

Retirement Decision of Belgian Couples and the Impact of the Social Security System

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Abstract

This paper examines the retirement patterns of married couples in Belgium. To analyze retirement behavior, we use administrative social security data from 2003 to 2017 in combination with a discrete choice random utility model. We focus in particular on the spousal bonus in pension payments to understand how financial incentives embedded in the structure of the social security system influence the retirement decisions of both partners. We simulate the elimination of the spousal bonus and find that while a small share of women delay their retirement, most shift to alternative social security benefits. Our results do not only highlight the significance of cross-program spillovers between various social security benefits, but also the heterogeneity in preferences for retirement and the asymmetry of retirement behavior between husbands and wives.

Keywords: Old-Age Labor Supply, Retirement Incentives, Spousal Bonus, Pension Reforms

JEL Classification: D10 , H55 , J26

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1 Introduction

As populations in developed countries continue to age, significant public spending challenges are expected to emerge. To maintain the financial stability of social security systems, many governments have introduced or are considering various policy reforms. Social security systems in most countries provide several pathways through which one can transition from work to retirement. Consequently, the success of a reform in one system often depends on the availability of alternative retirement options. Since changes in one social security program might encourage individuals to switch to other programs, predicting how people will respond to these reforms can be complex. Furthermore, as participation in the female labor force increases, retirement decisions should be examined within the broader framework of household rather than solely at the individual level. Ignoring potential interactions between spouses can lead to misleading conclusions, as the choices made by one partner in a particular program may influence the other partner's decisions, given the interconnectedness of their financial incentives and leisure preferences.¹ [Gustman and Steinmeier \(2000\)](#) and [Michaud and Vermeulen \(2011\)](#) address the interdependence of preferences and model joint retirement by assuming that the marginal utility of own leisure depends on the leisure of the spouse. Joint retirement models allow for forces beyond one's mere financial incentives; however, the difficulty lies in the identification of preferences since the complexity of the model can only be accounted for by a rich dataset. It is critical to understand the direct and indirect effects of retirement policy reforms along with the factors that tie spouses' retirement decisions together to reduce the financial strain on public pension schemes. In this paper, we study how the so-called "spousal bonus", which is a more advantageous rate of old age pensions that is granted to married individuals whose spouse has no or limited earnings (i.e. 75% instead of the standard

¹Several studies have documented that couples are often observed to exit the labor market around the same time, in a way that cannot only be explained by individual incentives to retire that each spouse faces ([Coile, 2004](#)).

60%), affects the retirement behavior of married Belgian workers with a particular focus on different retirement pathways and the role of shared household income.²

The spousal bonus is designed to alleviate the poverty of households with a single main earner. In general, households with a dependent spouse typically consist of a high-wage-earning husband and a low-wage-earning or inactive wife. By contrast, dual-earner households—where both spouses earn low wages are far less likely to benefit from spousal bonuses. In an environment of growing concerns about the stability of social security systems, the asymmetric nature of spousal benefits raises concerns regarding the fairness and adequacy of social security benefits. In particular, [Favreault and Steuerle \(2007\)](#) finds that even though reallocating aggregate resources paid for spousal bonus more equally within society reduces poverty, it has important trade-offs on the welfare of different beneficiary groups.

The availability of the spousal bonus can affect the retirement behavior of primary earners and dependents in different ways. First, due to the income effect, both partners could have higher demand for goods and leisure, which could increase their likelihood of retiring early. Second, it changes the price of retirement through a substitution effect. While for primary earners, this may lead to a stronger incentive to delay retirement due to high opportunity cost of retirement, for dependents, it decreases work incentives by reducing the reward for extra work. Spousal and survivors benefits are welfare-reducing due to their distortionary impact on the labor supply decision of married households and redistribution of wealth from relatively low-income households to high-income households. On the other hand, if spousal benefits were to be eliminated in an effort to balance the social security budget, relying

²When a spouse receives the spousal bonus, her/his partner's pensions are suspended or deducted from the spousal bonus amount, s/he cannot receive unemployment or sickness benefits, s/he can exercise a professional activity, provided that it does not exceed a certain amount (gross earnings below 12 951 Euros below age 65 in 2022).

on the primary earner's pensions would become unattractive. This would motivate the low-earner spouse to build up higher own social security benefits or substitute into alternative early retirement pathways. Consequently, the spillover effects between different social security programs are of great importance for the purpose of policy evaluation. Substitution into alternative retirement programs could lead to a greater burden than the spousal bonus. In this regard, our objective is to evaluate a hypothetical policy reform on the spousal bonus, taking into account financial spillovers and various retirement alternatives one can benefit from.

[Lammers, Bloemen, and Hochguertel \(2013\)](#) states that social benefits such as disability insurance and unemployment insurance have been used as early retirement pathways in addition to traditional early retirement programs, while [Autor and Duggan \(2003\)](#) finds that disability insurance is used as a substitute for unemployment insurance in the US. Moreover, when the eligibility criteria for disability insurance are strengthened, many individuals switch to other forms of social assistance ([Borghans, Gielen, & Luttmer, 2014](#)). [Pestieau and Stijns \(2008\)](#), [Desmet, Jousten, Perelman, and Pestieau \(2007\)](#) and [Jousten, Lefebvre, and Perelman \(2016\)](#) document the variety of retirement paths in Belgium and highlight that most Belgian workers leave the labor market permanently, receiving their primary income from disability, sickness, unemployment insurances, unemployment with company supplement, or old age pensions. On the other hand, [Johansson, Laun, and Palme \(2016\)](#) studies the impact of economic incentives on labor force exit through different income security programs in Sweden and finds that economic incentives generated by income taxes and the income security system significantly affect the timing of exit from the labor market to different degrees between people with different levels of health and education. [Venti and Wise \(2015\)](#) draws further attention on the heterogeneity of retirement pathways based on education levels. This paper contributes to the literature by examining

the impacts of a hypothetical policy reform, accounting for both substitution into alternative retirement pathways and household heterogeneity.

In order to understand the impact of the spousal bonus of pensions on the primary earner spouse and the dependent spouse, we construct a structural model of retirement which characterizes household decisions by carefully incorporating in the specific structure of the Belgian Social Security system including disability insurance, sickness benefits, spousal bonus, and unemployment insurance as pathways to retirement. There is a great deal of variation in how benefits are determined depending on the household type and average lifetime earnings, which potentially generates heterogeneity in retirement incentives. Our model incorporates observed and unobserved heterogeneity to capture differences in individual tastes. A prominent feature of our model is the consideration of retirement from a broader perspective. Similar to [Lefebvre and Orsini \(2011\)](#), we model the exit paths from the labor market through the various available schemes. Doing so, we are able to exploit the heterogeneity between different types of households and different types of retirement paths which allows us to better understand the substitution patterns between retirement paths and retirement ages in response to changes in social security rules.

This study contributes to the existing literature in several ways. First, income sharing among spouses can provide insurance, especially for the low-wage spouse. We find that on average, women are 4% less likely to retire before reaching the earliest eligibility age when the spousal bonus is hypothetically removed. This result is consistent with the findings of [Knapp \(2014\)](#), which shows that, following a reduction in spousal benefits, wives with lower household earnings increase their average labor force participation by 1.27 years. Second, similar to [Jousten and Lefebvre \(2019\)](#) which finds that men are less responsive to social security incentives, we do not find a

significant change in husbands' retirement behavior. The structure of the social security system creates asymmetric incentives for the primary-earner and the dependent in the household, so that for some couples it is more profitable for the dependent to substitute labor income by spousal benefits if s/he does not have access to alternative social security benefits. Third, when the spousal bonus becomes unavailable, individuals not only delay their retirement, but also switch to alternative retirement paths. In particular, more than half of the individuals who would be willing to benefit from the spousal bonus switch to alternative retirement via unemployment or disability insurance, providing evidence of the cross-program spillover effects with respect to hypothetical policy change. Hence, neglecting cross-program spillovers and interactions among household members can result in an underestimation of the cost of welfare programs and the effects of policy reforms. Fourth, there is a certain degree of heterogeneity in retirement incentives that should be taken into account when making policy predictions. For some couples, spousal benefits can create poor work incentives, as the low-wage earner may be entitled to lower social security benefits than the spousal bonus. Last but not least, the impact of the policy strongly depends on the magnitude of the default policy in place relative to other social security benefits. In a hypothetical case of reforming the spousal bonus from 50% to 25%, we observe a much stronger shift in the retirement probabilities of both men and women.

The remainder of the paper is structured as follows. In Section 2, we sketch the institutional framework of retirement in Belgium. Section 3 details the data used for our analysis. In Section 4, we provide a brief summary of retirement behavior in Belgium. Section 5 presents the estimation results of our model and the policy simulations. Section 6 concludes.

2 Institutional Background

In this section, we carefully detail the social security benefit structure in Belgium for the first pillar.³ The Belgian social protection landscape can be grouped into three main schemes: for wage-earners, for the self-employed and for civil servants. The focus of this research is on the wage-earners scheme, as it is the scheme that covers the majority of the population and provides a variety of benefits.

2.1 Old Age Pensions for Private Sector Employees

Individuals who worked as an employee in the private sector are entitled to a retirement pension, depending on the length of their career and pensionable earnings. In case one has a mixed career, s/he may be entitled to pensions from several schemes. The statutory retirement age is currently 65 years for both men and women but it will increase to 67 years by 2030. The career length required to get a full pension is 45 years or 14,040 days.⁴ If one works beyond this limit, the pension calculation will be based on the most advantageous 45 years of one's career. Individuals accumulate pension rights based on pensionable earnings for any given year. For each career year, the pensionable earnings correspond to the last earned wage and are subject to a floor and a ceiling. The accumulation of pension rights is capped at 60,026.75 Euros in 2021. The minimum wage floor is applied if one has at least 15 years of work experience, which amounts to 25,833.78 Euros in 2021 for a pensioner with full career.⁵ Working beyond meeting the age and career conditions for retirement is rewarded by a pension bonus which is available after the first year of pension claim. The pension

³Belgium has three different pillars in place consisting of public pensions, occupational pensions and individual savings. However, the first pillar provides the main source of income in retirement for the majority of the population, while occupational pensions are only available to approximately 59% of the population in 2016 ([European Commission and Directorate-General for Employment, Social Affairs and Inclusion \(2018\)](#)). There are many sector/company specific rules for occupational pensions and they provide a supplementary benefit which usually is paid as lump sum. Even though, for some individuals they might play a role in retirement decision, in this study we abstract from second and third pillar pensions.

⁴Note that this is based on the 6 days per week work regime, for those who are subject to the 5 days work regime, the days worked is converted to the 6 days regime. A full-time work year constitutes 312 days.

⁵15 years of work experience for at least one third of a full-time job in each year.

bonus is a lump sum for the number of days worked beyond pension eligibility.⁶

The replacement rate of pension benefits is based on one's family situation. The pension is computed at 75% (household rate) if an individual has a dependent spouse and at 60% (individual rate) in all other cases. The pension base consists of the accumulation of rights over one's career. One accumulates pension rights during the periods of work and during certain periods of inactivity (assimilated periods), such as unemployment, disability, or parental leave. The assimilated periods are valued at the last corresponding earned wage. The reference wage is calculated based on the history of wages earned during the career subject to a wage ceiling. The reference wage is adjusted to current prices.⁷ Benefits are calculated based on the following formula:

$$pen_n = \frac{\sum_{t=1}^n (\tilde{w}_t d_t + \bar{w}_t a_t)}{45} \quad (1)$$

where n is the career year in which one claims her/his pension. In case $n > 45$, the sum is taken over the most advantageous 45 years. d_t and a_t correspond to the number of days worked and the number of days assimilated during career year t , respectively. The reference wage for the days worked is given by $\tilde{w}_t = \min(\max(w_t, \underline{w}_t), \bar{w}_t)$, where w_t denotes the wage one earns in the career year t , $\underline{w}_t$ is the minimum wage that is taken into consideration if one earns below this threshold and $\bar{w}_t$ denotes the upper bound for the wage that is taken into consideration for pension calculation.⁸

⁶From 2006 until 2013, the rule for pension bonus for work after the full career was stricter, beyond age 62 and career length of 44 and benefits were based on a fixed amount per day that amounts to 1.94 Euros per day of extra work for the first 12 months and gradually increasing thereof. For example, the bonus of an additional year of full-time work would contribute a one-time payment of 605 EUR implying minor financial incentives for delayed retirement. For pensioners who claim after 01.01.2015 the pension bonus is abolished. See <https://www.sfpd.fgov.be/fr/montant-de-la-pension/calcul/bonus-de-pension>

⁷Pension benefits are indexed to the smoothed health index (price index, excluding alcoholic beverages, tobacco products and motor fuels) and increased smoothed health index reaches the central index. For more details; <https://statbel.fgov.be/en/themes/consumer-prices/health-index>

⁸Additionally, those who do not have a full career in wage-earners scheme can benefit from minimum pensions if they can prove at least 15 years of work at a 1/3rd of full time. In this case, the reference wage for each career year is determined by the minimum wage (in case the latter is higher). The beneficiary receives this alternatively computed pension if it is more favorable.

