the regression results that same person in the treatment group would earn on average €16, - less when compared to someone in the control group. Therefore, we conclude that the effect is of little economic relevance.

	Age group (18-30)	
	(1)	(2)
D_{imt}	-0.009*** (0.003)	-0.008*** (0.003)
Municipality FE	YES	YES
Time FE	YES	YES
Controls	NO	YES
Controls	NO	YES
Adj. R^2	12.4%	13.2%
Number of civil servants	5,387	5,387

*Table 12 Wage growth for young civil servants. Clustered standard errors at the civil servant level between parentheses. *** denotes significance at the 1% level, ** denotes significance at the 5% level, and * denotes significance at the 10% level.*

VI. Discussion & Conclusion

We analyzed the employment effects of Gradual Retirement Plans (GRPs) in municipalities with more than 100,000 citizens. We compared hours worked and net participation of older civil servants in municipalities with and without a GRP. As our time span includes the introduction of GRPs, we were able to estimate a difference-in-differences specification.

We found that GRPs increase the labor force participation of older workers. These effects are particularly strong at higher ages. When analyzing the effect of GRPs on total labor supply for different wage income groups, we found that the total hours worked for the middle- and high- wage income groups *increased* at the ages 60-65. Those effects are approximately equal to 6 and 11 full-time work weeks. For the low-wage income group we did not find a significant effect.

These results are partially in line with Montizaan, et al. (2010) who find in their stated preferences analysis that financial incentives (change in the accrual rate and pension income) have a positive and significant effect on the final retirement-age. They also find that the total amount of hours worked decreases at younger ages once gradual retirement plans become available. However, they find that total labor supply decreases once gradual retirement schemes are introduced while we find an increase, particularly for middle- and high wage income workers. The difference between our results could be explained by the very strong financial incentives in GRPs. These financial incentives are stronger than the ones in Montizaan, et al. (2010). Therefore, this may indicate that if financial incentives become particularly strong, total labor supply becomes positive.

As we do not observe output, it is not feasible to do a formal cost-benefit analysis. However, it is possible to describe the main trade-offs. On the one hand, we observe that older workers remain longer employed due to the introduction of GRPs. On the other hand, GRPs do not have a significant effect on short-run medication use. In addition, the financial costs of GRPs for municipalities may be quite high. If the group that remains longer employed has very specific knowledge in particular domains (e.g. health care, spatial planning), it could be worthwhile to introduce a GRP. In particular, due to decentralization in certain policy areas, the municipalities have been given additional tasks in the period under consideration. This could make the knowledge of senior civil servants more valuable. If this is the case, it may have been worthwhile to retain these older workers despite the high financial costs of GRPs.

Regarding the hiring decision of young civil servants, we observe that both treated and non-treated municipalities see an increase in the number of young civil servants over time. GRPs do not seem to have an impact on youth hirings by municipalities.

It is important to stress that our results are only limited to the public sector. Further research should investigate the outcomes of GRPs or alternative policies in other sectors of industry. It might also be interesting to look at labor supply effects in the longer term. If social norms change, then these effects might become larger as time passes by.

Bibliography

A&O fonds Gemeenten. (2020, September 29). *Toolkit Generatiepact.* Retrieved from Vraag en antwoord - argumentatie generatiepact: https://www.aeno.nl/uploads/AO_gemeenten_GP_Vraag-en-antwoord-—-argumentatie-GP.pdf

A+O fonds Gemeenten. (2014). *Personeelsmonitor Gemeenten.* Den Haag: Stichting A+O fonds Gemeenten.

A+O fonds Gemeenten. (2015, September 7). Generatiepact Deventer. Deventer, Overijssel, Nederland.

A+O fonds Gemeenten. (2016). Generatiepact Enschede. Enschede, Overijssel, Nederland.

A+O fonds Gemeenten. (2018). *Personeelsmonitor Gemeenten 2017.* Den Haag: A+O fonds Gemeenten.

Akkermans, M., Arts, K., Bos, W., van den brakel, M., Gidding, K., Goedhuys-van der Linden, M., . . . Verweij, G. (2018). *Armoede en sociale uitsluiting.* Den Haag: Centraal Bureau voor de Statistiek.

Albanese, A., Cockx, B., & Thuy, Y. (2020). Working time reductions at the end of the career: Do they prolong the time spent in employment? *Empirical Economics, 59(1)*, 99-141.

Alphen aan den Rijn. (2017, May 1). Regeling Generatiepact Alphen aan den Rijn. Alphen aan den Rijn, Zuid-Holland, Nederland.

Ambtenarensalaris.nl. (2020). *Wat is de werkbonus*. Retrieved October 19, 2020, from https://ambtenarensalaris.nl/kennisbank/algemeen/wat-is-de-werkbonus/

Atav, T., Jongen, E., & Rabaté, S. (2019). The effects of increasing the normal retirement age: evidence from the Netherlands.

Behaghel, L., & Blau, D. M. (2012). Framing social security reform: Behavioral responses to changes in the full retirement age. *American Economic Journal: Economic Policy, 4(4)*, 41-67.

Bekkers, H. (2019, June 19). *Gemiddelde leeftijd ambtenaar daalt*. Retrieved from Binnenlands Bestuur: https://www.binnenlandsbestuur.nl/ambtenaar-en-carriere/nieuws/gemiddelde-leeftijd-ambtenaar-daalt.9929846.lynkx

Bekkers, H. (2020). Jonge ambtenaar haakt af vanwege bureaucratie. *Binnenlands Bestuur*.

Bertoni, M., & Brunello, G. (2017). Does delayed retirement affect youth employment? Evidence from Italian local labour markets.

Boeri, T., Garibaldi, P., & Moen, E. (2016). A clash of generations? Increase in Retirement Age and Labor Demand for Youth (No. 11422). *CEPR Discussion Papers*.

Bokšić, S., Verweij, A., & Abbing, M. R. (2019). De kloof wordt kleiner, behalve op de arbeidsmarkt. *ESB*, 1467-96.

Bolhaar, J., Dillingh, R., & van Vuuren, D. (2017). Langer doorwerken: keuzes voor nu en later. *CBP Policy Brief in samenwerking met Netspar (10)*.

Börsch-Supan, A., Bucher-Koenen, T., Kutlu-Koc, V., & Goll, N. (2018). Dangerous flexibility–retirement reforms reconsidered. *Economic Policy, 33(94)*, 315-355.

Borusyak, K., Jaravel, X., & Spiess, J. (2021). Revisiting event study designs: Robust and efficient estimation. *arXiv preprint arXiv:2108.12419*.

Carta, F. D., & Von Wachter, T. M. (2021). workforce aging, pension reforms, and firm outcomes (No. w28407). *National Bureau of Economic Research*.

CBS (2022). Arbeidsdeelname; kerncijfers 2003-2022. Retrieved from CBS: *StatLine - Arbeidsdeelname; kerncijfers, 2003-2022 (cbs.nl)*

Coile, C. C., & Levine, P. B. (2011). Recessions, retirement, and social security. *American Economic Review*, 23-28.

Damman, M., & van Solinge, H. (2017). De combinatie van betaald en onbetaald werk in de jaren voor pensioen. *Netspar Industry Paper Series, (Design Paper 69)*.

de Pijper, B., Wildenburg, A., Montessori, R., van de Graaf, M., de Jong, M., van der Zanden, R., . . . Huitema, J. (2019). De kleine Gids voor de Nederlandse Sociale Zekerheid. In *3.7 Re-integratie door de gemeente* (pp. 211-214). Alphen aan den Rijn: Woltes Kluwer.

de Vos, K., Kapteyn, A., & Kalwij, A. (2018). Social security programs and employment at older ages in the Netherlands. *National Bureau of Economic Research*.

Doove, S., ter Haar, D., Schalken, N., & Span, T. (2019). *Inkomens- en arbeidsmarktpositie van de jongere partners van AOW-gerechtigden.* Den Haag.

Elsayed, A., de Grip, A., Fouarge, D., & Montizaan, R. (2018). Gradual retirement, financial incentives, and labour supply of older workers: Evidence from a stated preference analysis. *Journal of Economic Behavior & Organization, 150*, 277-294.

Euwals, R., Knoef, M., & Van Vuuren, D. (2011). The trend in female labour force participation: what can be expected in the future? *Empirical Economics 40.3*, 729-753.

Euwals, R., Van Vuuren, D., & Wolthoff, R. (2010). Early retirement behaviour in the Netherlands: Evidence from a policy reform. *De Economist, 158(3)*, 209-236.

FNV. (n.d.). *Gezond en vast werk met generatiepact Eerlijk verdelen tussen jong en oud*. Retrieved October 19, 2020, from https://www.fnv.nl/acties/generatiepact

Gemeente Alkmaar. (2018, January 4). Regeling Generatiepact. Alkmaar, Noord-Holland, Nederland.

Gemeente Amersfoort. (2017, Juli 26). Wijziging van de Arbeidsvoorwaardenregeling Gemeente Amersfoort (ARGA) betreffende invoering van de Regeling Generatiepact Gemeente Amersfoort 2017. Amersfoort, Utrecht, Nederland.

Gemeente Delft. (2016, Augustus 19). Regeling 60-80-100 en Regeling 80-90-100. Delft, Zuid-Holland, Nederland.

Gemeente Den Haag. (2015, September 1). Regeling Generatiepact 2015 Den Haag. Den Haag, Zuid-Holland, Nederland.

Gemeente Eindhoven. (2017, February 7). Raadsinformatiebrief. *Onderwerp: regeling Generatiepact*. Eindhoven, Noord-Brabant, Nederland.

Gemeente Emmen. (n.d.). Generatiepact Emmen. Emmen, Drenthe, Nederland.

Gemeente Groningen. (2013, December 17). Sociaal Statuut gemeente Groningen 2014-2018. Groningen, Groningen, Nederland.

Gemeente Haarlem. (2017, March 28). Invoeren Regeling Generatiepact Haarlem 2017. Haarlem, Noord-Holland, Nederland.

Gemeente Haarlem. (2018). Regeling Generatiepact Haarlem 2018-2021. Haarlem, Noord-Holland, Nederland.

Gemeente Haarlemmermeer. (2019, January 29). Raadsvoorstel. *Kadernota 2020 van de Gemeenschappelijke Regeling Cocensus*. Haarlemmermeer, Noord-Holland, Nederland.

Gemeente Leeuwarden. (2016, March 15). Regeling Generatiepact. Leeuwarden, Friesland, Nederland.

Gemeente Leiden. (2018, February 1). Gemeente Leiden - Regeling minder werken gemeente Leiden. Leiden, Zuid-Holland, Nederland.

Gemeente Nijmegen. (2017, July 11). Regeling Generatiepact gemeente Nijmegen. Nijmegen, Gelderland, Nederland.

Gemeente Tilburg. (2018, Augsut 16). Regeling generatiepact gemeente Tilburg. Tilburg, Noord-Brabant, Nederland.

Gemeente Utrecht. (2015, November 1). Generatiepact gemeente Utrecht. Utrecht, Utrecht, Nederland.

Gemeente Westland. (2016, September 16). *Gemeente Westland creëert banen voor jongeren*. Retrieved from Westlanders.nu: https://m.westlanders.nu/gemeentenieuws/gemeente-westland-creeert-banen-voor-jongeren-19178/

Gemeente Zwolle. (2015, March 25). Generatiepact 2015-2017. Zwolle, Overijssel, Nederland.

Gemeente Zwolle. (n.d.). Generatiepact 2017-2021. Zwolle , Overijssel, Nederland.

Gielen, A. C. (2009). Working hours flexibility and older workers' labor supply. *Oxford economic papers, 61(2)*, 240-274.

Goldin, C., & Katz, L. (2007). *Long-run changes in the US wage structure: narrowing, widening, polarizing (No. w13568).* National Bureau of Economic Research.

Gruber, J., & Wise, D. A. (2010). *Social security programs and retirement around the world: The relationship to youth employment.* University of Chicago Press.

Hernæs, E., Jia, Z., Piggott, J., & Vigtel, T. C. (2020). Work less but stay longer-Mature worker response to a flexibility reform.

Ilmakunnas, P., & Ilmakunnas, S. (2011). Diversity at the workplace: Whom does it benefit? *De Economist*, *159*, 223-255.

Kalwij, A., Kapteyn, A., & De Vos, K. (2010). Retirement of older workers and employment of the young. *De Economist, 158(4)*, 341-359.

Kantarci, T., & Van Soest, A. (2008). Gradual retirement: Preferences and limitations. *De Economist, 156(2)*, 113-144.

Kapteyn, A., de Vos, K., & Kalwij, A. (2010). *Social Security Programs and Retirement around the World: The Relatuionship to Youth Employment* (Vol. Chapter 8: Early Retirement and Employment of the Young in the Netherlands). (J. Gruber, & D. Wise, Eds.) Chicago: University of Chicago Press.

Kapteyn, A., Kalwij, A., & Zaidi, A. (2004). The myth of worksharing. *Labour Economics, 11(3)*, 293-313.

Kiesraad. (2013, November 13). *Databank Verkiezingsuitslagen*. Retrieved from Gemeenteraad 13 november 2013: https://www.verkiezingsuitslagen.nl/verkiezingen/detail/GR20131113

Kiesraad. (2014, November 19). *Databank Verkiezingsuitslagen*. Retrieved from Gemeenteraad 19 november 2014: https://www.verkiezingsuitslagen.nl/verkiezingen/detail/GR20141119

Kiesraad. (2014, March 19). *Databank Verkiezingsuitslagen*. Retrieved from Gemeenteraad 19 maart 2014: https://www.verkiezingsuitslagen.nl/verkiezingen/detail/GR20140319/630222

Lahey, J. (2008). Age, women, and hiring: an experimental study. *Journal of Human resources*, 30-56.

Lamers, L. M., & Van Vliet, R. C. (2004). The Pharmacy-based Cost Group model: validating and adjusting the classification of medications for chronic conditions to the Dutch situation. *Health policy, 68(1)*, 113-121.

Machado, C. S., & Portela, M. (2014). Hours of work and retirement behaviour. *IZA Journal of European Labor Studies, 3(1)*, 1-22.

Ministry of Internal Affairs. (2019, February 14). Beantwoording kamervragen van het lid Özütok. Den Haag, Nederland.

Ministry of Social Affairs. (2017, September). Activering quatem arbeidsgehandicaptenarbeidsbeperkten.

Mohnen, P. (2019). The impact of the retirement slowdown on the us youth labor market. *Working Paper*.

Montizaan, R., Cörvers, F., & De Grip, A. (2010). The effects of pension rights and retirement age on training participation: Evidence from a natural experiment. *Labour Economics, 17(1)*, 240-247.

Niemeijer, W. (2017). Wie pakt het Generatiepact? Een onderzoek naar de adoptie van het Generatiepact onder zes Nederlandse gemeenten. *MSc Thesis, Erasmus Universiteit Rotterdam*.

OECD. (2011). *Pensions at a Glance 2011: Retirement-income systems in OECD and G20 countries.*

Picchio, M., & Van Ours, J. (2013). Retaining through training even for older workers. *Economics of Education Review*, 29-48.

Rijken, K. (2017, June 26). *Binnenlands Bestuur*. Retrieved from Diversiteit onder ambtenaren nog steeds een probleem: https://www.binnenlandsbestuur.nl/ambtenaar-en-carriere/nieuws/diversiteit-onder-ambtenaren-nog-steeds-een.9566226.lynkx

Rijksoverheid. (n.d.). *Beschut werk voor mensen met een arbeidsbeperking*. Retrieved February 13, 2021, from https://www.rijksoverheid.nl/onderwerpen/werken-met-arbeidsbeperking/beschut-werk-voor-mensen-met-arbeidsbeperking

Rijksoverheid. (n.d.). *Loonkostenvoordelen (LKV)*. Retrieved October 19, 2020, from https://www.rijksoverheid.nl/onderwerpen/wet-tegemoetkomingen-loondomein-wtl/tegemoetkoming-loonkosten-oudere-jongere-of-gehandicapte-werknemers/loonkostenvoordelen-lkv

Rutten, A., van Vuuren, D., & Knoef, M. (2020). The effect of pension eligibility on spousal labor supply. *Netspar Working Paper*.

Schippers, J. J., & Vlasblom, J. D. (2019). Werkloze ouderen weer aan het werk? Het effect van reserveringsloon en zoekintensiteit. *Tijdschrift voor Arbeidsvraagstukken, 35(1)*, 6-25.

Schirle, T. (2008). Why have the labor force participation rates of older men increased since the mid-1990s? *Journal of labor economics, 26(4)*, 549-594.

Staatscourant. (2018, December 11). Regeling van de Staatssecretaris van Sociale Zaken en Werkgelegenheid van 3 december 2018, 2018-0000171280, tot vaststelling van de aantallen beschut werk voor het jaar 2019 (Regeling vaststelling aantallen beschut werk 2019). 1-9.

Statistics Netherlands (CBS). (n.d.). CBS microdata.

Van Dalen, H., & Henkens, C. (2019). Gaat het generatiepact zijn doel bereiken? *Me Judice, 11*.

Van Soest, A., & Vonkova, H. (2014). How sensitive are retirement decisions to financial incentives? A stated preference analysis. *Journal of Applied Econometrics, 29(2)*, 246-264.

Vereniging van Nederlandse gemeenten. (2020, December 31). *Kerngetallen financiële positie Nederlandse gemeenten*. Retrieved from Waarstaatjegemeente.nl: https://www.waarstaatjegemeente.nl/jive/

Verkooijen, L. (2017). *Arbeidsparticipatie ouderen flink gestegen.* Den Haag: Centraal Bureau voor de Statistiek.

Vestad, O. L. (2013). Early retirement and youth employment in Norway. *Statistics Norway*.

Veth, K., & Van Vuuren, T. (2020). De impact van het Generatiepact Vijf casestudies over ervaringen en gevolgen voor de duurzame inzetbaarheid. *Tijdschrift voor HRM*, 21-39.

Walstra, E. (2017, September 12). *Niveau ambtenaren stijgt*. Retrieved from Binnenlands Bestuur: https://www.binnenlandsbestuur.nl/ambtenaar-en-carriere/nieuws/niveau-ambtenaren-stijgt.9570875.lynkx

Weir, D. (2007). Are baby boomers living well longer. *Redefining retirement: How will boomers fare*, 95-111.

