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DISCUSSION PAPER SERIES

IZA DP No. 16735

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Giulia Klinges
University of Liège

Alain Jousten
University of Liège and IZA

Mathieu Lefebvre
Aix Marseille School of Economics

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ISSN: 2365-9793

IZA – Institute of Labor Economics

Schaumburg-Lippe-Straße 5–9
53113 Bonn, Germany

Phone: +49-228-3894-0
Email: publications@iza.org

www.iza.org

ABSTRACT

Social Security and Inequality in Belgium

Over the years, the Belgian social security system has undergone substantial reform with a prime focus on increasing older worker labor force participation. The paper explores the effect of past reforms on inequality in old age. We distinguish two separate effects: The mechanical effect considers the change in inequality and expected benefit levels due to the reforms for a fixed retirement age distribution. The behavioral effect accounts for the endogenous change caused by changes in the incentives to work. Our results show that mechanically, reforms have led to losses in expected benefits for all but the lowest income quintile. Behavioral changes had a positive but orders of magnitude smaller effect. Overall, inequality decreased as a result of reforms.

JEL Classification: D63, H55, I38, J26

Keywords: social security and public pensions, old-age labor supply, retirement, pension reforms, inequality

Corresponding author:
Alain Jousten
University of Liège
Faculty of Law
Place des Orateurs 3
B- 4000 Liège
Belgique

E-mail: ajousten@uliege.be

1. Introduction

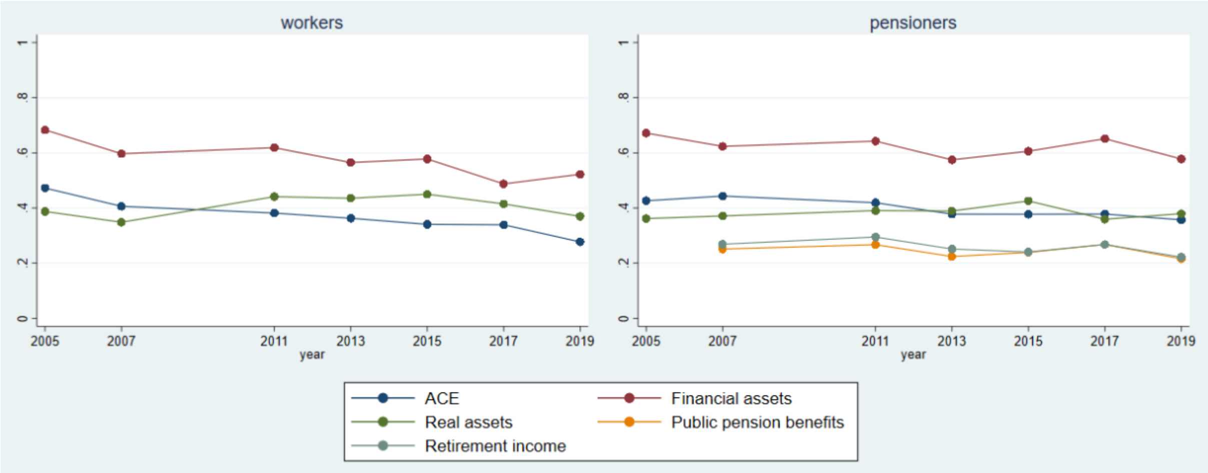
Over the last several decades, the Belgian social security system has undergone numerous reforms. While the primary goal of these reforms has been to increase the labor force participation especially among older workers, a secondary distributional objective has also been present. Previous studies pointed at the decisive role of public social security schemes and their successive changes in explaining the overall retirement patterns of the elderly in Belgium (see e.g., Pestieau and Stijns 1999; Dellis et al. 2004; Jousten and Lefebvre 2013, 2019; Fraikin et al. 2020, 2023). De Brouwer and Tojerow (2023) also document the role of early retirement reforms in explaining shifts between exit routes, namely a strong increase in the prevalence of long-term disability beneficiaries since 2005. Relatively little attention has been paid to the analysis of distributional consequences of social security reforms. Desmet et al. (2007) performed micro-simulation of hypothetical social security reforms and provided distributional, budgetary and behavioral analysis thereof.

While the baseline distributional situation in Belgium is rather stable, the relative roles of reforms and underlying trends are a priori unclear. Figure 1 presents the evolution of the Gini coefficient of various variables of Belgian workers and pensioners aged 55-64. Unsurprisingly, inequality is highest in financial assets, followed by labor income - represented by the average career earnings (ACE[1]) - and real assets. Across time, although we see a broadly similar pattern for both groups, inequality in financial assets and ACE tend to decrease more for the working group. Inequality in pension income is smaller than that for other income and asset groups. This observation is true for both public pension benefits and general retirement income that also includes occupational and private pensions – pointing at a heavy equalization effect of pensions due to the public pension system.

*This paper uses data from SHARE Waves 1, 2, 3, 4, 5, 6, 7, 8 and 9 (DOIs: 10.6103/SHARE.w1.800, 10.6103/SHARE.w2.800, 10.6103/SHARE.w3.800, 10.6103/SHARE.w4.800, 10.6103/SHARE.w5.800, 10.6103/SHARE.w6.800, 10.6103/SHARE.w7.800, 10.6103/SHARE.w8.800, 10.6103/SHARE.w8ca.800, 10.6103/SHARE.w9ca800) see Börsch-Supan et al. (2013) for methodological details.(1) The SHARE data collection has been funded by the European Commission, DG RTD through FP5 (QLK6-CT-2001-00360), FP6 (SHARE-I3: RII-CT-2006-062193, COMPARE: CIT5-CT-2005-028857, SHARELIFE: CIT4-CT-2006-028812), FP7 (SHARE-PREP: GA N°211909, SHARE-LEAP: GA N°227822, SHARE M4: GA N°261982, DASISH: GA N°283646) and Horizon 2020 (SHARE-DEV3: GA N°676536, SHARE-COHESION: GA N°870628, SERISS: GA N°654221, SSHOC: GA N°823782, SHARE-COVID19: GA N°101015924) and by DG Employment, Social Affairs & Inclusion through VS 2015/0195, VS 2016/0135, VS 2018/0285, VS 2019/0332, and VS 2020/0313. Additional funding from the German Ministry of Education and Research, the Max Planck Society for the Advancement of Science, the U.S. National Institute on Aging (U01_AG09740-13S2, P01_AG005842, P01_AG08291, P30_AG12815, R21_AG025169, Y1-AG-4553-01, IAG_BSR06-11, OGHA_04-064, HHSN271201300071C, RAG052527A) and from various national funding sources is gratefully acknowledged (see www.share-project.org). The paper also uses data from the generated Job Episodes Panel (DOI: 10.6103/SHARE.jep.800), see Brugiavini et al. (2019) for methodological details. The Job Episodes Panel release 8.0.0 is based on SHARE Waves 3 and 7 (DOIs: 10.6103/SHARE.w3.800, 10.6103/SHARE.w7.800). The authors gratefully acknowledge the data and inputs on differential mortality for use in this research provided by Prof. Eggerickx and co-authors. All remaining errors are our own. Corresponding Author. Email: ajousten@uliege.be.

[1] ACE refers to individual average career earnings. They are calculated by dividing the total earnings up to age 54 by the number of career years up to age 54.

Figure 1 : Evolution of the Gini coefficient separately for workers and pensioners aged 55-64



Source: Authors' calculations based on SHARE data.
Notes: Data on public pension benefits and retirement incomes are only shown from 2007 onwards for data comparability reasons. Data on ACE, public pension benefits and retirement income are individual-level data. Data on financial and real assets are non-equivalized household-level data.

The current paper expands this distributional analysis using more recent and more extensive data. It explores the effect of past reforms on inequality in old age, both through their direct impact on benefits (entitlements and generosity) and their indirect effect through modified employment patterns. More specifically, we calculate workers' social security wealth under different scenarios to capture the impact of the reforms by distinguishing two separate effects: the mechanical effect on the worker's benefit level and the behavioral effect through changing retirement decisions.

Our empirical analysis relies on data from the Belgian sample of the Survey of Health, Ageing and Retirement in Europe (SHARE). For data availability reasons, we restrict our attention to wage-earners aged 55-65 over the period 2005-2019. We calculate indicators of benefit entitlement and retirement incentive taking socio-demographic mortality differences into account. We propose simulations comparing these indicators with the counterfactual of what would have prevailed in the absence of important real-world reforms during our observation period. Finally, we determine how these reforms have affected the level of inequality.

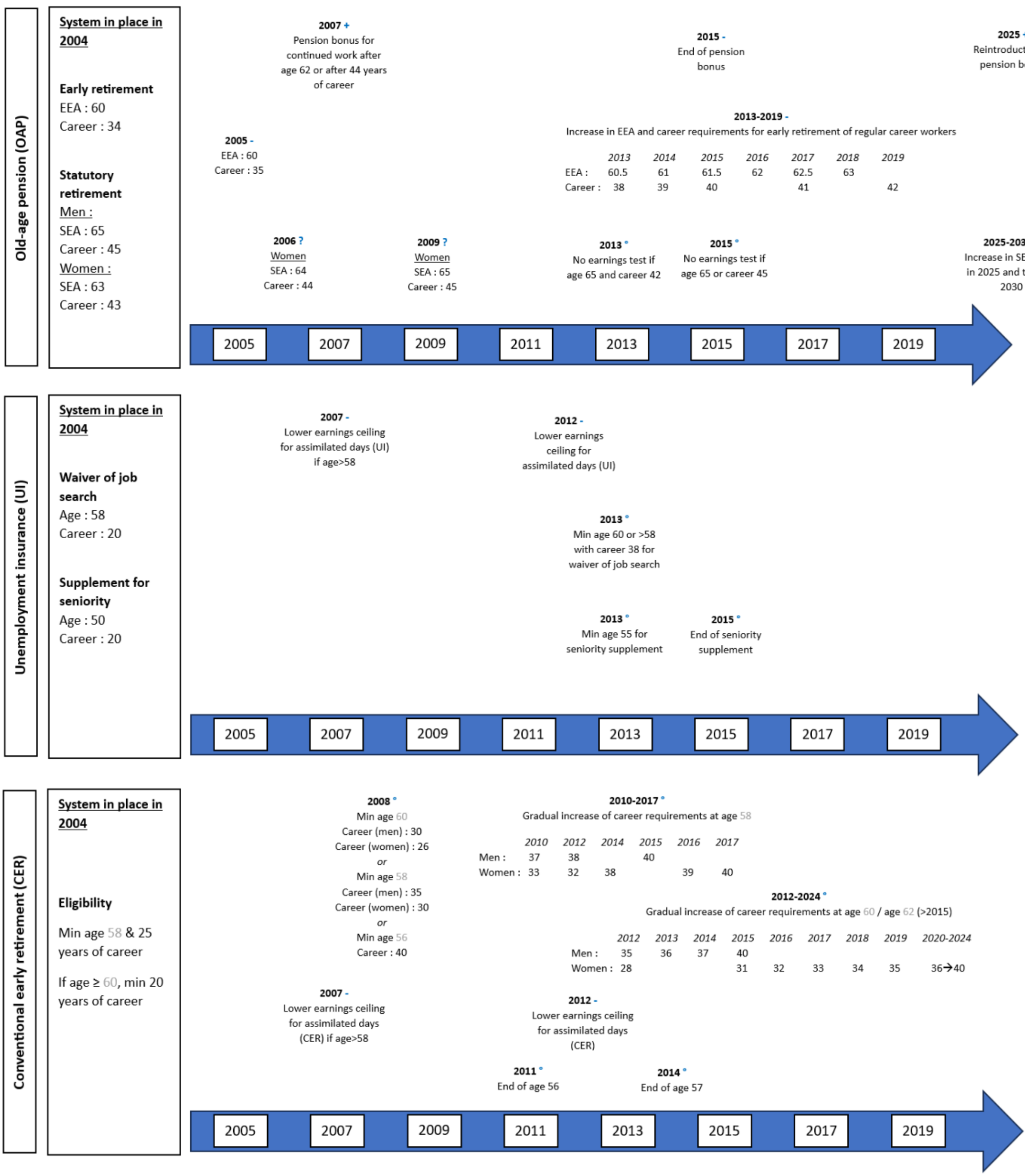
The structure of the paper is as follows. Section 2 provides an overview of the main features of the Belgian social security system (applying to wage-earners). It emphasizes changes that occurred since 2005 – the beginning of our observation period. Section 3 presents the data as well as the construction of incentive measures. This section also contains a description of the differences in life expectancy across social classes and details their use in the analysis. Section 4 proceeds with the estimation of retirement probabilities needed for our analysis. In Section 5 we show the results of our counterfactual analysis to capture the effect of the reforms on inequality. Section 6 concludes.

