

Who Gets to Age Well? An Analysis of the Public Pension System and Socio-Economic Inequalities Among Older Adults in Belgium

Dissertation submitted in fulfillment
of the requirements for the degree of

Ph.D. in Economics and Management

by

Giulia KLINGES

Jury:

Prof. Dr. Alain Jousten, Advisor, University of Liège

Prof. Dr. Mathieu Lefebvre, University of Strasbourg

Prof. Dr. Sergio Perelman, HEC Liège, Management
School of the University of Liège

Prof. Dr. Jérôme Schoenmaeckers, HEC Liège, Management
School of the University of Liège

Prof. Dr. Malene Kallestrup-Lamb, Aarhus University

Prof. Dr. Koen Decancq, University of Antwerp

Acknowledgements

I am very grateful to the many people who made this dissertation possible. First, I would like to express my deepest gratitude to my supervisor, Alain Joustien, for his continuous support throughout my PhD. I am sincerely thankful for his guidance and the many insightful comments he provided on my work. His approachability and his extraordinary expertise played a key role in completing this thesis. I also greatly appreciate the friendly and enriching conversations we shared over the years.

Special thanks also to the members of my thesis committee, who were consistently available and followed my work with great interest throughout the years. Thanks to Mathieu Lefebvre, with whom I worked very closely on several chapters of this dissertation. His excellence as a researcher and his approachable, easygoing nature made the collaboration both stimulating and enjoyable. I would also like to warmly thank Sergio Perelman for his many thoughtful and constructive comments, as well as his kind and encouraging words, which helped me stay motivated throughout.

My thanks also go to the members of my jury, Jérôme Schoenmaeckers, Malene Kallestrup-Lamb, and Koen Decancq, for their valuable comments during the private defense. Their challenging questions encouraged me to reflect more critically on my work and to see it from different perspectives. Their insightful feedback contributed significantly to improving this dissertation. I am particularly grateful to Jérôme, who, incidentally,

was the first to suggest, during my master's thesis defense, that pursuing a PhD could be an option for me. Until then, I had never considered this path.

I am deeply grateful to everyone who made it possible for me to participate in the International Social Security project of the NBER and to undertake a five-month research stay at the OECD in Paris. These experiences have been incredibly enriching and have greatly broadened my horizons. Collaborating with leading experts from around the world in the field of retirement systems and inequalities has been truly inspiring.

I would also like to thank my colleagues at the UER Economie for creating a friendly and supportive atmosphere during my PhD. Special thanks to Kelly, my office mate and dear friend. We started this journey together in 2019 and are completing it side by side. I will always cherish her support and kind words of encouragement, which have carried me through both challenging and joyful moments.

Lastly, I would like to express my sincere gratitude to my family and friends for their unwavering support and encouragement throughout the years. To my parents, thank you for teaching me from a young age that hard work and perseverance always pay off and can overcome any challenge. To my fiancé Raphaël, thank you for inspiring me to strive for more, and for your unconditional love, which keeps me grounded and supported every day. To my sister Chiara, thank you for being my biggest supporter and for always reminding me that I can achieve anything I set my mind to. This accomplishment would not have been possible without all of you.

Giulia

Liège, April 16, 2026

Contents

List of Figures	vii
List of Tables	xi
1 General Introduction	1
1.1 Background and motivation	2
1.2 Thesis outline	7
2 Institutional Context	13
2.1 Introduction	14
2.2 Structure, redistribution, and reforms in the Belgian public pension system for wage-earners	15
2.3 Other pension regimes in Belgium: Self-employed and civil servants	26
2.4 Social assistance for the older population : GRAPA	29
3 Past Social Security Reforms and Inequality in Old Age	31
3.1 Introduction	32
3.2 Calculation of incentive measures	34

3.3	Estimating retirement probabilities	48
3.4	Counterfactual analysis	54
3.5	Conclusion	67
4	The Public Pension System and the Gender Pension Gap	69
4.1	Introduction	70
4.2	The Gender Pension Gap	72
4.3	Calculation of pension benefits	82
4.4	Methodology	87
4.5	Counterfactual analysis	91
4.6	Conclusion	100
5	Pension Adequacy and Inequality under Reform Scenarios	103
5.1	Introduction	104
5.2	Calculation of pension benefits	107
5.3	Methodology	111
5.4	Counterfactual analysis	119
5.5	Assessing long-term variability	135
5.6	Conclusion	141
6	Trends in Health Inequalities among Retirees	143
6.1	Introduction	144
6.2	Linking pension reforms to health inequalities	146
6.3	Data	148
6.4	The morbidity gradient	154
6.5	Concentration indices	161
6.6	Difference in Health-Equivalent Age	164
6.7	Conclusion	168