In general, an individual who becomes inactive at the age of 55 can only start to take up old age pension (OAP) benefits at the early eligibility age. However, retirement before the early eligibility age is possible via several alternative social security benefits. In particular, one can leave the labor market permanently via old age unemployment insurance (UI), disability insurance (DI), and conventional early retirement (CER). The main reason these schemes act as alternative retirement paths relies on the access requirements of these programs and the broad availability of these benefits until one reaches the full retirement age. These programs are favored by many workers not only because they provide generous replacement rates but also because they allow workers to accumulate pension rights during periods of unemployment or disability through state subsidies. Unemployment and disability benefits can be obtained if the individual faces a displacement from work or an illness or disability that prevents work capacity by at least 66%. These benefits are continuous until age 65 as long as the person is above the old age unemployment eligibility age or as long as the disability continues.⁹ The specific nature of unemployment and disability benefits in Belgium makes them a potential alternative for retirement if one considers the efforts to look for a job more costly or values the leisure time more than the marginal net income one could get by returning to the labor market instead of receiving unemployment benefits. Another alternative is CER which gives access to old age workers who are replaced by a younger worker in addition to a supplement paid by the company. These benefits are paid until age 65 and one continues to build up pension entitlements during these periods. Note that CER differs from early retirement by claiming OAP earlier than the full retirement age. In OAP one is allowed to withdraw pensions as soon as eligible, in CER one receives replacement benefits and keeps accumulating OAP, so for someone who is eligible for both, it might be more profitable to exit by CER as this provides higher social security wealth and higher leisure time; however one would have to forego

⁹The eligibility age for old age unemployment has been gradually increasing throughout the time frame of this study and is provided on Table A1 in the appendix.

a degree of consumption due to earnings loss until 65.¹⁰ In addition, if one's partner is currently receiving old age pensions at the individual replacement rate, the couple can benefit from pensions at the household replacement rate when the working partner becomes inactive.

2.2 Spousal Bonus

In Belgium, individuals can be entitled to a pension at the household replacement rate, which is particularly beneficial for couples in which one partner has not accumulated sufficient pension rights. Pensions calculated under the household rate can be up to 25% higher than those based on the individual rate. The difference between these two rates is commonly referred to as the spousal bonus. Married couples can benefit from the spousal bonus when the spouse has limited or no professional revenue, does not receive any replacement income, such as unemployment, sickness, or disability benefits, receives a pension but its amount does not exceed the difference between the amount of retirement pension at the household replacement rate and the amount of retirement pension at the individual replacement rate.¹¹ The limited professional income for a working spouse should be below 11,627 Euros. The maximum amount of pensions someone with a full career can receive at the individual replacement rate in 2021 is 35,300 Euros, if s/he has a dependent spouse with no income, the spousal bonus amounts to 8,825 Euros.¹² On the other hand, for someone with full career and receiving minimum pension (15,911 Euros in 2021), the spousal bonus amounts to at most 3,978 Euros. Table 1 provides an overview of the spousal bonus and the share of couples who receive the spousal bonus over the household income distribution. We observe that couples with lower household income are less likely to receive the spousal bonus compared to those with higher income. This suggests that, although the spousal

¹⁰The specific requirements and benefits levels of these alternative retirement paths are detailed in the Appendix.

¹¹Cohabitation does not have an impact on a person's pension entitlement, cohabitants each receive their pensions at the individual replacement rate.

¹²If an individual has own pensions that are less than 8825 Euros, the couple receives a bonus that is equivalent to the difference between the primary earner partner's pension amount and 8825 Euros.

bonus helps compensate for pension gaps resulting from unpaid household work, it primarily benefits couples with larger lifetime income differences. In contrast, couples who equally shared household responsibilities, resulting in both partners having low pension rights, are less likely to benefit from the spousal bonus.

Table 1 Spousal Bonus by Income Quartile

	<i>Q1</i>	<i>Q2</i>	<i>Q3</i>	<i>Q4</i>
Share of Spousal Bonus Receivers	8.40%	27.48%	30.92%	33.59%
Average Spousal Bonus	3546	3843	4875	5360
Average Total HH Lifetime Income	554,115	999,300	1,295,214	2,295,182

Notes: Income quartile is based on one’s lifetime earnings at age 54. Average spousal bonus is the yearly amount a couple receives. The share of spousal bonus receivers is the share of couples that belong to the given income quartile among all the spousal bonus receivers. *Source: CBSS and author’s calculations.*

3 Data

This paper benefits from rich administrative data in Belgium. Our data consist of a representative sample of 250 000 individuals from 1917-1966 birth cohorts in Belgium observed over the 2003-2017 time period on all their records with social security institutions and full information on career histories for wage-earners since 1956. As our focus is to model retirement patterns, we select the subset of this sample where individuals are below the full-retirement age (65) and above 54 which leaves us with 25000 individuals and only 18000 of those are married. In order to capture the impact of financial incentives and the value of retirement at different ages, we focus only on the wage-earners scheme. We also eliminate those who are associated with multiple schemes and those who left the labor market before age 55. The reason for this restriction is that wage earners are the only group for whom we can trace back labor market status and earnings since 1956 and calculate their hypothetical pension entitlements from age 55 until the statutory retirement age of 65. To avoid potential endogeneity in marital status, we focus on couples who had been together for at least

five years by 2003 and observe them until 2017 or until one partner passes away. Furthermore, we restricted our analysis to couples with an age gap of no more than six years, excluding approximately 7% of the sample on each side of the distribution. To summarize, our sample consists of 5253 individuals from 1948-1952 cohorts, who have at most six years of age difference with their spouse and who have been employed at age 54 as well as their spouse.

To calculate the accrued pension benefits up to a given year, we follow the rules established for old-age pensions by assuming that the beneficiary retires in a given year between 2003 and 2017, and compute the hypothetical pension amount based on the assumption that the individual will continue working at the same intensity and wage as in their last active year until reaching old-age pension eligibility.¹³ We assume that individuals are fully aware of the pension system rules and plan their retirement under the expectation that these rules will remain unchanged in the future. Furthermore, to calculate the present discounted pension wealth for any given year, we adjust it by multiplying by the survival probabilities up to age 100, assuming a discount rate of 2%.¹⁴ Additionally, we simulate the hypothetical UI, DI, CER and entitlement for spousal bonus accounting for the labor market status and wage of the partner during the time frame of our analysis.

We define retirement as permanent termination of labor market activity, which is assumed to be an absorbing state. One can retire through various alternative ways such as unemployment insurance, unemployment with company supplement, disability insurance, or old age pensions. Earnings are defined as net after-tax earnings calculated based on individuals' gross annual labor market earnings adjusted for

¹³See [Fraikin, Jousten, and Lefebvre \(2021\)](#) for a detailed description of rules and laws for the Belgian Social Security system.

¹⁴Survival probabilities for a given age and year are obtained by Statbel.

inflation and expressed in 2019 euros. Personal income tax is calculated by determining the tax base after deduction of child benefits, family benefits, and professional expenses, and assessing the tax due based on four different tax brackets. Taxation is progressive and the tax rates in these brackets range between 25% and 50%. In addition to that, there are regional taxes; however, for the sake of simplicity, we do not take regional taxes into account.

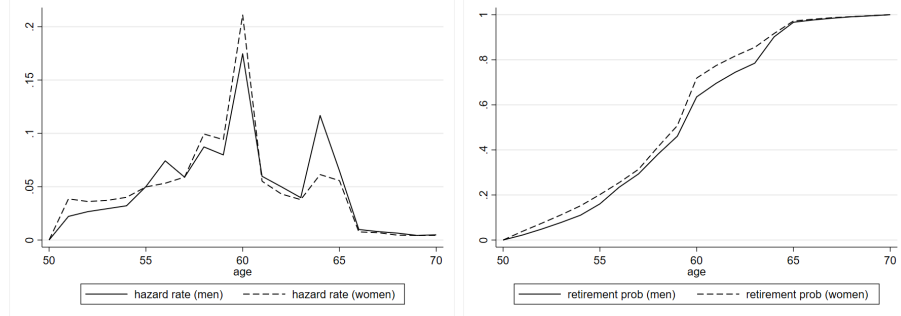
4 Retirement Behavior in Belgium

Figure 1 demonstrates the retirement likelihood in Belgium separately for men and women. The left panel plots the hazard rate, whereas the right panel shows the cumulative probability of exit from the labor market of the sampled individuals who were active in the labor market at age 50. We observe that in general women leave the labor market sooner than men, with a high spike in the retirement hazard at age 60. The average age of exit from the labor market for women is 57, while for men it is 58.4. Even though many people gradually exit the labor market starting from age 50, there are 3 main ages that individuals exit the labor market proportionally more than any other ages. The first one is 58 at which most of the individuals become eligible for CER besides some exceptional cases which allow one to benefit from CER at age 55 or earlier. Then a high number of individuals exit the labor market as soon as they reach the early retirement age of the old age pension system, which is 60 for cohorts born before 1953, and most remaining individuals exit at the full retirement age, 65.

4.1 Retirement Paths

Individuals in the wage-earners scheme can benefit from several early-retirement and social safety net programs such as old age unemployment, unemployment with company supplement, sickness and disability benefits, as well as retirement pensions.

Fig. 1 Retirement age



Notes: Retirement age conditional on being employed at 50 over 2003-2017. Left panel: Retirement hazard rates. Right panel: cumulative retirement probability. *Source: CBSS and author's calculations.*

We focus on the cohorts that were born between 1948 and 1952. These are the birth cohorts that had reached the normal retirement age of 65 in 2017 and who were observed from at least age 55. The purpose of selecting these cohorts is to have a full choice set for everyone in the sample available for the age interval 55-65 where majority of the labor force is observed to retire. Considering those who appear in the sample after age 55 or who are observed until some age before 65 imposes a selection bias and creates an unbalanced sample. For example, if we only observe some cohorts until age 60, we might have an over-representation of individuals who choose CER in hazard rates.

Table 2 shows the percentage share of workers in our sample who exited the labor market through different retirement routes. We observe that labor market exit behavior does not always align with the claiming of old-age pensions. Most individuals exit the labor market through unemployment with company supplement, while only 33% of the sample retires via old-age pensions. This suggests that alternative retirement routes play a significant role in Belgium, and the low effective retirement age can be partly attributed to that. Additionally, those who exit the labor market through claiming old age pensions mostly do so as soon as they reach the early retirement eligibility. It is evident from Table 2 that there are also significant differences between

men and women. Women in general are more likely to exit via unemployment or disability insurance, which provides lower replacement benefits. In addition to this, about 5% of women who were active in the labor market at age 54 exit with no individual benefits (ENB), mainly relying on the spousal bonus of old-age pensions through their partner. This may be due to income effects, where a higher-earning partner's pension makes an early exit financially viable, or it may reflect couples' preferences for joint leisure. Women are often secondary earners in households, and couples with large earnings gaps may find it more beneficial to take advantage of the spousal bonus, which can increase the primary earner's pension benefits by up to 25%. Another notable trend is that more men benefit from the CER compared to women. This is likely because CER eligibility requires stricter age and seniority conditions than regular unemployment insurance or disability insurance benefits, and women generally have lower seniority than men.