2. Social security reforms

In Belgium, there are four main exit routes into retirement for wage-earners: the old-age pension (OAP), the unemployment insurance (UI), the conventional early retirement (CER) and the disability insurance (DI). In the following, we outline each of those exit routes as applicable in 2023 and summarize reforms that have been implemented in the different systems since 2005, with a focus on their redistributive features. Figure 2 summarizes this information and presents the timeline of reforms implemented in each of these systems. In addition, we discuss the increasing role played by the GRAPA system, a social assistance program dedicated to the elderly.

For completeness, it is important to mention that the rules and reforms presented are those applicable to a standard worker not benefiting from any preferential regimes. As discussed by Fraikin et al. (2020), the Belgian social security system is quite complex both in terms of institutions and rules. Some categories of workers (pilots, mine-workers, etc.) are given a preferential treatment by law. Others have special rules granted by collective bargaining agreements, this is particularly true for access to early retirement systems. As SHARE data does not allow a more accurate reflection of preferential rules, we use the headline system as an approximation. A similar word of caution applies to the eligibility conditions for the GRAPA, where some essential data for determining eligibility is not available and hence simplified rules are applied.

Figure 2 : Timing of reforms



Source: Authors compilation based on Fraikin et al. (2023).
Notes: EEA: early eligibility age; SEA: statutory eligibility age.
+ : inequality is likely to increase; - : inequality is likely to decrease; ° : neutral to inequality; ? : unknown effect on inequality.

2.1. Old age pension

The old-age pension system (OAP) is the main public social security scheme and covers workers from the private sector and the contractual staff of the public sector. It is financed by social security contributions paid by employers and employees as well as various earmarked taxes and transfers from the general (federal) budget. The system works on a pay-as-you-go basis.

The amount of the pension benefit depends on the earnings history. In order to receive full benefits, a career of 45 years is required for both men and women. At first sight, the system looks proportional: the yearly pension benefit corresponds to 60% of the average yearly gross wage over the best 45 years of the career. In practice, a series of distributional elements are implemented that make the system effectively substantially more progressive.

First, periods spent on replacement incomes (e.g., career breaks, unemployment benefits, disability benefits) are assimilated to working periods and are credited at the last real wage in the pension calculation – no contributions are paid for these periods. Second, in certain circumstances a higher replacement rate of 75% is applied. This is the case if the individual has a dependent spouse who did not build up any or only small pension entitlement by himself/herself. The higher rate is applied to offer a more adequate pension to such households. But it is subject to a pension or earnings test of the spouse. Third, for past earnings, there are (indexed) floors[2] and ceilings[3] which ensure that the pensionable earnings are within a certain – effectively ever more rather narrow – range. They are indexed to the consumer price index (CPI). The floors are further adapter to the career fraction. In addition, there were occasionally a discretionary increase in the earnings ceiling to correct for a lack of real wage indexation. For certain types of assimilated periods the ceiling was lowered in 2007 and 2012. Fourth, there is a minimum level for pension[4] that is applied if certain career conditions are met. It is indexed using the CPI and further adapted to the career fraction. The occasional increases let the minimum pension increase faster than the average pension, which leads more and more towards a flat-rate benefit. Fifth, as past earnings and the pension benefits are both indexed using the health index, this leads to a double loss for the pensioners. The health index is in fact a slowed-down version of the CPI. For past earnings, longer careers are penalized as the health index does not reflect real wage growth. For pensions in payment, pensioners are not fully protected against inflation either. To reduce the erosion of purchasing power, pensions in payment are generally increased by 2% every 5 years.

The statutory eligibility age (SEA) is currently 65 years for both men and women. For women, the SEA had been gradually increased from the age of 60 before July 1 1997 to 65 as of January 1 2009, broadly in 3-year steps (61 as of July 1 1997, and 62, 63, 64 and 65 respectively as of

[2] The earnings floor is only applied if a person proves a minimum career of 15 years with at least 1/3 of the year affiliated with wage-earner scheme (active or not). As of 01/11/2023, it amounts to EUR 30874.43.

[3] For earnings in 2022, the normal ceiling is set to EUR 71519.98. Since 2007 a lower ceiling is applied to certain assimilated periods which amounts to EUR 65808.31 in 2022. The “minimum” ceiling exists since 2012 and is applied to long-term unemployment periods and time spent in CER. It is equal to EUR 30269.27 in 2022.

[4] In 2023 the minimum pension amounts to EUR 20036.84 for a full career. To be eligible for the minimum pension, the worker has to prove at least 2/3 of the years of a full career, with each year containing at least 2/3 of affiliation with the wage earner scheme (active or not). Special rules apply to part-time workers and mixed careers.

January 1 2000, 2003, 2006, and 2009) – aligning it with the system for men[5]. The SEA is scheduled to increase further to 66 in 2025 and to 67 in 2030 for both men and women.

If certain career conditions are satisfied, it is possible to retire before the SEA. From 2004-2012, the early eligibility age was equal to 60. From 2013 on, it has increased by half a year each year and stands at 63 since 2018. The minimum career in order to be eligible for early retirement has increased as well over the years. In 2004, a minimum career of 34 years was necessary to be eligible. This has increased since then and ended up at 42 career years in 2019. However, for individuals with very long careers, it is still possible to retire at age 60.

In the Belgian OAP system, benefits are not actuarially adjusted if they are claimed before the SEA. This means that if a full career of 45 years is reached, the individual has right of full benefits. Early claiming only causes lower benefits if the career remains incomplete, but no further reductions are undertaken.

When working beyond the SEA, benefits can increase further even if a full career is reached. Since the most advantageous career years are used for the pension calculation, years with lower earnings will be replaced by years with higher earnings. In addition, a pension bonus was introduced in 2007 that increased benefits by a fixed amount if the individual worked past a certain age or career length. This bonus was again abandoned in 2015. Currently, a revised bonus is planned to be reinstated beginning July 1, 2024, for workers retiring on or after January 1, 2025.

Once the OAP is claimed, work is still possible. However, such earnings are in principle subject to an earnings test and benefits are withheld if earnings surpass a certain threshold. Since 2015, no earnings test applies to workers above the SEA or with a career length past 45 years.

2.2. Unemployment insurance

Unemployment insurance (UI) is available to wage-earners who have lost their job at any age, as long as they have a work history of at least 12 months. UI benefits are not limited in time and their level depends on unemployment duration and the family situation – with a floor imposed on monthly earnings. In the first 3 months of unemployment, the replacement rate is equal to 65%, with earnings capped. Thereafter, until the 6th month, the replacement rate remains at 65%, but the cap is lowered by an amount corresponding to approximately 8 percent. From month 7 till 12, individuals have the right of 60% of the wage with the same cap still applying (1st period of unemployment). In the 2nd period of unemployment, applicable as of the second year of benefits, the generosity further decreases, with differentiation by household status. Cohabitants with dependents continue to get 60% subject to an even lower salary cap, whereas cohabitants without a dependent receive 40% with the same lower salary cap. For singles, yet a different replacement rate applies in this 2nd period at 55% with a special even lower cap on their earnings. The exact duration of this second period of benefits depends on the length of the professional career and ends at the latest after 36 months. After the end of the second period, the worker enters the 3rd period of unemployment, during this period, workers

[5] With the increase in SEA, the full career requirement also increased for women from 40 to 45 in similar steps, now matching the requirement for men.

benefit from a (lower) benefit that is no longer earnings-linked, but still depends on the family situation.[6]

Generally, the unemployed need to be available for the labor market and be actively looking for a new job. Payments end upon re-employment or when the SEA is reached. In this case, the individual automatically shifts to the OAP system and starts receiving the old-age pension.

Before 2015, if certain age and career conditions were met, the individual could get a seniority supplement in addition to the UI benefits. The amount depended on the age and the family situation. At the introduction of the supplement, the eligibility conditions were to be at least 50 years with a career of at least 20 years as wage-earner. In 2013, the age condition was increased to 55 years and in 2015, the seniority supplement was abandoned.

A special feature of the UI system is the status of old-age unemployed (OAU). Under OAU rules the unemployment benefits remain unchanged and do not decrease with unemployment duration. In addition, those eligible are exempted from actively looking for a job and they only need to be available for the labor market to a certain extent. However, since its introduction in 1985, the eligibility rules for the OAU have become gradually more stringent. The eligibility age has changed from 55 to 58 or 60 and the minimum career has increased from 20 years to 38 years over the years.

Time spend in unemployment is assimilated to working time. While in principle, the last real gross wage is imputed for the pension calculation, a special (lower) salary ceiling was introduced in 2007 for unemployment days if the unemployed is older than 58. The ceiling was further decreased in 2012 for unemployment durations of more than one year.

2.3. Conventional early retirement

The conventional early retirement (CER) is a system of early exists from the labor market that is organized outside of the old-age pension system. CER retirees collect a two-tiered benefit up until they reach the SEA – at which time they are automatically rolled over into the OAP system. The first benefit component consists of a special UI benefit that is more generous than the regular ones. The early retiree receives 60% of the last gross wage independently from the household status and of the total duration of benefit receipt – with a cap of monthly earnings of EUR 2711.53 in 2023. The second component consists of an additional payment from the former employer. The supplement is equal to half the difference between the last net wage and the UI benefit – also subject to a cap.

Eligibility conditions have changed gradually and have become stricter over our period of observation. In 2004, individuals were eligible for CER at age 58 with a minimum career of 25 years or at age 60 with a minimum career of 20 years. In 2008, the eligibility age 56 was introduced if a career of 40 years was fulfilled. In the same year, the career condition was increased to 30 years for men and 26 years for women in order to be eligible at age 60, and to 35 years for men and to 30 years for women to access the benefits at age 58. From 2010 on, the access to the CER system has become more restrictive as career conditions and minimum ages

[6] The floor on monthly earnings is of EUR 1954.99 in 2023. During the 1st period of unemployment in months 1-6 the cap is of EUR 3234.45 of per month, and for months 7-12 it is EUR 3014.56. In the 2nd period of unemployment, the cap is of EUR 2817.04 for cohabitants and of EUR 2755.73 for singles, all numbers for 2023.

further increase. In 2023, individuals are eligible at age 62 with a minimum career of 40 years for men and 39 years for women.

As for the UI, time spent in CER is fully credited towards the build-up of pension rights - with the same caps as for UI.

2.4. Disability insurance

The disability insurance (DI) system is targeted at individuals no longer able to work (in their current job) for reasons of long-term sickness or accidents. Benefits are paid out if certain conditions are met. First, the individual needs to satisfy minimum contributory requirements. The insured needs to have worked for at least 180 days (or 800 hours for part-time workers) during the last 12 months (certain assimilated days included). Second, the individual needs to be recognized as unable to work with a loss of earnings capacity of at least 66% over a period of at least 12 months. During the first year, regular check-ups are done during which the status "unable to work" is validated or withdrawn.

During the first 12-months period of the so-called – primary incapacity – wage-earners continue to receive their wage from the former employer for the first month and receive afterwards 60% of their last gross wage from social security for the remainder of the year – with salary caps applied. After the first year of incapacity, a worker enters the disability status. Disability benefits have a similar but separate calculation basis (with different reference periods and different caps) – with benefits further depending on the household status. For individuals with a dependent, the replacement rate increases to 65%. Singles receive 55% of their last gross reference wage and individuals cohabiting 40%.