7 Gender Differences in the Use of Disability Insurance as an Exit Pathway into Retirement	171
7.1 Introduction	172
7.2 Exit pathways into retirement and policy reforms	175
7.3 Data and exit patterns	176
7.4 Factors associated with DI exits	182
7.5 Fairlie decomposition	186
7.6 Conclusion	194
 8 General Conclusion	 197
8.1 Research objective	198
8.2 Key findings and policy implications	199
8.3 Limitations and directions for further research	205
 A Additional Material of Chapter 3	 209
A.1 Career construction and benefit calculation with SHARE data	210
A.2 Sample of the analysis	214
A.3 Illustration of the average <i>SSW</i> presented in Table 3.5	217
 B Additional Material of Chapter 4	 219
B.1 Comparison of income distribution - sample of analysis vs. EU-SILC	220
B.2 Evolution of the GPG at different points of the distribution using strategy 1	221
B.3 Change in the distribution of pension income throughout the counterfactual situations of strategy 1	225
B.4 Counterfactual analysis using strategy 2	226

C Additional Material of Chapter 5	233
C.1 Average career characteristics by marital status and gender	234
C.2 Alternative version of Simulation C : granting additional career year for child-rearing to both parents	234
C.3 Estimation of retirement probabilities	238
 D Additional Material of Chapter 6	 245
D.1 Further details on the construction of the health measures .	246
D.2 Concentration indices	248
 E Additional Material of Chapter 7	 251
E.1 Health deficit index	252
E.2 Underlying Logit regressions for the Fairlie decomposition .	256
E.3 Sensitivity analysis: Impact of crisis years	260
 Bibliography	 267

List of Figures

1.1	Income quintile share ratio	5
2.1	Timing of reforms	16
3.1	Evolution of the Gini coefficient separately for workers and pensioners aged 55-64	33
3.2	Distribution of the yearly net pension benefits – SHARE and predictions	37
3.3	Average <i>SSW</i> per age, exit route and gender	39
3.4	Average aggregated <i>SSW</i> per age and gender	40
3.5	Average <i>ITAX</i> per age	42
3.6	Life expectancy at age 50 by social class, cohort and gender	46
3.7	Average aggregated <i>SSW</i> and <i>ITAX</i> per social class	47
3.8	Instantaneous retirement probability per age – actual and predicted	52
3.9	Aggregated retirement probabilities per age, quartile of ACE and gender	53
3.10	Change in aggregated retirement probabilities per age, quartile of ACE and gender	59
3.11	Decomposition of reform effects – differentiated mortality rates	62
3.12	Average <i>SSW</i> per decile of ACE – separately for OAP, UI and CER exit route without GRAPA	65
3.13	Average <i>SSW</i> per decile of ACE – agg. <i>SSW</i> without and with GRAPA	66

4.1	Drivers of the gender pension gap	74
4.2	Distribution of the yearly gross pension benefits – ONP and predictions	84
4.3	Distribution of the predicted pension benefits separately for men and women	86
4.4	Evolution of the GPG at the average - scenario 1-3	93
4.5	Evolution of the GPG at different quintiles – scenario 1-3	95
4.6	Evolution of the GPG at the average – scenario 4-5	98
4.7	Evolution of the GPG at different quintiles – scenario 4-5	99
5.1	Distribution of the yearly net pension benefits – SHARE and predictions	109
5.2	Average gain in yearly net pension benefits by marital status and gender – simulation A	121
5.3	Decomposition of the effect – simulation A	123
5.4	Average gain in yearly net pension benefits by marital status and gender – simulation B	127
5.5	Decomposition of the effect – simulation B	129
5.6	Average gain in yearly net pension benefits by marital status and gender – simulation C	132
5.7	Decomposition of the effect – simulation C	134
5.8	Aggregated retirement probabilities per age and gender	138
5.9	Change in aggregated retirement probabilities	139
6.1	Health by income decile – Functional health	155
6.2	Health by income decile – Diagnosed health	156
6.3	Health by income decile – Comprehensive health	156
6.4	Health by income decile – Mental health	157
6.5	Health by income decile – Cognitive health	158
6.6	Normalized gradient over time	159
6.7	Concentration curves	162