Table 2 Percentage Share of Exit Routes From the Labor Market

Age	<i>Men</i>					<i>Women</i>				
	OAP	CER	UI/DI	ENB	Total	OAP	CER	UI/DI	ENB	Total
55	0.00	0.05	0.03	0.00	0.09	0.00	0.02	0.05	0.01	0.08
56	0.00	0.10	0.03	0.00	0.13	0.00	0.03	0.04	0.00	0.08
57	0.00	0.08	0.02	0.00	0.11	0.00	0.04	0.04	0.01	0.09
58	0.00	0.13	0.03	0.00	0.16	0.00	0.13	0.03	0.01	0.17
59	0.00	0.05	0.01	0.00	0.07	0.00	0.05	0.02	0.01	0.08
60	0.15	0.05	0.01	0.00	0.21	0.20	0.06	0.02	0.00	0.29
61	0.04	0.02	0.00	0.00	0.07	0.04	0.02	0.01	0.00	0.07
62	0.03	0.01	0.00	0.00	0.05	0.03	0.01	0.01	0.00	0.05
63	0.02	0.00	0.00	0.00	0.03	0.01	0.01	0.01	0.00	0.03
64	0.02	0.00	0.00	0.00	0.02	0.03	0.00	0.00	0.00	0.03
65	0.05	0.00	0.00	0.00	0.05	0.05	0.00	0.00	0.00	0.05
Total	0.32	0.52	0.15	0.00	1.00	0.35	0.37	0.23	0.05	1.00

Notes: Exit paths comprise individuals who leave the labor market via claiming old age pensions (OAP), individuals who were unemployed but receive a supplement from the company on top of unemployment benefits (CER), individuals who benefit from unemployment and disability insurance (UI/DI), and those who were not observed to receive any social security benefits and are assumed to rely on private savings and household income (ENB). *Source: CBSS and author's calculations.*

The asymmetry in exit paths exists not only between men and women, but also across income groups. Table 3 shows the share of individuals who exit via different paths by lifetime income quartile. We observe that individuals who exit the labor market via DI and UI are almost twice as many in the bottom of the income distribution compared to the top. This indicates that the experience of retirement is not homogeneous in society and that the majority of low-income individuals exit the labor market through unemployment or disability insurance. In addition, the replacement rate under different retirement paths differs not only based on one's career history but also with household type, inducing further heterogeneities among retirees.

Table 3 Percentage Share of Exit Routes From the Labor Market by Income Quartile

	<i>Men</i>				<i>Women</i>			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
OAP	0.43	0.27	0.20	0.43	0.37	0.31	0.33	0.40
CER	0.28	0.55	0.64	0.41	0.28	0.47	0.50	0.43
UI/DI	0.29	0.16	0.12	0.13	0.30	0.19	0.14	0.13
ENB	0.00	0.02	0.04	0.03	0.06	0.03	0.03	0.04

Notes: Income quartile is based on one's lifetime earnings at age 54. Exit paths comprise : individuals who leave the labor market via claiming old age pensions (OAP), individuals who were unemployed but receive a supplement from the company on top of unemployment benefits (CER), individuals who benefit from unemployment and disability insurance (UI/DI) and those who were not observed to receive any social security benefits and are assumed to rely on private savings and household income (ENB). *Source: CBSS and author's calculations.*

4.1.1 Benefit Levels by Retirement Path

Based on the family situation of each individual, Table 4 reports the observed pension benefits in 2019 Euros for those who receive pensions separately at the single rate and the household rate. In addition, we report the average career length at age 65 for each exit path. The sample used in these tables is the subsample of those who are observed to receive pension benefits from the social security institution. 99% of the individuals who receive pensions at the household rate are male, therefore we only report pensions at the household rate for males.

Table 4 Benefit Levels and Seniority by Type of Exit

	Seniority		Single Pensions		HH Pensions	Spousal bonus
	Women	Men	Women	Men		
DI	29.98 (8.89)	36.67 (6.24)	16227 (5493)	23201 (4607)	30000 (6142)	6000 (1228)
UI	31.91 (8.04)	35.41 (7.50)	17995 (5880)	23164 (5449)	29137 (6838)	5827 (1368)
CER	39.02 (4.54)	40.17 (3.63)	22119 (5315)	27290 (4460)	35045 (5954)	7009 (1191)
OAP	38.68 (8.08)	42.50 (5.60)	18705 (6683)	26720 (5932)	31191 (8511)	6238 (1702)
Total	34.33 (10.04)	39.65 (5.91)	19101 (6664)	26327 (5387)	32455 (7688)	6491 (1538)

Notes: The subsample consists of individuals who are observed to receive pension benefits based on the data coming from ONP. Reported values are the mean of the sample, and standard deviation in parantheses. The HH pensions are for those who have dependent spouse and benefit from the spousal bonus for pensions. All the monetary values are in 2019 Euros. *Source: CBSS and author's calculations.*

Regardless of the type of exit, women have lower pension entitlements than men; however, to some extent, this can be explained by the lower seniority of women when they leave the labor force. The most advantageous exit path appears to be the CER, since, regardless of the exit age, individuals who benefit from this option keep accumulating pension rights up to age 65. In addition, the group of individuals who exit the labor market via CER has a high seniority level to be eligible for this option. Hence, on average, those who benefit from CER receive relatively higher pension benefits compared to other exit paths from the labor market, whereas, those who leave the labor market with unemployment or disability insurance are the least advantageous group, as they have shorter careers, which translate into lower pension benefits. On average an individual with a dependent spouse receives a spousal bonus of around 6500 Euros, which is equivalent to an individual pension with 19 years of work at minimum wage. Hence, having a high-earning primary earner in the household can encourage the couple to

benefit from the spousal bonus if the secondary earner has a short career, especially below 20 years.

5 Model

In order to incorporate in different sources of heterogeneity and reflect the difference in the type of exit from the labor market, we formulate a mixed logit model. A sampled individual i , who contemplates retirement after age 54, faces a choice amongst 11 retirement ages via up to 4 different retirement routes.¹⁵ We assume that these states are mutually exclusive, and each state is associated with a different level of consumption. Leisure only varies over different retirement ages and stays the same among different retirement paths at a given retirement age. Retirement is a terminal state, once a worker exits the labor market, s/he cannot return. We assume that spouses share the household income equally. [Bonke \(2013\)](#) shows that the vast majority of households pool their incomes and finds that although the wife's income share is on average 43% of the household income, she gets 53% of the assigned consumption. Based on the analysis of couples in Switzerland, [Bütikofer, Gerfin, and Wanzenried \(2009\)](#) finds that on average the female share of household income is about 0.48, but not significantly different from 0.5, while this share increases to almost 0.55 when the wife contributes half of the household income. In the light of this evidence, we believe that equal household income sharing can be an appropriate assumption. Our data do not contain any information on the amounts of consumption or savings; hence, we follow a static framework. The individual compares her/his discounted utility at age 54 for all possible retirement path choices until the statutory retirement age. By considering the full set of available alternatives, it is assumed that the individual will choose the alternative with the highest utility. Individuals know their preferences with certainty, but we cannot observe individuals' preferences. Hence, there is a stochastic part

¹⁵Depending on the eligibility for each alternative, the number of alternatives vary for each individual at any age and equal to at most 4. The details of eligibility conditions for each social security program is given in Table [A1](#) in the Appendix. All individuals are assumed to retire latest by the full retirement age.

of utility which is assumed to be distributed as extreme value type-1. We assume a stylized functional form of utility as in [Van Soest and Vonkova \(2013\)](#). The discounted sum of within-period utilities depends on employment status and income. Individual i has an indirect utility function for retirement path s that is composed of two additive parts, a systematic component V_{is} , and a stochastic component ϵ_{is} where,

$$U_{is} = V_{is} + \epsilon_{is} \quad (2)$$

for $s = (r, a)$ for each $r \in \{55, 56, \dots, 65\}$, and $a \in \{ENB, UI/DI, CER, OAP\}$.

$$V_{is} = V_{i(r,a)} = \alpha_i^c \sum_{t=55}^{100} \beta^{t-55} \pi_{t|55} \log(c_t(s, p_p^t)) + \alpha_i^l \sum_{t=55}^{100} \beta^{t-55} \pi_{t|55} \log(l_t(s)) + \epsilon_{is} \quad (3)$$

We allow for variation of preferences across the population through observed individual characteristics denoted by X_k for $k \in \{c, l\}$. In our specification X_k denotes a vector of individual and couple specific characteristics where $X_l = (\text{Own Income Quartile}, \text{Relative Earnings}, \text{Eligible}, \text{Age Difference}, \text{Age Difference Squared})$ and $X_c = (\text{Own Income Quartile}, \text{Relative Earnings})$. The own income quartile is defined as the quartile of an individual's total lifetime earnings at age 54, based on the distribution of earnings across the entire sample at age 54. Relative earnings is the ratio of average lifetime earnings of an individual to average lifetime household earnings, *i.e.*, $\frac{\sum_{t=1}^{N_i} w_{it}}{N_i}$, where N_i denotes individual i 's career length at age 54. *Eligible* is a dummy variable that shows whether one has reached the earliest age to be able to claim OAP and the age difference is calculated by subtracting the reference individuals' age from her/his partner's age. We assume that preferences vary across individuals based on location in the income distribution, relative earnings compared to their spouse, the age difference between partners and eligibility status for receiving an old age pension. The coefficients α_i^{l1} determine the influence

of a change in these factors on marginal utility of leisure, and α_i^{c1} for consumption, whereas α^{c0} and α^{l0} reflect unobserved heterogeneity in preferences.

$$\alpha_i^l = \alpha^{l0} + \alpha^{l1'} X_l \quad (4)$$

$$\alpha_i^c = \alpha^{c0} + \alpha^{c1'} X_c \quad (5)$$

Consumption and leisure at age t given retirement path s are defined as follows;

$$c_t(s, p_p^t) = \frac{1}{2} \left[I_{work=1|s}^t w + (1 - I_{work=1|s}^t) b_t(s) + (1 - p_p^t \mathbf{1}^T) w_p + p_p^t (b_p)_t^T \right] \quad (6)$$

$$l_t(s) = \begin{cases} 1 & \text{if } I_{work=1|s}^t = 0 \\ \frac{2}{3} & \text{if } I_{work=1|s}^t = 1 \end{cases}$$

for each $s = (r, a)$ where $r \in \{55, 56, \dots, 65\}$, and $a \in \{ENB, UI/DI, CER, OAP\}$.

$I_{work=1|s}^t$ is a dummy that indicates whether the individual's labor market status is active or not in the retirement path choice s at age t . One receives wages if s/he is active and obtains retirement benefits, $b_t(s)$ if s/he retires through retirement path s . The household consumption consists of both partners' revenues and is equally shared by the partners. $(b_p)_t$ denotes the vector of retirement benefits one's partner could obtain under each retirement path, *i.e.*, $(b_p)_t = ((b_p^{ENB})_t, (b_p^{UI/DI})_t, (b_p^{CER})_t, (b_p^{OAP})_t)$. We assume that an individual does not have perfect knowledge of her/his partner's future retirement decision but knows the likelihood of all the retirement paths that are likely to be chosen. Hence, we assume that one's partner will be retired with probability p_p^t which is a vector of probabilities over the set of retirement alternatives, *i.e.*, $p_p^t = ((p^{ENB})_p^t, (p^{UI/DI})_p^t, (p^{CER})_p^t, (p^{OAP})_p^t)$. It is exogenous, but varies by the age, gender, and career length of one's partner. We assume that the difference between the time endowment and the hours worked constitutes leisure time. Individuals are endowed with 1 unit of time in each period. If one decides to work at age t , then s/he

devotes one third of her/his time to work until s/he retires permanently. We abstract from partial retirement and part-time work.¹⁶ We assume that the maximum lifespan is 100 years.