Similar to the CER and UI system, individuals automatically roll over into the OAP system once the SEA is reached and years spent in DI are fully credited at the last real wage for the pension calculation. However, the ceiling for assimilated days in DI has not been lowered over time as it is the case for the UI and CER, making the DI exit route slightly more generous.

2.5. GRAPA

In addition to these four main systems, a social assistance program (GRAPA for *Garantie de Revenu aux Personnes Agées*) provides a financial aid to people older than 65 whose "resources" are below a certain threshold, with the meaning of "resources" determined through an elaborate asset and income test. In 2023, this threshold is equal to EUR 17520.96 per year for people living alone and EUR 11680.68 per year for people living together. The practical implementation is done by the OAP administration that examines the household's resources. If resources per individual are too low, a supplement is paid out that allows to reach the threshold. Contrary to the OAP minimum pension, which requires to satisfy certain career conditions, the only conditions to be met in order to be eligible for the GRAPA is having the main residence in Belgium and a minimum age of 65 years. Moreover, the elderly needs to have the Belgian citizenship or be in an "assimilated situation" which makes the GRAPA available to a wide range of other nationalities.

The resource threshold is lower for people living together because it is assumed that individuals in the same household benefit from economies of scale. Therefore, they need less to reach the same standard of living compared to an individual living alone. In addition, it is assumed that people share their resources within a household. This is why the resources of all people living in the household are considered in the examination of resources. The means test includes incomes like pension and labor income, financial assets as well as real estate ownership.

The GRAPA thresholds have increased each year since its introduction in 2001. These increases were larger than the inflation rate, making the GRAPA program ever more generous over the years. As an illustration, if thresholds would have been adapted to inflation only from January 2001 to January 2023, they would have been equal to EUR 11333.33 per year for an individual living alone and EUR 7555.56 per year for an individual living with other people.

3. Calculation of incentive measures

In our subsequent analysis, we use two main measures of retirement incentives: the social security wealth (SSW) which sums up discounted social security benefits from the beginning of retirement over the expected remaining life span; and the implicit tax rate on continued activity. They summarize the generosity of the system.

Below, we first present the data and then detail how the financial incentives are calculated for each individual in the sample.

3.1. Data & sample

The analysis relies on the Belgian data from SHARE (Survey of Health, Ageing and Retirement in Europe). It is a cross-national panel dataset that covers 28 European countries and Israel. Belgium participates in SHARE since 2005 and therefore, data from 2005 to 2019 is available for our analysis. The questions asked in SHARE relate to the occupational status and the health of the respondents and their potential spouses, as well as to the economic and social situation of the household, including relations with their children and close relatives.

In addition to the regular waves of survey, retrospective information has been collected in two different times. This has allowed to construct the so-called SHARE Job Episodes Panel that contains labor market information of the individuals throughout their life. This panel is used to construct the career of each person on a yearly basis in order to calculate the pension entitlements. Since the SHARE Job Episodes Panel only delivers wage information for years a person started or left a job, we use a linear interpolation to fill in missing wage information.

For the purpose of the analysis, we select workers that are about to leave the labor market and are born between 1941 and 1964 so that the sample of analysis is composed of individuals aged 55-65 in the period of observation (2005-2019). We focus our attention on the population of active wage-earners, but our sample includes people who have mixed employment histories as wage-earners, civil-servant or self-employed. We end up with 5875 observations which corresponds to 1422 distinct individuals.

The following table shows some descriptive statistics of the individuals for the first year they appear in the sample.

Table 1 : Main characteristics of the individuals present in the sample, in their first observation year

SAMPLE			
	All	*Men*	*Women*
Number of observations	5875	3113	2762
Number of individuals	1422	756	666
marital status			
married	67%	71%	62%
unmarried	33%	29%	38%
Average years of career	35	37	34
Average ACE at age 54 (in 2023 EUR)	65547	78477	50870

Source: Authors' calculations based on SHARE data.
Notes: ACE refers to individual average career earnings. They are calculated by dividing the total earnings up to age 54 by the number of career years up to age 54.

3.2. Benefit calculation

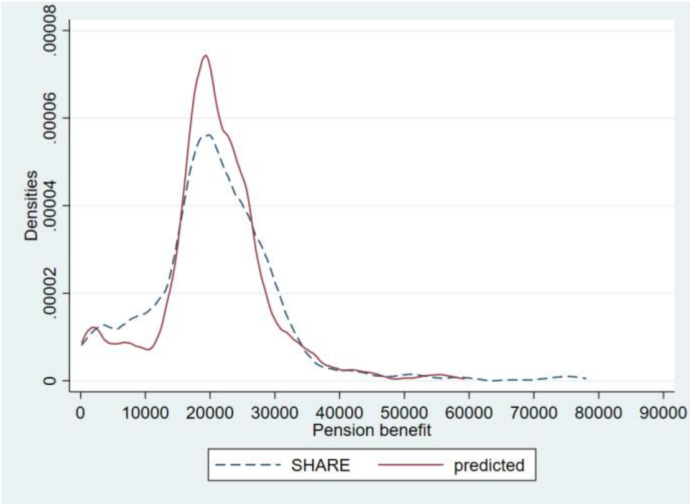
For each individual in the sample and for each year of observation, we calculate the stream of after-tax benefits the individual could claim if he opted out through each of the four exit routes using the rules in place at the possible year of exit. Put differently, let $b_{k,a}(R, i)$ denote the benefit of an individual i at age a (>R) who exits the labor market at age R through the exit pathway k.

For the OAP exit route, strict eligibility criteria exist. If these criteria are not yet met, zero benefits are imputed for those periods. As soon as an individual becomes eligible for early retirement or reaches the statutory eligibility age (SEA), benefits are allocated. For CER exits, simplified eligibility conditions are also verified. Individuals eligible for the CER are assumed to get a CER payment until the SEA of 65. Non-eligible individuals are assumed to exit through the UI pathway, collecting thus the less generous UI benefits until the SEA. For UI and DI exits, individuals collect UI and DI benefits until the SEA of 65. Hence, for those three latter exit routes, positive benefits are imputed – with automatic rollover into OAP at the SEA.

For each year, the social security rules in place are used to calculate the pension benefits based on each individual's career, marital status as well as the partner's earnings. To validate our benefit calculations, pension entitlements are calculated and compared to the stated pension benefit in the SHARE dataset[7]. Figure 3 shows the distribution of the pension benefits declared in SHARE and the ones calculated with our simulation tool[8]. On average, we calculate a yearly net pension benefit of EUR 20608 while respondents declare a yearly net pension benefit of EUR 20597 (expressed in 2023 EUR).

[7] SHARE does not make a difference between pensions coming from the wage-earner, self-employed or civil servant system. Therefore, the comparison is done with the sum of all pensions. GRAPA supplements are included.
[8] To end up with more observations, the validation of the calculator was done not exclusively for people from the sample but for all people born between 1941-1964. No matter at what age they exit the labor market or under which status. We have 914 matches.

Figure 3 : Distribution of the yearly net pension benefits – SHARE and predictions



Source: Authors' calculation based on SHARE data.

3.3. Incentive measures

Using these annual benefit amounts, we calculate two aggregate indicators of incentives for each individual: the aggregate social security wealth (SSW) and the implicit tax on continued activity (ITAX).

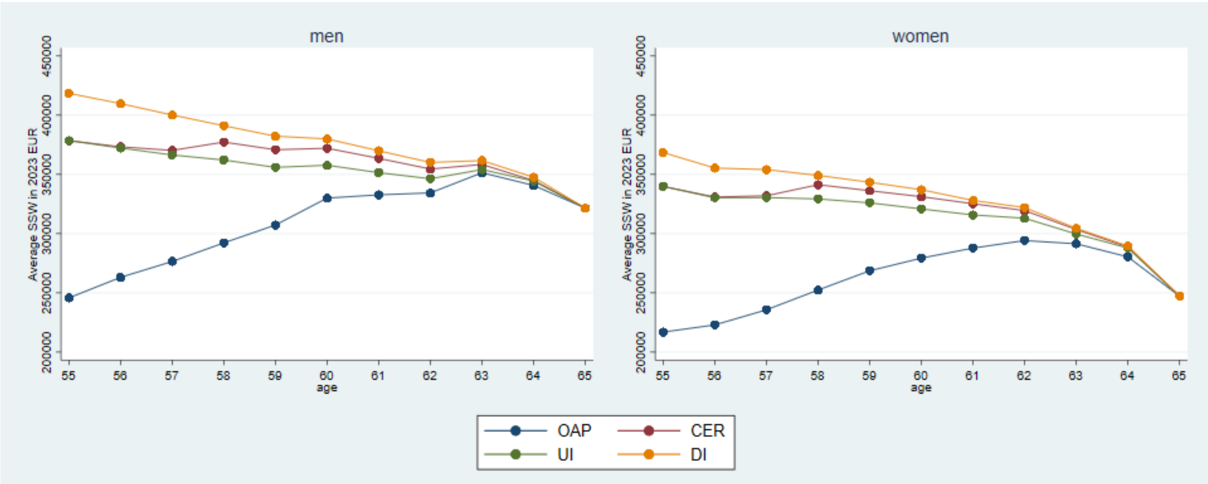
The SSW is the present discounted value of all future benefits from a given exit route. It is calculated separately for each of the four exit schemes. SSW for an individual i who starts to claim benefits from exit pathway k as of retirement age R is then given by:

$$SSW_k(R,i) = \sum_{a=R}^{T} b_{k,a}\sigma_{i,a}\beta^{a-R}$$

Where $b_{k,a}$ denotes the after-tax benefit from exit route k at age a>R. These benefits are summed up from retirement age R until death T. The benefits are discounted allowing for mortality adjustments and time preferences. $\sigma_{i,a}$ is the survival probability at age a for individual i. It differs according to the social class, gender and the birth cohort. More details about the survival probabilities are presented in the next section. β is the time discount rate that is assumed to be equal to 3% real.

Figure 4 presents the average SSW for each exit route by age, separately for men and women. The DI exit route is the most generous scheme at all ages. This can be explained by the more generous earnings ceilings in this pathway. The CER scheme presents the second highest. CER benefits are larger than the simple UI benefits because of the supplement paid by the former employer. However, this pathway remains pretty close to the UI scheme at the ages 55-57. Most individuals are not eligible for the CER at those ages and are thus assumed to exit via UI. In most years in our period of observation, CER becomes available at age 58 and we see that the distance in the average SSW between those two exit routes becomes larger. The least favorable exit route is the OAP scheme. It is especially less generous if individuals exit at a relatively early age. The reason for this is that a benefit of zero is assumed until the individual becomes eligible for OAP. Pension entitlements do thus not further increase in the years between exit and the claiming of OAP as it is the case for the three previous exit routes. Figure 4 also shows that OAP SSW increases for lower ages for the same reason. Then as individuals reach the age range at which early retirement becomes available, SSW decreases slightly with age. This shows that the loss in benefit payments by postponing claiming by one year is on average larger than the gain in pension benefits due to adding one year of earnings in the calculation. Since at age 65, individuals are automatically transferred to the OAP scheme, the average SSWs of the different pathways get closer to each other as we approach the SEA because less years are spent in CER, UI or DI. We end up with identical SSWs in the four exit pathways at age 65.