6.8	Concentration indices over time	163
6.9	Share of individuals with very good health	165
7.1	Proportion of disabled wage-earners aged 55-64 relative to total employed wage-earners in the private sector over time, by gender	173
A.1	Distribution of the yearly net pension benefits – SHARE and predictions	214
A.2	Average <i>SSW</i> per decile of ACE	217
B.1	Distribution of yearly gross pension benefits, separately for men and women	225
C.1	Average gain in yearly net pension benefits by marital status and gender – simulation C alternative	236
C.2	Decomposition of the effect – simulation C alternative	237
C.3	Instantaneous retirement probability per age – actual and predicted	242
D.1	Concentration indices over time - alternative specification for functional health	250

List of Tables

3.1	Summary statistics of sample, working wage-earners aged 55-65	35
3.2	Life expectancy by social class and gender	45
3.3	Regression results - labor market exit	49
3.4	Reforms considered in the counterfactual analysis	54
3.5	Average <i>SSW</i> and decomposition of reform effects, by decile of ACE	61
3.6	Gini coefficient	63
3.7	Gini coefficient- separate systems	67
4.1	Summary statistics of sample, retirees aged 65-78	83
4.2	Yearly gross pension benefits separately for men and women – ONP and predictions	85
4.3	Counterfactual situations	92
5.1	Summary statistics of sample, retirees aged 65+	108
5.2	Calculated average yearly net pension benefit per category of marital status – in 2025 EUR	110
5.3	Comparison of measures – simulation A	120
5.4	Comparison of measures – simulation B	125
5.5	Comparison of measures – simulation C	131
5.6	Average retirement age	140
6.1	Summary statistics of sample, retirees aged 60-79	153
6.2	Differences in Health-Equivalent Age	167

6.3 Change in differences in Health-Equivalent Age from 2005 to 2021/22	168
7.1 Summary statistics of sample, working wage-earners aged 55-64	178
7.2 Chosen exit routes over time, by gender	181
7.3 Logit regression - labor market exit via DI	184
7.4 Fairlie decomposition – men vs. women in period 1	189
7.5 Fairlie decomposition – women in period 1 vs. period 2	192
A.1 Summary statistics of sample, working wage-earners aged 54	216
A.2 Composition of the sample	216
B.1 Percentage of sample contained in the different EU-SILC quintiles	221
B.2 Comparison EU-SILC 65+ and sample	221
B.3 Strategy 1 - Gender pension gap - average	222
B.4 Strategy 1 - Gender pension gap - quintile 1	223
B.5 Strategy 1 - Gender pension gap - quintile 5	224
B.6 Counterfactual situations - strategy 2	227
B.7 Strategy 2 - Gender pension gap - average	230
B.8 Strategy 2 - Gender pension gap - quintile 1	231
B.9 Strategy 2 - Gender pension gap - quintile 5	232
C.1 Average career length and earnings by marital status and gender	234
C.2 Comparison of measures – simulation C alternative	235
C.3 Summary statistics of sample, working wage-earners aged 55-65	239
C.4 Regression results - labor market exit	243
D.1 Functional health – list of variables used	246
D.2 Diagnosed health – list of variables used	248
D.3 Concentration indices	249

E.1	Decomposition of the health deficit index	254
E.2	Logit regression - labor market exit via DI - men only period 1	258
E.3	Logit regression - labor market exit via DI - women only period 1	259
E.4	Chosen exit routes over time, by gender - sensitivity analysis	261
E.5	Logit regression - labor market exit via DI - sensitivity analysis	263
E.6	Fairlie decomposition – men vs. women in period 1 - sensi- tivity analysis	264
E.7	Fairlie decomposition – women in period 1 vs. period 2 - sensitivity analysis	266

Chapter 1

General Introduction

1.1 Background and motivation

The conversation surrounding social security systems has grown in scope over the past years. Its financial sustainability has been a long-standing issue, particularly with the grow in longevity and the baby boomer generation reaching retirement age, putting the funding of these systems at risk in many countries. This topic has been extensively debated and analyzed over the years (European Commission, 2012, 2024; Grech, 2013; International Monetary Fund, 2014). However, more recently, other concerns such as inequality and adequacy have come to the forefront as well.