Appendix I: Common trend assumption and endogenous adoption

In Appendix I, we show several graphs that analyzes whether political reasons could have played a role in adopting a GRP for different municipalities (the full list of municipalities that we analyze is discussed in the next section). To do so, we plot the youth unemployment in the age category 25-45. We use open access yearly data from Statistics Netherlands to do this. We provide data for the period 2006-2015, meaning that we start 8 years before the first municipality in the treatment group introduces a GRP.

The first figure in the appendix (Figure 6) shows that the average yearly unemployment rate for individuals in the age category 25-45. We do not observe much difference between the treatment and control group. More precisely, we observe that the average unemployment rate is 0.1 to 0.6%-points lower in the municipalities in the treatment group. Including or excluding G4 municipalities does not seem to make much of a difference. The biggest difference we observe is in 2015 when youth unemployment is 0.8%-points higher for the treatment group when compared to the control group.

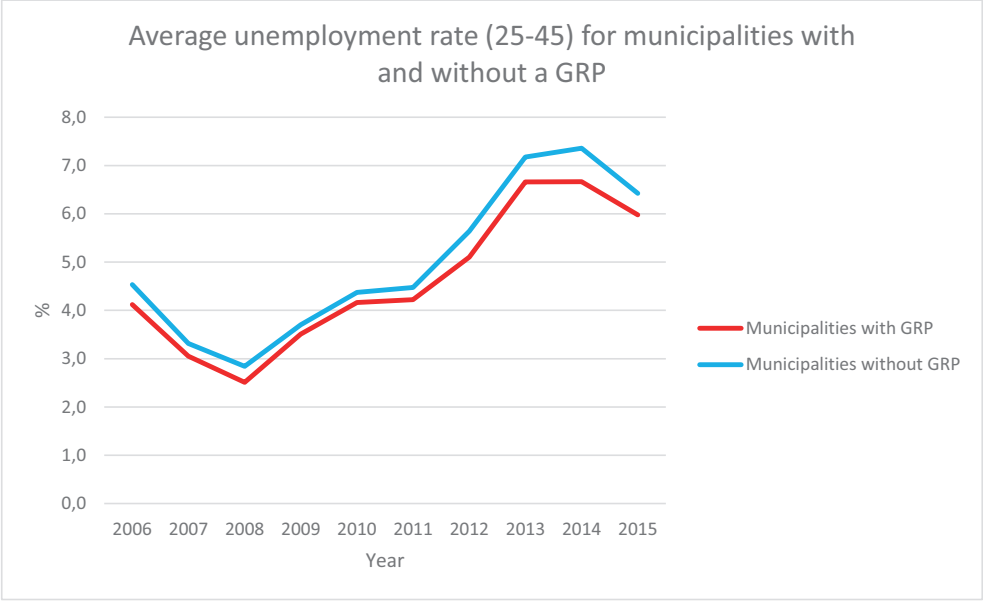

Figure 6 Average unemployment rate (age 25-45) for municipalities with and without a GRP. The p-value of the Chi-squared test is equal to 1.

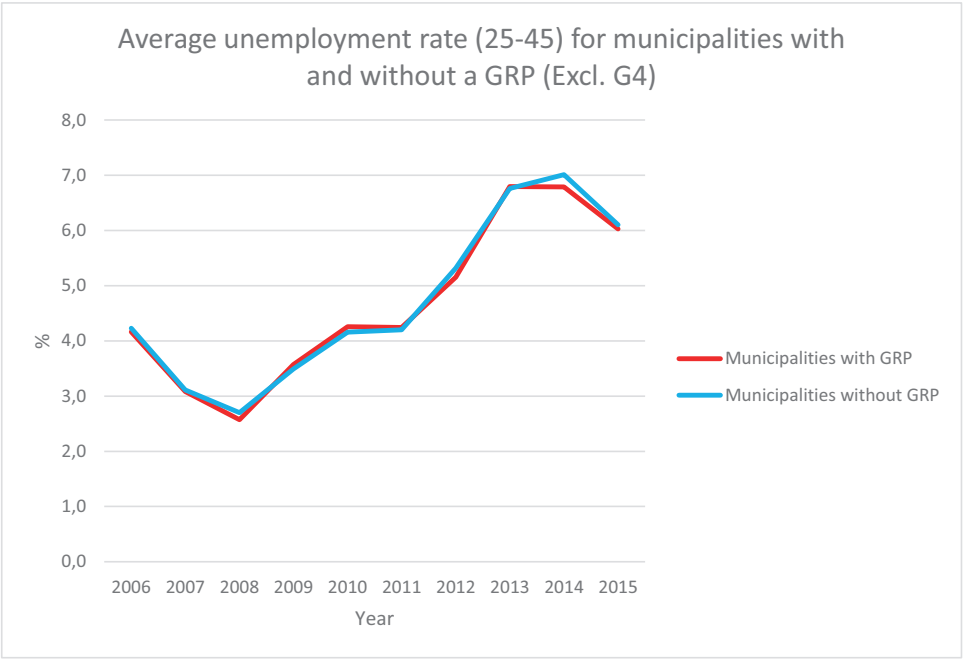

Figure 7 Average unemployment rate (age 25-45) for municipalities with and without a GRP (excluding G4 municipalities). The p-value of the Chi-squared test is equal to 1.

We as well analyzed the differences in voting behavior between municipalities. To do so, we compared the outcome of the municipalities elections of 2014 for municipalities that did and did not introduce a GRP (Kiesraad, (2014); Kiesraad, (2014); Kiesraad, (2013)). We focus on the main national parties that as well participate in municipality elections. Those parties are CDA, VVD, D66, PvdA, SP, GroenLinks, and the ChristenUnie/SGP. Considering our dataset, we observe that the last mentioned political party sometimes participates as one party during an election with this name or as two separate parties, namely Christen-Unie and SGP. For our analysis, we merged them together. Local parties are as well merged together in the variable “others”.

We calculate the vote share of the main national parties as the number of votes they received divided by the total number of votes casted in that municipality. In case one of the larger national parties did not participate, we set the vote share equal to zero. The vote share of other parties is then defined as one minus the vote share for the national parties. Some national parties like the PVV did only participate in a small number of municipalities in 2014 and are therefore merged together

with "others"[49]. Thereafter we calculate the average percent of the vote share each party received in the treatment and control group.

Figure 8 and Figure 9 below show the difference in voting behavior between municipalities that introduce and do not introduce a GRP. We observe that the differences in voting behavior are rather small. The biggest difference is 2.3%-points for GroenLinks, indicating that for every 1000 votes there will be 23 votes more for GroenLinks in municipalities that adopted a GRP. The differences are not significant and therefore we conclude that political differences cannot have played a major role in choosing to adopt a GRP or not.

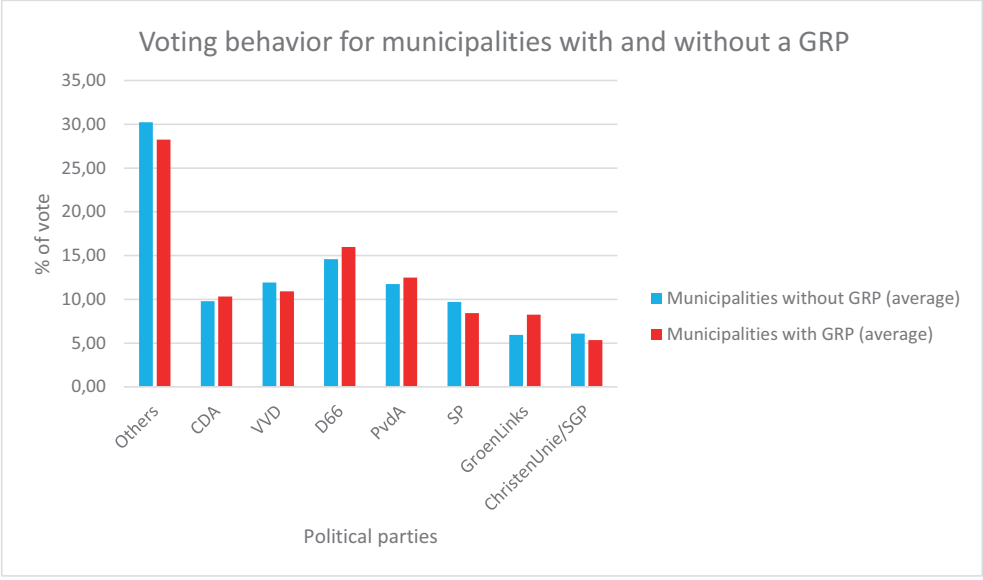

Figure 8 Voting behavior for municipalities with and without a GRP. χ^2-test provides a p-value of 0.98. Hence, the distributions are not significantly different between municipalities with and without a GRP.

[49] Note that this does not mean that one party received the vote share "others" as it is possible for multiple local parties to participate in a municipality election.

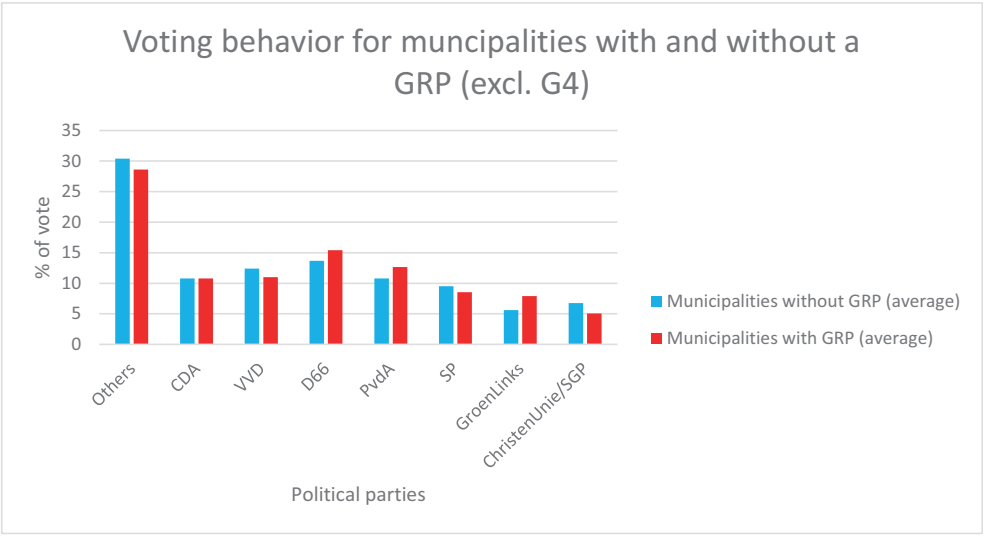

Figure 9 Voting behavior for municipalities with and without a GRP. χ^2-test provides a p-value of 0.95. Hence, the distributions are not significantly different between municipalities with and without a GRP.

Next, we analyze the differences in te municipalities debt position. Municipalities with a higher debt level may be less likely to adopt a GRP as it may have high startup cost both in terms of salary as well as in terms of hiring. Therefore we compare the average solvency ratio for the treatment and control group in the period 2013-2018 (data for earlier years are not available). The solvency ratio indicates how healthy municipalities are. A solvency ratio of less than 20% may indicate that municipalities may face problems in the long run.

Table 13 below shows the average solvency ratio for the periode 2013-2018 for treatment and control group in % and the corresponding p-value. None of the differences are significant. It does not matter whether we include or exclude the G4 municipalities (Table 14).

Group/year	2013	2014	2015	2016	2017	2018
Municipalities with GRP (%)	28.88	23.44	25.04	26.8	26.05	26.21
Municipalities without GRP (%)	38.92	30.56	29.16	29.03	28.18	29.19
p-value	0.31	0.35	0.56	0.75	0.75	0.65

Table 13. Average solvency ratios for municipalities that do and do not introduce a GRP (Excluding G4 municipalities). Source: (Vereniging van Nederlandse gemeenten, 2020)

Group/year	2013[1]	2014	2015	2016	2017	2018
Municipalities with GRP (%)	28.88	24.61	25.79	27.19	26.58	26.29
Municipalities without GRP (%)	40.67	32.31	31.52	31.45	30.83	31.51
p-value	0.19	0.27	0.38	0.52	0.51	0.39

Table 14. Average solvency ratios for municipalities that do and do not introduce a GRP. 1: For the year 2013 there are no data available for the municipalities Den Haag and Utrecht. Source: (Vereniging van Nederlandse gemeenten, 2020).

Appendix II: additional graphs

II. A Extensive margin including G4 muncipalities

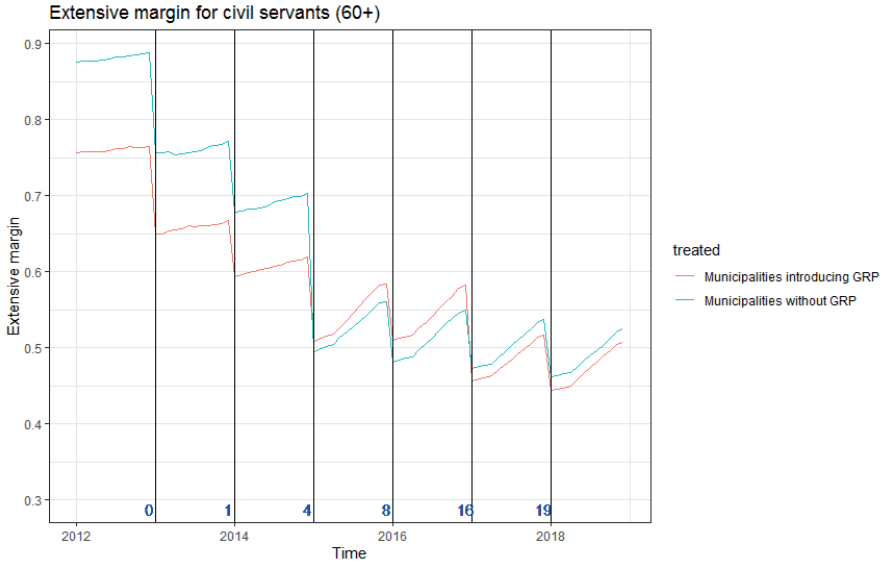

Figure 10 Extensive margin plot for municipalities with and without GRP including G4 municipalities. The vertical lines accompanied by a blue number indicate how many municipalities adopted a GRP in that year or earlier (that means there was one municipality in 2014, there were 3 municipalities in 2015, etc.)

II.B Intensive margin including G4 municipalities

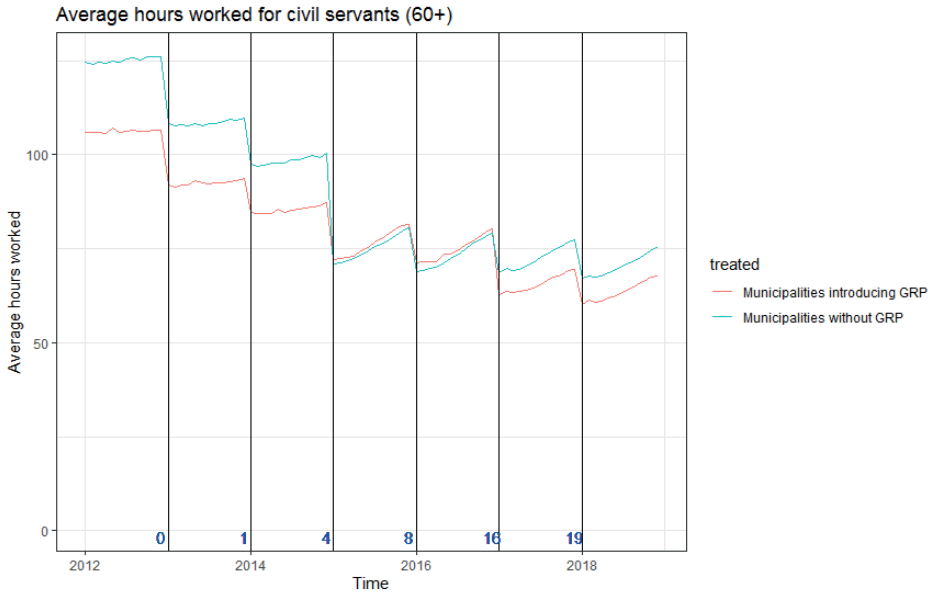

Figure 11 Average hours worked per month for older civil servants (60+) working at municipalities with and without a GRP. The vertical lines accompanied by a blue number indicate how many municipalities adopted a GRP in that year or earlier (that means there was one municipality in 2014, there were 3 municipalities in 2015, etc.)

II.C Additional graphs regarding youth employment

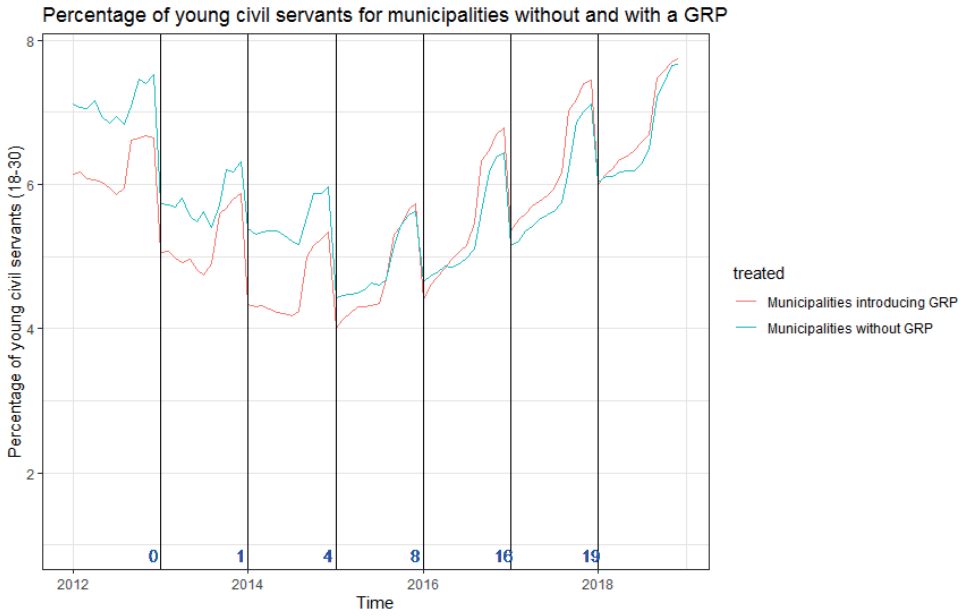

Figure 12 Percentage of young civil servants employed by municipalities including G4. The vertical lines accompanied by a blue number indicate how many municipalities adopted a GRP in that year or earlier (that means there was one municipality in 2014, there were 3 municipalities in 2015, etc.)