The systematic component of the indirect utility function is assumed to be concave in consumption and the remaining lifetime leisure after retirement. The discount factor β is assumed to be 0.98, and $\pi_{t|54}$ denotes the survival probabilities conditional on being alive at age 54. We assume that the expectations are formed when one is 54 years old, and the benefit levels are based on one's most recent wage and career history prior to the decision. To compute benefit levels beyond age 54, we assume that one continues to work at the same wage level beyond age 54 (up to age t where $t \leq 65$). w is the observed wage at age 54, and $b_t(s)$ is the simulated social security benefits to which one would be entitled at age t if s/he were to retire via retirement path, s . There is no wage uncertainty; assuming that an individual is working at the baseline, s/he may continue to receive the same level of nominal annual earnings until age 65 if s/he chooses not to retire earlier.¹⁷ The unemployment and disability benefits are calculated based on one's reference wage which is the last earned wage subject to floors and ceilings. Here we represent one's reference wage by w . The replacement rate for unemployment and disability benefits is on average 40% of the reference wage. The minimum amount of company supplement, sup_r is equal to half the difference between one's net reference wage and unemployment benefits. The details of the social security benefits per retirement alternative are demonstrated in Table 5. Consumption is assumed to be equally shared within the household; therefore, the amount of benefits of the partner and the retirement path is also crucial in determining the expected benefit levels of different retirement options. Individuals'

¹⁶Even though some individuals can decrease the hours worked and hence the professional income when their partner claims old age pensions, we are interested in the potential impacts of the spousal bonus in driving one to completely drop out from the labor market, hence, the current paper abstracts from partial retirement.

¹⁷This is a simplification for the baseline model, however we believe that this is not very restrictive as we observe stationary wages in our sample especially, after age 50.

own earnings depend on their retirement age and path choice, whereas partner's expected earnings are estimated by the sample probabilities of being in any possible state. We calculate the estimated income of the spouse based on the sample probabilities of being in any possible state at a given age.

Table 5 Benefit Levels by Retirement Path

Exit Path (s)	SS Benefits $b_t(s)$ for $t < 65$	SS Benefits $b_t(s)$ for $t \geq 65$	Partner's OAP Benefits
ENB	0	0	$1.25pen_t^p$
UI/DI	$(0.4w)$	pen_{65}	pen_t^p
CER	$(0.4w + sup)$	pen_{65}	pen_t^p
OAP	pen_r	pen_r	pen_t^p

Notes: $b_t(s)$ represents the amount of benefits one can receive in a given period t , if s/he were to choose path s among 4 retirement alternatives. The unemployment and disability benefits are calculated based on one's reference wage which is the last earned wage subject to floors and ceilings. Here we represent one's reference wage by w . The replacement rate of unemployment and disability benefits are on average 40 % of the reference wage for the relevant time frame. The minimum amount of company supplement, sup_r is equal to half the difference between one's net reference wage and unemployment benefits. Pensions are calculated based on the formula given in section 2. If one reaches age 65, all other social security benefits are replaced by OAP.

For example, the household consumption at age 55 under the retirement path $s = (55, a)$ is equal to $b_{55}(55, a) + (1 - p_p^{55}\mathbf{1}^T)w_p + p_p^{55}(b_p)_{55}^T$ for $a \in \{ENB, UI/DI, CER, OAP\}$. Table 6 illustrates the household consumption levels at each age for an individual retiring at age r via retirement alternative a . If one chooses to retire at age 55 through retirement path a , s/he will benefit from a consumption of $(b_{55}(55, a) + (1 - p_p^{55}\mathbf{1}^T)w_p + p_p^{55}(b_p)_{55}^T)/2$ while by working an additional year, s/he can consume $(w + (1 - p_p^{55}\mathbf{1}^T)w_p + p_p^{55}(b_p)_{55}^T)/2$ at age 55 and $(b_t(55, a) + (1 - p_p^t\mathbf{1}^T)w_p + p_p^t(b_p)_t^T)/2$ afterwards. The trade-off between retiring at age r via different alternatives helps us identify one's preferences for consumption. For example, if one contemplates retiring at age 55, s/he can choose between ENB and

UI/DI and these two alternatives will provide different degrees of consumption; under ENB the consumption level is either 0 if the partner is not withdrawing pensions yet or depends solely on partner's pensions, whereas under UI/DI one gets a proportion of the last earned wage. On the other hand, if one is retiring via alternative a but contemplates whether to retire at age r vs. $r + 1$, this helps us identify preferences for leisure.

Table 6 Individual consumption under different retirement paths

Age	$r = 55$	$r = 56$	$r = 57 \dots$
55	$(b_{55}(55, a) + (1 - p_p^{55} \mathbf{1}^T)w_p + p_p^{55}(b_p)_{55}^T)/2$	$(w + (1 - p_p^{55} \mathbf{1}^T)w_p + p_p^{55}(b_p)_{55}^T)/2$	$(w + (1 - p_p^{55} \mathbf{1}^T)w_p + p_p^{55}(b_p)_{55}^T)/2$
56	$(b_{56}(55, a) + (1 - p_p^{56} \mathbf{1}^T)w_p + p_p^{56}(b_p)_{56}^T)/2$	$(b_{56}(56, a) + (1 - p_p^{56} \mathbf{1}^T)w_p + p_p^{56}(b_p)_{56}^T)/2$	$(w + (1 - p_p^{56} \mathbf{1}^T)w_p + p_p^{56}(b_p)_{56}^T)/2$
57	$(b_{57}(55, a) + (1 - p_p^{57} \mathbf{1}^T)w_p + p_p^{57}(b_p)_{57}^T)/2$	$(b_{57}(56, a) + (1 - p_p^{57} \mathbf{1}^T)w_p + p_p^{57}(b_p)_{56}^T)/2$	$(b_{57}(57, a) + (1 - p_p^{57} \mathbf{1}^T)w_p + p_p^{57}(b_p)_{57}^T)/2$
58	...	$(b_{58}(56, a) + (1 - p_p^{58} \mathbf{1}^T)w_p + p_p^{58}(b_p)_{58}^T)/2$	$(b_{58}(57, a) + (1 - p_p^{58} \mathbf{1}^T)w_p + p_p^{58}(b_p)_{58}^T)/2$
59	...	...	$(b_{59}(57, a) + (1 - p_p^{59} \mathbf{1}^T)w_p + p_p^{59}(b_p)_{59}^T)/2$
60	...	...	...
61	...	...	...
62	...	...	...
63	...	...	...
64	...	...	...
65	...	...	...
...	...	...	...
100	$(b_{100}(55, a) + (1 - p_p^{65} \mathbf{1}^T)w_p + p_p^{65}(b_p)_{65}^T)/2$	$(b_{100}(56, a) + (1 - p_p^{65} \mathbf{1}^T)w_p + p_p^{65}(b_p)_{65}^T)/2$	$(b_{100}(57, a) + (1 - p_p^{65} \mathbf{1}^T)w_p + p_p^{65}(b_p)_{65}^T)/2$

Notes: The amount of benefits per path is illustrated in Table 5. One receives labor income until the retirement age and social security benefits as of retirement age, the benefits under UI/DI and CER continue until age 65, thereafter, everyone is rolled over to OAP.

It is likely that different respondents will have different preferences even after controlling for the observable individual and household characteristics. [Daniels and Hensher \(2000\)](#) indicates that the error correlation between alternatives could be confounded with the unobserved preference heterogeneity if the variation in the unobserved heterogeneity is ignored. One way to control for this is to specify the parameters associated with each attribute as random ([Hensher & Greene, 2003](#)). In order to incorporate potential unobserved preference heterogeneity, a random parameters logit model is used ([K. Train, 2001](#)). This approach assumes that preferences can vary across the population with density $f(\alpha)$, and each individual knows their own α_{is} and ϵ_{is} . It is also natural to expect that the random components associated with different attributes are correlated. For example, individuals may prefer to consume more when they have more leisure time. The mixed logit model not only accounts for the random taste variation across individuals but also incorporates in the substitution between alternative choices and correlation in unobserved factors. This allows us to better understand individuals' preferences for consumption and leisure. Hence, controlling for the potential correlation between random parameters can be of great importance in obtaining efficient estimates.

In this paper, we assume that individual-specific preferences for consumption and leisure are normally distributed, $\alpha_i^k \sim \mathcal{N}(\mu^k, \Sigma^k)$ for $k \in \{c, l\}$. The joint distribution of the individual specific parameters is then multivariate normal, i.e. $\alpha_i \sim \mathcal{N}(\mu, \Sigma)$ where μ is a mean vector and Σ is a covariance matrix. Suppose that the retirement path s_i in the choice set S_i is chosen by individual i . Assuming that ϵ_{is} is IID Type-1 extreme value, the conditional choice probability of individual i is given by;

$$P(s_i|X_i, \alpha_i) = \frac{\exp(\alpha_i x_{is})}{\sum_{n \in S} \exp(\alpha_i x_{in})} \quad (7)$$

for each $s = (r, a)$ for $r \in \{55, 56, \dots, 65\}$, and $a \in \{ENB, UI/DI, CRE, ENB\}$. As a result, the unconditional choice probability is the integral over all possible values of α_i and takes the following form:

$$P(s_i|X_i, (\mu, \Sigma)) = \int P(s_i|X_i, \alpha_i) f(\alpha_i|(\mu, \Sigma)) d(\alpha) \quad (8)$$

Since the integral does not have a closed form solution, we need to approximate the log likelihood function by Monte Carlo simulations. In the Maximum Simulated Likelihood Estimation, the parameters are treated as fixed unknown quantities. Point estimates of (μ, Σ) are obtained via maximization of the simulated log-likelihood function by BHHH algorithm with 500 random draws:¹⁸

$$\hat{P}(s_i|X_i, (\mu, \Sigma)) = \frac{1}{500} \sum_{m=1}^{500} P(s_i|X_i, (\mu_m, \Sigma_m)) \quad (9)$$

Our results in Table 7 report the mean and standard deviation of the point estimates. Next, we estimate the probability of individual i choosing the retirement path s for all $s \in S$ based on the point estimates and compare the alternative with the highest choice probability in the choice set with the actual choice to identify the predictive power of our model.

5.1 Estimation Results

Parameter estimates from the method of simulated maximum likelihood estimation are shown in Table 7. The first column refers to the combined sample of women and men, while columns two and three represent the results for the subsets of women and men, respectively. Although the combined sample does not permit a detailed analysis of preference heterogeneity of men and women, it provides valuable insights into the

¹⁸See [K.E. Train \(2009\)](#) for a detailed description.

Table 7 Parameter Estimates

	(All Sample)	(Women)	(Men)
Consumption (α_i^c)			
Constant	0.489*** (0.029)	0.601*** (0.078)	0.558*** (0.045)
Own Income Quartile	0.035*** (0.002)	0.041*** (0.003)	0.031*** (0.002)
Relative Earnings	-0.457*** (0.048)	-0.353** (0.171)	-0.641*** (0.073)
Leisure (α_i^l)			
Constant	1.341*** (0.113)	1.027*** (0.225)	3.078*** (0.204)
Own Income Quartile	-0.026 (0.025)	0.119*** (0.040)	-0.145*** (0.029)
Relative Earnings	2.031*** (0.257)	2.377*** (0.580)	-0.145 (0.367)
Eligible	0.109 (0.073)	0.601*** (0.115)	-0.399*** (0.089)
Age Difference	-0.006 (0.009)	0.025* (0.014)	0.011 (0.016)
Age Difference Squared	-0.004* (0.002)	-0.007* (0.004)	-0.003 (0.004)
Eligible (main-effect)	1.636*** (0.175)	3.021*** (0.283)	0.424** (0.201)
σ_c	0.038	0.156	0.019
σ_{cl}	0.116	0.436	0.066
σ_l	0.527	1.386	0.240
Observations	5,253	2,190	3,063
Log Likelihood	-14,391.730	-5,997.122	-8,193.381
AIC	29817.634	12385.223	17113.770

Notes: *p<0.1; **p<0.05; ***p<0.01.