In general, the topic of inequality has been increasingly coming into focus in academia, politics, and the public discourse for quite some time. More and more studies highlight social, economic, and health disparities, and political debates are increasingly centered on questions of fair distribution of resources. Several factors may explain this shift: on the one hand, globalization and technological change have led to growing income and wealth gaps, making inequality more visible. On the other hand, social media and a more connected public help expose and discuss injustices more quickly. Moreover, economic crises, such as the 2008 financial crisis or the Covid pandemic have affected individuals differently, exacerbating existing inequalities and increasing the pressure to address these issues.

This increasing interest in inequality is also evident when it comes to retirement. Growing attention is being paid to disparities in pension entitlements and income security among retirees. Because older individuals often rely on transfers from public social security systems, they are highly dependent on how these systems are designed and therefore constitute a particularly vulnerable group. Governments are thus closely scrutinized for their ability to safeguard the well-being of older citizens and to address

social inequalities¹.

Public pension systems include a range of features designed to ensure adequate income in old age. Mechanisms such as minimum pension thresholds, survivor's pension, and pension credits for career interruptions play a key role in this regard. Beyond securing basic living standards, these measures also help to alleviate income disparities among retirees by providing a safety net for vulnerable groups and mitigating the cumulative effects of lifetime inequalities. In this way, pension systems function not only as instruments for retirement income, but also as tools for promoting social equality in the final stage of the life course. As a result, the Gini coefficient among retirees is slightly lower compared to that of the working-age population in most EU countries, reflecting reduced income inequality in older age (SPC and DG EMPL, 2024).

Across the EU, the extent and nature of redistributive elements vary significantly among pension systems, influencing how effectively inequalities are addressed. Some countries have more comprehensive mechanisms to reduce disparities, while others are less progressive. Belgium stands out as having one of the most progressive pension systems according to the OECD progressivity index², despite the fact that pensions are fundamentally earnings-related (SPC and DG EMPL, 2024).

¹The Belgian Commission for Pension Reform 2020-2040 (2014) emphasizes that the well-being of older individuals depends not only on the pension system, but also on a broader set of factors, including access to and quality of healthcare and long-term care, housing policies, opportunities for social and community engagement, and the extent to which society values the contributions and participation of older people. In 2013, the Belgian government established the Belgian Commission for Pension Reform 2020-2040, composed of twelve experts from diverse ideological and disciplinary backgrounds, including law, economics and sociology. The Commission was tasked with reflecting on the overall structure of the pension system and exploring reforms that could enhance its social and economic sustainability over the medium to long term.

²The OECD progressivity index attributes a score of 100% to a pension system based solely on a universal basic scheme, whereas a system in which pension entitlements are fully proportional to lifetime earnings receives a score of 0%. Belgium ranks 4th among the most progressive pension systems, behind Norway, Denmark and Czechia. The index lies above 50% for those countries, meaning that less than half of the income inequality experienced over a lifetime is reflected in pension benefits (SPC and DG EMPL, 2024).