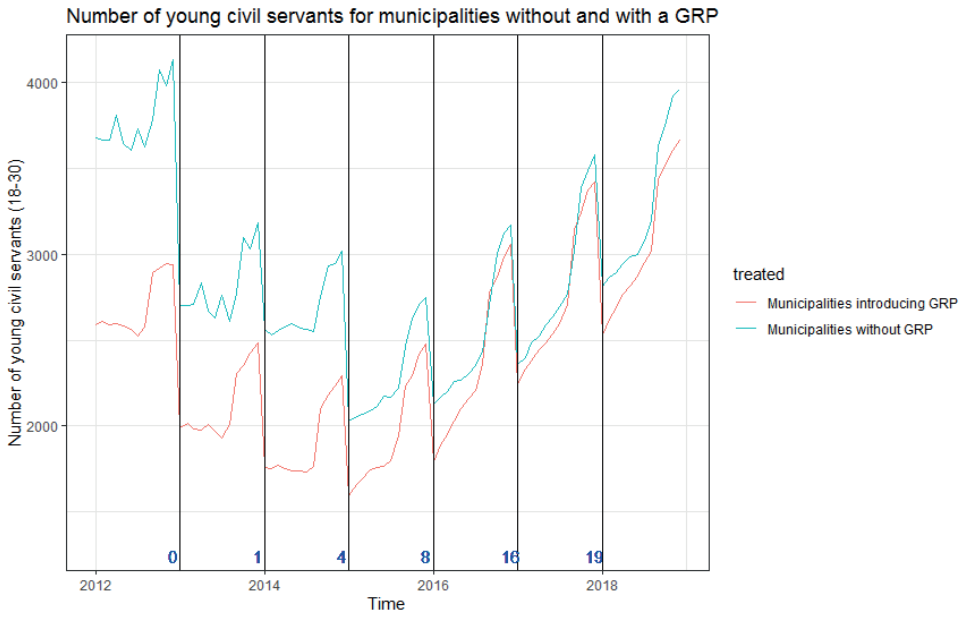

Figure 13 Number of young civil servants employed by municipalities including G4. The vertical lines accompanied by a blue number indicate how many municipalities adopted a GRP in that year or earlier (that means there was one municipality in 2014, there were 3 municipalities in 2015, etc.)

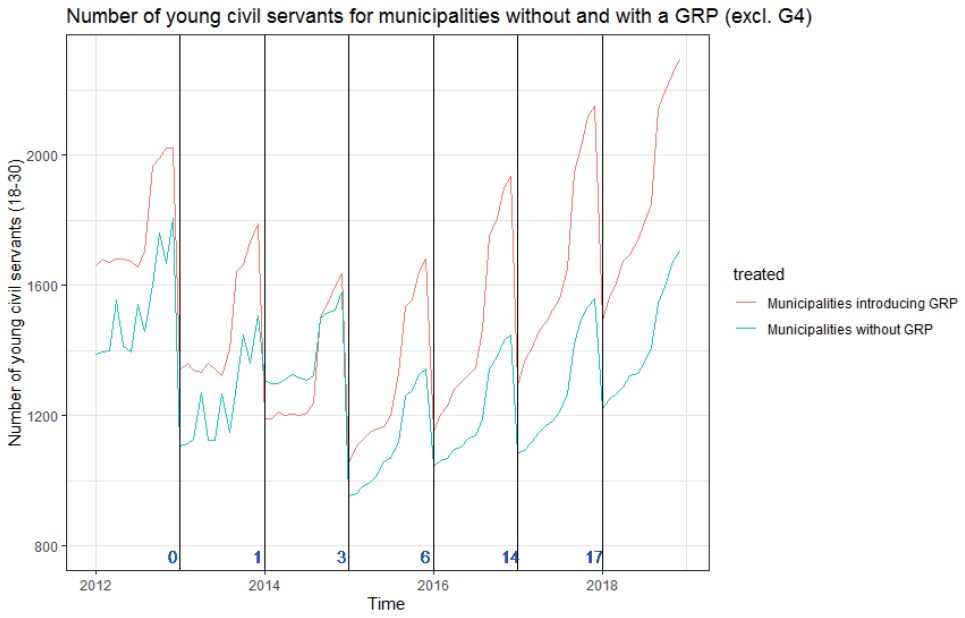

Figure 14 Number of young civil servants employed by municipalities excluding G4. The vertical lines accompanied by a blue number indicate how many municipalities adopted a GRP in that year or earlier (that means there was one municipality in 2014, there were 3 municipalities in 2015, etc.)

II.D Average Wage growth

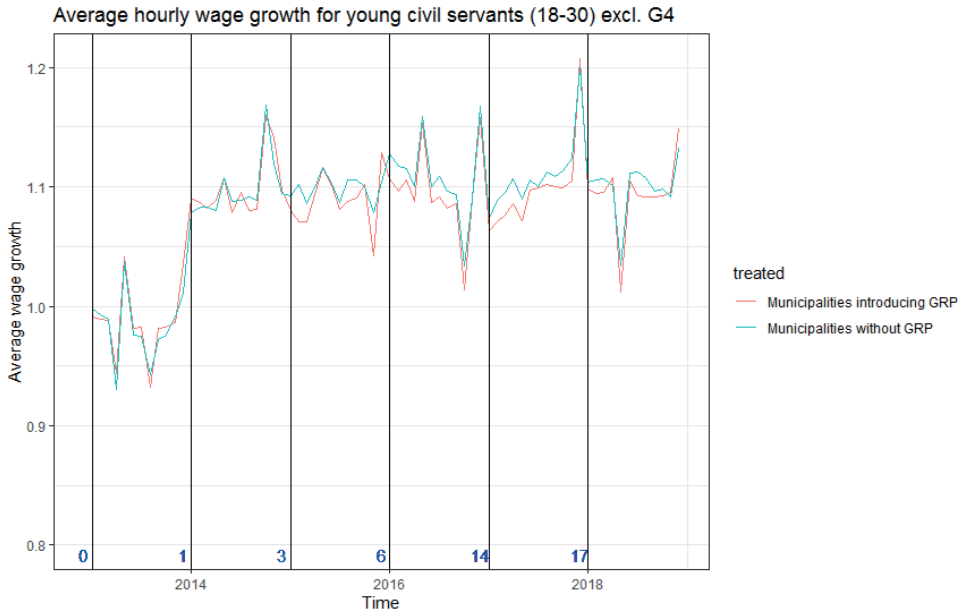

Figure 15 Average hourly wage growth for young civil servants in the treatment and control group (excluding G4 municipalities).

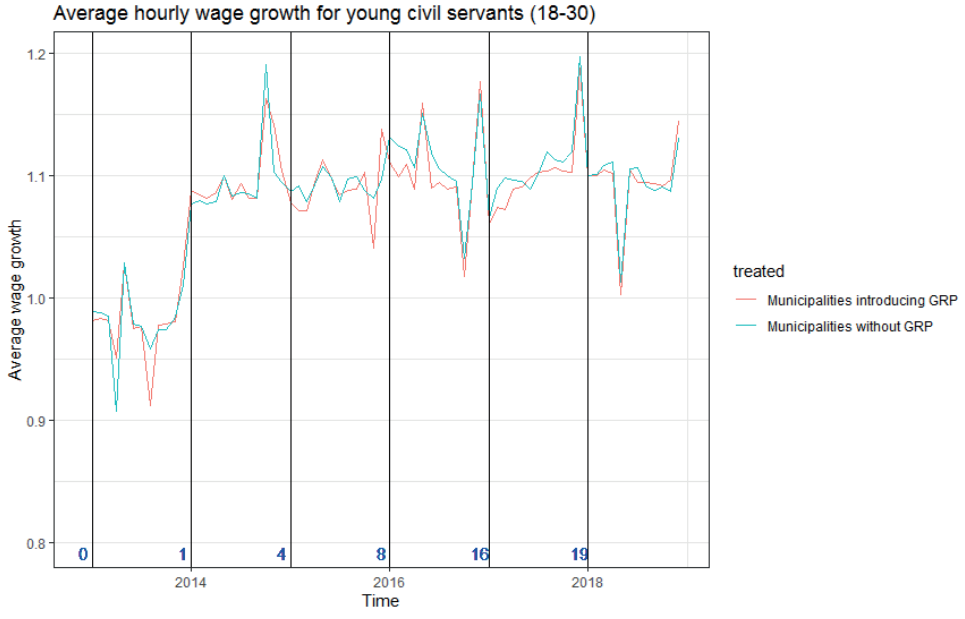

Figure 16 Average hourly wage growth for young civil servants in the treatment and control group (including G4 municipalities).

Appendix III: Additional regression tables

To check whether the effects of the GRP are different between older male and female civil servants we run to same regression as (1), but now only on the population of male and female civil servants separately. In this way, we check for heterogeneous effects between men and women. The tables below show that the same conclusions hold for both men and women.

EXCL. G4 Older civil servants (60+): Intensive and extensive margin combined						
	Male			Female		
D_{imt}	2.899**	2.534**	-6.468***	2.759**	2.484**	-1.870
	(1.145)	(1.109)	(1.809)	(1.279)	(1.216)	(1.966)
$D_{imt} * age(61)$			0.285			0.397
			(1.270)			(1.360)
$D_{imt} * age(62)$			6.593***			3.004
			(1.812)			(1.941)
$D_{imt} * age(63)$			13.422***			6.280***
			(2.122)			(2.275)
$D_{imt} * age(64)$			17.375***			8.962***
			(2.356)			(2.498)
$D_{imt} * age(65)$			20.792***			11.955***
			(2.287)			(2.428)
1st generation immigrant		1.135	1.010		6.636**	6.691**
		(2.693)	(2.698)		(2.825)	(2.824)
2nd generation immigrant		1.883	1.953		8.950***	8.904***
		(2.476)	(2.472)		(2.687)	(2.681)
Kidsdummy		5.917***	5.933***		2.147	2.129
		(2.476)	(1.321)		(1.711)	(1.710)
married		3.327**	3.351**		-17.637***	-17.680***
		(1.458)	(1.458)		(1.468)	(1.468)
Age dummies						
61		-3.341***	-3.389***		-4.984***	-5.078***
		(0.413)	(0.500)		(0.452)	(0.567)
62		-9.907***	-11.477***		-11.409***	-12.218***
		(0.681)	(0.830)		(0.736)	(0.926)
63		-19.132***	-22.799***		-19.448***	-21.353***
		(0.933)	(1.157)		(1.007)	(1.294)
64		-33.088***	-38.392***		-31.553***	-34.631***
		(1.173)	(1.458)		(1.253)	(1.630)
65		-66.913***	-74.704***		-57.522***	-62.499***
		(1.298)	(1.572)		(1.366)	(1.725)
α	136.338***	133.813***	133.932***	104.582***	117.381***	117.152***
	(5.574)	(5.520)	(5.510)	(7.698)	(7.322)	(7.326)
Controls	NO	YES	YES	NO	YES	YES
Municipality FE	YES	YES	YES	YES	YES	YES
Time FE	YES	YES	YES	YES	YES	YES
Adj. R^2	10.5%	15.9%	16.1%	6.8%	13.6%	13.7%
Civil servants	8,629	8,629	8,629	5,760	5,760	5,760

*Table 15 Clustered standard errors at the civil servant level between parentheses. *** denotes significance at the 1% level, ** denotes significance at the 5% level, and * denotes significance at the 10% level. Age 60 is the reference category in the above regression.*

EXCL. G4 Older civil servants (60+): extensive margin						
	Male			Female		
D_{imt}	0.038*** (0.007)	0.36*** (0.007)	-0.020* (0.012)	0.038*** (0.010)	0.036*** (0.009)	0.004 (0.014)
$D_{imt} * age(61)$			0.001 (0.008)			0.001 (0.010)
$D_{imt} * age(62)$			0.039*** (0.012)			0.019 (0.015)
$D_{imt} * age(63)$			0.083*** (0.014)			0.044** (0.017)
$D_{imt} * age(64)$			0.108*** (0.015)			0.069*** (0.019)
$D_{imt} * age(65)$			0.131*** (0.015)			0.091*** (0.019)
1st generation immigrant		-0.000 (0.017)	-0.001 (0.017)		0.004 (0.019)	0.005 (0.019)
2nd generation immigrant		0.017 (0.016)	0.017 (0.016)		0.040** (0.018)	0.040** (0.018)
Kidsdummy		0.031*** (0.008)	0.032*** (0.008)		0.027** (0.012)	0.027** (0.012)
married		0.017* (0.009)	0.017* (0.009)		-0.061*** (0.010)	-0.062*** (0.010)
Age dummies						
61		-0.018*** (0.003)	-0.018*** (0.003)		-0.034*** (0.004)	-0.034*** (0.004)
62		-0.056*** (0.004)	-0.065*** (0.005)		-0.079*** (0.006)	-0.084*** (0.007)
63		-0.111*** (0.006)	-0.134*** (0.007)		-0.141*** (0.008)	-0.154*** (0.010)
64		-0.201*** (0.008)	-0.234*** (0.009)		-0.234*** (0.010)	-0.258*** (0.012)
65		-0.431*** (0.008)	-0.481*** (0.010)		-0.448*** (0.010)	-0.486*** (0.013)
α	0.916*** (0.035)	0.905*** (0.034)	0.905*** (0.034)	0.887*** (0.052)	0.931*** (0.051)	0.929*** (0.051)
Controls	NO	YES	YES	NO	YES	YES
Municipality FE	YES	YES	YES	YES	YES	YES
Time FE	YES	YES	YES	YES	YES	YES
Adj. R^2	11.2%	16.3%	16.5%	8.5%	14.1%	14.2%
Civil servants	8,629	8,629	8,629	5,760	5,760	5,760

*Table 16 Clustered standard errors at the civil servant level between parentheses. *** denotes significance at the 1% level, ** denotes significance at the 5% level, and * denotes significance at the 10% level. Age 60 is the reference category in the above regression.*

Appendix IV: Regressions results including G4

Older civil servants (60+): Intensive and extensive margin combined			
D_{imt}	2.139*** (0.736)	2.063*** (0.707)	-2.464** (1.090)
$D_{imt} * age(61)$			0.188 (0.697)
$D_{imt} * age(62)$			3.016*** (1.011)
$D_{imt} * age(63)$			6.263*** (1.190)
$D_{imt} * age(64)$			9.616*** (1.286)
$D_{imt} * age(65)$			11.180*** (1.249)
Male		16.822*** (0.656)	16.809*** (0.656)
1st generation immigrant		6.324*** (1.037)	6.282*** (1.038)
2nd generation immigrant		2.804** (1.261)	2.769** (1.260)
Kidsdummy		5.674*** (0.724)	5.630*** (0.724)
married		-5.032*** (0.715)	-5.053*** (0.715)
Age dummies			
61		-3.259*** (0.225)	-3.287*** (0.226)
62		-8.753*** (0.368)	-9.398*** (0.437)
63		-16.399*** (0.496)	-17.918*** (0.600)
64		-28.521*** (0.610)	-31.162*** (0.737)
65		-57.804*** (0.669)	-61.483*** (0.798)
α	131.610*** (4.598)	123.698*** (4.432)	123.687*** (4.430)
Controls	NO	YES	YES
Municipality FE	YES	YES	YES
Time FE	YES	YES	YES
Adj. R^2	8.9%	14.4%	14.4%
Civil servants	25,461	25,461	25,641

*Table 17 Clustered standard errors at the civil servant level between parentheses. *** denotes significance at the 1% level, ** denotes significance at the 5% level, and * denotes significance at the 10% level. Age 60 is the reference category in the above regression.*

Older civil servants (60+): extensive margin			
D_{imt}	0.035*** (0.005)	0.033*** (0.005)	0.003 (0.007)
$D_{imt} * age(61)$			0.005 (0.005)
$D_{imt} * age(62)$			0.022*** (0.007)
$D_{imt} * age(63)$			0.043*** (0.008)
$D_{imt} * age(64)$			0.063*** (0.009)
$D_{imt} * age(65)$			0.067*** (0.009)
Male		0.026*** (0.004)	0.026*** (0.004)
1st generation immigrant		0.021*** (0.007)	0.021*** (0.007)
2nd generation immigrant		0.017** (0.008)	0.017** (0.008)
Kidsdummy		0.033*** (0.005)	0.033*** (0.005)
Married		-0.014*** (0.005)	-0.014*** (0.005)
Age dummies			
61		-0.020*** (0.002)	-0.021*** (0.002)
62		-0.055*** (0.003)	-0.059*** (0.003)
63		-0.105*** (0.003)	-0.115*** (0.004)
64		-0.188*** (0.004)	-0.205*** (0.005)
65		-0.397*** (0.005)	-0.418*** (0.005)
α	0.940*** (0.029)	0.934*** (0.028)	0.934*** (0.028)
Controls	NO	YES	YES
Municipality FE	YES	YES	YES
Time FE	YES	YES	YES
Adj. R^2	9.4%	13.8%	13.9%
Civil servants	25,461	25,461	25,641

*Table 18 Clustered standard errors at the civil servant level between parentheses. *** denotes significance at the 1% level, ** denotes significance at the 5% level, and * denotes significance at the 10% level. Age 60 is the reference category in the above regression.*

IV.A Male and female separately

Older civil servants (60+): extensive margin						
	Male			Female		
D_{imt}	0.032*** (0.006)	0.031*** (0.006)	-0.008 (0.009)	0.037*** (0.008)	0.034*** (0.008)	0.014 (0.012)
$D_{imt} * age(61)$			0.007 (0.006)			0.003 (0.007)
$D_{imt} * age(62)$			0.030*** (0.009)			0.014 (0.011)
$D_{imt} * age(63)$			0.058*** (0.010)			0.026** (0.013)
$D_{imt} * age(64)$			0.077*** (0.011)			0.050*** (0.014)
$D_{imt} * age(65)$			0.080*** (0.011)			0.053*** (0.014)
1st generation immigrant		0.022** (0.009)	0.022** (0.009)		0.021** (0.013)	0.020* (0.011)
2nd generation immigrant		0.006 (0.011)	0.006 (0.011)		0.036*** (0.013)	0.036*** (0.013)
Kidsdummy		0.032*** (0.006)	0.032*** (0.006)		0.029*** (0.008)	0.028*** (0.008)
married		0.015** (0.006)	0.014** (0.006)		-0.052*** (0.007)	-0.052*** (0.007)
Age dummies						
61		-0.018*** (0.002)	-0.019*** (0.002)		-0.025*** (0.003)	-0.026*** (0.003)
62		-0.052*** (0.003)	-0.058*** (0.004)		-0.061*** (0.004)	-0.065*** (0.005)
63		-0.101*** (0.004)	-0.114*** (0.005)		-0.114*** (0.006)	-0.121*** (0.007)
64		-0.184*** (0.005)	-0.203*** (0.006)		-0.197*** (0.007)	-0.212*** (0.008)
65		-0.398*** (0.006)	-0.423*** (0.007)		-0.396*** (0.007)	-0.415*** (0.009)
α	0.939*** (0.035)	0.929*** (0.034)	0.930*** (0.034)	0.937*** (0.008)	0.973*** (0.051)	0.972*** (0.051)
Controls	NO	YES	YES	NO	YES	YES
Muncipality FE	YES	YES	YES	YES	YES	YES
Time FE	YES	YES	YES	YES	YES	YES
Adj. R^2	10.7%	15.1%	15.2%	8.0%	12.6%	12.6%
Civil servants	15,721	15,721	15,721	9,740	9,740	9,740