Age difference is calculated by subtracting the reference individuals' age from her/his partner's age. Relative earnings is the ratio of lifetime average wage to the lifetime household average wage. Income quartile is calculated as the quartile of one's lifetime total earnings at age 54. Eligible is a dummy variable reflecting whether one has reached the earliest age to be able to claim OAP. *Source: CBSS and author's calculations.*

average worker's preferences as they approach retirement.¹⁹ Both estimated parameters in our model are significantly different from zero, indicating that individuals' valuations of consumption and leisure play a crucial role in shaping their retirement

¹⁹Even though our analysis indicate that estimating the model separately for men and women is important, we believe the inclusion of the joint sample estimates serves a complementary purpose as it provides a benchmark for the gender-specific findings.

decisions. The observed heterogeneity alone does not explain the preference heterogeneity. We have significant variation in both consumption and leisure parameters and the correlation between the two is also significant, which is confirmed by Wald, Likelihood Ratio, and Lagrange Multiplier tests.²⁰

Individuals' utility is affected positively by higher levels of consumption and leisure. The direction of the preferences for consumption are in line for men and women however, we observe significant differences in the heterogeneity of leisure preferences. It is important to exercise caution and assess each sample independently. Our purpose is to understand how preferences for each sample are distributed controlling for the observed differences. Our results indicate that the observed heterogeneity leads to an asymmetry of preferences. Several studies have found evidence of asymmetry between men and women due to asymmetry in financial constraints of husbands and wives (Blau (1998); Coile (2004)). The asymmetry in our results can result from various underlying factors such as women retiring for care duties or higher opportunity cost of husbands' retirement. European Commission: Eurostat (2019) reports that many women engage in informal care giving activities, or looking after grandchildren upon retirement, indicating that retirement decisions of women could be influenced by care responsibilities. An average household consists of a primary-earner husband and a part-time or low-wage-earner wife resulting in the specialization of men in the labor market and women in care or household chores. This implies that husbands with higher own income have higher opportunity cost of retirement, which provides support for the traditional breadwinner role of an average man. On the other hand, a positive marginal utility of leisure for women with higher own income highlights the income effect being dominant. For women, relative earnings within the household is an important factor behind preference heterogeneity. Since the eligibility conditions for retirement are not symmetrical for men and women due to women having shorter

²⁰See Table B2 and Table B3 in the Appendix.

careers on average, spouses may perceive financial retirement incentives in asymmetric ways. [Jaumot-Pascual, Monteagudo, Kleiber, and Cuenca \(2018\)](#) argue that care was a constraining factor in older women’s leisure. Due to care duties for children earlier during their career, women usually have lower pension accumulations which makes early retirement routes more attractive compared to OAP. Consequently, the care duties taken earlier in life have an impact on the labor income potential at senior ages and hence, providing lower opportunity cost of retirement compared to their husbands’ implying that when a household member requires care, family responsibilities might be a barrier to women’s employment at old-age. In contrast, according to [Gustman and Steinmeier \(2000\)](#), women appear to be influenced more by their own economic variables than by their husbands’ when making retirement decisions. The higher marginal utility for women with high shares of household income could indicate that these women face lower financial constraints for retirement compared to those with lower shares of household income, while men with a high share of household income have lower marginal utility of leisure due to the breadwinner role. The asymmetry of the impact of retirement eligibility on leisure supports this hypothesis. Women on average value leisure more upon reaching retirement eligibility unlike men, which explains the gap in the effective retirement age between men and women. The age difference seems to be an important factor for women only. Wives who are up to 4 years younger than their partner enjoy leisure relatively more, which suggests that the joint leisure might as well play a role in women’s retirement decision, though our model is not sophisticated enough to identify this latter channel.

5.2 Model Fit

We have a good prediction of retirement age. Our model captures the spikes in the earliest eligibility age for CER and OAP. Figures [2](#) and [3](#) show the actual hazard

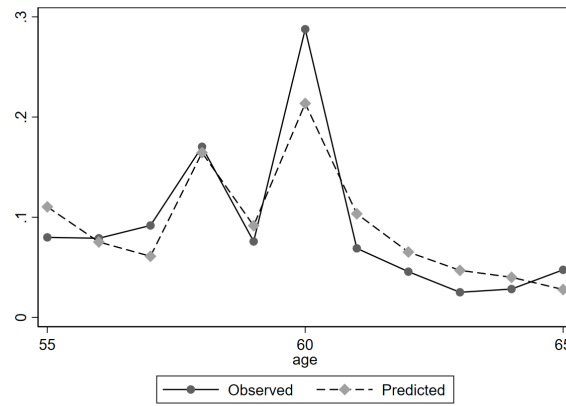
rates observed in the data along with the predictions of our model under the current retirement rules. These hazard rates are obtained by averaging up each individual's probability of retiring by any retirement path over the whole sample. In general, it can be seen that the model gives a good prediction of the actual retirement time. However, the predicted frequencies for retirement paths are less accurate as we use a static model and hence do not capture any potential uncertainty. In order to improve the precision of the retirement path predictions, it might be better to add uncertainty. However, our model does a fairly good job in explaining the effects of all social insurance alternatives rather than the old age pensions alone or the maximum one can achieve by any retirement path. In particular, common practice is to take the maximum attainable pension wealth to analyze the impact of financial incentives. It is crucial to note that individuals are not necessarily able to access all alternative social insurance paths, and considering all options gives us the flexibility to capture the opportunity cost of choosing one alternative compared to the other. In addition to predicted hazard rates, we use another criterion based on the alternative with the highest estimated probability of choice. The deviation of the predicted retirement age from the observed retirement age is reported in figures [B6](#), [B7](#) and [B8](#) for the full sample, women and men, respectively.²¹ Our estimates for the most likely retirement age are within 2 years of the observed retirement age for about 67% of women and 73% of men.

5.3 Policy Simulations

Using the preference parameters in Table [7](#), we simulate the elimination of the spousal pension benefits. We then repeat the same exercise with a more radical approach of increasing spousal pension benefits to 50%. These two reforms would influence household consumption and in the absence of the spousal bonus, the couple might face insufficient means, which could trigger the secondary earner to delay retirement. In contrast, those who have strong leisure preferences may still retire at the same

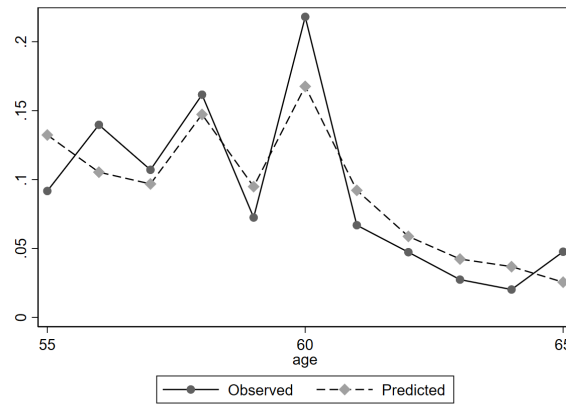
²¹These figures can be found in section [B](#).

Fig. 2 Female Labor Force Exit by Age



Notes: Hazard rates are obtained by averaging up each individual's probability of retiring by any retirement path. The spike at age 58 and correspond to common early eligibility ages. *Source: CBSS and author's calculations.*

Fig. 3 Male Labor Force Exit by Age

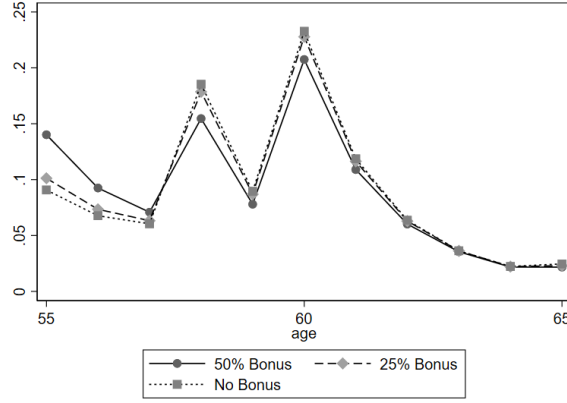


Notes: Hazard rates are obtained by averaging up each individual's probability of retiring by any retirement path. The spike at age 58 and correspond to common early eligibility ages. *Source: CBSS and author's calculations.*

age either by converting to alternative retirement paths or exit without individual benefits as before.

The predicted probabilities at each age between 55 and 65 in these two hypothetical cases are presented in figures 4 and 5 for women and men, respectively. On average, the share of women who retire before 58 drops from 23% to 21% when the spousal

Fig. 4 Retirement Hazard Rates, Policy Simulation, Women

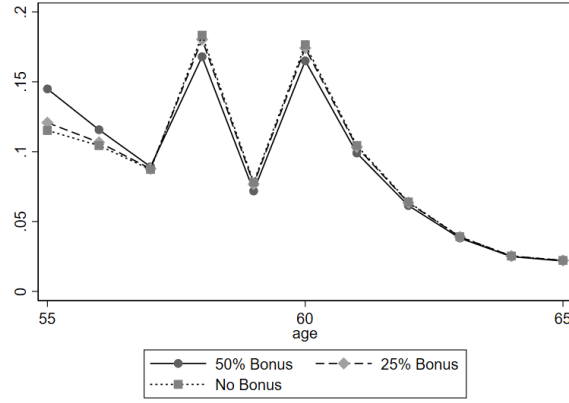


Notes: Hazard rates are obtained by averaging up each individual's probability of retiring by any retirement path. The 25% Bonus is the current policy in place. No bonus is the hypothetical case when we calculate lifetime consumption without the spousal bonus and 50% Bonus is the hypothetical case where every individual faces twice of the bonus they face now if they were to retire without individual benefits and their partner is receiving old age pensions. *Source: CBSS and author's calculations.*

bonus is removed, while the difference in the retirement probabilities when the bonus is increased to 50% is much higher. The increase in the spousal bonus increases the likelihood to retire before age 58 from 23% to 30%. We believe that this result reflects individuals' ability to substitute between various retirement alternatives.

When the bonus amount is doubled, it can become as high as social security benefits one would receive under different retirement paths such as UI/DI or CER which in turn can result in earlier retirement ages instead of waiting for the eligibility age for early retirement schemes especially, for those who have high valuations of leisure time. Furthermore, we observe that the impact of the policy change is more pronounced for women than for men. The reason behind this could be the fact that the primary earner in most households has access to higher benefits due to longer careers and higher earnings potential. Surprisingly, we do not observe any delay in men's retirement age, although on average men are 3% more likely to retire before age 58 if the spousal bonus is raised to 50%. These results highlight that the receipt of spousal bonus can result

Fig. 5 Retirement Hazard Rates, Policy Simulation, Men



Notes: Hazard rates are obtained by averaging up each individual's probability of retiring by any retirement path. The 25% Bonus is the current policy in place. No bonus is the hypothetical case when we calculate lifetime consumption without the spousal bonus and 50% Bonus is the hypothetical case where every individual faces twice of the bonus they face now if they were to retire without individual benefits and their partner is receiving old age pensions. *Source: CBSS and author's calculations.*

in the secondary earner to leave the labor market upon retirement of her/his spouse. Hence, the secondary earner in the household, who has low expected social security wealth, is more likely to coordinate labor market behavior based on the incentives of the primary earner.