Figure 4 : Average SSW per age, exit route and gender

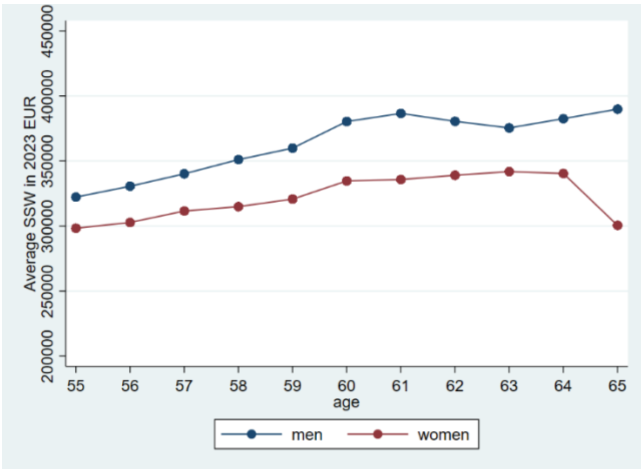


Source: Authors' calculation based on SHARE data.
Note: Full sample of person-year observations 2005-2019.

We then aggregate the four SSW by exit route into a single aggregated SSW. The aggregation method used is similar to the one applied by Dellis et al. (2004). The number of observed exits into CER, UI and DI at a certain age is used as a proportion of the total number of employed individuals at this age. The residual weight is given to the OAP scheme assuming that anybody else would leave through OAP. In addition to the age, the weights are further differentiated by year and sex. As a reminder, the aggregated SSW also includes pension benefits derived from people's career as civil-servant and self-employed.

Figure 5 presents the average aggregated SSW per exit age, separately for men and women. The aggregated SSW is increasing with age meaning that the aggregated SSW is mostly driven by the OAP scheme. Overall, we see that the average SSW is lower for women compared to men at all ages.

Figure 5 : Average aggregated SSW per age and gender



Source: Authors' calculation based on SHARE data.
Note: Full sample of person-year observations 2005-2019.

Based on the SSW, a second incentive measure is calculated: the implicit tax rate (ITAX).

The ITAX is based on the accrual (ACC) that measures the variation in SSW that is obtained by postponing retirement by one year. Retiring one year later can have two effects on the SSW. On the one hand, benefit entitlements $b_{k,a}(R, i)$ can increase because of additional earnings. On the other hand, benefits can be forgone because claiming is postponed by one year. This is however only the case if the individual was eligible for immediate payments of benefits.

$$ACC(R,i) = SSW(R+1,i) - SSW(R,i)$$

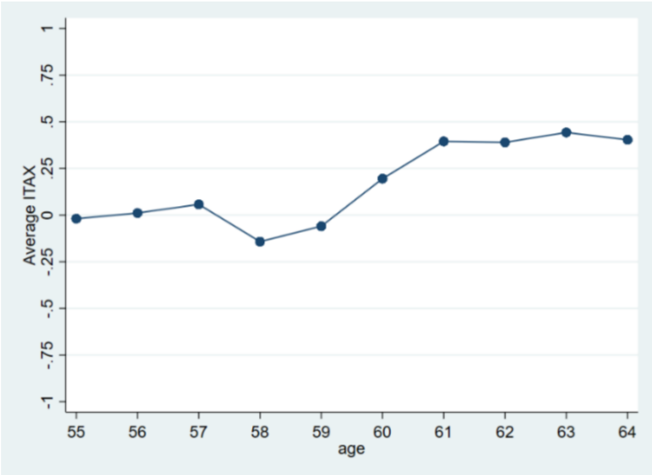
If the ACC is negative, an implicit tax is imposed for working longer by the social security system. Using the ACC, we can calculate the implicit tax rate by dividing the negative accrual by the after-tax earnings during the additional year Y_i.

$$ITAX(R,i) = \frac{-ACC(R,i)}{Y_i}$$

A positive value means that there is an extra implicit tax on working longer beyond income taxes and social insurance contributions originating on the benefit side of social security, a negative value represents an implicit subsidy for working longer. The ITAX will be mainly used in the regressions for predicting retirement probabilities.

Figure 6 presents the average ITAX per exit age. It is close to zero for the ages 55-57. This means that on average, the increase in benefit entitlements because of additional earnings more or less compensates the forgone benefits because claiming is postponed by one year. For the ages 58-59 the average is however negative. The increase in benefit entitlements is in this age range larger than the benefits forgone due to the postponed claiming. By working one more year, people are more frequently satisfying the career conditions for early benefits under the OAP and CER regime leading to a discrete increase in expected benefit levels. The ITAX increases sharply from age 60 on. Since people are more likely to be already eligible for immediate payments in this age range, the increase in benefit entitlements can no longer offset the benefits forgone by postponing claiming, which leads on average to a positive implicit tax on working longer.

Figure 6 : Average ITAX per age



Source: Authors' calculation based on SHARE data.
Note: Full sample of person-year observations 2005-2019.

3.4. The differences in life expectancy by socio-economic status

As mentioned above, in the calculation of the SSW, we use survival rates that are differentiated by social class, gender and birth cohort. This is an important input of our analysis of inequality at old age. In this section we present the data and the construction of the mortality tables that are used for this differentiation.

Data & definition of socio-economic status

To our knowledge, no income-stratified life tables are available for Belgium, neither from official Belgian statistics nor from academia. The closest work we are aware of is the one by Eggerickx et al. (2018) analyzing the evolution of social differences in mortality in Belgium over 25 years – which serves as a basis for our socio-economic differentiation strategy. Eggerickx et al. (2018) produced mortality tables by social class using matched data from the national register and the population censuses. They obtain tables from 1992 to 2016 by 5-year group (1992-1996, 2002-2006, 2012-2016) for 5-year age groups and by gender (and district).

Eggerickx et al. assume that the socio-economic position of one individual cannot be summarized by a unidimensional factor and define the social classes using a multidimensional indicator that accounts for the educational level, the socio-professional category and the housing characteristics[9]. They group the Belgian population (inactive individuals included) into 4 quartiles based on this multidimensional indicator: the disadvantaged social group, the low intermediate social group, the high intermediate social group and the advantaged social group. A mortality table has been created for each of the 4 social groups, for 3 periods of observations and separately for men and women.

[9] See Eggerickx et al. (2018) for a detailed presentation of the method used to obtain the social class indicator. In a nutshell, they use a scoring method to aggregate the three dimensions that are the highest education level obtained, the employment and occupational status and if the individual is the owner of her housing.

Table 2 shows their estimations of life expectancy by social class and gender. The results show that despite the increase in life expectancy over the last decades, there are still social inequalities in mortality. Women live significantly longer than men, with a total difference of life expectancy beyond 5 years. Whatever the period, the life expectancy of the advantaged group is higher than the one of the disadvantaged group – with the gap tending to increase over time. In addition, this gap is much larger for men than for women. For example, in 2012-2016 the differences in life expectancy at birth between the top and the bottom quartile is 9.1 years for men, while it is only 6.5 years for women.

Table 2 : Life expectancy by social class and gender

Social group	1992-1996	2002-2006	2012-2016	Increase from 1992-96 to 2012-16
	Men			
Disadvantaged	69.6	72.0	73.9	4.3
Low intermediate	73.5	76.7	78.1	4.6
High intermediate	75.4	78.4	80.0	4.6
Advantaged	78.0	80.7	83.0	5.1
Total	**73.3**	**75.8**	**78.1**	**4.8**
	Women			
Disadvantaged	78.3	79.6	80.4	2.1
Low intermediate	81.1	83.3	84.1	3.0
High intermediate	82.2	84.3	84.8	2.6
Advantaged	83.1	85.6	87.0	3.9
Total	**80.1**	**81.7**	**83.1**	**3.0**
	Differences between women and men			
Disadvantaged	8.7	7.6	6.5	-2.2
Low intermediate	4.6	6.6	5.9	1.3
High intermediate	6.8	5.9	4.9	-1.9
Advantaged	5.1	4.9	4.0	-1.1
Total	**6.8**	**5.9**	**5.0**	**-1.8**

Source: Eggerickx et al. (2018)

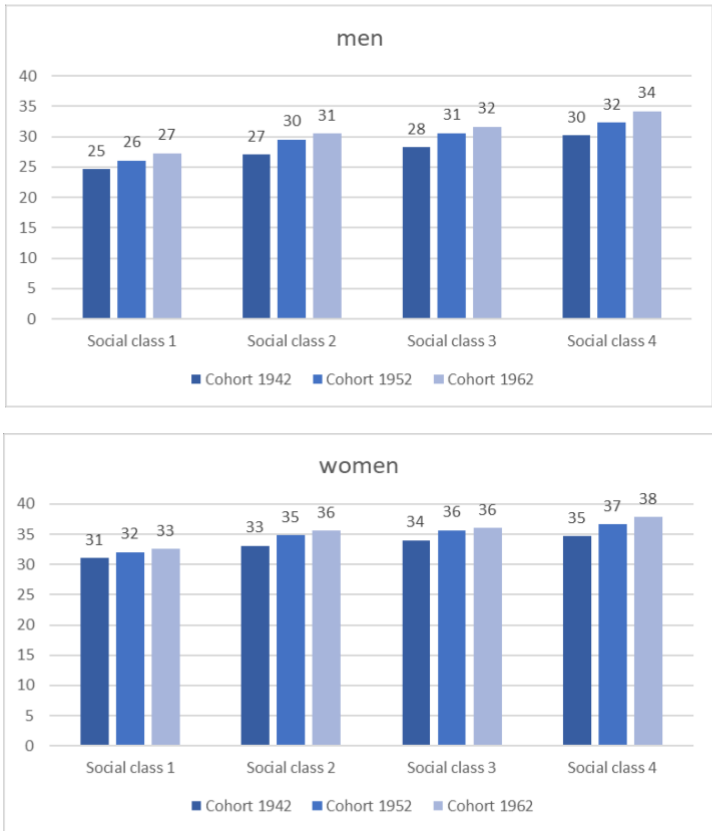
Cohort-based mortality tables

We use the mortality tables produced by Eggerickx et al. (2018) to obtain cohort-based mortality tables for our calculation of social security incentives. This is done in three steps. First, we expand the tables by age groups to individual ages following the mortality observed in the total population. Then we fill information for the in-between years for the three periods of observation using linear interpolation. Finally, we project mortality for future years until 2070 using the projections made by the Belgian Statistical Office (Stabel, 2023) to obtain cohort-based mortality rates. As a result, we obtain mortality information by social class, gender and for the years 1992 to 2070.

To match these mortality tables with our data from SHARE, we created a social class multidimensional score similar to Eggerickx et al. (2018) using the SHARE data and divided the Belgian SHARE population into 4 social quartiles. Each individual in SHARE can thus be associated with cohort-based mortality rates until the age of 100.

To emphasizes the importance of using *cohort-based* mortality rates in the analysis, Figure 7 illustrates the life expectancy at age 50 for the four social classes[10] and men and women, separately for three cohorts included in our sample. We see the differences that exist between the cohorts with a higher life expectancy for later birth cohorts. As already discussed above, life expectancy increases with social class and is higher for women.

Figure 7 : Life expectancy at age 50 by social class, cohort and gender



Source: Authors' calculations based on the cohort-based mortality tables.

Differentiated mortality rates and incentive measures

Figure 8 presents the SSW and ITAX per social class, once calculated with differentiated mortality rates, once calculated with non-differentiated mortality rates.