*Table 19 Clustered standard errors at the civil servant level between parentheses. *** denotes significance at the 1% level, ** denotes significance at the 5% level, and * denotes significance at the 10% level. Age 60 is the reference category in the above regression.*

Older civil servants (60+): Intensive and extensive margin combined						
	Male			Female		
D_{imt}	1.697*	1.655*	-4.628***	2.754**	2.534**	0.048
	(0.962)	(0.929)	(1.442)	(1.113)	(1.068)	(1.641)
$D_{imt} * age(61)$			0.845			-0.368
			(0.949)			(1.011)
$D_{imt} * age(62)$			4.711***			1.229
			(1.349)			(1.504)
$D_{imt} * age(63)$			9.021***			2.849
			(1.574)			(1.782)
$D_{imt} * age(64)$			12.207***			6.342***
			(1.705)			(1.908)
$D_{imt} * age(65)$			13.180***			8.308***
			(1.653)			(1.851)
1st generation immigrant		5.049***	4.999***		7.976***	7.942***
		(1.352)	(1.353)		(1.589)	(1.589)
2nd generation immigrant		0.500	0.471		6.853***	6.819***
		(1.685)	(1.683)		(1.859)	(1.859)
Kidsdummy		5.758***	5.709***		2.858**	2.828**
		(0.890)	(0.890)		(1.210)	(1.209)
married		2.977***	2.957***		-14.805***	-14.826***
		(0.974)	(0.974)		(1.030)	(1.030)
Age dummies						
61		-3.188***	-3.335***		-3.759***	-3.664***
		(0.297)	(0.345)		(0.338)	(0.411)
62		-8.997***	-9.926***		-8.952***	-9.248***
		(0.484)	(0.567)		(0.554)	(0.673)
63		-17.042***	-19.088***		-15.967***	-16.733***
		(0.651)	(0.775)		(0.748)	(0.924)
64		-29.906***	-33.036***		-26.860***	-28.796***
		(0.801)	(0.951)		(0.913)	(1.131)
65		-61.440***	-65.466***		-52.003***	-55.030***
		(0.877)	(1.031)		(0.994)	(1.209)
α	140.100***	137.710***	137.912***	112.451***	122.961***	122.728***
	(5.622)	(5.487)	(5.480)	(7.696)	(7.274)	(7.277)
Controls	NO	YES	YES	NO	YES	YES
Municipality FE	YES	YES	YES	YES	YES	YES
Time FE	YES	YES	YES	YES	YES	YES
Adj. R^2	10.3%	15.0%	15.1%	6.7%	12.0%	12.1%
Civil servants	15,721	15,721	15,721	9,740	9,740	9,740

*Table 20 Clustered standard errors at the civil servant level between parentheses. *** denotes significance at the 1% level, ** denotes significance at the 5% level, and * denotes significance at the 10% level. Age 60 is the reference category in the above regression.*

IV.B regressions for young civil servants

	Age group (18-30)	
	Log (young civil servants)	% of young civil servants
D_{mt}	0.060 (0.073)	0.156 (0.319)
Adj. R^2	92.7%	71.5%
Number of observations	2,688	2,688

*Table 21 The effect of adopting a GRP on the number of younger workers hired. Clustered standard errors at the municipality level between parentheses. *** denotes significance at the 1% level, ** denotes significance at the 5% level, and * denotes significance at the 10% level.*

	Age group (18-30)	
D_{imt}	-0.002 (0.002)	-0.002 (0.002)
Adj. R^2	14.6%	15.3%
Controls	NO	YES
Number of civil servants	10,322	10,322

*Table 22 Wage growth for young civil servants. Clustered standard errors at the civil servant level between parentheses. *** denotes significance at the 1% level, ** denotes significance at the 5% level, and * denotes significance at the 10% level.*

Appendix V: The effects of GRPs on medication use

In addition to the employment effects of GRPs, we analyzed the effect of GRPs on medication use for older civil servants. Since medication data is only available per year, we rewrite the monthly dataset to yearly data. Moreover, since we find the largest effects of GRPs for the middle- and high wage income group, we focus this analysis on this group.[50]

We have data on medication use for four categories, namely: hypertension, high cholesterol (hyperlipidemia), pain and inflammation, and mental diseases (depression, anxiety, and tension). The medical condition, ATC code, and description of the ATC code is summarized in Table 23.

medical condition (1)	ATC-code (2)	Description of ATC-code (3)
Hypertension	C02A, C02B, C02C, C02D, C02K, C02L, C02N,	Antihypertensives: antiadrenergic agents, centrally acting, ganglion-blocking, peripherally acting, other antihypertensives
	C03A,	Low-ceiling diuretics, thiaziden
	C07A, C07B,C07C, C07D, C07E, C07F,	Beta blocking agents
	C08C, C08D, C08E, C08G,	Calcium channel blockers
	C09A, C09B	Angiotensin-converting enzyme (ACE) inhibitors
Cholesterol	C10A	Cholesterol and triglyceride reducers
Pain and inflammation	M01A	Non-steroids anti-inflammatory and antirheumatic products
	N02A	Opioids
Depression, Anxiety and tension	N06A	Tricyclic antidepressants
	N05A	Selective serotonin reuptake inhibitors
	N05C	Monoamine oxidase inhibitors

[50] In case we focus on the entire population, the results do not change.

	N07B	Other antidepressants
	N05B	Anxiolytics

Table 23 *Overview of medication use. The first column indicates the medical condition. The second column the ATC code of medication. The description of ATC code is presented in the third column. Adapted from Lamers and Van Vliet (2004).*

To analyze the effect of GRPs on medication use, we use a linear probability model and run the following regression:

$$med_{im,t} = \alpha + \gamma_t + \delta_m + \beta_1 D_{mt} + \beta_2 X_{imt} + \epsilon_{imt} \quad (A1)$$

The dependent variable is $med_{im,t}$, which indicates whether individual i who works for municipality m uses medication in year t. If this is (not) the case, the variable is equal to unity (zero). γ_t and δ_m are year dummies and municipality dummies, respectively. D_{mt} is a dummy variable equal to unity in case a GRP is available in municipality m in year t. If this is not the case, D_{mt} equals zero. The control variables X_{imt} are equal to the ones in the main text. Lastly, ϵ_{imt} denotes the error term.

The main coefficient of interest is β_1. In case this coefficient is positive (negative), it indicates that the introduction of GRPs lead to more (less) medication use. Since one of the main goals of GRPs is to let older workers reach the pension eligibility age healthily, we expect a negative sign for β_1. We analyze the effects of GRPs on medication use in the year a GRP becomes available (t=0) as well as one and two years after implementation of a GRP (t=1 and t=2, respectively). Table 24 shows the results.

We find negative effects of GRPs on medication use for mental diseases (hypertension) in the range of minus 0.6 to minus 1%-point (minus 0.1 to minus 0.8%-points). These effects are, however, not significantly different from zero. We find positive yet insignificant effects for pain and inflammation (0.3-0.6%-points). For cholesterol we find sometimes a positive and sometimes a negative effect. However, also these coefficients are insignificant.

	(1)	(2)	(3)
	Pain and inflammation		
	t=0	t=1	t=2
D_{mt}	0.3 (0.8)	0.6 (0.7)	0.3 (0.7)
	Mental diseases		
	t=0	t=1	t=2
D_{mt}	-0.1 (0.5)	-0.2 (0.5)	-0.8 (0.5)
	Hypertension		
	t=0	t=1	t=2
D_{mt}	-0.6 (0.8)	-0.8 (0.8)	-1.0 (0.8)
	Cholesterol		
	t=0	t=1	t=2
D_{mt}	-0.02 (0.7)	0.1 (0.7)	-0.0 (0.8)
Yeardummies	X	X	X
Municipality FE	X	X	X
Controls	X	X	X
Civil servants	9,737		

*Table 24: The effect of GRPs on medication use for several medication categories. A coefficient of -1.0 indicates that medication use decreases by 1%-point due to the introduction of a GRP. Y=0, Y=1, and Y=2 indicate the effect of GRPs on the year of implementation, one year after implementation ,and two years after implementation, respectively. *** indicates significance level at 1%, ** at 5%, and * at 10%. Clustered standard errors at the civil servant level between parentheses.*

Chapter 3. The effect of job finding on medication use

A.T.G.J. Rutten[1]

Abstract

I analyze the effect of job finding on health. To do so, I use the Dutch unemployment benefit reform of 2006 as an instrument. This reform decreased the maximum entitlement period for some workers, while for others it did not change. I find that a decrease in the maximum entitlement period leads to an increase in the probability that someone works. This in turn affects medication use. I find that medication for hyperlipidemia, mental diseases, and pain and inflammation significantly decreases due to finding work.

Keywords: optimal unemployment insurance, medication use, administrative data

JEL codes: H51, H53, I18, J65

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This paper uses confidential microdata from Statistics Netherlands (CBS). The datasets I use can be obtained by filing a request directly to CBS. The above mentioned author is willing to help others to get access to these datasets.

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I Introduction

The negative relationship between well-being and unemployment has been widely documented in the literature (Norström, et al. (2019); Wilson & Walker(1993); Clark & Oswald (1994); Paul & Moser, (2009)). Moreover, the health of employed workers tends to be higher than the health of unemployed. For instance, Yildiz, Schuring, Knoef, and Burdorf (2020) report that unemployed workers are more likely to have cardiovascular diseases, mental disorders, inflammatory conditions, and respiratory diseases for the Netherlands.

However, the relationship between unemployment and health (or medication use) is difficult to analyze for several reasons. First, it could be the case that people with worse health are less likely to be productive. As a result, they are more likely to lose their job and file for unemployment insurance (UI). Second, unemployed workers with worse health are more likely to stay longer unemployed (Steward, 2000). Third, being unemployed may lead to a decrease in the stock of health (Stutzer and Lalive (2004)). To deal with those issues, several papers focus on exogenous events like plant closure. In these studies, one group is affected by the closure and another group of workers that work at a different factory are not (Kuhn, Lalive, and Zweimüller (2009); Browning, Moller Dano, and Heinesen (2006)).

This paper does not focus on the aforementioned events. Instead, I use a change in the unemployment insurance (UI) scheme in the Netherlands to determine the relationship between work and medication use. Due to this reform, most workers that filed for UI faced a decrease in the maximum entitlement period. Some groups, however, did not. This provides me with an ideal setting to test how a decrease in UI duration affects job finding.

I use administrative data from Statistics Netherlands to analyze the effect of a decrease in the maximum entitlement period on finding a job. The administrative contains a wide range of background variables as well as economic variables. Lastly, these administrative data also contain medication use per year, which means that I do not have to rely on self-reported health measures.

To determine the effect of work on medication use, I use an instrumental variable strategy. In the first stage of the regression, I find that decreasing the maximum entitlement period has a positive and significant effect on finding a job. In other words, a decrease in the maximum entitlement period is a relevant instrument. In the second stage of the regression, I use this instrument to determine the effect of work on the use of medication. I find that work significantly decreases medication use for

mental illnesses as well as hyperlipidemia, and pain and inflammation[2]. I do not find any significant effect when analyzing medication for hypertension.

The contribution to the literature is twofold. First, understanding how the design of UI insurance contributes to overall cost is important. The standard Baily (1978) – Chetty (2006) formula shows that there is trade-off between income insurance and reintegration in the labor market. More precisely, an increase in UI generosity may increase moral hazard as it makes unemployed workers less likely to look for vacancies or accept a job offer. Spinnewijn (2015) offers an extensions to this standard framework by taking into account behavioral elements. However, there have been little extensions taking into account healthcare cost. Since health care costs increase strongly during the last decades in most OECD countries (Hagist & Kotlikoff, 2005), it is important to know how changes in UI affects these costs. The Netherlands is a country that is ideally suited to address this relationship for several reasons. First, health insurance in the Netherlands is mandatory for everyone, regardless of gender, age, and/or working history. Although I do not have data on subjective well-being, universal health insurance coverage suggests that health care costs are more informative regarding underlying health status than in a setting where health insurance is voluntary. Second, the Dutch system covers to a large extent the costs associated with take-up of health care (visiting a GP, hospitalizations, and prescribed medication). Therefore, the use of medication provides direct information on the health status of individuals.

Second, as far as I know, this is the first paper that analyzes how a change in UI duration affects personal health. Other papers like Kuka (2020) or Cylus, Glymour, and Avendano (2015) focus on the replacement rate to analyze effects on self-reported health or suicide rates, respectively. I show that not only the level of benefits matters to determine the effect on health but also the UI duration. Combining the findings in this paper with the aforementioned papers may indicate that a UI benefit scheme with a high replacement rate and a short duration may be optimal from a health perspective.

The setup of the rest of the paper is as follows. Section II discusses the related literature. Section III describes the unemployment insurance (UI hereafter) reform, the Dutch health care system, and the medication under consideration in this study. Section IV provides the descriptive statistics and Section V discusses the estimation method and the result. Lastly, section VI concludes.

[2] For this category, there is only an effect after three years.

II literature review

In this section, I discuss the related literature. In general, there are two branches of literature. First, I will focus on the literature that covers the relationship between unemployment and health, explaining whether unemployment could lead to worse health outcomes. Thereafter I will discuss papers that analyze the effects of UI schemes on health. In particular, the second question analyzes whether unemployment insurance schemes can potentially mitigate negative health effects. Although this paper mainly adds to the literature for the second question, I discuss both questions. In this manner, it becomes clear how this paper adds to the overall literature.

II.A Health and unemployment

To start with, the health of unemployed workers tends to be lower than those of employed workers. Analyzing the literature, there are three possible explanations for this. First, there could be a selection effect of ill workers into unemployment (García-Gómez, Jones, & Rice (2010); Schmitz (2011)). To deal with these issues several papers focus on exogenous events to determine the effect of unemployment on health.

For instance, Kuhn, Lalive, and Zweimüller (2009) use a propensity score matching method by exploiting the exogenous event of plant closure. Using this event, they can estimate the effect of job loss on health outcomes by using objective health measures. They find that job loss increases hospitalizations for mental health reasons as well as an increase in prescriptions for antidepressants for males. However, they do not find any effect in terms of public health costs due to health provisions (i.e. hospitalizations, doctor visits, drug use, etc.). Keefe, et al. (2002) report an increase in excess risk of self-harm in a sample of displaced workers after the bankruptcy of a meat-processing plant. Eliason and Storrie (2009) find that alcohol-related mortality and suicide rates were about twice as high for Swedish workers that lost their job after plant closure. In a similar vein, Sullivan and Von Wachter (2009) show that for high-seniority male workers the mortality rate is more than fifty percent higher after the year of displacement. Field and Briggs (2001) find that jobless workers in the UK visit general practitioners more often when compared to employed workers with similar characteristics.

The findings of the previously mentioned papers are not in line with Browning, Moller, Dano, and Heinesen (2006). Using a sample of the male Danish population over the period 1981-1999, they find that plant closure does not result in hospitalization for stress-related diseases.[3] Salm (2009) find similar results for older workers in the US. In other words, these last two cited papers argue that

[3] It is, however, important to note that the study of Kuhn et al. (2009) takes into account the take-up of all kinds of health care provisions covered by public health insurance. In that sense, that study has a wider scope.

there is a selection effect of unemployed workers into unemployment and that unemployment itself cannot be a shock that determines bad health outcomes.

The second mechanism that could play a role is that poor health causes workers to remain longer unemployed. Stewart (2001) analyzes how health status affect the duration of the unemployment spell. He finds that bad health significantly increases the duration of the unemployment spell. As a consequence, the unemployed workers have (almost by construction) a lower health than working individuals as healthier workers tend to find a job faster.

Third, unemployment itself may lead to a decrease in the stock of health. Krueger and Mueller (2012) find that the lifestyle of unemployed and employed workers differs. This could lead to different health outcomes. This difference in life patterns could be related to the feeling of social exclusion for unemployed workers (Pohlan, 2019). In addition, Stutzer and Lalive (2004) focus on subjective well-being and find that social norms play an important role in explaining the life satisfaction of unemployed workers. They find that in regions where the social norm "to live off one's own income" is stronger, there is a decrease in subjective well-being. In a similar vein, Hetschko, Knabe, and Schöb (2014) argue that older workers who switch from unemployment to retirement report higher life satisfaction than older workers that remain unemployed. This may indicate that unemployment has a lower identity value than retirement as the social norm expects the former group to be active in the labor force. Lastly, Urbanos-Garrido and Lopez-Valcarcel (2015) find that mental health decreases once an unemployed worker remains longer unemployed. This may also indicate that employment itself has essential social purposes in terms of status and identity.

II.B Health and government programs

Apart from the above-mentioned mechanisms, another component that plays a role in explaining health outcomes is the relationship between government programs and health. Several studies show that directly providing health insurance and medical services for low-income adults is associated with higher health care utilization and improved self-reported health (Finkelstein, et al., 2012). However, government programs can affect health outcomes not only via health-related programs but as well through income effects (Evans & Garthwaite, 2014).