5.4 The impact of Policy Change on Retirement path

In the first part of our analysis, we develop a discrete choice model where one chooses between four alternatives from age 55 to age 65 which consist of exiting the labor market with no individual social security benefits, exiting the labor market via DI, UI, exiting the labor market via CER and exiting the labor market by claiming pensions. Additionally, we assume that these alternatives are mutually exclusive as individuals are in general not allowed to combine multiple social security benefits and a very small number of people keep working beyond claiming pensions, which we believe is negligible. In these 4 cases, individuals enjoy different levels of consumption. The reason that we include exit without individual social security benefits in our choice

set is to be able to detect the impact of the spousal bonus as the patterns in the data show that when one partner has low pension entitlements, the couple could benefit from the spousal bonus instead and claim only the pensions of the principal owner, while the other exits the labor market without any benefits. In this regard, we now focus on individuals' preference for different retirement paths.

Table 8 Change In Retirement Probabilities In Response To Hypothetical Policy Change

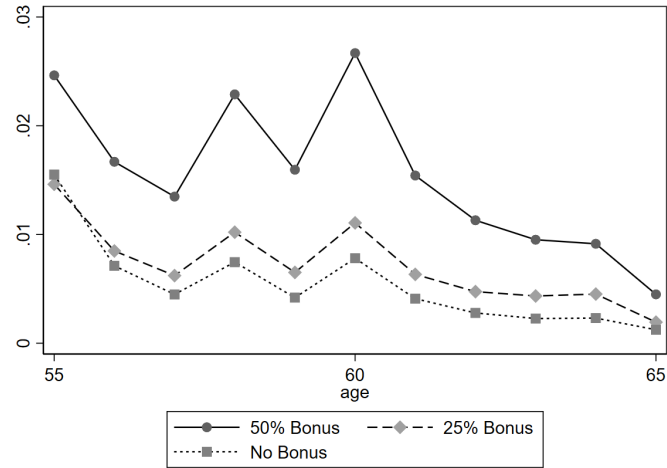
	Women			Men		
	50% Bonus	25% Bonus	No Bonus	50% Bonus	25% Bonus	No Bonus
ENB	0.301	0.18	0.144	0.183	0.128	0.114
UI/DI	0.313	0.379	0.403	0.413	0.44	0.448
CER	0.266	0.308	0.316	0.296	0.312	0.315
OAP	0.119	0.135	0.14	0.113	0.12	0.122

Notes: Exit paths consist of leaving the labor market via claiming old age pensions (OAP), receiving a supplement from the company on top of unemployment benefits (CER), receiving unemployment and disability insurance (UI/DI) and not receiving any social security benefits and are assumed to rely on private savings and household income (ENB). *Source: CBSS and author's calculations.*

Table 8 represents the change in retirement probabilities by retirement path in response to a hypothetical change in the spousal bonus policy. We observe that the change in retirement behavior of women is more pronounced compared to men. When the spousal bonus is removed, there is almost no change in the expected retirement path of men, while women are 4% less likely to exit the labor market without individual social security benefits compared to the baseline. Furthermore, the results provide evidence for the substitution patterns between retirement paths based on changes in the benefit structure. More than half of individuals who normally retire through ENB switch to UI/DI which indicates that removal of the spousal bonus may hardly decrease the financial burden on the social security system. In Figure 6, we take a closer look at the predicted probabilities for ENB. The difference between predicted

retirement probabilities with and without spousal bonus is much smaller before age 58. This indicates that those who leave the labor market at younger ages usually do so due to high leisure preferences, and a change in the policy structure would have a smaller impact on their behavior. On the other hand, above 58, the probability of retirement through ENB is much smaller when the spousal bonus is eliminated. This result highlights the preference heterogeneity in the population. Individuals who have high attachment to the labor market tend to retire later, and when they face a decrease in household income, the substitution effect between consumption and leisure leads them to delay retirement to compensate for the lost household income. On the other hand, those with lower attachment to the labor market either keep their initial choice unchanged or only substitute into an alternative social insurance program instead of delaying their retirement age.

Fig. 6 Retirement Hazard Rates, Policy Simulation, Women, ENB



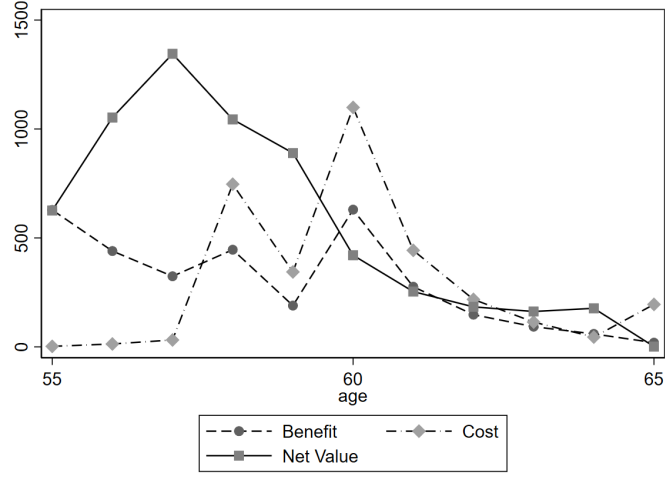
Notes: Hazard rates represent each woman's probability of retiring by ENB. The 25% Bonus is the current policy in place. No bonus is the hypothetical case when we calculate lifetime consumption without the spousal bonus, and 50% Bonus is the hypothetical case where every individual faces twice of the bonus they face now if they were to retire without individual benefits and their partner is receiving old age pensions. *Source: CBSS and author's calculations.*

5.5 Cost-Benefit Evaluation

We now turn our attention to the implications of the hypothetical elimination of the spousal bonus on the aggregate cost/benefit to the social security budget. Choice models appear to have income effects when the predictions of the model change due to changes in income. Our model is based on a random utility model with significant preference heterogeneity; hence, there are substantial income effects that aggravate complexity in defining cost/benefit analysis. In the presence of income effects, Marshallian and Hicksian surpluses diverge. The common practice is to calculate the Hicksian surplus, which is the expected change in utility normalized by price. This allows one to obtain a representation of the welfare change in monetary units. However, income effects are present and price is not fixed in our model, hence it makes it complicated to obtain a monetary representation of welfare change. Instead, we focus on the cost of the spousal bonus of pension benefits on the social security budget. We calculate the average burden on the social security system under the existing policy scheme making use of the estimated parameters and predicted probabilities for each alternative. Then, we calculate the predicted probabilities when the spousal bonus is eliminated and compare the average burden under the no spousal bonus case to the initial expected utility. We find that the average benefit and cost on the social security budget per person will be as indicated in Figure 7. Due to substitution between different paths, the realized benefit and cost will vary at different potential retirement ages. The overall financial benefit of removing the spousal bonus policy will almost cancel out the burden of alternative social security programs. However, our analysis only represents the effects on those women who were active in the labor market at age 55. Most of the spousal bonus beneficiaries leave the labor market much earlier, hence, our analysis does not reflect the total cost/benefit to the social security system. Potentially, financial gains would be much larger than we estimated assuming that those early exiting individuals would not come back to the labor market. Those

individuals who are at the bottom of the income distribution are those who are hurt the most relative to the rest. The potential reason is that for individuals located in the middle or the right of the income distribution, the decrease in disposable income following the removal of the spousal bonus is almost offset by the increase in income due to substitution in alternative social insurance programs. In contrast, the poorest individuals have limited access to alternative social insurance programs, making them the most affected by policy changes.

Fig. 7 Cost/Benefit Analysis of Policy Elimination



Notes: Women only. Cost refers to providing other types of social security benefits when spousal bonus is removed. Benefit refers to unspent social security funds by eliminating the bonus. *Source: CBSS and author's calculations.*

5.6 Robustness Check on the Functional Form of the Utility Function

A common problem in structural econometric models is that parameter estimates can be sensitive to the functional form of the utility function. An alternative way to check for the robustness of our results is to practice our analysis with a more flexible utility function. In this regard, we consider a second-order polynomial utility function as

in [van Soest, Das, and Gong \(2002\)](#). A polynomial function provides a more general structure and is capable of capturing preferences with a higher accuracy. We present the parameters in this case in [Table 5.6](#). Parameter estimates under quadratic utility specification are in general in the same direction as our estimates. The marginal utility of consumption and leisure are both positive. Under a quadratic specification, the age difference between partners loses significance. This implies that, on average, leisure preferences do not depend on the age difference between spouses.

Table 9 Parameter Estimates with Quadratic Utility

	(All Sample)	(Women)	(Men)
Consumption			
Constant	0.209*** (0.009)	0.190*** (0.018)	0.255*** (0.017)
Own Income Quartile	0.012*** (0.001)	0.020*** (0.003)	0.007*** (0.002)
Relative Earnings	-0.262*** (0.016)	-0.260*** (0.037)	-0.294*** (0.025)
<i>Consumption</i> ²			
Constant	-0.0003*** (0.00002)	-0.0002*** (0.00004)	-0.0004*** (0.00003)
Own Income Quartile	0.00000 (0.00000)	-0.00002** (0.00001)	0.00002*** (0.00000)
Relative Earnings	0.0003*** (0.00003)	0.0003*** (0.0001)	0.0003*** (0.00004)
Leisure			
Constant	-0.466 (0.375)	-0.789 (0.621)	1.099 (0.738)
Own Income Quartile	0.060 (0.090)	0.345** (0.143)	-0.127 (0.122)
Relative Earnings	6.192*** (0.815)	6.518*** (1.594)	3.439*** (1.292)
Eligible	9.521*** (0.582)	10.050*** (0.915)	9.140*** (0.781)
Age Difference	-0.079*** (0.030)	-0.008 (0.049)	-0.057 (0.062)
Age Difference Squared	0.003 (0.008)	-0.010 (0.013)	0.008 (0.014)
<i>Leisure</i> ²			
Constant	-0.508*** (0.087)	-0.407*** (0.138)	-0.578*** (0.168)
Own Income Quartile	0.010 (0.019)	0.061** (0.030)	-0.017 (0.026)
Relative Earnings	1.121*** (0.180)	1.071*** (0.342)	0.831*** (0.281)
Eligible	1.605*** (0.102)	1.593*** (0.156)	1.714*** (0.146)
Age Difference	-0.021*** (0.007)	-0.010 (0.011)	-0.017 (0.014)
Age Difference Squared	0.001 (0.002)	-0.002 (0.003)	0.003 (0.003)
Consumption*Leisure	0.0001 (0.0004)	0.001** (0.001)	-0.001 (0.001)
Eligible	15.011*** (0.826)	16.424*** (1.307)	13.686*** (1.090)
σ_c	0.0004	0.001	0.0003
σ_{cl}	0.009	0.015	0.007
σ_l	0.239	0.440	0.135
Observations	5,253	2,190	3,063
Log Likelihood	-13,280.600	-5,602.762	-7,583.000

Notes: *p<0.1; **p<0.05; ***p<0.01. Age difference is calculated by subtracting the reference individuals' age from her/his partner's age. *Consumption*² refers to the quadratic functional form. *Source*: CBSS and author's calculations.

6 Conclusion

This paper explores retirement spillovers induced by the financial incentives embedded in the Belgian Social Security System. In order to understand the impact of joint financial incentives of spouses, we pay specific attention to the spousal bonus, a 25% pension premium granted to a pensioner if his/her spouse has no or limited pension entitlement or labor income. In doing that, we use a broad definition of retirement. We do not only define individuals who leave the labor market by claiming pension benefits as retired but also, we consider those who stop labor market participation terminally through old age unemployment, disability insurance or unemployment with company supplement. We use detailed micro-level data to simulate potential social security benefits of Belgian private sector employees by applying the rules and formulas of the taxation and social security system for a sample of married individuals. Based on these simulations, we have constructed individual consumption and leisure levels assuming that spouses share household income equally.