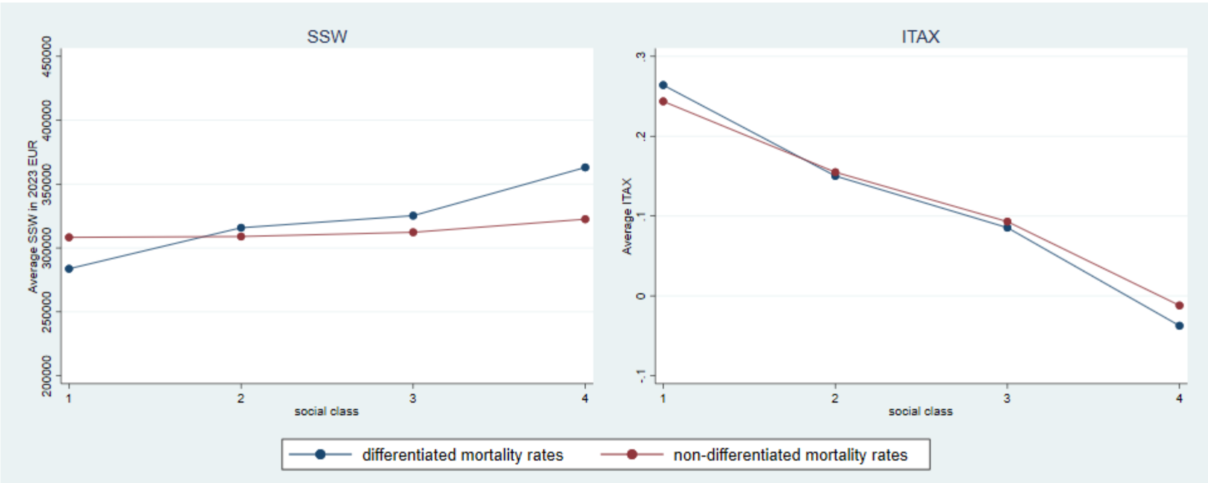
A positive relationship exists between the social class and SSW. The more socially advantaged a person, the higher his SSW, which is especially true when differentiated mortality rates are used. This can be explained by two reasons: First, individuals from a higher social class have on average higher earnings which leads to higher pension benefits due to the calculation method

[10] Social class 1 refers to the first social quartile, hence the rather disadvantaged SHARE population. Social class 4 contains the fourth social quartile, thus the socially more advantaged.

of benefits. Second, individuals from higher social classes have a higher life expectancy which leads to a collection of benefits over a longer period. When using non-differentiated mortality rates, this second effect vanishes. We assume that individuals from the lower social classes live longer and individuals from the upper social classes live shorter than they actually do. This leads to an overestimation of the SSW of the lower social class and an underestimation of it at the upper end of the social distribution. Consequently, we would underestimate inequality in SSW when using non-differentiated mortality rates.

Between the social class and ITAX we see a negative correlation. The higher the social class, the lower the ITAX. This can be explained by the same two reasons. The socially advantaged benefit more from working one more year because they earn more on average and can thus increase their pension to a greater extent. As they live longer on average and draw their benefit over a longer period, they benefit from an increased pension for longer. Again, this second effect disappears if we do not account for the differences in life expectancy that exist between social classes. We would underestimate the ITAX of the socially disadvantaged while overestimating it for individuals from the upper social classes.

Figure 8 : Average aggregated SSW per social class



Source: Authors' calculations based on SHARE data.

4. Estimating retirement probabilities

Finally, in order to simulate the effects of the reforms on inequality, we estimate the retirement probabilities. In the following, we present the estimation results for four different models to assess the stability of our results to various specifications. We then use results from a Probit regression to predict the conditional retirement probabilities. Finally, these conditional retirement probabilities are aggregated and transformed into unconditional retirement probabilities.

The dependent variable is *retirement* which equals 1 if the individual exits the labor market through one of the four exit routes at that age. It equals 0 if the individual remains active on the labor market. *SSW* and *ITAX* are used as explanatory variables in the regression. We control for a series of socio-demographic variables: the social class, gender, if the individual worked part-time or full-time, the average career earnings and its square, the industry, if the individual has a partner, the partner's current earnings and its square, the age and the year.

Table 3 presents the results of the regression for four different models: the standard linear probability model (LPM), the LPM with fixed effects and random effects as well as the Probit model. For the Probit model, the marginal effect at the mean is presented.

Table 3 : Regression results

		LPM	Fixed effects	Random effects	Probit
ITAX		+ 0.0068 *	+ 0.0062 **	+ 0.0068 *	+ 0.0097 ***
SSW / 100.000		+ 0.0218 ***	- 0.0939 ***	+ 0.0218 **	+ 0.0198 ***
social class (base : 3)	1	+ 0.0596 ***	/	+ 0.0596 ***	+ 0.0550 ***
	2	+ 0.0120	/	+ 0.0120	+ 0.0106
	4	- 0.0383 ***	/	- 0.0383 ***	- 0.0382 ***
female		- 0.0029	/	- 0.0029	- 0.0027
part-time		+ 0.0167	- 0.0451 **	+ 0.0167	+ 0.0151
ACE54 / 1.000	level	- 0.0006 ***	/	- 0.0006 ***	- 0.0005 ***
	squared	+ 0.0000 ***	/	+ 0.0000 ***	+ 0.0000 ***
industry (base : manufacturing)	agriculture, forestry, hunting	- 0.0228	- 0.1050	- 0.0228	- 0.0236
	mining & quarrying	- 0.0722 *	+ 0.1283	- 0.0722 *	- 0.0464
	electricity, gas & water supply	- 0.0073	- 0.1314	- 0.0073	- 0.0146
	construction	+ 0.0241	+ 0.0172	+ 0.0241	+ 0.0158
	wholesale and retail trade	- 0.0371 **	- 0.0036	- 0.0371 **	- 0.0318 ***
	hotels and restaurants	- 0.0480	- 0.0556	- 0.0480	- 0.0349 *
	transport, storage and communication	- 0.0362 *	- 0.0142	- 0.0362 **	- 0.0288 *
	financial intermediation	- 0.0132	- 0.0173	- 0.0132	- 0.0105
	real estate and renting	- 0.0539	- 0.1357 **	- 0.0539 **	- 0.0409
	public administration and defence	- 0.0597 ***	- 0.0647	- 0.0597 ***	- 0.0442 ***
	education	- 0.0602 ***	- 0.0512	- 0.0602 ***	- 0.0435 ***
	health and social work	- 0.0451 ***	- 0.0375	- 0.0451 ***	- 0.0389 ***
	other community	- 0.0670 ***	- 0.0656	- 0.0670 ***	- 0.0505 ***
partner		+ 0.0221 **	- 0.0744 **	+ 0.0221 **	+ 0.0186 **
partner's current salary/1000	level	- 0.0004 ***	- 0.0006 ***	- 0.0004 ***	- 0.0004 ***
	squared	+ 0.0000	+ 0.0000 *	+ 0.0000	+ 0.0000
age (base : 55)	56	+ 0.0136	+ 0.0162	+ 0.0136	+ 0.0236
	57	+ 0.0519 ***	+ 0.0463	+ 0.0519 ***	+ 0.0865 ***
	58	+ 0.0774 ***	+ 0.0636	+ 0.0774 ***	+ 0.1313 ***
	59	+ 0.1386 ***	+ 0.1149	+ 0.1386 ***	+ 0.2101 ***
	60	+ 0.1814 ***	+ 0.1743 *	+ 0.1814 ***	+ 0.2702 ***
	61	+ 0.1497 ***	+ 0.1737	+ 0.1497 ***	+ 0.2295 ***
	62	+ 0.1325 ***	+ 0.1473	+ 0.1325 ***	+ 0.2070 ***
	63	+ 0.1647 ***	+ 0.1561	+ 0.1647 ***	+ 0.2605 ***
	64	+ 0.3608 ***	+ 0.3686 **	+ 0.3608 ***	+ 0.5120 ***
year (base : 2005)	2006	+ 0.0192	+ 0.1874 ***	+ 0.0192	+ 0.0116
	2007	- 0.0774 ***	+ 0.1877 ***	- 0.0774 ***	- 0.0549 ***
	2008	+ 0.0156	+ 0.3037 ***	+ 0.0156	+ 0.0111
	2009	- 0.0433 *	+ 0.3163 ***	- 0.0433 *	- 0.0295 *
	2010	+ 0.0326	+ 0.4290 ***	+ 0.0326	+ 0.0231
	2011	- 0.1062 ***	+ 0.3348 ***	- 0.1062 ***	- 0.0767 ***
	2012	- 0.0072	+ 0.4599 ***	- 0.0072	- 0.0062
	2013	- 0.1085 ***	+ 0.4024 ***	- 0.1085 ***	- 0.0781 ***
	2014	+ 0.0484 *	+ 0.5825 ***	+ 0.0484 *	+ 0.0336 *
	2015	- 0.0997 ***	+ 0.4978 **	- 0.0997 ***	- 0.0745 ***
	2016	- 0.0146	+ 0.6054 ***	- 0.0146	- 0.0135
	2017	- 0.0996 ***	+ 0.5473 **	- 0.0996 ***	- 0.0651 ***
	2018	+ 0.0769 **	+ 0.7599 ***	+ 0.0769 **	+ 0.0511 **
	2019	- 0.1695 ***	+ 0.5534 *	- 0.1695 ***	- 0.0892 ***
cons		+ 0.0716 **	+ 0.0120	+ 0.0716 **	/
R^2 Pseudo R^2 (Probit)		0.1128	0.0097	0.1128	0.1542
Number of observations		5875	5875	5875	5875

Source: Authors' calculations based on SHARE data.
Notes:
Full sample of person-year observations 2005-2019.
*** $p<0.01$, ** $p<0.05$, * $p<0.1$.

In all models we detect a positive and significant marginal effect from ITAX. The probability to retire increases with a larger tax on continued activity. The coefficient of SSW is also positive and significant in all models except for the fixed effect model. This is consistent with previous findings by Fraikin et al. (2023)[11]. In the fixed effect model, unobserved individual characteristics are removed (like demand for leisure and time preferences). In the other models, the SSW measure might capture a positive effect on the retirement probability because it is correlated with those unobserved characteristics.

Looking at the other explanatory variables, individuals from the lowest social class have a higher probability to retire compared to the third social class. No significant difference can be found between the second and third social class. The probability to retire of the fourth social class is significantly lower to that of the third one. No significant difference can be found between men and women once we control for the industry in which the individual works. Since certain industries are male/female dominated, it is thus likely that the significant gender effect found by Fraikin et al. (2023) is actually due to industry differences[12]. Individuals that work part-time have on average a higher retirement probability in all models except in the fixed effects model. Fraikin et al. (2023) already highlighted, that this result does not have to be contradictory: "While the part-time variable captures a status in the other models (being a part-time worker, retirement is earlier), in the FE specification it captures the transition into part-time status (shifting into part-time status, reduces the likelihood of full exit from labor market)." (Fraikin et al., 2023, p.21). However, this effect is only significant in the fixed effects model. Having higher average career earnings first decreases the retirement probability (it pays to keep working when more is earned). However, at a certain point, earning more translates to a higher probability to retire (when more is earned, there is less need to work longer). In certain industries, a significant difference can be found compared to the manufacturing industry which serves as the reference industry in this regression. The coefficients show that people are less likely to retire when they are working in the mining and quarrying industry, in wholesale and retail trade, in transportation, real estate, public administration, education or health care compared to the manufacturing industry. Having a partner significantly increases the probability to retire in all models except the fixed effects model. The partner's current earnings first decrease the retirement probability up to a certain point. Afterwards, higher partner earnings lead to a higher retirement probability. The coefficients of the age dummies show that the older an individual, the higher his/her retirement probability. A peak can be detected at age 60 and 64. The year dummies show that there are significant differences from one year to the other.

To evaluate the predictive power of our regression models, Figure 9 plots the actual instantaneous retirement probabilities and the predicted ones. We select the Probit specification as our benchmark. Predictions are very close to the observed probabilities. The probability increases with age with a spike at age 60, where early retirement becomes available for most of the years in the period of observation, and at age 64.