The same holds as well for the generosity of unemployment insurance schemes. Although several papers discuss how UI reforms affect labor market outcomes (van Ours & Vodopivec, (2006); Lammers, Odding, Schwartz, Heyma, & Meij (2020); de Groot & van der Klaauw, (2019); Card, Chetty, & Weber, (2007); Lalive (2008)), the impact of UI reforms on the use of medication is limited. Kuka (2020) investigates how potential UI generosity affects the health status and health risk behaviors of the unemployed. Exploiting changes in state UI law, she finds that higher UI generosity leads to

higher self-reported health. However, she does not find any short-term changes in risky behaviors such as alcohol consumption or smoking. Cylus, Glymour, and Avendano (2014) find that more generous unemployment schemes decrease suicide rates in recessions. In a similar vein, Cylus, Glymour, and Avendano (2015) find that a 63% increase in the level of unemployment insurance benefits could potentially mitigate any negative effects on self-reported health in the US. In a similar vein, Vahid Shahidi, et al. (2016) find that generous unemployment insurance programs could positively affect the health of unemployed workers.

III Institutional framework

Having discussed the related literature, this section discusses the UI reform as was introduced by the Dutch government in October 2006. After having done this, I discuss how the Dutch healthcare system works and provide information on medication.

III.A Before the reform

Before the UI reform of 2006, the Dutch UI system had three types of UI insurance. First, there was the short-term UI scheme. The short-term UI scheme had a maximum duration of six months. Second, there was the long-term UI scheme. The maximum duration of the long-term UI scheme depends on the worker's labor market history. The minimum duration is six months, and the maximum UI duration is five years and depends on a worker's labor market history (see Figure 1). Both the short term and long-term UI are equal to 70% of the last earned wage. Third, there is the extended UI scheme. This scheme has a maximum duration of two years and is only available for workers that are eligible for the long-term UI scheme. Those workers are eligible at the end of the entitlement period. The extended UI scheme equaled 70% of the minimum wage. Lastly, it is important to note that this extended UI scheme was only available for workers that filed for UI prior to August 11, 2003.

To be eligible for the short-term UI scheme, a worker has to satisfy the weeks' condition. This means that a worker has worked at least 26 weeks out of the last 39 weeks. Workers already work one week in case they work one day in that week.[4] To be eligible for the Long-term UI scheme, workers need to satisfy both the week condition and the year condition. To meet the latter obligation, workers need

[4] In case a worker did not work during a particular week because of illness, disability or unpaid leave, the 39 weeks threshold does no longer hold. Holds as well for pregnancy, childbirth, child adoption, and foster care. In these cases, the number of 39 weeks increases by the number of weeks that one of the above-mentioned circumstances played a role.

to work for at least four out of five years for at least 52 days each year. In case a worker has a longer working history than four years, the maximum duration of the UI scheme increases via a stepwise function.[5] This information is summarized in the first two columns of Table 1.

	(1)		(2)	
	Before the reform		After the Reform	
	Weeks condition (26/39 weeks)	Years condition (4/5 years)	Weeks condition (26/36 weeks)	Years condition (4/5 years)
Short-term UI	✓		✓	
Long-term UI	✓	✓	✓	✓
Extended UI	✓	✓	NA	NA

Table 1 Overview of UI eligibility conditions. There are two criteria that determine whether someone is eligible for UI, namely the weeks condition and the years condition. The checkmark in each cell indicates which condition needs to be met to be eligible for either a short-term UI, long-term UI, and / or extended UI. After the reform, the extended UI does not longer exist. Therefore, these cells are filled with NA. This table is based on Ministry of Social Affairs (2005).

III.B After the reform

In October 2006, the Dutch UI insurance system changed. First, the weeks' condition becomes stricter. This means that out of the last 36 weeks someone must work at least 26 weeks to be eligible for the short-term UI. To be eligible for the long-term UI, a person needs to meet both the years condition and the weeks' condition. The years' condition did not change after the reform. In other words, a worker still needs to have worked 4 out of the last 5 years for at least 52 days. The extended UI scheme was abolished except for older workers.[6]

Second, the replacement rate increased for the first two months to 75%. Thereafter it decreases to the initial level of 70%. Lastly, there is a decrease in the maximum UI insurance. This is graphically represented in Figure 1.

[5] It is also possible to increase the number of working years with a care allowance. Taking care of a child that is younger than five years old or informal care can be used to increase the years of working history.

[6] Older workers could still make use of the Extended UI called IOW.

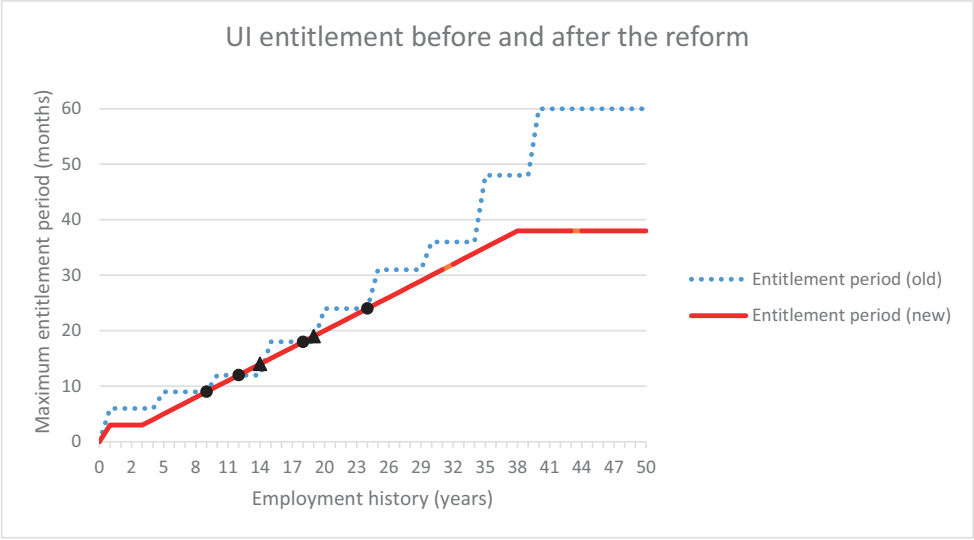

Figure 1 maximum UI entitlement before and after the UI reform of 2006. A circle indicates no change due to the UI reform; a triangle indicates an increase in the entitlement period. All other workers – that are not indicated by a circle or triangle – face a decrease in their UI entitlement. Based on Von Bergh, Ramparichan, and Schippers (2019).

Figure 1 shows the difference between the new and the old scheme regarding the maximum entitlement period based on labor market history. The dashed blue line indicates the UI build-up under the old system. I observe that the old system of UI rights is a step-function that increases after having reached a particular threshold. For instance, the maximum entitlement period increased from six to nine months when the employment history increases from five to six years.

The new scheme shows a different build-up regime. After one to three working years, there is a maximum UI entitlement of three months. After three working years, the maximum UI entitlement period increases by one month for every year worked. This UI build-up is capped at 38 months. In other words, after having worked more than 38 years, the maximum UI entitlement no longer increases.

The difference between the old and new system of UI entitlement rights allows us to compare individuals who faced an increase or decrease in UI entitlement rights to those that did not have any change. This is summarized in Table 2. In particular, workers with 9, 12, 18, and 24 years of employment history did not see a change in their entitlement period after the reform (indicated by the black circle in the graph). On the other hand, workers with for instance 13, 14, or 19 years of employment history saw an increase in their unemployment duration after the reform. Lastly, all other workers with a different employment history face a decrease in UI entitlement. For example, everyone with more than 26 years of employment history will face a decrease in UI entitlement. This

variation in the change of UI rights is the mechanism I exploit in the first stage of the instrumental variable analysis in sections V.

Lastly, workers who filed for UI before October 2006 do not face a decrease in their UI duration. In other words, it is not the case that unemployed workers thought they were eligible for twelve months of UI, but, due to the reform, get an update that their entitlement period has been reduced to ten months. Only new cases (i.e., workers that file for UI after September) could face a decrease in their maximum UI duration (see Table 2). In other words, only new cases are confronted with a decrease in their maximum UI entitlement and they will know so from the beginning.

Employment history (years)	Increase / Decrease / no change in UI entitlement (months)
25, 30, 35-50	Decrease > 5
26, 31	-5
5, 20, 27, 32	-4
0.5-3, 6, 15, 21, 28, 33	-3
4, 7, 10, 16, 22, 29, 34	-2
8, 11, 17, 23	-1
9, 12, 18, 24	0
13, 19	+1
14	+2

Table 2 Increase/ decrease / no change in UI entitlement (months) for a given number of employment years due to the UI reform of 2006. Based on Von Bergh, Ramparichan, and Schippers (2019).

III.C Dutch healthcare system

Having discussed the UI reform, I now provide an analysis of the Dutch health care system. One of the main features of the Dutch health care system is that coverage is universal. More precisely, everyone above the age of 18 should buy health insurance.[7] Hence, health insurance does not depend on someone's age (like Medicare in the US) or income (like Medicaid). Moreover, because of this mandatory insurance a large fraction of the health care costs is reimbursed and not paid by the individual. A more elaborate overview of the Dutch healthcare system is represented in Appendix III.

III.D Overview of medication

When discussing how a change in the UI system affects health outcomes[8], I focus on two medication groups. The first group consist of medication which take-up rate may change once employment status changes. Therefore I focus on four medication categories, namely: hypertension,

[7] Everyone below the age of 18 receives free health care.
[8] Van Ooijen, Alessie, and Knoef (2015) discuss a model that describes the evolution of health. They show that persistence in health is rather high.

hyperlipidemia (high cholesterol), pain and inflammation, and mental diseases (i.e. depression, anxiety, and tension).

I limit myself to these four groups as not every medical condition is relevant in this study. Since job loss is a stressful event, stress levels are likely to increase. This could cause hypertension as well as hyperlipidemia. Moreover, hypertension could also be caused by an increase in alcohol use. Several studies show a positive relationship between losing a job and an increase in alcohol use (Popovici & French, (2013); Compton, Gfroerer, Conway, & Finger, (2014)). Pain and inflammation cover medication use to both physical and mental pain. For the latter category, the focus is mainly on headaches. Chinta, Rao, Narendran, Malla, and Joshi (2013) show that there are more headache-related hospital admissions in regions with higher unemployment. Lastly, I include medication for mental health diseases as several papers discuss the role of mental health and unemployment (Murphy and Athanasou (1999); Backhans and Hemmingsson, (2012)).

The second group which I take into consideration is not likely to change once employed status changes. The reason for this is that this type of medication use is more chronic. This group consists of three categories, namely: Epilepsy, diabetes, and respiratory diseases (e.g., asthma).

Both categories and the corresponding medication are summarized in Table 3 below. I base these disease categories on Lamers and Van Vliet (2004)[9]. Each medical condition in column (1) of Table 3 is accompanied by a 4-digit ATC code in column (2). The ATC system is a classification system for medication. The description of these medicines is represented in column (3). For instance, the ATC codes C08C, C08D, C08E, and C08G are all calcium channel blockers. All medicines that are not mentioned in Table 3 are excluded from the analysis.

medical condition (1)	ATC-code (2)	Description of ATC-code (3)
Hypertension	C02A, C02B, C02C, C02D, C02K, C02L, C02N,	Antihypertensives: antiadrenergic agents, centrally acting, ganglion-blocking, peripherally acting, other antihypertensives
	C03A,	Low-ceiling diuretics, thiaziden

[9] There are two differences compared to the table in Lamers and Van Vliet (2004). First, they sometimes use ATC codes with more than 4 digits. Statistics Netherlands only provides medicines up to four digits and that is why the four digits medication category is represented in Table 3. Second, after consulting CBS, I decided to include two other categories for mental medication use, namely N07B and N05C. N05C is a very strong antidepressant whereas N07B is a collective term for several antidepressants. Lastly, I decided to make a) depression and b) anxiety, and tension one category as this concerns mental health.

	C07A, C07B,C07C, C07D, C07E, C07F,	Beta blocking agents
	C08C, C08D, C08E, C08G,	Calcium channel blockers
	C09A, C09B	Angiotensin-converting enzyme (ACE) inhibitors
Hyperlipidemia	C10A	Cholesterol and triglyceride reducers
Pain and inflammation	M01A	Non-steroids anti-inflammatory and antirheumatic products
	N02A	Opioids
Depression, Anxiety and tension	N06A	Tricyclic antidepressants
	N05A	Selective serotonin reuptake inhibitors
	N05C	Monoamine oxidase inhibitors
	N07B	Other antidepressants
	N05B	Anxiolytics
Epilepsy	N03A	Anti-epileptics
Diabetes	A10A	Insulin
	A10B	Blood glucose lowering drugs excl. insulins
Respiratory diseases	R03A, R03B, R03C, R03D	Inhalation sympathomimetics.

Table 3 Overview of diseases. The first column indicates the main category and the second column the ATC code of medicines. The description of ATC code is presented in the third column. Adapted from Lamers and Van Vliet (2004).

III.E Limitations

There are several limitations to this study which concern both the unemployment insurance reform and the Dutch health care system. The drawback of the unemployment insurance reform is that the UI scheme becomes more generous in the first two months. The reason for this is that the replacement rate increases from 70 to 75%. However, this increase in the replacement rate is rather

limited (i.e. the five percent increase cannot make up for losing an additional month of UI entitlement). Therefore, I believe it is not a major concern as the overall effect is still a less generous UI system. Nevertheless, in an ideal setting the replacement rate would have remained constant in the first two months.

With respect to the Dutch health care system there are two drawbacks. First, during the period I discuss there are several changes in the contract between health insurers and insured persons. For instance, until 2007 there was a no-claim discount[10] equal to €255, - and a voluntary deductible. This means that it was possible to receive money if a person did not have any health care cost. Since 2008, this has been replaced by a mandatory deductible that equals € 150, -. This means that each individual no longer receives money in case there is no treatment. Moreover, it implies that in the case of medical treatment, the first €150, - have to be paid by the insurer.[11]

Second, some medicines have their own deductible. Which medicine has its own deductible changes yearly.[12] Apart from this, the prices for generic medications decreased over the period 2004-2008 due to a covenant.[13] All of the above issues make it very hard to state what the costs of a particular medicine are. This may therefore affect which medicines are (not) bought in a particular year.

Lastly, Lock-in effects could play a role in the estimation strategy. In particular, it could be the case that people do not have time to pick up their medication once they are employed. As a result, medication use could decrease, while the underlying health status is still the same. However, I do not think that this is a large concern for the setting used in this paper. A recent paper in the US shows that employed workers are more likely to take up the covid-19 vaccine when compared to unemployed workers (Khubchandani, et al., 2021). If time availability is the main driver, this pattern should be opposite.

In a similar vein, if income drops substantially after becoming unemployed, it may become too expensive to buy medication. As a result, only those that find a job can buy medication to address their health care problems. However, health care coverage does not depend on employment status in the Netherlands. In addition, there are only small out of pocket expenses for medication use.[14] As a result, financial constraints are not likely to affect medication use.

[10] In Dutch: No-claim korting.
[11] Children are still excluded from the deductible.
[12] The exact amount is determined by the Ministry of Health (Overheid.nl, 2005).
[13] In the covenant “voluntary price reduction of generic medication by 40%” several parties agreed to reduce the prices of generic medication by 40%. This covenant was implemented in 2004 and lasted several years (Zorginstituut Nederland, n.d.).
[14] For instance, in case patients visit their general practitioner, there are no out of pocket expenses.

IV Descriptive Statistics

In the previous section, I discussed the institutional framework regarding the unemployment insurance reform as well as the Dutch health care system. I will implement in section V an instrumental variable strategy to analyze the effect of having a job on medication use. The instrument I use for this is the UI reform of 2006. As explained in the previous section, the UI reform of 2006 decreased the maximum UI duration for most workers, while for some it did not change.[15] In the first stage of the regression, I will exploit the difference in change in entitlement period to determine how a change in the maximum UI duration affects the job finding probability. Using this reform as an instrument gives me the possibility to determine the effect of work on the use of medication.

I use microdata from Statistics Netherlands to analyze the effects. With these data[16], I construct a dataset based on inflow into UI over the period July 2004- December 2008. In this way, I observe the inflow into the UI 27 months before and 27 months after the UI reform of October 2006. Yearly medication use is available for the years 2006-2011.[17] The medication data covers all medication that are covered by health insurance.

Using this microdata from Statistics Netherlands I have information on several economic as well as background variables. For instance, I have data on the sector where someone worked before becoming unemployed, the beginning date of the UI spell as well as the end date. I also have data on the sector[18] someone previously worked in. Lastly, I can construct the labor market history of each worker.[19] I only select individuals that meet the stricter weeks' condition. This means that someone

[15] I omit the group that saw an increase in the maximum UI duration in this analysis.

[16] I use the following data files: gbahuishoudensbus, gbapersoontab, baansommentab, baankenmerkenbus, medicijntab, wwpersoonbus, and polisbus. polisbus was used for the figure in the introduction and is not used for the rest of the analysis. I merge baansommentab en baankenmerkenbus based on "rinpersoons", "rinpersoon", and "baanid" to determine whether someone works in a particular month. I use the ATC-code from table 2 to determine whether someone uses a particular medicine in a particular year.

[17] This means that I do not observe medication use after one year of unemployment for individuals that lost their job in 2004.

[18] I determine the sector someone worked in to look at the employer one year before filing for UI. In case someone worked in multiple sectors, I select them into one sector to make sure that the fraction of sector shares add up to one.

[19] The labor market history is the sum of the fictional labor market history and the actual labor market history. Before 1999, there are no job records to determine someone's labor market history. Therefore, fictional labor market history is used. Following De Groot & Van der Klaauw (2019), I set the labor market history of 1998 equal to the labor market history of 1999 provided that the individual is at least 18 years old in 1998. Before 1998, I use the formula 1998-1-birthyear-18. For instance, someone born in 1970, would have a labor market history in 1997 of nine years (1998-1-1970-18). After 1999, I can determine the labor market history based on "actual" jobs. To do so, I use the "baanid" which indicates the employer someone is working for in a particular month one year before filing for UI. It is possible to trace the baanid over time back to 1998. This allows me to calculate the actual labor market history. In case someone has multiple jobs, I take the longest job history spell in this period.

should at least have worked for 6 months before unemployment and worked at least 52 days for at least four out of the last five years.

Regarding background variables, I have data on gender, family situation (married / not married), whether there is a child present in the household, use of medication, and the person's birthday. The latter is important to exclude workers that file for UI after the age of 60. Analyzing Figure 1, I observe that (especially) workers before the reform could reach the pension eligibility age of 65 with the duration of the UI insurance. Therefore, I focus on workers filing for UI in the age group 20-60. Moreover, Picchio and Van Ours (2020) find that mental health is for some groups positively or negatively affected due to retirement. As a consequence, this may affect medicication use. By excluding the ages before retirement, I make sure that this effect does not play a role. After these restrictions, I end up with 594,394 unemployment spells.