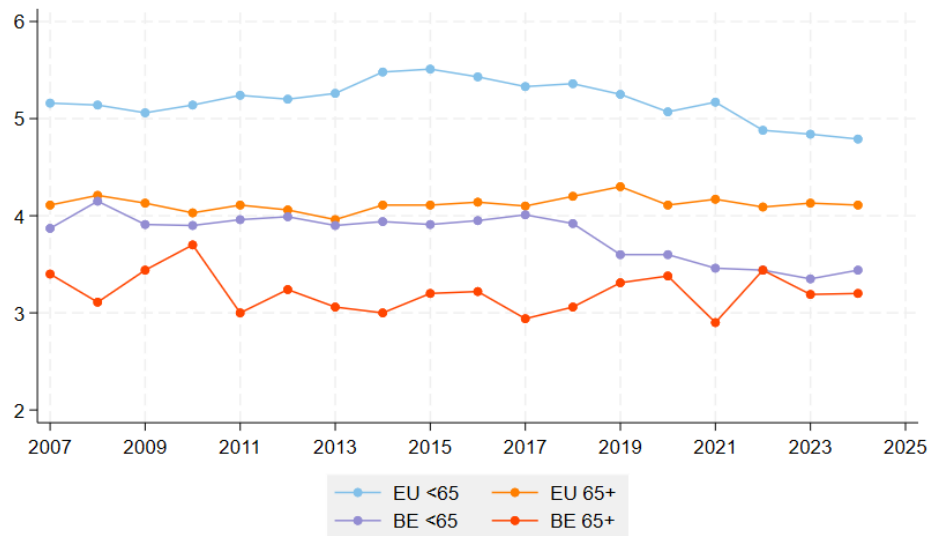
Indeed, Belgium performs better than the EU average in terms of income inequality among retirees, with the highest-income quintile of people aged 65 or over receiving an income about three times higher than the lowest-income quintile in 2024. For the EU as a whole, this ratio lies at around 4. However, when it comes to the adequacy of pensions, Belgium falls below the EU average. The aggregate replacement ratio, which measures the ability to maintain pre-retirement earnings after retirement, remains lower than in many other EU countries (SPC and DG EMPL, 2021). This indicates that Belgium's pension system, while effective at reducing inequality, offers less capacity to preserve income levels in retirement compared to the EU average.

Figure 1.1 presents the evolution of income inequality among those aged 65+ and the working-age population in Belgium and the EU using the income quintile share ratio³ as a measure. It shows that income inequality among older adults in Belgium has fluctuated over time, particularly between 2008-2012 and 2020-2023. However, no clear long-term trend can be observed. In contrast, the EU average displays a more stable trend. Moreover, inequality among the older population in Belgium was initially lower than among the working-age population, but recent trends reveal a shift. While inequality among the working-age population has shown a steady decrease in recent years, inequality among older adults has remained volatile, moving in both directions. As a result, by 2022 the inequality levels of the two age groups had converged and are now broadly similar.

While the different economic crises mentioned could explain some of the fluctuations in income inequality among Belgium's older population, other factors such as the various reforms implemented in the social se-

³The income quintile share ratio (S80/S20) measures the ratio of total disposable income received by the top 20% of the population to that received by the bottom 20%. The higher the ratio, the higher the inequality.

Figure 1.1: Income quintile share ratio



Source: Eurostat (2025b).

curity system may also have contributed. Reforms in retirement systems, even if driven primarily by concerns of financial sustainability or efficiency, often entail redistributive effects, as different groups experience them or respond to them in distinct ways. Such reforms influence both the benefits available to retirees and their labor market behavior, potentially affecting their retirement decisions. Such shifts in retirement patterns and income support may affect inequalities in old age in ways that may be unintended or unforeseen. Recognizing these effects is crucial for policymakers, especially in the current context of population ageing and rising life expectancy, which are driving widespread pension system adjustments.

Despite the presence of numerous redistributive mechanisms in Belgium's pension system and a lower level of income inequality among retirees, certain profiles continue to lag behind, indicating a "structural incapacity of the pension system to deal with certain life courses" (SPC and DG EMPL, 2021, p.12). In particular, women face lower pension entitlements compared to men, often due to their incomplete careers, which are frequently interrupted by caregiving responsibilities. This leaves women

more vulnerable to financial difficulties in retirement. Even though the gender pension gap is shrinking as younger cohorts of women participate more extensively in the labor market, the gap persists. The subject has gained significant attention in recent years⁴, highlighting these disparities in retirement benefits between men and women.

Public pension systems influence far more than income in old age. By shaping financial security, they also affect key non-monetary dimensions of later life, including health outcomes and social inclusion. These dimensions are crucial as well when discussing decent ageing, as wellbeing encompasses more than income alone and includes a broader set of factors that determine quality of life. In Belgium, inequalities in overall wellbeing⁵ are larger than inequalities in income, largely reflecting substantial disparities in health (Decancq and Panagamuwa Gamage, 2024). The design of pension systems – and reforms to them – can have important implications for these broader dimensions of wellbeing, particularly for health. Adequate and stable pension income can reduce financial stress, enable access to healthcare and nutritious living conditions, and support active participation in social and community life. Moreover, the pension system directly shapes the timing and intensity of individuals’ work trajectories by setting the legal retirement age and eligibility conditions for retirement; it therefore affects older individuals’ health beyond its indirect effects via income. Through these channels, pension systems play a central role not only in economic security but also in structuring health inequalities and shaping the overall wellbeing and quality of life of older individuals. Taking these broader impacts into account is essential for understanding the full consequences of pension policies in Belgium.