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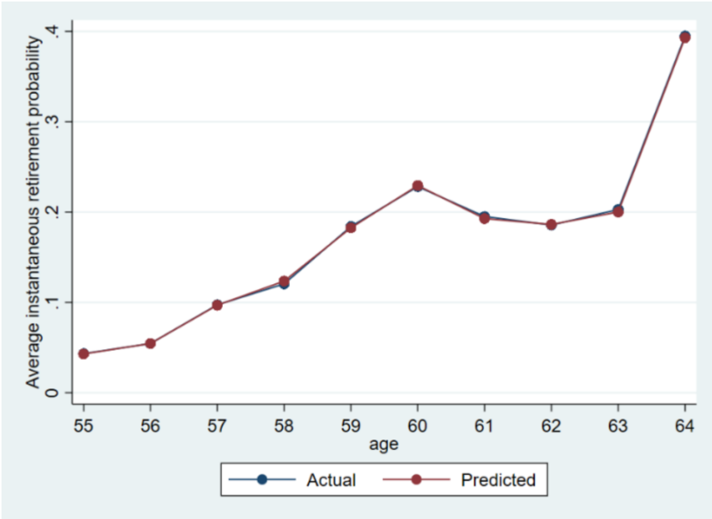
[11] We obtain smaller coefficients for ITAX and SSW compared to what was found by Fraikin et al. (2023). The reason for this is the difference in our sample. We include younger people who seem to be less affected by SSW and ITAX in their retirement decision. When doing the regression for a sample similar to the one used by Fraikin et al. (2023), we obtain coefficients that are larger compared to here and more similar in magnitude to what was found by Fraikin et al. (2023).

[12] Fraikin et al. (2023) do not control for the industries but use a summarized measure of three sectors of activity.

Figure 9 : Instantaneous retirement probability per age – actual and predicted (Probit model)



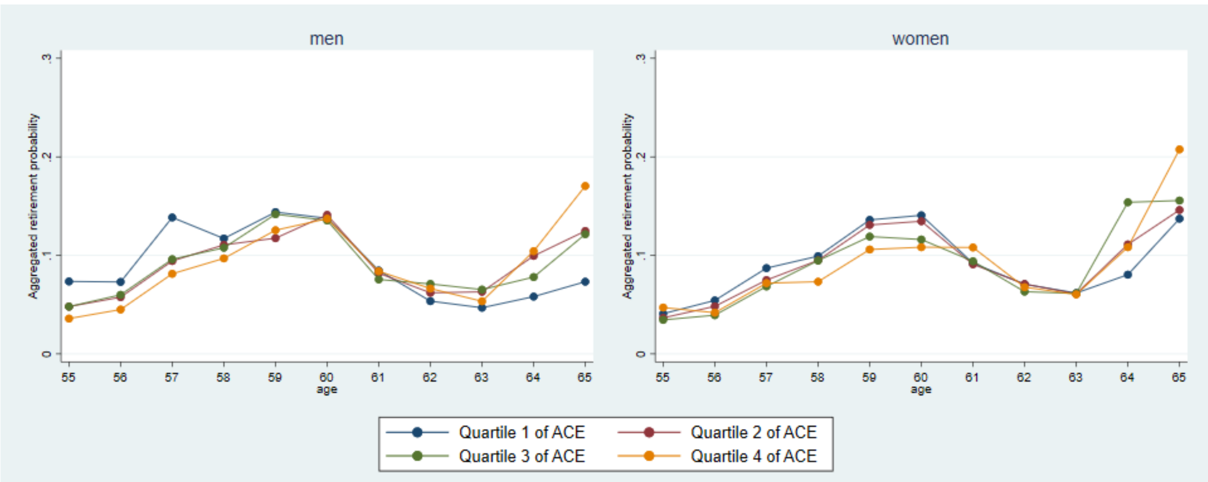
Source: Authors' calculation based on SHARE data.
Note: Full sample of person-year observations 2005-2019.

After predicting the instantaneous retirement probabilities using the Probit model, they are aggregated over 4 quartiles of ACE for each age from 55 to 65, separately for men and women.

The predictions of the Probit model provide the probability of an individual to retire at a certain age *conditionally* that he remains in the labor market until that age. However, since we calculate afterwards a weighted average of the SSW over the different possible retirement ages, we need the *unconditional* retirement probabilities whose sum equals 1 (when adding age 55 to age 65). For the transformation of the instantaneous retirement probabilities, we use the method described by Suresh et al. (2022) since we are operating in a discrete-time framework.

The following figure shows the transformed aggregated retirement probabilities. In general, we see that individuals from the lower quartile of ACE have the tendency to retire earlier while the upper quartiles tend to retire later. For all quartiles a peak can be detected around age 60, the age around which early retirement becomes available, and of course at age 65, the SEA.

Figure 10 : Aggregated retirement probabilities per age, quartile of ACE and gender



Source: Authors' calculation based on SHARE data.

5. Counterfactual analysis

In order to identify the effect of the various reforms that happened since the early 2000's on old-age inequality, we simulate counterfactual situations. We calculate counterfactual incentive measures with the objective to eliminate the changes attributable to the policy reforms and to examine what would have been the situation in the absence of the reforms implemented between 2005 and 2019. Hence, next to the actual SSW which is calculated using the actual rules in the social security system throughout the years, we calculate a counterfactual SSW. This one is obtained by relying on the social security rules in place in 2004 only (without the reforms implemented ever since). The same applies to ITAX.

Since the SSW and ITAX would have been different if the reforms would not have happened, so will be the retirement probabilities predicted by the model. We hence also compute two types of retirement probabilities: actual and counterfactual ones.

5.1. Simulated reforms

Table 4 : Reforms considered in the counterfactual analysis

OAP system	UI system	CER system	GRAPA system
-Increasing SEA for women (2006 and 2009) -Stricter eligibility rules for early retirement (2005 and 2013-2019) -Introduction and removal of the pension bonus (2007 and 2015)	-Reduced earnings ceilings for UI periods (2007 and 2012)	-Reduced earnings ceilings for CER periods (2007 and 2012) -Stricter eligibility rules for CER (2008-2019)	-More generous GRAPA (2005-2019)

Source: Authors

Table 4 lists the reforms considered in the counterfactual analysis and their expected impact on inequality is indicated with a +/- on Figure 2 summarizing reforms over the last decades. The redistributive effect of the gradual increase in SEA for women from 63 to 65 and the accompanying increase in the number of required years for a complete career is difficult to assess. On the one hand, most women do not reach a full career and are thus not entitled to a full pension. By increasing the number of required years for a full pension, women's benefits are likely to decrease. On the other hand, by increasing the SEA, women have an incentive to stay longer on the labor market which will in turn lead to higher benefits. The total redistributive effect is thus ambiguous.

The stricter rules for OAP early retirement are likely to decrease inequality. Workers in OAP early retirement often do not complete the career and do therefore not get a full pension. With the reform, they have an incentive to stay longer in the labor market and come closer to a complete career which increases their pension benefits.

The pension bonus on the other hand, benefits individuals that have already a complete career, and therefore higher benefits. The bonus increases their benefits even further and is thus likely to increase inequality.

The lowering of the earnings ceiling for periods spend in UI or CER is likely to decrease inequality. High income individuals are more likely to have a wage that exceeds the new ceiling and therefore they will be more affected by this reform.

The fact that the eligibility rules for CER became stricter is likely to be neutral in terms of inequality. All income classes are affected by this in the same way if we assume that the length of the career is not associated with the income class.

The increased generosity in the GRAPA thresholds is expected to decrease inequality since this reform only benefits people from the lower distribution.

5.2. Mechanical and behavioral effects

In the analysis, we distinguish two separate effects. The mechanical effect consists of the change in the distribution of benefit levels by the reforms for a fixed distribution of the retirement age. However, the reforms are likely to change the distribution of the retirement ages by changing the incentives to continue working. This generates a behavioral effect of the reforms on inequality.

To distinguish those two separate effects, we calculate three different SSW for each individual in the sample[13]. Each of them is an average of the SSW at different retirement ages weighted by the aggregated probability of retiring at that age. As explained, the predicted retirement probabilities are aggregated by sex and quartile of average career earnings (ACE). In the formula we denote a combination of sex and quartile as subgroup *S*. *A* denotes "actual" and refers to the situation with reforms, and *CF* denotes "counterfactual" which indicates the situation without reforms.

- SSW with reforms

This represents the SSW of a person according to the actual rules in the social security system (reforms included). We multiply the *actual* SSW with the *actual* aggregated retirement probability at each age and take the sum over age 55-65.

$$SSW(i)\ with\ reform\ = \sum_{R=55}^{65} SSW_{R,i,A} * p_{R,S,A}\ \ with\ i \in S$$

[13] For technical reasons, the sample changes slightly. More details are given in the appendix A.1.

- SSW without reforms – mechanical effect only

For this measure we multiply the *counterfactual* SSW (according to the social security rules in 2004 - without the reforms) with the *actual* aggregated retirement probabilities at each age and take the sum over age 55-65. This computation ignores thus that retirement probabilities may have changed due to the reforms.

$$SSW(i)\ without\ reform - mech.effect\ only\ = \sum_{R=55}^{65} SSW_{R,i,CF} * p_{R,S,A}\quad with\ i \in S$$

- SSW without reform - total effect

We multiply the *counterfactual* SSW with the *counterfactual* retirement probabilities at each age and take the sum over age 55-65. In this measure, we consider thus that retirement probabilities may have changed due to the reforms.

$$SSW(i)\ without\ reform - total\ effect\ = \sum_{R=55}^{65} SSW_{R,i,CF} * p_{R,S,CF}\quad with\ i \in S$$

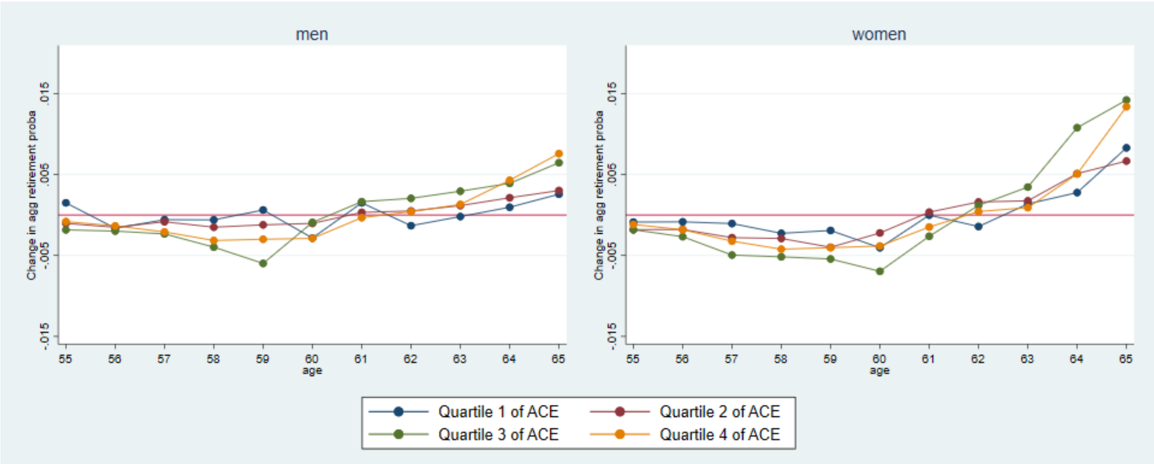
The difference between *SSW with reform* and *SSW without reform – mechanical effect only* delivers the mechanical effect of the reform on the SSW by affecting the level of the benefits received. By comparing the *SSW without reform – mechanical effect only* with the *SSW without reform – total effect* we capture the behavioral effect of the reforms through changing retirement probabilities. The comparison between the *SSW with reform* and the *SSW without reform – total effect* shows us the total change in SSW due to the reforms.

5.3. Results

The changes in retirement patterns due to the reforms

The comparison between the actual and counterfactual aggregated retirement probabilities shows us how the reforms since 2005 have affected retirement decisions. Figure 11 shows that in general, individuals tend to retire later because of the reforms and this effect is larger for the upper quartiles. The reforms lead to a decrease in retirement probability at the younger ages and an increase at the older ages. The graph also shows that the reforms had a bigger impact on women's retirement decision. The women's change in the probability to retire is slightly larger in magnitude than men's. However, in general the effect of the reforms on the retirement probabilities is rather minor.

Figure 11 : Change in aggregated retirement probabilities per age, quartile of ACE and gender because of the reforms



Source: Authors' calculation based on SHARE data.

Decomposition into mechanical and behavioral effect: analysis per decile of ACE

To emphasize the importance of considering the differences that exist in life expectancies when analyzing inequality at old age, we compare the results using the mortality tables that are differentiated by social class (as described in Section 3.4.) with the ones with non-differentiated mortality.