Table 4 shows summary statistics for the groups that had no change and an increase in the maximum UI duration, respectively. I show the averages before and after the UI reform for each group. Analyzing the probability that someone works after several months, I observe that the group with a decrease in the maximum UI duration has a higher job finding probability than the group that did not face a decrease. More precisely, the difference equals 1 to 1.9%-points (column 5).

Discussing the sectors where someone previously worked, I observe that the sectors are roughly similar between both groups. For instance, the sector "other" decreases after the reform in both groups by approximately 6 and 7%-points, respectively. Moreover, personal characteristics like gender and ethnicity are as well approximately equal between both groups. The biggest difference between both groups is marital status. The difference equals approximately 5%-points.

Lastly, when analyzing medication use, I observe that hypertension, pain and inflammation, and hyperlipidemia increases for both groups after the reform. The increase in medication use, however, is stronger for the group that did not see a decrease in the maximum UI entitlement period. For depression, anxiety, and tension, I observe that medication use decreases in both groups. Here the decrease is also larger for the group that faced a decrease in the entitlement period. Medication for diabetes, epilepsy, and respiratory diseases will be used for the placebo check in section V.C. As these medications are mostly chronic diseases, their medication use should not be affected by a change in employment status.

Lastly, to determine the total market labor history I add up the actual and fictional labor market history. Since someone only needs to work 52 days in a particular year to increase the entitlement period, the years of labor market history is rounded up as soon as the decimal sign is bigger than 0.143.

	Control (No change in UI duration)			Treatment (Decrease in UI duration)			
	(1)	(2)		(3)	(4)		(5)
	Prior reform	After reform	Δ_1 (2)-(1)	Prior reform	After reform	Δ_2 (4)-(3)	$\Delta_2 - \Delta_1$
Job characteristics							
Job within 12 months	0.705	0.695	**-0.01**	0.683	0.692	**0.009**	**0.019**
Job within 24 months	0.757	0.694	**-0.063**	0.724	0.671	**-0.053**	**0.010**
Job within 36 months	0.761	0.680	**-0.081**	0.720	0.653	**-0.067**	**0.014**
Difference in max UI duration (months)	0	0	**0**	0	-3.6	**-3.6**	**-3.6**
Sectors							
% Agriculture (prev.)	2.3	4.1	**1.8**	2.6	2.8	**0.2**	**-1.6**
% Construction (prev.)	25.4	26.6	**1.2**	25.3	24.3	**-1.0**	**-2.2**
% Transportation (prev.)	5.8	5.5	**-0.3**	5.1	4.8	**-0.3**	**0.0**
% Services (prev.)	50.0	52.4	**2.4**	50.3	56.4	**6.1**	**3.7**
% Government (prev.)	6.0	6.8	**0.8**	4.5	6.5	**2.0**	**1.2**
% other (prev.)	10.6	4.5	**-6.1**	12.2	5.1	**-7.1**	**-2.0**
Medication use							
% Hypertension y+1	5.6	6.8	**1.2**	8.2	9.0	**0.8**	**-0.4**
% Hypertension y+2	5.6	7.8	**2.2**	9.0	9.7	**0.7**	**-1.5**
% Hypertension y+3	6.4	8.5	**2.1**	9.8	10.6	**0.8**	**-1.3**
% Depression, anxiety, and tension y+1	14.1	12.8	**-1.3**	14.6	13.1	**-1.5**	**-0.2**
% Depression, anxiety, and tension y+2	14.8	10.5	**-4.3**	15.2	10.4	**-4.8**	**-0.5**
% Depression, anxiety, and tension l y+3	13.1	10.4	**-2.7**	13.6	10.2	**-3.4**	**-0.7**
% Pain and inflammation y+1	22.9	24.5	**1.6**	24.3	25.2	**0.9**	**-0.7**
% Pain and inflammation y+2	23.4	25.1	**1.7**	24.9	25.5	**0.6**	**-1.1**
% Pain and inflammation y+3	24.2	25.5	**1.3**	25.4	25.6	**0.2**	**-1.1**
% Hyperlipidemia y+1	2.7	5.3	**2.6**	5.2	5.3	**0.1**	**-2.5**
% Hyperlipidemia y+2	3.0	4.2	**1.3**	5.7	6.0	**0.3**	**-1.0**
% Hyperlipidemia y+3	3.4	5.0	**1.6**	6.2	6.8	**0.6**	**-1.0**
% epilepsy y+1	1.0	1.4	0.4	1.2	1.4	0.2	-0.2
% epilepsy y+2	1.2	1.4	0.2	1.3	1.5	0.2	0.0
% epilepsy y+3	1.2	1.4	0.2	1.4	1.6	0.2	0.0

% diabetes Y+1	1.6	2.0	0.4	2.4	2.7	0.3	-0.1
% diabetes Y+2	1.8	2.3	0.5	2.6	3.0	0.4	-0.1
% diabetes Y+3	2.1	2.6	0.5	2.8	3.3	0.5	0.0
% asthma Y+1	7.0	7.5	0.5	7.2	7.8	0.6	-0.1
% asthma Y+2	7.2	8.2	1.0	7.5	8.2	0.7	-0.3
% asthma Y+3	7.7	8.0	0.3	7.9	8.5	0.6	-0.3
Personal characteristics							
% male	54.0	54.0	**0**	57.6	55.3	**-2.3**	**-2.3**
% married / cohabiting	68.4	66.9	**-1.5**	61.8	61.2	**-0.6**	**0.9**
% 1st immigrant	15.5	17.1	**1.6**	13.6	15.2	**1.6**	**0**
% 2nd immigrant	8.3	7.9	**-0.4**	8.7	9.4	**0.7**	**1.1**
Number of spells	29,308	23,255		311,173	230,658		

Table 4 Summary statistics of workers that filed for unemployment between July 2004 and December 2008. The control group consists of workers with 9, 12, 18, or 24 years of labor market history. The treatment group consist of all workers that face a decrease in the maximum UI duration.

Having discussed the differences between the group that is affected by the reform and the unaffected group, I test for the common trend assumption in Figure 2. Figure 2 shows the quarterly inflow for workers that faced a decrease in UI duration (left) and those that did not see a change. I observe that there is not a different pattern in both groups different before and after the reform. For instance, in the first quarter of 2005, both groups see a spike in the inflow of workers. These spikes occur as well in the first quarter of 2006 and 2007. After 2008, both groups show an increase in UI enrollment. Therefore, I conclude there is not much difference in UI enrollment between both groups before and after the reform.

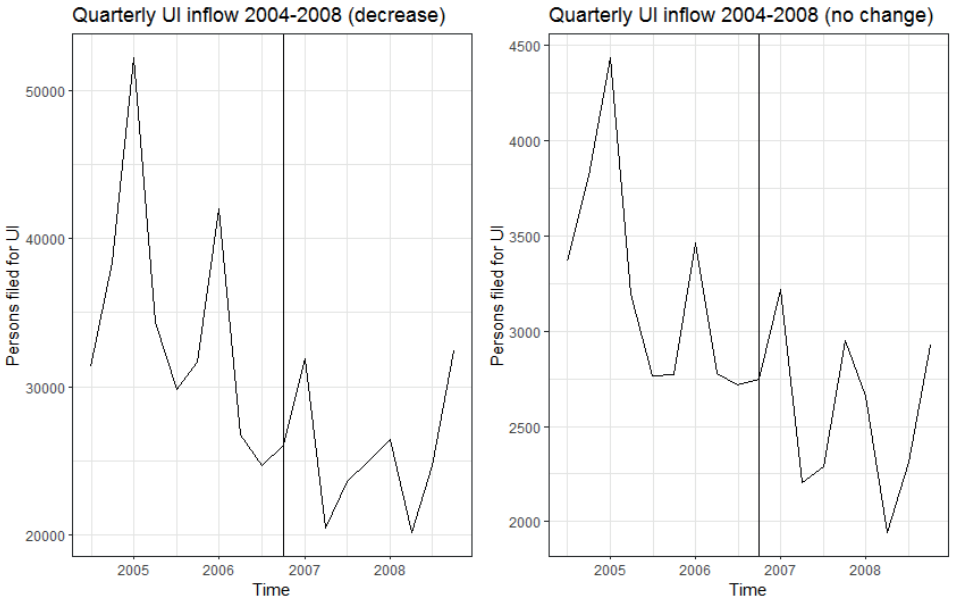

Figure 2: Inflow in UI for groups that did and did not face a reduction in UI duration. The vertical line indicates the period before and after the reform for groups with a decrease in UI entitlement rights (left) and no change in UI entitlement rights (right).

In appendix I, I show that medication use among unemployed workers is higher than for employed workers. Moreover, I show the average of unemployed workers who found a job 12 months after filing for UI. I do the same for workers finding a job 24 and 36 months after filing for UI. I observe in these figures that the group that faces a reduction in UI insurance finds a job faster after the reform. Therefore, I expect that a decrease in UI duration has a positive effect on the employment probability.

V Regression analyses

I analyze the effect of finding a job on medication use. To do so, it is not possible to run a regression of finding a job after several months on medication use.[20] One of the reasons for this is that ill workers might be more likely to become unemployed (see section II). Therefore, I need an instrument to determine how the probability of finding a job affects medication use. The instrument I use is the UI reform of 2006.

[20] This naïve regression is displayed in appendix II. A.

The main idea is that comparing unemployed workers with each other (instead of employed and unemployed workers) create an ideal control group. Therefore, this reform allows me to compare individuals that face a decrease in their maximum UI duration and compare them to those that were not affected. In other words, the reduction in UI duration for some unemployed workers provides me with an instrument to determine the effect of job finding. If this instrument is relevant, I can use this instrument in the second stage to determine the effect on medication use.

V.A. IV assumptions

A successful IV strategy relies on several assumptions. In this section, I discuss why they are plausible in this environment. To start with, IV strategies rely on the independence assumption. In this context, it means that who did and did not face a decrease in UI entitlement does not depend on the underlying health status. Although I cannot test someone's health, Table 4 shows that before the reform the differences between the treatment and control group in terms of sector employment and personal characteristics are relatively small (column 1 and column 3).[21]

Moreover, IV strategies also rely on the exclusion restriction. In this context, it means that a decrease in UI duration does not affect health, but only affects health through the job finding channel. Health would most likely be negatively affected if workers face a decrease in their max UI duration after filing for UI. As an example, if workers think they are eligible for twelve months of UI, but after six months get an update that it will only be ten months, it could potentially increase stress levels and as a result decreases their health. However, the reform that is described here only affects new applications. As a result, only new applicants face a reduction in the max UI duration and know so from the beginning. Therefore, I believe it is likely that the exclusion restriction holds.

Lastly, the instrument should satisfy the criteria of monotonicity. Here it means that a reduction in UI duration cannot have both a negative and a positive effect on job search. Therefore, I assume that a decrease in UI duration has a positive effect on job search. In section II, I already discussed several empirical papers that show how a decrease in UI generosity affects has a positive effect on job finding. This in line with the theory on job search models. The literature on job search models predicts that a less generous UI scheme positively impacts job finding. More precisely, a less generous UI scheme decreases the reservation wage, which leads to a faster outflow of unemployment. The reasons for this are that workers become less selective in accepting job offers. Moreover, a decrease in the reservation wage increases the marginal benefits of search, which increases the number of job applications (Mortensen, 1986). In a similar vein, Van den Berg (1990)

[21] The only large difference between the treatment and control group before to reform is the variable married / cohabiting where the difference is 5.7%-points.

builds a job search model taking into account that the UI entitlement period is finite. Due to this feature, the present value of being unemployed decreases with the time spent in unemployment. As a consequence, the reservation wage declines, and unemployed workers increase their search effort. As a result, the job finding rate increases. Boone and Van Ours (2012) provide an addition to these models by showing that the quality of the new job plays an important role when unemployed workers start working again. If unemployed workers believe that employers are willing to accept delays in the starting date of the new contract, workers can exploit UI insurance (i.e. extra leisure time). By using Slovenian unemployment spells, they find evidence that this is indeed the case. Combinig all these findings, a reduction in UI duration could result in a faster outflow of unemployment, either via an increase in job search, or due to a reduction in moral hazard.

V.B First stage

I compare unemployed workers that faced a decrease in their maximum entitlement duration with those that did not see any change. To do so, I estimate the following first-stage regression, which is similar to De Groot and Van der Klaauw (2019):

$$work_{imt} = \alpha + \lambda_t + \mu_m + \gamma_h + \beta_1 D_{it} + \beta_2 X_{it} + \epsilon_{imt} \qquad (1)$$

Here $work_{imt}$ denotes whether individual i who previously worked in sector m has a job t months after filing for UI. α is a constant, λ_t and μ_m denote time dummies on a quarterly basis and sector dummies, respectively. γ_h denote a set of dummies for each possible duration of labor market history.[22] The variable D_{it} is a variable that capturers the change in the maximum unemployment spell due to the reform. For instance, someone with 31 years of labor market experience would have received 36 months of UI benefits in the old system but only 31 months in the new system. As a result, the variable D_{it} equals minus 5. For the control group, the variable D_{it} equals zero. The coefficient β_1 captures the effect of the reduction of the maximum unemployment duration on finding a job after t months. In case a decrease in the unemployment duration increases (decreases) the probability of working after one year, I expect the coefficient to be negative (positive). X_{it} denote a set of control variables. I control for whether someone has been enrolled in the past two years into UI and whether someone reactivates old unemployment benefit rights. Furthermore, I control for several socioeconomic variables such as gender, marital status, and ethnicity. I do not control for age

[22] As already explained in section IV, I exclude workers with 13 and 14 months of labor market history. The reason for this is that after the reform this group received labor market training. I also exclude workers with 19 years of labor market history as I am interested in the effects of a decrease in UI entitlement (and not an increase).

as age is strongly correlated with the maximum entitlement period.[23] Lastly, ϵ_{imt} denotes the error term. The results of this regression are presented in Table 5.

Job at t+12	(1)	(2)	(3)
D_{it}	-0.004*** (0.0004)	-0.004*** (0.0004)	-0.004*** (0.0004)
Male dummy			0.002* (0.001)
Married			0.009*** (0.001)
Reenrollment			-0.144*** (0.008)
Filed prev. 2 years			-0.055*** (0.002)
1st immigrant			-0.085*** (0.002)
2nd immigrant			-0.025*** (0.0021)
α	0.155*** (0.050)	0.137*** (0.048)	0.146*** (0.049)
Time FE	YES	YES	YES
Labor market history	YES	YES	YES
Sector dummies	NO	YES	YES
Controls	NO	NO	YES
F-statistic	668.6	617.5	627.7
Adj. R^2	6.0%	6.0%	6.7%
Number of observations	594,394	594,394	594,394

*Table 5 The effect of a reduction in the maximum entitlement period on finding a job after twelve months. *** denotes significance at the 1% level, ** denotes significance at the 5% level, and * denotes significance at the 10% level. Robust standard errors between parentheses.*

I observe that the coefficient β_1 is negative and significant at the 1% level. This means that a reduction in the maximum UI entitlement increases the job finding probability. As an example, in case an individual saw a reduction of 5 months in the entitlement period, the probability of having a job after twelve months increases by $-0.004 * (-5) = 0.02$, or 2%-points.

The size, significance, and magnitude of the coefficient do not change much once I add sector dummies and additional control variables. Adjusted R^2, however, increases substantially once I include the sector dummies. Moreover, the F-statistic is larger than ten, indicating the instruments I use are not weak. In Appendix II, I run the same regression for finding a job after 24 months and 36

[23] See footnote 19. This footnote explains that the total labor market history is determined by the fictional labor market history. This again is determined by the age of the individual.

months, respectively. The results are similar to the results presented in Table 5. All in all, I conclude that the instrument I use is relevant.

V.C. Second stage

Having discussed the results for the first stage regression, I now discuss the second stage. In the second stage, I run the following regression:

$$med_{imy} = \kappa + \lambda_t + \mu_m + \gamma_h + \delta_1 \widehat{work_{imt}} + \beta_2 X_{it} + \zeta_{imt} \qquad (2)$$

In regression (2), med_{imy} denotes whether individual i who worked previously in sector m makes use of any medication y year after filing for UI. Unlike work, I only observe medication use per year instead of a monthly level. Therefore, I decided to use a different subscript for time in this regression. Table 3 shows the medical categories I use as dependent variables. Note that the last categories (respiratory diseases, diabetes, and epilepsy) are discussed in section V.C. as they are used for a placebo check. Medication use is only observed on a yearly basis. κ denotes the intercept. λ_t, μ_m, γ_h, and X_{it} have the same meaning as in regression (1). ζ_{imt} denote the error term. Table 6 shows the results of the second stage regression, when analyzing medication use one year, two years, and three years after filing for UI, respectively.

Mediciation use			
		Hypertension	
	Y=1	Y=2	Y=3
$\widehat{work_{im,t+12}}$	0.016 (0.095)	-0.048 (0.095)	-0.021 (0.097)
		Mental diseases	
	Y=1	Y=2	Y=3
$\widehat{work_{im,t+12}}$	-0.179** (0.083)	-0.470*** (0.087)	-0.345*** (0.078)
		Pain and inflammation	
	Y=1	Y=2	Y=3
$\widehat{work_{im,t+12}}$	-0.046 (0.099)	0.022 (0.098)	-0.218** (0.100)
		Hyperlipidemia	
	Y=1	Y=2	Y=3
$\widehat{work_{im,t+12}}$	-0.168** (0.086)	-0.184*** (0.087)	-0.095 (0.09)
Time FE	YES	YES	YES
Labor market history	YES	YES	YES
Sector dummies	YES	YES	YES
Controls	YES	YES	YES
Number of observations	517,423	594,394	594,394

*Table 6 The effect of finding work on the use of medication (second stage). Y=1, Y=2, and Y=3 denote one, two, and three years after filing for unemployment. Mental diseases are the collective name for depression, anxiety, and tension. The column Y+1 has less observations as medication use is only available after 2005. As a consequence, workers filed for UI in 2004 are omitted from this regression. *** denotes significance at the 1% level, ** denotes significance at the 5% level. Robust standard errors between parentheses.*

I observe that finding a job does not have a significant effect on medication for hypertension. For all three years, the results are insignificant. Analyzing medication use for depression, anxiety, and tension, I find a negative and significant effect. More precisely, the chance that someone uses medication the year after filing for UI benefits decreases by 17.9%-points if someone has a job. For two and three years later, this effect is equal to minus 47%-points and minus 34.5%-points, respectively. For pain and inflammation, I only find a negative significant effect three years after filing for UI. The coefficients for earlier years are insignificant. Lastly, focusing on medication for hyperlipidemia I find negative and significant effects one and two years after someone filed for UI.