In order to understand married individuals' retirement behavior and predict the impact of changes in the benefit structure, we have employed a discrete choice model of retirement path. The main underlying assumption of our model is that individuals choose the optimal retirement age and path conditional on the attainable net wealth and remaining lifetime leisure that optimize their utility. Our model is able to capture important details of the retirement decision of both husbands and wives, with pronounced labor force exit at ages 58 and 60. To evaluate the implications of our estimates, we simulated the effects of two hypothetical policy reforms on retirement age and retirement path. In the first policy reform, the spousal pension bonus that is granted to the primary earner is removed. In other words, those couples consisting of one primary earner and one dependent are no longer able to benefit from extra pension benefits. In the second reform, we consider the spousal bonus to be 50% of

the primary earner's pensions rather than 25%.

Our results show that there is a considerably small impact of the hypothetical policy change of removing the spousal bonus. Women are on average 4% less likely to exit with no individual social security benefits when their partner no longer receives a spousal bonus. Furthermore, more than half of the individuals, who would be willing to benefit from the spousal bonus initially, switch to alternative retirement via UI/DI. This highlights that those who benefit from the spousal bonus have high leisure preferences and even when the bonus is removed, they would exit the labor market before they reach the earliest eligibility age for retirement schemes. Furthermore, both individual and spousal financial incentives play a strong role in couples' retirement decision.

From a policy perspective, our study suggests that policy reforms targeting specific goals can generate significant spillover effects and may even push individuals to consider alternative options rather than delaying their retirement. Significant heterogeneity in preferences indicates that the behavioral response to policy reforms can be difficult to predict when alternative paths are disregarded. In particular, women are more likely to leave the labor market earlier via alternative routes, mainly unemployment or disability benefits. Hence, efforts to increase the effective retirement age should not be restricted to the regular retirement or auxiliary benefits, but instead should cover the entire set of welfare programs that allow old age people to leave the labor market earlier. On the other hand, those who mostly benefit from spousal pension benefits are usually women with low earnings potential, and the availability of spousal bonus protects them against the risk of old age poverty. Although removing the spousal bonus might trigger some individuals to delay retirement, it may also leave certain households with insufficient means.

While this paper provides useful insights into reform-induced effects that would arise if the spousal bonus in Belgium were to be removed, several extensions could be considered in future research. First, the current model abstracts from savings. While this assumption allows for a more tractable framework and puts the focus on labor supply decisions, it limits the intertemporal scope of households' responses to pension reforms – hence an extension might be warranted in future work. Second, the current framework assumes perfect foresight and a stable economic framework. Relaxing these assumptions in a more general framework could possibly yield different behavioral responses. Third, the paper focuses on stable (married) couples. Integrating marital dynamics, particularly interrupted marital histories or non-traditional household structures, might be an increasingly important extension to consider in future work. Together, these extensions could strengthen the robustness and generalizability of the current model and contribute to a thorough understanding of the policy landscape in Belgium.

Appendix A The Belgian Social Security System

There are several alternative social security programs in addition to old age pensions that provide a source of income for older workers and are sometimes used as early retirement schemes. These include disability benefits, unemployment benefits, and unemployment with company supplement. The detailed information on each of these schemes' requirements is given below, as well as other social security benefits that are available in Belgium. The main reason these schemes serve as alternative retirement paths is the wide accessibility of these programs and the generous availability of benefits until one reaches the full retirement age. These programs are preferable by many workers as they provide generous replacement rates and allow them to accumulate pension rights during the period of unemployment/disability through state subsidies. Furthermore, these programs may also be preferable by the employer as they allow the company to cut employment costs under financial distress or to replace the work force via younger workers. The availability of these alternative retirement routes provides workers with the option to terminate their career permanently prior to the pension eligibility age.

A.1 Old Age Unemployment

In Belgium, unemployment benefits do not have a fixed termination date, the duration of unemployment benefits depends on various factors, including work history, participation in training programs, and compliance with job search requirements. Although younger workers may face stringent limits, for individuals aged 50 and above in Belgium can receive unemployment benefits for an unlimited duration, provided that they meet the eligibility requirements. This means that unemployment benefits continue until one is eligible for a pension. However, unemployment benefits gradually decrease over time, except for individuals over 55 years of age. In addition,

one continues to accumulate old age pensions during this period as assimilated days. The specific nature of unemployment and disability benefits in Belgium make them an alternative for retirement if one considers the efforts to look for a job more costly or values the leisure time more than the marginal net income s/he could get by returning to the labor market instead of receiving unemployment benefits.

Eligibility for unemployment benefits depends on the employment history of an individual preceding the loss of her/his job. For instance, if an individual loses her/his job after age 50, s/he can be eligible for the UI either with a salaried work for 624 days during the preceding 42 months; 312 days of work in the preceding 42 months and 1,560 days in the 10 years preceding these 42 months; or 416 days in the preceding 42 months and 1664 days in the 10 years preceding these 42 months.²² The amount of unemployment benefits depends on one's family situation, the last salary received, and the employment history. Cohabitants with dependents: 60% of reference earnings, single persons: 55% of reference earnings, Cohabitants without dependents: 40% of reference earnings, and since 2012 the system has been reformed and benefits are designed to gradually decrease over time if unemployment persists for longer than a year. Since 2012, unemployment benefits are degressive and consist of three compensation periods based on the length of the unemployment period, and benefits are capped by several different limits at each period.²³ Additionally, the unemployment benefit with the seniority supplement is awarded after the first year of unemployment to older unemployed. Unemployed workers older 50 years old can be considered as "old-age unemployed". The eligibility criteria for the old age unemployment insurance was to be above 50 years old with 20 years of labor force participation history since 1995, which has been reformed and the age requirement was increased to 55 in 2013. In addition, those with at least 20 years of seniority and older than 58 are exempted

²²Younger individuals are subject to different set of eligibility rules based on employment histories. See <https://www.onem.be/fr/documentation/feuille-info/t31>

²³See <https://www.onem.be/fr/documentation/feuille-info/t67> for details.

from job search between 2004 and 2013. This requirement was restricted to those above 60 years of age or those with at least 38 years of seniority since 2013. In 2015, the old age unemployment insurance is abolished and newly unemployed workers are no longer granted a seniority supplement.

A.2 Conventional Early Retirement

Individuals who were made redundant by their employer qualify for the unemployment scheme with company supplement or, in other words, Conventional Early Retirement (CER) given that they meet the conditions of age, seniority and eligibility for unemployment benefits. The eligibility conditions for the CER have gradually been tightened. Until 2008, the requirement for CER was to have at least 58 years of age with 25 years of career, which was raised to 60 years of age with at least 30 years of career for men and 26 for women. Since 2015, it is set to 62 years of age with at least 40 years of seniority for men and 31 years for women, that is expected to increase to 40 by 2024. Furthermore, workers who have a long career, who work in heavy jobs, or who suffered physical problems in their previous job are exceptionally eligible for CER at earlier ages. In addition, companies are obliged to replace laid-off workers if the worker is under a certain age, except when the company is recognized to be in financial difficulty²⁴. The benefits of unemployment with company supplement consists of two parts; an unemployment benefit paid by ONEM, and a supplement paid by the previous employer. The amount of unemployment benefit will be equal to 60% of the last capped gross earnings for individuals with dependents, 50% for those without dependents, and 40% for co-habiting persons, while the company supplement corresponds to half of the difference between the net reference remuneration and the unemployment benefits.

²⁴60 in 2011, which was raised to 62 in 2015

A.3 Disability Benefits

In Belgium, the sickness and disability insurance consists of two periods: "primary incapacity for work" which lasts up to one year and "invalidity" in the case of at least 66% loss of capacity for work due to sickness or disability. During the primary incapacity for work, employers keep the payment of wages for a limited period (guaranteed salary), and then income-related benefits paid by the mutual insurance fund. To be eligible for these benefits, one needs to prove her/his incapacity by a doctor report, have 180 days of actual work or assimilated periods during the six months prior to the invalidity, and have ceased professional activity resulting in a reduction of earning capacity of at least 66%." The amount of benefits is the same as the unemployment benefits during the first six months and amounts to 60% of the reference salary that is considered to calculate the unemployment benefits for the second six months. In case one's loss of earnings due to sickness persists after the primary period, then s/he is considered as invalid and entitled to DI as long as the incapacity lasts or until the retirement age. The amount of benefits for a worker with dependents is 65%, without dependents 55% and for co-habiting persons 40% of the lost earnings. ²⁵

A.4 Survivors' Pension

In the event of the death of a spouse, the surviving spouse is entitled to a survivors' pension, calculated as 100% of the deceased person's retirement pension that is calculated at the individual rate. If the deceased spouse was not retired at the time of death, the career length of the deceased is calculated as the number of years between the 20th birthday and the time of death and the survivors' pension is calculated as at single rate. Survivors' pensions are subject to a ceiling in case one is to combine a survivors' pension with their own old-age pension up to an amount of 110% of the

²⁵<https://www.missoc.org/missoc-database/comparative-tables>

survivors' pension. Moreover, survivors' pensions can be combined with a professional income if one earns below a certain limit; however, it is not possible to combine it with replacement income after a year. To be entitled to the survivors' pension, one must have reached a given age at the time of death (45 years in 2015, since 2015, the survivors' pension age has increased each year by six months, 48 years in 2021) unless one has a dependent child or an incapacity for work of at least 66%. In case one is below this age threshold, s/he is granted a transitional benefit. The minimum amount of survivors' pensions for someone whose deceased partner had a full career amounts to 15 698 in 2019 and the highest amount depends on whether one accumulates survivors' pensions in combination with other benefits.

A.5 The Guaranteed Income For Elderly Persons (GRAPA)

Individuals whose main residence is in Belgium are eligible for a means-tested safety-net income when they reach full retirement age (currently 65). The amount of GRAPA depends on one's resources and family situation. The basic amount was 912.03 Euros for cohabitants, and 1368.05 Euros for singles (in 2022 at index 162.66). When calculating the GRAPA benefits all the financial resources of the individual and their partner is taken into account. For those who have financial resources below the guaranteed amount, an additional payment is made to provide her/him with this minimum level of income. This implies that if the primary earner has low pensions, the couple can receive an additional top-up to the extent that the household resources are below the guaranteed income.

A.6 Career Break

In Belgium, RVA/ONEM (National Employment Office) is the social security institution responsible for providing the career-break system. This system allows employees to temporarily suspend their careers or reduce working hours while receiving a financial allowance. The career-break system includes several schemes, such as the thematic

leave (e.g., parental leave, palliative care leave), and the older worker system. These schemes aim to provide flexibility for workers to manage personal, family, or health needs while maintaining some income support. The time credit specific to workers at the end of their career allows reducing professional activity until retirement. To obtain this time credit, one must meet several access conditions with ONEM as well as the employer. Note that the end-of-career time credit does not provide the possibility of completely interrupting professional activity, it only allows one to decrease work intensity by $1/5$ or $1/2$ depending on the existing work regime prior to the application. If one wishes to temporarily suspend all professional activity, one needs to apply for full-time time credit with reasons. To benefit from career break, one needs to be at least 55 years old; however, those who have a career history of 28 and above can also access it as of 50 years old. However, end-of-career time credit is not accessible to the whole population, as for employers employing 10 workers or less, end-of-career time credit requires the employer's agreement. The allowance for career break is a flat rate. Its amount does not vary depending on one's salary, however, it is calculated based on the fraction of the reduction in work intensity and the current work intensity. Note that one can satisfy the access conditions to time-credit but not the benefit conditions in some cases, in those cases no supplement from ONEM is provided.

A.7 Occupational Pensions

The occupational pension is an extra-legal benefit set up by a company sector, an individual employer or a group of employers. Occupational pensions allow one to build up an interest or capital with a pension institution, or an insurance company (group insurance) and the benefits are released when the employee takes up their statutory pension. occupational pensions are only available for about 59% of the population in 2016 (2018 OECD Pension Adequacy Report). There are many sector/company specific rules for occupational pensions and, by nature, they provide a supplementary

benefit which usually is paid as lump sum. Although occupational pensions may influence retirement decisions for some individuals, this study abstracts from them.