Table 5 presents the average SSW per decile of ACE for each of the three SSW as well as the decomposition of effects[14]. It shows that the first decile benefits directly from the reform thanks to an increase of the amounts of benefits. And since they tend to retire a little later because of the reforms, the behavioral effect is positive as well. All combined, this leads to a slight increase in SSW because of the reforms. For the remaining deciles the opposite is true when considering the mechanical effect. It is negative and they lose from the reform because of reduced benefits. But since the reforms push them to retire later, the behavioral effect is positive. However, as mentioned before, the magnitude of the behavioral effect is really small and because the mechanical effect surpasses the behavioral effect, the upper deciles lose in total from the reforms. Figure 12 illustrates the average mechanical, behavioral and total effect separately for the different deciles, both in absolute values and relatively to the *SSW without reform – total effect*.

Results are qualitatively similar when using non-differentiated mortality rates, with SSW merely at a lower level across the board. The reason for a lower SSW across all deciles is the composition of our sample[15]. The proportion of individuals from the lower social classes is quite small in our sample because we select people that are still active at age 54. Hence even in the lower deciles of our sample, we have a relatively large proportion of people from the upper social classes, leading to a broad-based drop of SSW for most of our sample, including the lowest decile. Since the proportion of upper-class individuals increases with decile, the reduction in average SSW increases with decile when switching to non-differentiated mortality rates.

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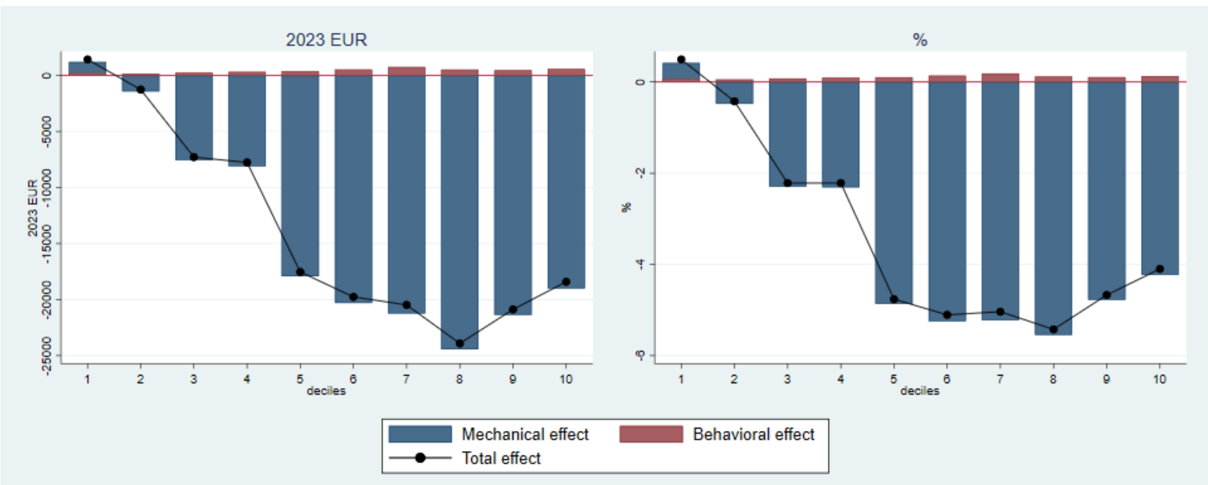
[14] Figure A.1 in appendix A.2 illustrates the different SSW per decile of ACE that are presented in Table 5.
[15] See appendix A.1. for more details.

Table 5 : Average SSW and decomposition of reform effects, by decile of ACE

PANEL A : Differentiated mortality rates									
decile of ACE	SSW (in 2023 EUR)			mechanical effect		behavioral effect		total effect	
	with reform	without reform mechanical effect only	without reform total effect	€	%	€	%	€	%
1	291645	290433	290211	1212	0,42%	222	0,08%	1434	0,49%
2	295408	296829	296664	-1421	-0,48%	165	0,06%	-1256	-0,42%
3	321421	328964	328708	-7543	-2,29%	256	0,08%	-7287	-2,22%
4	342625	350717	350387	-8092	-2,31%	330	0,09%	-7762	-2,22%
5	350712	368637	368251	-17925	-4,87%	386	0,10%	-17539	-4,76%
6	367186	387486	386947	-20300	-5,25%	539	0,14%	-19761	-5,11%
7	386011	407251	406490	-21240	-5,23%	761	0,19%	-20479	-5,04%
8	416824	441271	440737	-24447	-5,55%	534	0,12%	-23913	-5,43%
9	426139	447496	447020	-21357	-4,78%	476	0,11%	-20881	-4,67%
10	430728	449725	449141	-18997	-4,23%	584	0,13%	-18413	-4,10%
PANEL B : Non-differentiated mortality rates									
decile of ACE	SSW (in 2023 EUR)			mechanical effect		behavioral effect		total effect	
	with reform	without reform mechanical effect only	without reform total effect	€	%	€	%	€	%
1	284313	283141	282915	1172	0,41%	226	0,08%	1398	0,49%
2	284364	286102	285941	-1738	-0,61%	161	0,06%	-1577	-0,55%
3	307534	315178	314921	-7644	-2,43%	257	0,08%	-7387	-2,35%
4	326366	334508	334169	-8142	-2,44%	339	0,10%	-7803	-2,34%
5	328281	346287	345894	-18006	-5,21%	393	0,11%	-17613	-5,09%
6	348789	368954	368406	-20165	-5,47%	548	0,15%	-19617	-5,32%
7	364294	385304	384520	-21010	-5,46%	784	0,20%	-20226	-5,26%
8	391208	415272	414724	-24064	-5,80%	548	0,13%	-23516	-5,67%
9	392447	413429	412927	-20982	-5,08%	502	0,12%	-20480	-4,96%
10	399419	418066	417445	-18647	-4,47%	621	0,15%	-18026	-4,32%

Source: Authors' calculation based on SHARE data.

Figure 12 : Decomposition of reform effects – differentiated mortality rates



Source: Authors' calculation based on SHARE data.

Measures of inequality

As the results of the analysis per decile show, the first decile benefits slightly, while the upper deciles lose from the reforms. This should thus lead to a reduction in inequality. As Table 6 shows, the Gini coefficient of the *SSW with reform* is reduced compared to the one of the *SSW without reform*. Overall inequality is thus reduced.

When comparing the Gini coefficient of the counterfactual unreformed SSW indicators (mechanical and total), we see that rounded numbers appear identical though they are not equal[16]. This was expected since the difference in the actual and counterfactual aggregated retirement probabilities is small.

Looking at the Gini coefficient when non-differentiated mortality rates are used, one notices that it is smaller than with differentiated mortality. This is due to the fact that the SSW decreases much more for the upper deciles compared to the lower deciles, which leads to SSW that are closer to each other. This means that inequality is underestimated if the differences in life expectancy across social classes are not accounted for. One might think that inequality is less of a concern than it actually is. When analyzing inequality at old age it thus of importance to consider those differences.

Table 6 : Gini coefficient

	Differentiated mortality rates	Non-differentiated mortality rates
With reform	0.109	0.099
Without reform *Mechanical effect only*	0.121	0.109
Without reform *Total effect*	0.121	0.109

Source: Authors' calculations based on SHARE data.

The Gini coefficients in SSW appear to be quite small. For comparison, the OECD (2021) reports a Gini coefficient of 0.237 in equivalized disposable income for the Belgian population older than 65 in 2018. Several reasons can be identified to explain this difference. First, contrary to the OECD, we are not measuring inequality in realized income, but in expected wealth. These are therefore two different indicators. Moreover, our wealth indicator only includes wealth from social security, which contains less inequality compared to other income and wealth sources. Second, we calculate the SSW for the individual and not for the household, which also has distributional implications. Furthermore, the SSW is a weighted average over 4 different exit routes and over 10 possible exit ages, which enables us to grasp the different options that people have and among which they choose, and which allows us to distinguish between the mechanical and behavioral effect. This methodological choice has the effect of smoothing out variations and providing a more balanced distribution[17].

[16] The Gini is slightly larger in the *SSW without reform – mechanical effect only* compared to the *SSW without reform – total effect*. This makes sense since the actual retirement probabilities (reforms included) are used in the former measure. We saw that the reforms push people to retire later and that this effect is larger for the upper distribution. The actual retirement probabilities are thus slightly more beneficial for the upper deciles which leads to slightly more inequality in this measure.

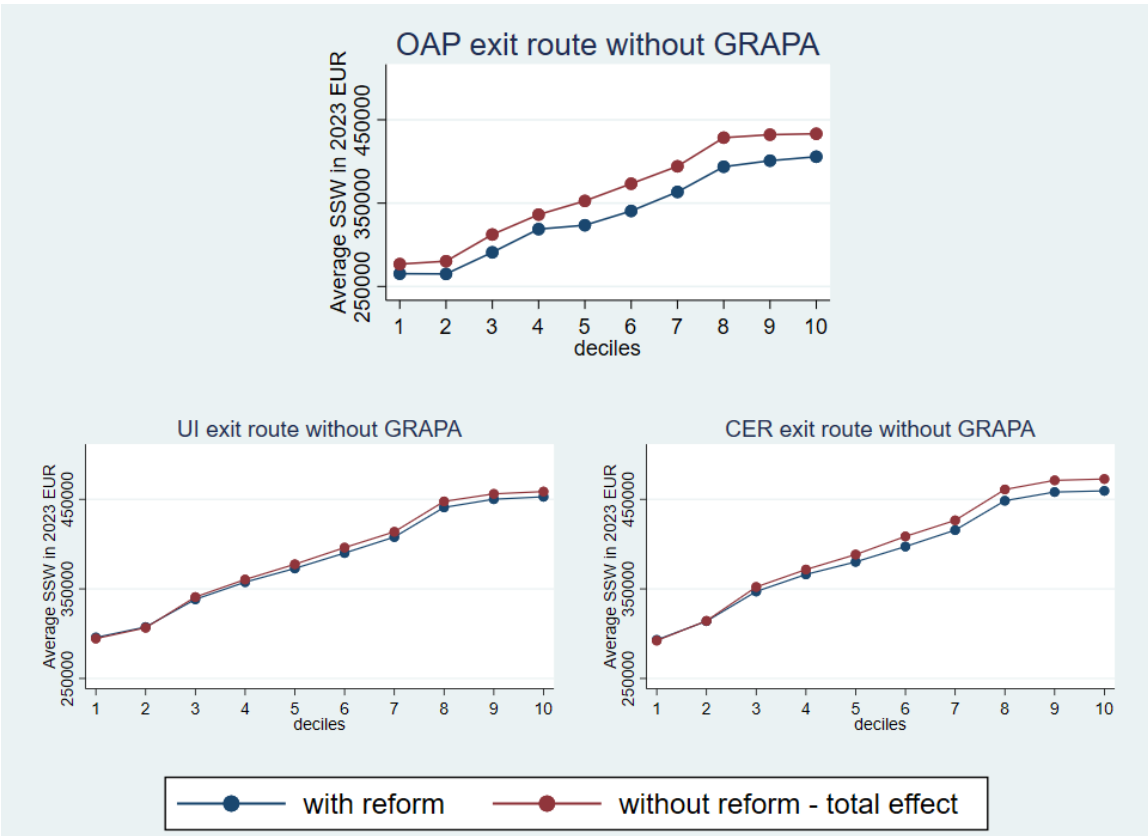
[17] These lower Gini coefficients of SSW are conceptually consistent with the Gini indicators of Figure 1.