Those coefficients are equal to minus 16.8%-points and minus 18.4%-points, respectively. For the third year, the coefficient is no longer significant.

In addition to the IV-estimates in Table 6, I also show the reduced form estimates in Appendix II.C. More precisely, the reduced form estimates show as well that a reduction in maximum UI entitlement results in lower use of medication for depression, anxiety, and tension as well as for hyperlipidemia and pain and inflammation. Moreover, this appendix also presents the results for males and females separately. I observe that not all results are significant, but the sign is still in the same direction as the main results presented in Table 6. Moreover, I observe that the coefficient for mental diseases are both significant for males and females (except for $Y = 1$; this one is insignificant for males). However, the coefficient for females is significantly larger than for males. The difference in magnitude is difficult to interpret as social stigma (Chatmon, 2020) and some mental diseases are more pronounced to females than males (National Institute of Mental Health, 2021). More precisely, males are less likely to look for help in case of mental problems and females are more likely to face mental disease like depression and anxiety. This could make males less likely to look for treatment in the first place. As a result, we cannot conclude that unemployment for females has a stronger negative effect on mental health than for males.

V.D. Placebo test

In the previous section I find negative and significant effects on medication use for hyperlipidemia, pain and inflammation, and mental diseases. In this section I use a placebo test to test the robustness of the results. To do so, I run the same regression as in equation (2), but now for medication use that is strongly related to chronic diseases. In particular, I focus on the medication use of Epilepsy, diabetes, and respiratory diseases (e.g., asthma). The results are displayed in Table 7.

Medication use			
		Epilepsy	
	Y=1	Y=2	Y=3
$\widehat{work_{im,t+12}}$	0.015 (0.029)	0.032 (0.030)	-0.024 (0.029)
		Diabetes	
	Y=1	Y=2	Y=3
$\widehat{work_{im,t+12}}$	0.056 (0.056)	0.081 (0.057)	0.048 (0.059)
		Respiratory diseases	
	Y=1	Y=2	Y=3
$\widehat{work_{im,t+12}}$	-0.019 (0.064)	-0.021 (0.065)	0.053 (0.067)
Time FE	YES	YES	YES
Labor market history	YES	YES	YES
Sector dummies	YES	YES	YES
Controls	YES	YES	YES
Number of observations	517,423	594,394	594,394

*Table 7 The effect of finding work on the use of medication (second stage). Y=1, Y=2, and Y=3 denote one, two, and three years after filing for unemployment. The column Y+1 has less observations as medication use is only available after 2005. As a consequence, workers filed for UI in 2004 are omitted from this regression. *** denotes significance at the 1% level, ** denotes significance at the 5% level, and * denotes significance at the 10% level. Robust standard errors between parentheses.*

I observe that the results for epilepsy, diabetes, and respiratory diseases are all insignificant. In other words, this means that a reduction in UI duration does not have an effect on medication for chronic illnesses. This is what should be expected and therefore it strengthens our result.

VI. Discussion and conclusion

In this paper, I study the effect of job finding on medication use. As the relationship between unemployment and health is unclear, I use an instrumental variable approach to determine the effect of work on medication use. The instrument I use is a decrease in the maximum entitlement period for UI benefits. Given that some groups were exposed to this decrease and others were not, I can use the first stage of my IV-design to determine how the effect of a decrease in the entitlement period affects the job finding probability.

I find that a decrease in the maximum entitlement period increases the probability of finding a job. Using this outcome in the second stage of my regression, I find that an increase in the job finding probability results in a significant reduction in the use of medication for hyperlipidemia, mental

diseases, and pain and inflammation. . I do not find any effect on medication for hypertension. Since large effects are rather common when using IV estimation, I interpret the size of the coefficient with caution. The sign, however, shows that there is a negative effect on medication use, which is also confirmed by the reduced form analysis in Appendix II.C.

There are several possible explanations for these results. To start with, the relative generous UI scheme in the Netherlands could explain why I do not find a negative effect of job finding for hypertension. However, being employed has benefits that can explain the decrease in other medication categories. To start with, people with a job have more financial security. An increase income makes it therefore possible to live a healthier life. Moreover, non-financial incentives could play a role as well. For instance, long-term unemployment itself could negatively impact (mental) health. Therefore, an increase in search incentives – due to a reduction in UI generosity – may not only result in finding a job faster, but also a reduction in medication use. The health benefits could arise from being able to meet a social norm that dictates that workers should provide for their own income. In case the social norm dictates that people should provide for their own income, people who cannot do so could develop negative feeling about themselves, resulting in a decrease in health. The increase in search incentives may not only help them to find a job faster but may also help to meet the social norm. Lastly, the lifestyle of unemployed and employed workers is different. It may be the case that employed workers have a healthier lifestyle than unemployed workers, which results in better health. Therefore, finding a job could have a positive on health. Which reason is the most dominant is a question for future research.

Overall, these results imply that a shortening of the UI duration may have a positive side effect on health. Combining these findings with Kuka (2020) and Cylus, Glymour, and Avendano (2015) regarding the replacement rate, it may indicate that shorter UI schemes combined with a high replacement rate are optimal from a health perspective. However, this still raises the question why unemployed workers themselves are not able to incorporate these positive spillover effects. Apart from behavioral elements like information constraints or procrastination, beliefs could also play a role. More precisely, Spinnewijn (2015) uses agent's beliefs (optimistic and pessimistic) regarding employment prospects to determine the optimal UI scheme. It is possible that these types of beliefs not only effect the optimal UI duration, but also have a spillover effect on medication use. For instance, if workers have too pessimistic beliefs regarding their employment changes, it could affect their time spend in unemployment as well as their health. A decrease in the UI duration could force them to start applying earlier. As a result, they may not only find a job, but they may also build self-esteem. This in turn could negatively impact medication use. Whether this channel could play a role is open to future research.

Lastly, a possible drawback of this study is that I only focus on unemployed workers. In other words, I focus on a particular segment of the entire labor force. This means that our results cannot be used to say something about the effect of work on health for the employed workers. For instance, the health effects of working full-time vs part-time cannot be addressed by this study. This limits somewhat the scope of this analysis.

Bibliography

Backhans, M. C., & Hemmingsson, T. (2012). Unemployment and mental health—who is (not) affected? *The European Journal of Public Health, 22(3)*, 429-433.

Baily, M. (1978). Some aspects of optimal unemployment insurance. *Journal of Public Economics, 10(3)*, 379-402.

Boone, J., & van Ours, J. (2012). Why is There a Spike in the Job Finding Rate at Benefit Exhaustion? *De Economist, 160*, 413–438.

Browning, M., Moller Dano, A., & Heinesen, E. (2006). Job displacement and stress-related health outcomes. *Health economics, 15(10)*, 1061-1075.

Card, D., Chetty, R., & Weber, A. (2007). Cash-on-hand and competing models of intertemporal behavior: New evidence from the labor market. *The Quarterly journal of economics, 122(4)*, 1511-1560.

Chatmon, B. (2020). Males and mental health stigma. *American Journal of Men's Health, 14(4),*, 1557988320949322.

Chetty, R. (2006). A general formula for the optimal level of social insurance. *Journal of Public Economics, 90(10)*, 1879-1901.

Chinta, R., Rao, M. B., Narendran, V., Malla, G., & Joshi, H. (2013). Economic recession and headache-related hospital admissions. *Hospital Topics, 91(2)*, 37-42.

Clark, A. E., & Oswald, A. J. (1994). Unhappiness and unemployment. *The Economic Journal, 104(424)*, 648-659.

Compton, W. M., Gfroerer, J., Conway, K. P., & Finger, M. S. (2014). Unemployment and substance outcomes in the United States 2002–2010. *Drug and alcohol dependence, 142*, 350-353.

Cylus, J., Glymour, M. M., & Avendano, M. (2014). Do generous unemployment benefit programs reduce suicide rates? A state fixed-effect analysis covering 1968–2008. *American journal of epidemiology, 180(1)*, 45-52.

Cylus, J., Glymour, M. M., & Avendano, M. (2015). Health effects of unemployment benefit program generosity. *American journal of public health, 105(2)*, 317-323.

De Groot, N., & Van der Klaauw, B. (2019). The effects of reducing the entitlement period to unemployment insurance benefits. *Labour Economics, 57*, 195-208.

de Pijper, B., Wildenburg, A., Montessori, R., van de Graaf, M., de Jong, M., van der Zanden, R., . . . Huitema, J. (2019). De kleine Gids voor de Nederlandse Sociale Zekerheid. In *3.7 Re-integratie door de gemeente* (pp. 211-214). Alphen aan den Rijn: Woltes Kluwer.

Eliason, M., & Storrie, D. (2009). Does job loss shorten life? *Journal of Human Resources, 44(2)*, 277-302.

Evans, W. N., & Garthwaite, C. L. (2014). Giving mom a break: The impact of higher EITC payments on maternal health. *American Economic Journal: Economic Policy, 6(2)*, 258-290.

Field, K. S., & Briggs, D. J. (2001). Socio-economic and locational determinants of accessibility and utilization of primary health-care. *Health & social care in the community, 9(5)*, 294-308.

Finkelstein, A., Taubman, S., Wright, B., Bernstein, M., Gruber, J., Newhouse, J. P., . . . Group., O. H. (2012). The Oregon health insurance experiment: evidence from the first year. *The Quarterly journal of economics, 127(3)*, 1057-1106.

García-Gómez, P., Jones, A. M., & Rice, N. (2010). Health effects on labour market exits and entries. *Labour Economics, 17(1)*, 62-76.

Hagist, C., & Kotlikoff, L. (2005). Who's going broke? comparing growth in healthcare costs in ten OECD countries (No. w11833). *National Bureau of Economic Research*.

Hetschko, C., Knabe, A., & Schöb, R. (2014). Changing identity: Retiring from unemployment. *The Economic Journal, 124(575)*, 149-166.

Keefe, V., Reid, P., Ormsby, C., Robson, B., Purdie, G., Baxter, J., & Incorporated, N. K. (2002). Serious health events following involuntary job loss in New Zealand meat processing workers. *International Journal of Epidemiology, 31(6)*, 1155-1161.

Khubchandani, J., Sharma, S., Price, J. H., Wiblishauser, M. J., Sharma, M., & Webb, F. J. (2021). COVID-19 vaccination hesitancy in the United States: a rapid national assessment. *Journal of community health, 46*, 270-277.

Krueger, A. B., & Mueller, A. I. (2012). The lot of the unemployed: a time use perspective. *Journal of the European Economic Association, 10(4)*, 765-794.

Kuhn, A., Lalive, R., & Zweimüller, J. (2009). The public health costs of job loss. *Journal of health economics, 28(6)*, 1099-1115.

Kuka, E. (2020). Quantifying the benefits of social insurance: unemployment insurance and health. *Review of Economics and Statistics, 102(3)*, 490-505.

Lalive, R. (2008). How do extended benefits affect unemployment duration? A regression discontinuity approach. *Journal of econometrics, 142(2)*, 785-806.

Lamers, L. M., & Van Vliet, R. C. (2004). The Pharmacy-based Cost Group model: validating and adjusting the classification of medications for chronic conditions to the Dutch situation. *Health policy, 68(1)*, 113-121.

Lammers, M., Odding, C., Schwartz, T., Heyma, A., & Meij, M. (2020). Effecten van maatregelen WW en IOW in de Wet werk en zekerheid.

Ministry of Social Affairs. (2005, November 11). Wijziging van de Werkloosheidswet en enige andere wetten in verband met de wijziging van het WW-stelsel en wijziging in het ontslagrecht. THe Hague, Zuid-Holland, Netherlands.

Mortensen, D. T. (1986). Job search and labor market analysis. *Handbook of labor economics, 2*, 849-919.

Murphy, G. C., & Athanasou, J. A. (1999). The effect of unemployment on mental health. *Journal of Occupational and organizational Psychology, 72(1)*, 83-99.

National Institute of Mental Health. (2021, May). *Women and Mental Health*. Retrieved from https://www.nimh.nih.gov/health/topics/women-and-mental-health

Norström, F., Waenerlund, A. K., Lindholm, L., Nygren, R., Sahlén, K. G., & Brydsten, A. (2019). Does unemployment contribute to poorer health-related quality of life among Swedish adults? *BMC Public Health, 19(1)*, 1-12.

Overheid.nl. (2005, August 2). *Staatsblad van het Koninkrijk der Nederlanden*. Retrieved from https://zoek.officielebekendmakingen.nl/STB-2005-389.html

Paul, K. I., & Moser, K. (2009). Unemployment impairs mental health: Meta-analyses. *Journal of Vocational behavior, 74(3)*, 264-282.

Picchio, M., & Van Ours, J. C. (2020). Mental health effects of retirement. *De Economist, 168(3)*, 419-452.

Pohlan, L. (2019). Unemployment and social exclusion. *Journal of Economic Behavior & Organization, 164*, 273-299.

Popovici, I., & French, M. T. (2013). Does unemployment lead to greater alcohol consumption? *Industrial Relations: A Journal of Economy and Society, 52(2)*, 444-666.

Salm, M. (2009). Does job loss cause ill health? *Health Economics, 18(9)*, 1075-1089.

Schmitz, H. (2011). Why are the unemployed in worse health? The causal effect of unemployment on health. *Labour economics, 18(1)*, 71-78.

Spinnewijn, J. (2015). Unemployed but optimistic: Optimal insurance design with biased beliefs. *Journal of the European Economic Association, 13(1)*, 130-167.

Stewart, J. M. (2001). The impact of health status on the duration of unemployment spells and the implications for studies of the impact of unemployment on health status. *Journal of health economics, 20(5)*, 781-796.

Stutzer, A., & Lalive, R. (2004). The role of social work norms in job searching and subjective well-being. *Journal of the European Economic Association, 2(4)*, 696-719.

Sullivan, D., & Von Wachter, T. (2009). Job displacement and mortality: an analysis using administrative data. *The Quarterly Journal of Economics, 124(3)*, 1265-1306.

Urbanos-Garrido, R. M., & Lopez-Valcarcel, B. G. (2015). The influence of the economic crisis on the association between unemployment and health: an empirical analysis for Spain. *The European Journal of Health Economics, 16(2)*, 175-184.

Vahid Shahidi, F., Siddiqi, A., & Muntaner, C. (2016). Does social policy moderate the impact of unemployment on health? A multilevel analysis of 23 welfare states. *The European Journal of Public Health, 26(6)*, 1017-1022.

Van den Berg, C., Klabbers, G. D., Sens, I., Wildenburg, A., & Hop, A. (2007). *De Kleine Gids voor de Nederlandse Sociale Zekerheid 2007.2.* Deventer: Kluwer.

Van den Berg, G. (1990). Nonstationarity in job search theory. *The review of economic studies, 57(2)*, 255-277.

van Ooijen, R., Alessie, R. J. M., and Knoef, M. (2015). Health Status Over the Life Cycle. Netspar Discussion Paper No. 10/2015-062, Available at SSRN: https://ssrn.com/abstract=2743110

van Ours, J. C., & Vodopivec, M. (2006). How shortening the potential duration of unemployment benefits affects the duration of unemployment: Evidence from a natural experiment. *Journal of Labor economics, 24(2)*, 351-378.

Vlasblom, J. D., & Schippers, J. (2019). Werkloze ouderen weer aan het werk?: Het effect van reserveringsloon en zoekintensiteit. *Tijdschrift voor Arbeidsvraagstukken, 35(1)*.

Von Bergh, M., Ramparichan, M. M., & Schippers, J. (2019). Wat werkt voor de WW? 14.

Wilson, S. H., & Walker, G. M. (1993). Unemployment and health: a review. *Public health, 107(3)*, 153-162.

Yildiz, B., Schuring, M., Knoef, M. G., & Burdorf, A. (2020). Chronic diseases and multimorbidity among unemployed and employed persons in the Netherlands: a register-based cross-sectional study. *BMJ open, 10(7), e035037*, 1-9.

Zorginstituut Nederland. (n.d.). *Beleidsmaatregelen geneesmiddelen 2004*. Retrieved June 8, 2022, from https://www.gipdatabank.nl/beleidsmaatregelen-geneesmiddelen/beleid-genees-2004

Appendix I Additional figures

Figure 3 shows the use of medication among employed and unemployed workers in the Netherlands. Figure 3 shows that medication use is higher for all four categories (hypertension, pain and inflammation, hyperlipidemia, and mental diseases (i.e. depression, anxiety, and tension).

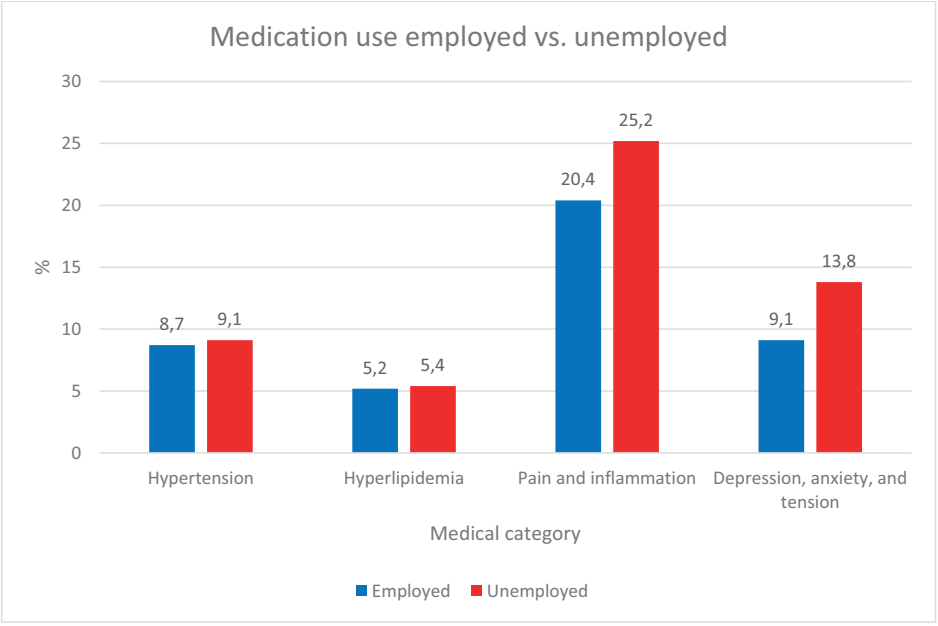

Figure 3 Difference in medication use for employed and unemployed workers (2006-2008) for four medical categories. I plot the average use of medication one year after a person filed for unemployment insurance and compare the average medication use with persons that worked and did not file for unemployment. This figure was constructed using microdata from Statistics Netherlands.