⁴MIGAPE (Mind the Gap in Pensions) is an international research initiative supported by the European Union’s Rights, Equality and Citizenship Programme, with the goal of enhancing the understanding of the gender pension gap. In 2024, it was also a central issue during Belgium’s Presidency of the EU.

⁵The authors measure wellbeing using five dimensions: income, health, unemployment, and perceptions of crime and pollution. Their analysis is conducted on the general Belgian population and does not specifically focus on older individuals.

It is evident that the issue of disparities in retirement is particularly relevant today, in a context of growing awareness of inequalities and demographic changes, which have prompted ongoing pension reforms with distributional consequences. This highlights the need for a closer examination of the relationship between pension system design and income inequality in later life, in order to understand how policy choices shape outcomes for different groups of retirees.

1.2 Thesis outline

The objective of this thesis is to analyze the Belgian public pension system in relation to inequality. Pension systems worldwide vary in how pensions are calculated, including the extent and nature of redistributive features included to mitigate inequality and provide a more adequate pension for everyone. Given that Belgium implements numerous redistributive mechanisms, it presents an interesting case study to explore how specific elements within the pension system contribute to redistribution. In addition to examining the current system, this thesis also explores the effects of past reforms and the impact of potential future reforms on inequality. Furthermore, this thesis also touches upon the issue of health inequalities among retirees as well as the rise in the use of disability insurance to exit the labor market. Through this examination, the aim is to gain a deeper understanding of the impact of the social security system on inequality at old age.

Chapter 1 comprises the general introduction.

Chapter 2 lays the foundation for the present work by providing an overview of the Belgian social security system applied to wage-earners that is relevant for the study of retirement. It introduces the regulations of the

current system with a focus on the redistributive aspects, and the evolution of the system over time since the early 2000s. For this, the four main exit pathways into retirement are considered: exit via the old-age pension program, the conventional early retirement program, the unemployment insurance program and the disability insurance program. Additionally, a distinction is made between individual and derived pension rights. This is particularly important when addressing the issue of gender inequality. Even though the present work focuses on wage-earners, the key components of the social security system applied to self-employed and civil servants is outlined as well and compared to the functioning of the system for wage-earners, in order to provide a more complete outline of the Belgian social security landscape. Since inequality and pension adequacy is the central theme of this work, the social assistance program dedicated to the older population – the GRAPA – is also addressed. By outlining these essential elements, this chapter equips the reader with the necessary understanding to follow the analyses presented in the subsequent chapters.

Chapter 3 examines the past, aiming to extract valuable lessons by exploring the effect of past social security reforms on income inequality in old age. For this, two separate effects are distinguished: 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. Moreover, differentiated mortality rates are considered for different social classes, showing the importance of these variations in life expectancy when analyzing inequality. This retrospective analysis offers valuable insights into how past decisions and policies have shaped current disparities. The conclusions drawn remain relevant for shaping effective policies that tackle inequalities and promote a more equal future.

Chapter 4 focuses on the current system and studies the gender dimension. The purpose of this chapter is to analyze how the various redistributive corrections implemented in the Belgian public pension system impact gender inequality, a well-known issue that receives increasing attention. This chapter provides understanding in how the public pension system helps reduce income inequalities that arise in both the labor market and the private sphere prior to retirement. Moreover, special emphasis is placed on the variability of the gender pension gap depending on the assumptions made regarding the attribution of the household supplement as well as the income concept used for the calculation. The gender pension gap is a complex phenomenon that depends heavily on assumptions. A comprehensive analysis and sensitivity check of different assumptions is therefore crucial in order to obtain a more accurate picture of gender inequality in the Belgian pension system, which this chapter provides.