Table A1 demonstrates the evolution of eligibility conditions for various social security benefits. Access requirements have been strengthened over time. Note that there is a pattern of uniformity among social security programs, the reforms are converging so that the requirements for different retirement alternatives are becoming similar over time. Figure A.7 shows the retirement hazard rates per path. The strongest spike is at age 60 for OAP and at age 58 for CER. These ages are the most common eligibility ages for these programs. Note that UI and ENB follow a continuous pattern rather than jumps and discontinuities.

Table A1 Social Security Eligibility Conditions in Belgium

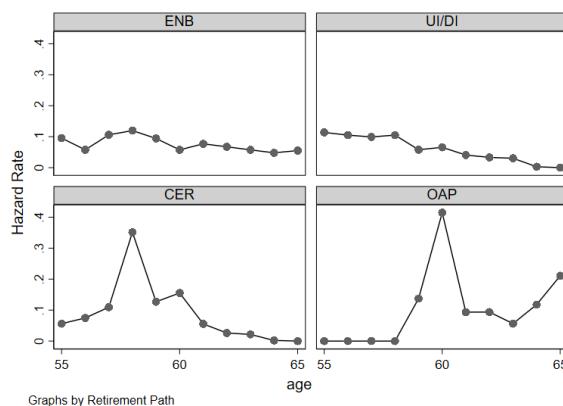
year	UI		CER			OAP	
	age	career	age	men	career women	age	career
2002	50		60(58)	20(25)	20(25)	60	30
2003	50		60(58)	20(25)	20(25)	60	32
2004	58	20	60(58)	20(25)	20(25)	60	34
2005	58	20	60(58)	20(25)	20(25)	60	35
2006	58	20	60(58)	20(25)	20(25)	60	35
2007	58	20	60(58)	20(25)	20(25)	60	35
2008	58	20	60(58)	30(35)	26(30)	60	35
2009	58	20	60(58)	30(35)	26(30)	60	35
2010	58	20	60(58)	30(37)	26(33)	60	35
2011	58	20	60(58)	30(37)	26(33)	60	35
2012	58	20	60(58)	35(38)	28(35)	60	35
2013	60(<60)	20(>38)	60(58)	35(38)	28(35)	60.5	38
2014	60(<60)	20(>38)	60(58)	35(38)	28(38)	61	39
2015	60(<60)	20(>38)	62	40	31	61.5	40
2016	60(<60)	20(>38)	62	40	32	62	40
2017	60(<60)	20(>38)	62	40	33	62.5	41

The above conditions represent the earliest eligibility conditions for the specified social insurance program. The UI conditions are for no job search obligation. Individuals who get unemployed and have the required conditions are no longer obligated to search for a job and can retain UI benefits until they have access to OAP or until the full retirement age, which is 65. In parentheses, we report alternative requirements for those with longer careers. Source: Mutual Information System on Social Protection (MISSOC) <https://www.missoc.org/missoc-database/comparative-tables/>

Differences in choice of the retirement path is demonstrated in figure A.7. Majority of individuals retire as soon as they reach the earliest pension eligibility age of 60, while

the second-largest group retires with CER at age 58 which is the earliest eligibility age of CER for the majority of workers. The share of UI/DI and ENB are rather small. Furthermore, in figure A2, we demonstrate the evolution of retirement wealth by retirement age for households in 4 different income quartiles with and without the spousal bonus. This figure indicates that single-earner couples at the bottom of the income distribution do not have significant incentives to delay retirement whereas the higher income groups can do better by working another year. Moreover, if the spousal bonus is to be removed, an average couple would have needed to delay retirement by about 2 years to reach the same consumption level with the spousal bonus.

Fig. A1 Hazard Rates by Retirement Path

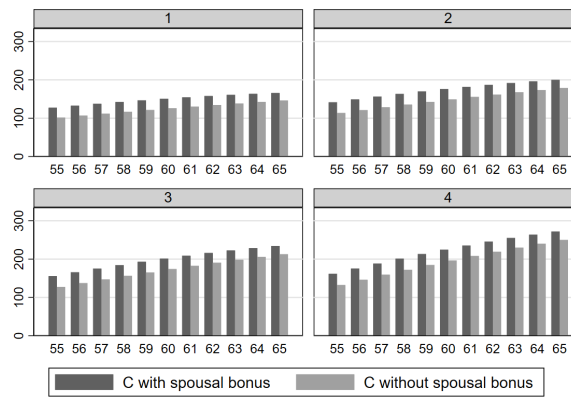


Notes: Exit paths comprise : individuals who leave the labor market via claiming old age pensions (OAP), individuals who were unemployed but receive a supplement from the company on top of unemployment benefits (CER), individuals who benefit from unemployment and disability insurance (UI/DI) and those who were not observed to receive any social security benefits and are assumed to rely on private savings and household income (ENB). Source: CBSS and author's calculations.

A.8 Simulation of Social Security Benefits

In order to calculate financial incentives one would face at every alternative over ages 55 to 65, we have simulated the eligibility and benefit rules of the social security

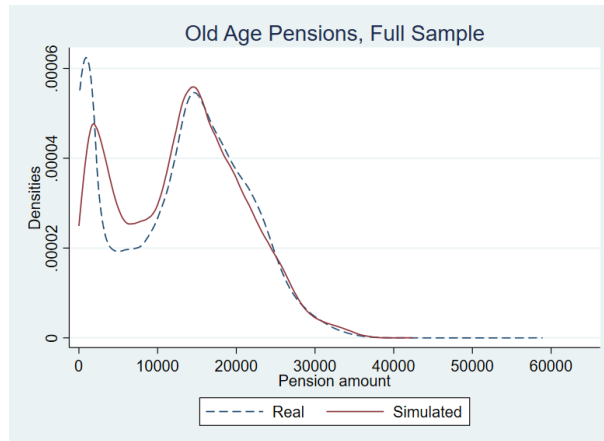
Fig. A2 Change in Wives' Consumption By Income Quartile Due to Removal of the Spousal Bonus



Notes: The graph is only for the alternative exit with no individual social security benefits. C represents the lifetime discounted consumption if one is to retire at a given age and in 1000s of Euros. *Source: CBSS and author's calculations.*

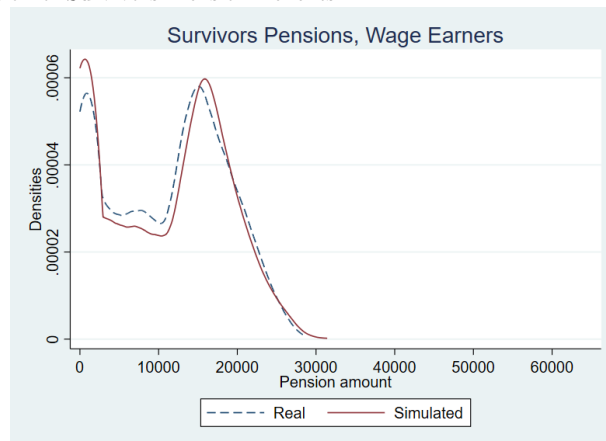
system in Belgium. Figures A3, A4, A5 represent how close our calculations of hypothetical social security benefits under different schemes get to the observed social security benefits.

Fig. A3 Simulation of Pension Benefits



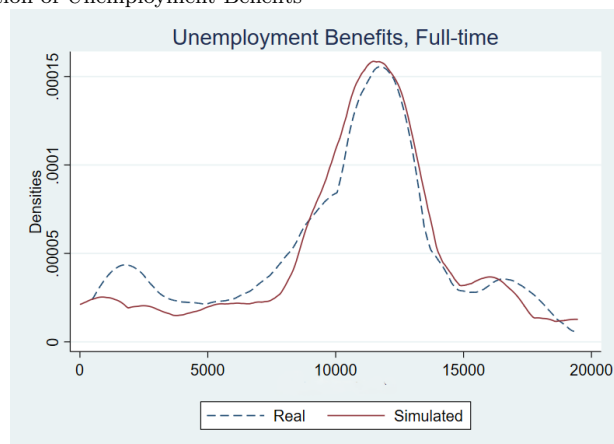
Source: CBSS and author's calculations.

Fig. A4 Simulation of Survivors' Pension Benefits



Source: CBSS and author's calculations.

Fig. A5 Simulation of Unemployment Benefits



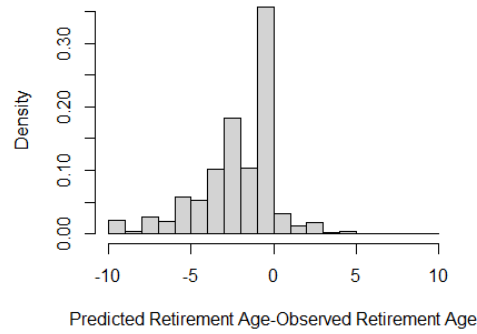
Source: CBSS and author's calculations.

Appendix B Model Fit

In this section, we present the ability of our model to predict the retirement age separately for men and women and provide model specification tests.

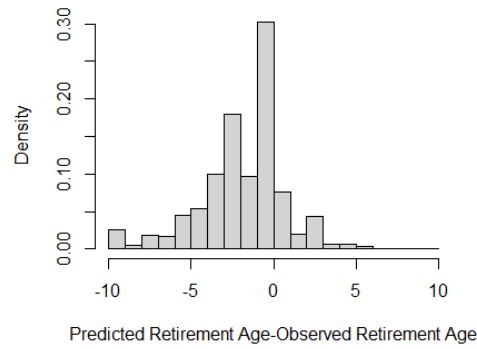
[McFadden and Train \(2000\)](#) proposed the Lagrange Multiplier tests to test the presence of random components, which provides us with a statistical basis for the fixed point estimates to be preserved or not. Moreover, we also report Wald and Likelihood

Fig. B6 Model Fit, All Sample



Notes: The deviation of the predicted retirement age with the highest predicted probability from the observed retirement age. *Source: CBSS and author's calculations.*

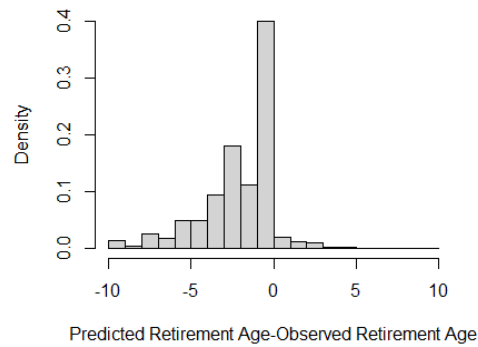
Fig. B7 Model Fit, Women



Notes: The deviation of the predicted retirement age with the highest predicted probability from the observed retirement age. *Source: CBSS and author's calculations.*

Ratio tests. All the tests indicate that we strongly reject the null of no random effects. Hence, mixed logit estimation method is used in our analysis. Additionally, in the next step, we test the correlation between random factors consumption and leisure and our tests indicate that we strongly reject the null of no correlation between random components.

Fig. B8 Model Fit, Men



Notes: The deviation of the predicted retirement age with the highest predicted probability from the observed retirement age. *Source: CBSS and author's calculations.*

Table B2 Model Specification Tests, The Presence of Random Effects

Model	wald	lagrange multiplier	likelihood ratio
All Sample			
stat	625.688	497.993	830.159
p-value	0	0	0
Women			
stat	393.993	308.774	672.784
p-value	0	0	0
Men			
stat	311.084	325.498	338.552
p-value	0	0	0

Note: The hypothesis of no random parameters is strongly rejected.

Table B3 Model Specification Tests, Correlation Tests of Random Effects

Model	wald	lagrange multiplier	likelihood ratio
All Sample			
stat	111.518	45.792	70.037
p-value	0	0	0
Women			
stat	191.417	57.951	103.956
p-value	0	0	0
Men			
stat	41.811	28.053	33.675
p-value	0	0	0

Note: The hypothesis of no correlated random parameters is strongly rejected.

Declarations

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Conflicts of interest/competing interests

The authors have no competing interests to declare that are relevant to the content of this article.

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