Further analysis[18]

So far, we have seen that inequality decreases because of the reforms that happened between 2005 and 2019. However, it would be interesting to identify which reforms initiated this decrease and if there are other reforms that actually increased inequality. To do so, we look separately at the different systems. First, we only look at the OAP exit route without considering the GRAPA supplement to see the effect of the reforms that happened in this system, then we look at the reforms in the CER system and finally the UI system. The DI exit route is not considered here because no reform happened in this system since 2005. In the end we look at the aggregated SSW (all 4 exit routes) without GRAPA supplement and compare it to our previous results (aggregated SSW with GRAPA supplement) to see what difference the reforms in the GRAPA make.

Since the previous analysis showed that the behavioral effect is only minor, we compare here only the *SSW with reform* with the *SSW without reform – total effect* and do not distinguish between mechanical and behavioral effect.

Figure 13 : Average SSW per decile of ACE – separately for OAP, UI and CER exit route without GRAPA



Source: Authors' calculations based on SHARE data.

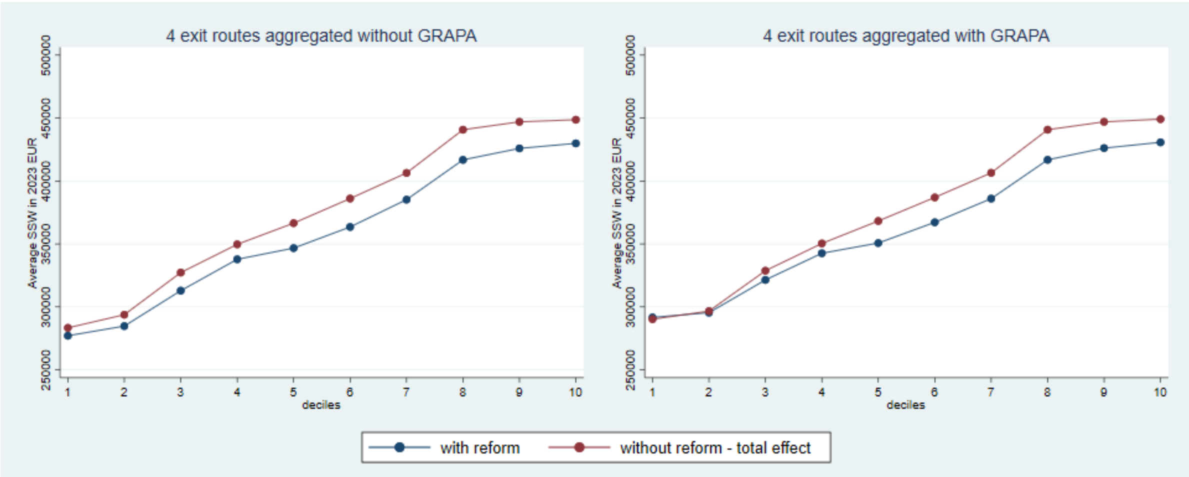
Looking at the OAP exit route, we see that all deciles lose from the reform that happened in this system. The average *SSW with reform* is below the *SSW without reform*. However, the loss is larger for the upper deciles compared to the lower deciles which should nevertheless lead to a reduction in inequality. This might be due to the ever-stricter rules for early retirement. The loss

[18] In this part we only consider differentiated mortality rates.

in pension benefits when no longer meeting the conditions is larger for high-income individuals compared to low-income individuals.

The effect of the reforms in the UI and CER system is similar: there is little to no effect for the lower deciles and a loss for the upper deciles which should thus also lead to a decrease in inequality. This is most certainly due to the reduction in earnings ceilings for UI and CER periods that only affects individuals whose income is above the ceiling.

Figure 14 : Average SSW per decile of ACE – Aggregated SSW without and with GRAPA



Source: Authors' calculations based on SHARE data.

The comparison of the aggregated SSW without GRAPA with the one with GRAPA shows that the GRAPA only plays a role in the lower deciles. This was expected since it is an assistance program dedicated to the poor. The SSW increases when the supplement is added. As shown previously, none of the reforms in the OAP, UI and CER systems was beneficial for anybody and consequently everyone's SSW decreased because of the reforms. Now when the GRAPA is added, we see that the lower decile no longer loses from the total reforms. Hence a more generous GRAPA has a positive effect on the lower decile that offsets the negative effect from the reforms in the other systems.

Table 7 : Gini coefficient – separate systems

	With reform	Without reform *Total effect*
OAP without GRAPA	0.127	0.131
UI without GRAPA	0.117	0.122
CER without GRAPA	0.116	0.124
Aggregated without GRAPA	0.120	0.126
Aggregated with GRAPA	0.109	0.121

Source: Authors' calculations based on SHARE data.

The comparison of the Gini coefficients supports the previous conclusions. The reforms in all systems lead to a slight decrease in inequality. The reform that made the GRAPA more generous had the biggest impact.

6. Conclusion

In this analysis we explore the impact of the social security reforms implemented between 2005 and 2019 on inequality in the flow of incomes from the Social Security at old age using the survey-data from SHARE. Focusing on Belgian wage-earners, we calculate how their SSW evolved due to the reforms applying a counterfactual analysis.

For this we distinguish two separate effects: The mechanical effect considers the change in benefit levels due to the reforms for a fixed retirement age distribution. The behavioral effect accounts for the change in the retirement age distribution caused by changes in the incentives to continue working.

The results show that the mechanical effect is positive for the first decile while being negative for the remainder of the distribution. The behavioral effect is positive for all deciles since the reforms tend to lead to later retirement. Since the behavioral effect only represents a very minor part in the total effect of the reforms on the SSW, it is the mechanical effect that remains the most important. Overall, the first decile's SSW increases slightly, and the upper deciles' SSW decreases because of the reforms leading to a reduction in inequality. A more detailed analysis of the four different exit routes shows that the more generous GRAPA supplement offsets the negative effect of the remaining reforms for the first decile. Without this reform in the GRAPA system, the first decile would have lost as well from the reforms. However, inequality would still have decreased since the loss of the upper deciles is larger.

In the analysis we consider differentiated mortality rates for four social classes. A decision that turns out to be very important when exploring inequality. The upper social classes have a higher life expectancy which leads to a collection of benefits over a longer period. This amplifies the inequality that already exists because of different earnings histories. When ignoring the differences in mortality rates, one would underestimate inequality at old age.

The comparison of the measures of inequality between the average earnings and the SSW demonstrates that the pension system already reduces inequality to a large extent before the reforms. The additional effect of the reforms is small.

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Appendix

A.1. Sample of the analysis

To calculate the *SSW with reform*, *SSW without reform – mechanical effect only* and the *SSW without reform – total effect*, we multiply for each possible age of exit R the SSW of the individual i with the aggregated probability of retiring at that age.

$$SSW(i) = \sum_{R=55}^{65} SSW_{R,i} * p_{R,S} \quad with\ i \in S$$

For this calculation, we need thus a full set of SSW from age 55 to 65 for each individual from our sample. This is not the case in our initial sample because of several reasons. First, we include mixed careers. This can lead to gaps in the calculation of the SSW if an individual switched status after age 54 because we only calculate the SSW for the years a person worked as wage-earner. Second, people can retire before age 65, and our calculation of the SSW ends at the age the individual actually exits the labor market. Lastly, an individual can disappear from the dataset because he/she did no longer participate in SHARE or died.

To ensure a full stream of SSW at all ages between 55 and 65 we use a subsample of our initial sample for the analysis. We select individuals that appear as active wage-earners at age 54 and assume that they continue working like this until age 65. We consider thus their career up to age 54 and calculate their SSW_{55}-SSW_{65} by assuming they remain active as wage-earner until age 65, even though this might in reality not be the case.

Since we are interested in the effect of the reforms that happened between 2005 and 2019, we look at individuals that have a certain number of years in this period. We select thus people born between 1946 and 1964 for the analysis and end up with 1132 individuals in the sample.

The following table shows some descriptive statistics of the individuals that are kept in our sample for the analysis, at age 54.

Table A.1 : Main characteristics of the individuals present in the sample, at age 54

SAMPLE	All	Men	Women
Number of individuals	1132	612	520
Marital status			
married	72%	76%	68%
unmarried	28%	24%	32%
Average years of career	34	35	33
Average ACE at age 54 (in 2023 EUR)	64665	75415	52012

Source: Authors' calculations based on SHARE data.

Notes: ACE refers to individual average career earnings. They are calculated by dividing the total earnings up to age 54 by the number of career years up to age 54.

For the purpose of the presentation, we divide our sample into 10 deciles based on the individuals' ACE at age 54. We compare thus the relatively poor to the relatively rich of our sample. However, since we only select individuals that were still active at age 54 in our sample, we likely face a selection issue with a sample that is not necessarily representative of the Belgian population. Indeed, looking at the composition of the sample, we see that the proportion of people from the first social class is quite small in the total sample. Only 10% are from the disadvantaged social class and 38% come from the advantaged social class. Our sample is thus composed of the more advantaged individuals. When looking separately at the first and last decile we observe that the composition changes from one decile to the other. In the first decile more people from the lower social classes and less people from the higher social classes are present. As we move up in deciles, the proportion of the lower social class decreases and the percentage of people from the higher social classes increases. In the analysis, we compare thus the relatively poor and the relatively rich from a sample that is composed of rather more socially advantaged people.

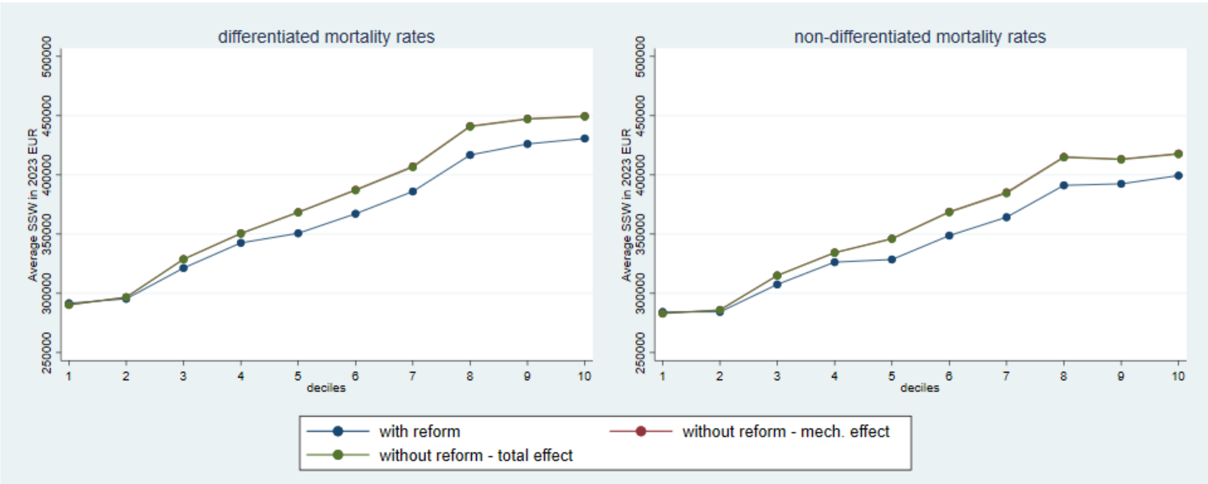
Table A.2 : Composition of the sample

Composition of the sample				
	Social class 1	Social class 2	Social class 3	Social class 4
Total	10%	22%	30%	38%
Decile 1	21%	35%	26%	18%
Decile 10	5%	11%	35%	49%

Source: Authors' calculations based on SHARE data.

A.2. Illustration of the average SSW presented in Table 5

Figure A.1 : Average SSW per decile of ACE



Source: Authors' calculation based on SHARE data.

Figure A.1 presents the average SSW per decile of ACE for each of the three SSW. The average *SSW without reform – total effect* lies more or less on top of the *SSW without reform – mechanical effect only* illustrating the minor effect of the reforms on the retirement probability. However, the difference with the *SSW with reform* is striking and a clear tendency can be detected. Not much change occurred for the first two deciles while we see that the *SSW with reform* lies below the other ones for the upper deciles. They lose thus from the reform. When using non-differentiated mortality rates, results are qualitatively similar, with SSW merely at a lower level across deciles.