Figure 4, 5 and 6 show the fraction of unemployed workers over the period 2004-2006 who work 12, 24 and 36 months later, respectively. More precisely, in case an unemployed worker enrolled in UI in January 2005 and find a job in January 2006, the variable is equal to one. In case the worker was still unemployed, the variable equals zero. The results are presented per quarter of UI inflow. Analyzing the figures, we observe that workers that workers who saw a decrease in UI duration are less likely to work 12, 24, or 36 years later. This is probably due this group consists also of a large group of older workers. Vlasblom and Schippers (2019) show that this group finds it more difficult to find a job after becoming unemployed. Second, the gap between both lines becomes smaller after the reform. Sometimes the job finding rate is even higher in (2008-q3 and 2007-q4) for the group that faces a decrease in UI insurance compared to the group that did not see a decrease.

Figure 4 Fraction of unemployed workers who work at 12 months after filing for UI. The red (blue) line indicates the fraction of workers that found a job twelve months later for workers that faced a decrease (did not face a decrease) in their maximum UI duration. The vertical black line indicates the moment of the UI reform.

Figure 5 Workers filed for unemployment that worked 24 months later. The red (blue) line indicates the group of workers that had a decrease (no change) in their maximum entitlement period. The black vertical line indicates the moment of the UI reform.

Figure 6 Workers filed for unemployment that worked 36 months later. The red (blue) line indicates the group of workers that had a decrease (no change) in their maximum entitlement period. The black vertical line indicates the moment of the UI reform.

Appendix II Additional regression results

II.A Naïve regression

Table 8 shows the effect of finding a job on medication use. More precisely, I run the regression:

$$med_{im,y} = \kappa + \lambda_t + \mu_m + \gamma_h + \delta_1 work + \beta_2 X_{it} + \eta_{imy}$$

This regression is similar to (2) except for the variable $work$ and a different symbol for the error term η. More precisely, the variable work is not instrumented here, but simply a dummy variable equal to one (zero) in case someone (is unemployed) works twelve months later.

I find mostly negative and significant estimation results for each medical category. The only exception is medication for pain and inflammation where I find a small positive and significant coefficient of 0.3%-points. The results, however, are not easy to interpret. For example, it is likely the case that workers that have better health are more likely to find a job faster. As a result, it is hard to give the coefficients a causal interpretation (see as well section II).

Medication use			
		Hypertension	
	Y=1	Y=2	Y=3
$Job\ at\ t+12$	-0.016*** (0.001)	-0.013*** (0.001)	-0.011*** (0.001)
α	0.317*** (0.051)	0.313*** (0.051)	0.360*** (0.053)
$Adj.R^2$	5.5%	5.8%	6.1%
		Mental diseases	
	Y=1	Y=2	Y=3
$Job\ at\ t+12$	-0.053*** (0.001)	-0.042*** (0.001)	-0.038*** (0.001)
α	0.140*** (0.034)	0.135*** (0.032)	0.129*** (0.028)
$Adj.R^2$	2.5%	2.2%	2.0%
		Pain and inflammation	
	Y=1	Y=2	Y=3
$Job\ at\ t+12$	-0.005*** (0.001)	0.001 (0.001)	0.003** (0.001)
α	0.222*** (0.048)	0.209*** (0.047)	0.211*** (0.047)
$Adj.R^2$	1.0%	0.8%	0.9%
		Hyperlipidemia	
	Y=1	Y=2	Y=3
$Job\ at\ t+12$	-0.012*** (0.001)	-0.011*** (0.001)	-0.010*** (0.001)
α	0.276*** (0.051)	0.286*** (0.052)	0.285*** (0.052)
$Adj.R^2$	5.6%	6.0%	6.3%
Time FE	YES	YES	YES
Labor market history	YES	YES	YES
Sector dummies	YES	YES	YES
Controls	YES	YES	YES
Number of observations	517,423	594,394	594,394

*Table 8 The effect of finding a job one year later on medication use one, two, and three years later, respectively. The column Y=1 has less observations as medication use is only available as of 2006. As a consequence, workers filed for UI in 2004 are omitted from this regression. *** denotes significance at the 1% level, ** denotes significance at the 5% level, and * denotes significance at the 10% level. Robust standard errors between parentheses.*

II. B Additional results: First stage

Table 9 and Table 10 show other first stage results. More precisely, they show the effect of a decrease in the job market duration on finding a job 24 and 36 months later, respectively. The regression is the same as regression (1).

Job at t+24	(1)	(2)	(3)
D_{it}	-0.006*** (0.0004)	-0.006*** (0.0004)	-0.006*** (0.0004)
Male-dummy			-0.003*** (0.001)
Married			0.014*** (0.001)
Reenrollment			-0.118*** (0.008)
Filed prev. 2 years			-0.057*** (0.002)
1st immigrant			-0.089*** (0.002)
2nd immigrant			-0.024*** (0.002)
α	0.132*** (0.047)	0.127*** (0.047)	0.135*** (0.048)
Time FE	YES	YES	YES
Labor market history	YES	YES	YES
Sector dummies	NO	YES	YES
Controls	NO	NO	YES
Adj. R^2	5.9%	5.9%	6.6%
Number of observations	594,394	594,394	594,394

*Table 9 The effect of a reduction in the maximum entitlement period on finding a job after 24 months. *** denotes significance at the 1% level, ** denotes significance at the 5% level, and * denotes significance at the 10% level. Robust standard errors between parentheses.*

Job at t+36	(1)	(2)	(3)
D_{it}	-0.006*** (0.0004)	-0.006*** (0.0004)	-0.006*** (0.0004)
Maledummy			-0.008*** (0.001)
Married			0.016*** (0.001)
Reenrollment			-0.099*** (0.008)
Filed prev. 2 years			-0.064*** (0.002)
1st immigrant			-0.099*** (0.002)
2nd immigrant			-0.028*** (0.002)
α	0.155*** (0.048)	0.162*** (0.048)	0.172*** (0.048)
Time FE	YES	YES	YES
Labor market history	YES	YES	YES
Sector dummies	NO	YES	YES
Controls	NO	NO	YES
Adj. R^2	5.5%	5.5%	6.4%
Number of observations	594,394	594,394	594,394

*Table 10 The effect of a reduction in the maximum entitlement period on finding a job after 36 months. *** denotes significance at the 1% level, ** denotes significance at the 5% level, and * denotes significance at the 10% level. Robust standard errors between parentheses.*

Lastly, when analyzing female and males separately, I find as well similar results for males and females in the first stage. A difference between both genders is that females are less likely to find a job when married, while males are more likely to find a job when married. The results are displayed in Table 11.

	Male			Female		
Job at t+12	(1)	(2)	(3)	(1)	(2)	(3)
D_{it}	-0.004*** (0.0005)	-0.004*** (0.0005)	-0.004*** (0.0005)	-0.003*** (0.0006)	-0.003*** (0.0006)	-0.003*** (0.0006)
Married			0.035*** (0.002)			-0.020*** (0.001)
Reenrollment			-0.153*** (0.011)			-0.136*** (0.012)
Filed prev. 2 years			-0.075*** (0.002)			-0.039*** (0.002)
1st immigrant			-0.084*** (0.002)			-0.090*** (0.003)
2nd immigrant			-0.024*** (0.003)			-0.028*** (0.003)
α	0.088* (0.052)	0.050 (0.052)	0.032 (0.052)	0.313*** (0.103)	0.312*** (0.094)	0.354*** (0.104)
Time FE	YES	YES	YES	YES	YES	YES
Labor market history	YES	YES	YES	YES	YES	YES
Sector dummies	NO	YES	YES	NO	YES	YES
Controls	NO	NO	YES	NO	NO	YES
F-statistiek	455.6	423.0	439.8	221.2	204.1	216.6
Adj. R^2	7.1%	7.2%	8.1%	4.6%	4.6%	5.2%
Number of observations	335,270	335,270	335,270	259,124	259,124	259,124

*Table 11 The effect of a reduction in the maximum entitlement period on finding a job after 12 months for males and females separately. *** denotes significance at the 1% level, ** denotes significance at the 5% level, and * denotes significance at the 10% level. Robust standard errors between parentheses.*

II.C Additional results: second stage

Table 12 shows the reduced form estimates. More precisely, I use the change in UI duration as an independent variable to determine the effect on medication use. This means that I replace the $\widehat{work_{im,t+12}}$ in regression (2) with D_{it}. Note that the change in UI duration is always smaller or equal than zero. Table 12 shows positive and significant coefficients for depression, anxiety, and tension for all years. The same holds as well for pain and inflammation in year 3 and hyperlipidemia in the first two years. This means that a decrease in the maximum UI duration has negative on the use of medication. As an example, in case a worker faced a decrease in UI duration with 3 months, the probability of using medication for mental diseases after two years decreases by $0.002 * (-3) = -0.006$, or minus 0.6%-points.

Medication use			
		Hypertension	
	Y=1	Y=2	Y=3
D_{it}	-0.000 (0.0003)	0.000 (0.0003)	0.000 (0.0003)
α	0.314*** (0.052)	0.312*** (0.052)	0.359*** (0.053)
$Adj.R^2$	5.4%	5.7%	6.1%
		Mental diseases	
	Y=1	Y=2	Y=3
D_{it}	0.001** (0.0003)	0.002*** (0.0003)	0.001*** (0.0003)
α	0.137*** (0.034)	0.144*** (0.032)	0.134*** (0.028)
$Adj.R^2$	2.0%	1.9%	1.7%
		Pain and inflammation	
	Y=1	Y=2	Y=3
D_{it}	0.000 (0.0004)	-0.000 (0.0003)	0.0007** (0.003)
α	0.2225*** (0.048)	0.208*** (0.047)	0.218*** (0.047)
$Adj.R^2$	1.0%	0.9%	0.9%
		Hyperlipidemia	
	Y=1	Y=2	Y=3
D_{it}	0.0006** (0.0003)	0.0006** (0.0003)	0.0003 (0.0003)
α	0.279*** (0.051)	0.290*** (0.052)	0.287*** (0.052)
$Adj.R^2$	5.6%	6.0%	6.3%
Time FE	YES	YES	YES
Labor market history	YES	YES	YES
Sector dummies	YES	YES	YES
Controls	YES	YES	YES
Number of observations	517,423	594,394	594,394

*Table 12 The effect of a change in maximum UI duration on the use of medication. These are the reduced form estimates. Y=1, Y=2, and Y=3 denote one, two, and three years after filing for unemployment. Mental diseases are the collective name for depression, anxiety, and tension. The column Y+1 has less observations as medication use is only available as of 2006. As a consequence, workers filed for UI in 2004 are omitted from this regression. *** denotes significance at the 1% level, ** denotes significance at the 5% level. Robust standard errors between parentheses.*

Table 13 shows the second stage results for male and female separately. Although not all results are significant compared to Table 6 in section V.B., the sign is everywhere correct.

Medication use	Male			Female		
	(1)	(2)	(3)	(1)	(2)	(3)
	Hypertension			Hypertension		
	Y=1	Y=2	Y=3	Y=1	Y=2	Y=3
$\widehat{work_{im,t+1}}$	0.092	0.094	0.062	-0.046	-0.149	-0.140
	(0.106)	(0.11)	(0.108)	(0.197)	(0.202)	(0.207)
	Mental diseases			Mental diseases		
	Y=1	Y=2	Y=3	Y=1	Y=2	Y=3
$\widehat{work_{im,t+1}}$	-0.083	-0.246***	-0.190***	-0.583**	-1.342***	-0.960***
	(0.082)	(0.077)	(0.073)	(0.238)	(0.358)	(0.277)
	Pain and inflammation			Pain and inflammation		
	Y=1	Y=2	Y=3	Y=1	Y=2	Y=3
$\widehat{work_{im,t+1}}$	-0.062	0.037	-0.140	0.027	0.035	-0.036
	(0.105)	(0.103)	(0.104)	(0.224)	(0.224)	(0.238)
	Hyperlipidemia			Hyperlipidemia		
	Y=1	Y=2	Y=3	Y=1	Y=2	Y=3
$\widehat{work_{im,t+1}}$	-0.122	-0.165*	-0.111	-0.122	-0.038	0.137
	(0.098)	(0.099)	(0.100)	(0.161)	(0.166)	(0.177)
Time FE	YES	YES	YES	YES	YES	YES
Labor market history	YES	YES	YES	YES	YES	YES
Sector dummies	YES	YES	YES	YES	YES	YES
Controls	YES	YES	YES	YES	YES	YES
Number of observations	290,738	335,270	335,270	226,685	259,124	259,124

*Table 13 The effect of finding work on the use of medication (second stage) for males and females separately. Y=1, Y=2, and Y=3 denote one, two, and three years after filing for unemployment. Mental diseases are the collective name for depression, anxiety, and tension. The column Y+1 has less observations as medication use is only available as of 2006. As a consequence, workers filed for UI in 2004 are omitted from this regression. *** denotes significance at the 1% level, ** denotes significance at the 5% level. Robust standard errors between parentheses.*

Appendix III The Dutch Health care system

Figure 7 shows how the Dutch health care market functions. Households are obliged to buy health insurance from a private health insurer. The health insurance market is a competitive market with several insurance companies. The main purpose of this competition is to keep the price of health insurance low. In exchange for health insurance, households must pay a nominal (fixed) insurance premium. The insurance premium will decrease if insurers choose a deductible. In other words, a higher deductible means a lower insurance premium.

Apart from the nominal premium, households must pay income taxes. Part of the income tax consists of income-dependent social premiums that are used to pay for healthcare costs.[24] These income taxes are used in two ways. First, they are used as an income-dependent health care allowance. In this way, each household in the Netherlands can buy health insurance. Second, they are used to compensate health insurance companies for insurers that need a lot of health care. [25] As health insurers are not allowed to discriminate among different subgroups, they must accept everyone. In other words, health insurers have to accept anyone regardless of age, health risks, or any other criteria[26]. Lastly, the Dutch health care authority monitors the health insurance companies. Their main objective is to make sure that insurers are well informed about the insurance they have and to make sure that health insurance companies offer sufficient treatment possibilities in case the insurers become ill.

[24] In 2007, the income-dependent contribution equaled 6.5% of someone's wage or allowance. the contribution is levied on a maximum of €30 623, -.
[25] In Dutch: vereveningsbijdrage.
[26] An exception to this rule is persons that did not pay their health insurance or tried to deliberately mislead the health insurer. The health insurer may reject such a client for the next five years. Other insurance companies cannot refuse.

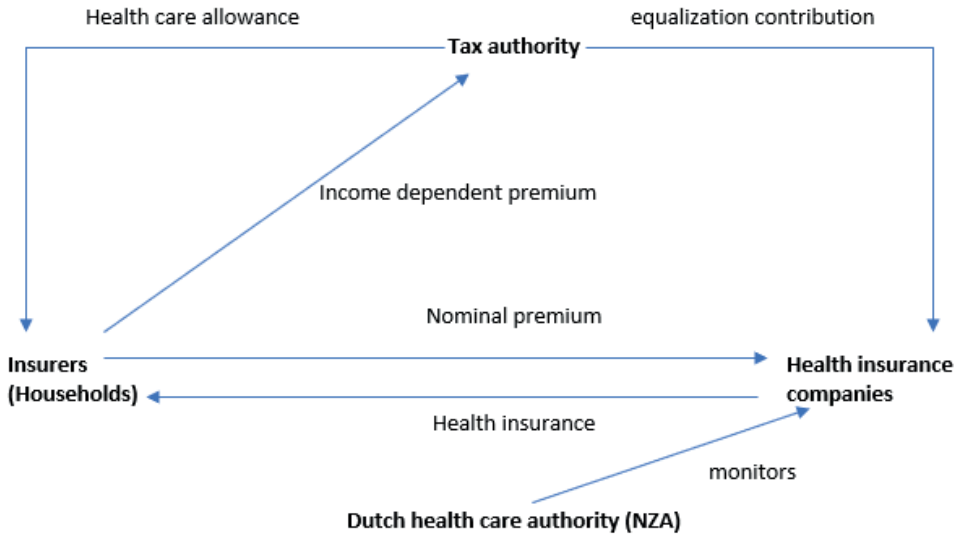

Figure 7: Overview (simplified) of the Dutch healthcare system. Based on Van den Berg, Klabbers, Sens, Wildenburg, and Hop (2007).

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Dit proefschrift is een verzameling van drie hoofdstukken over werk en pensioen. De eerste twee hoofdstukken gaan over pensioenbeslissingen. In het laatste hoofdstuk staat de relatie tussen werk en gezondheid centraal. Alle drie de hoofdstukken maken gebruik van Nederlandse arbeidsmarkthervormingen en empirische econometrische methoden om inzicht te krijgen in de bovengenoemde relaties.

Vanuit een beleidsperspectief kunnen twee bredere conclusies worden getrokken uit dit proefschrift. Ten eerste laat dit proefschrift zien dat de rol van financiële prikkels in het uittredingsgedrag in belangrijke mate kan verschillen tussen verschillende inkomensgroepen. Ten tweede toont dit proefschrift aan dat niet-financiële determinanten van arbeidsmarktgedrag ook belangrijk zijn. Al met al laat dit proefschrift zien dat zowel financiële als niet-financiële prikkels moeten worden meegenomen om de effecten van beleid goed te doorgronden.

Adelbert Theodorus Gerardus Johannes Rutten (Valkenswaard, 1996) behaalde zijn bachelor Economie en Bedrijfseconomie cum laude aan Tilburg University in 2017. Tevens voltooide hij in dezelfde periode het CentER Honors Programma en het Discourses on Europe Honors programma. Vervolgens behaalde hij aan dezelfde universiteit zijn Research Master diploma in 2019. In de vier jaren daarna schreef hij zijn proefschrift onder begeleiding van zijn promotoren, Daniël van Vuuren en Marike Knoef. Zijn PhD werd gefinancierd door Instituut Gak in samenwerking met Tilburg University. Sinds juni 2023 is hij economisch onderzoeker voor SEO Economisch Onderzoek in het cluster Arbeid.

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