Chapter 5 attempts to improve pension adequacy and inequality in old age without placing an additional burden on the economy. It analyzes the impact of three potential reforms on different measures of inequality and adequacy, while keeping pension expenditure fixed. Furthermore, the effect is examined by marital status and gender to analyze whether the reforms support individuals that are considered as more vulnerable in the current system. This forward-looking approach seeks to identify strategies that could enhance the social security system, aiming to improve equality and provide better support for the vulnerable.

Chapter 6 sets the focus on health inequalities among Belgian retirees. Past pension reforms, which centered on raising the legal retirement age while scaling back the system's overall generosity, may have had unequal health effects on poorer individuals compared to their richer counterparts, thereby raising concerns about widening health inequalities. Using three complementary descriptive approaches, this chapter looks at the

trends in socio-economic health disparities over the last 20 years and provides an exploratory perspective on their potential alignment with broader pension policy developments.

Chapter 7 investigates the growing use of the disability insurance (DI) as a pathway into retirement and assesses the extent to which past social security reforms have contributed to this development. Given that the increase in DI exits is substantially more pronounced among women than among men, a central objective of the chapter is to shed light on the underlying gender differences and to explore the broader question of whether men and women may differ in their responses to social security reforms. The analysis employs regression analysis alongside a Fairlie decomposition, in order to quantify how much of the observed gender gap and the sharp rise in DI exits over time among women can be attributed to observable characteristics.

Chapter 8 summarizes the main findings of this study, discusses certain limitations and suggests potential avenues for future research.

Note that this thesis focuses on the first pillar of the pension system – public pensions – while setting aside the second and third pillars, namely occupational and private pensions. This choice is motivated by an interest in understanding how the government seeks to mitigate cumulative lifetime disparities through the public pension system and in gaining a deeper insight into the role of social security in shaping inequality in old age. Focusing on the first pillar, however, provides only a partial picture of inequality in later life, as it excludes other retirement income sources as well as disparities in wealth and income from capital.

Concentrating solely on public pensions carries the risk of underestimating overall inequality. In Belgium, wealth is far more concentrated than income, leading to a markedly unequal distribution of capital income

(OECD, 2024; Kuypers, 2024; De Mulder et al., 2024). Occupational and private pensions are unevenly spread across sectors, income groups, and gender, contributing to higher overall inequality in retirement income (INASTI, 2023; OECD, 2025). In this sense, the dissertation captures the more redistributive component of old-age income provision while leaving out the most unequal ones. Nonetheless, public pensions remain the primary source of income for retirees in Belgium (OECD, 2019), meaning the analysis still addresses the most significant element of income in retirement. These considerations are important to keep in mind throughout this thesis.

Chapter 2

Institutional Context

2.1 Introduction

This chapter provides an overview of the social security system in Belgium, focusing on aspects relevant to the study of retirement, and equips the reader with the necessary background for the analyses that follow.

The Belgian pension system distinguishes between three main schemes: those for wage-earners, the self-employed and civil servants¹. Since the focus of this thesis is on wage-earners, the discussion in this chapter will primarily center on that system. Section 2.2 covers this and places a particular emphasis on the redistributive features of the system, while also providing an overview of the main reforms². For the sake of completeness, the other two schemes will be briefly discussed in Section 2.3, with particular attention to the main differences compared to the wage-earners' system. Given that the theme of this thesis concerns inequality and pension adequacy, Section 2.4 introduces the GRAPA, a social assistance program aimed at supporting the older population.

Before delving into the details of the functioning of the pension system, it is important to acknowledge the role of social partners in shaping pension policy and reforms, as they constitute a key feature of the Belgian system's governance and evolution. Belgian pension policy is not determined solely through legislative action but is deeply embedded in a framework of corporatist negotiation, where trade unions and employer organizations play a central role in shaping reforms. This results in a pattern of negotiated reform, where major policy changes are rarely imposed unilaterally but instead reflect compromises between competing interests,

¹The wage-earner pension scheme is the largest one. It follows the self-employed scheme and then the civil servant scheme. In 2025, 54% of pensioners receive a pension from the wage-earner scheme; 20% from both the wage-earner and self-employed scheme; 12% from both the wage-earner and civil servant scheme; 8% from the civil servant scheme; 4% from the self-employed scheme; and 2% from all three schemes. (Pensionstat, 2025).

²For a detailed presentation of reforms in the last decades in Belgium, see Fraikin et al. (2021) and Fraikin et al. (2025).

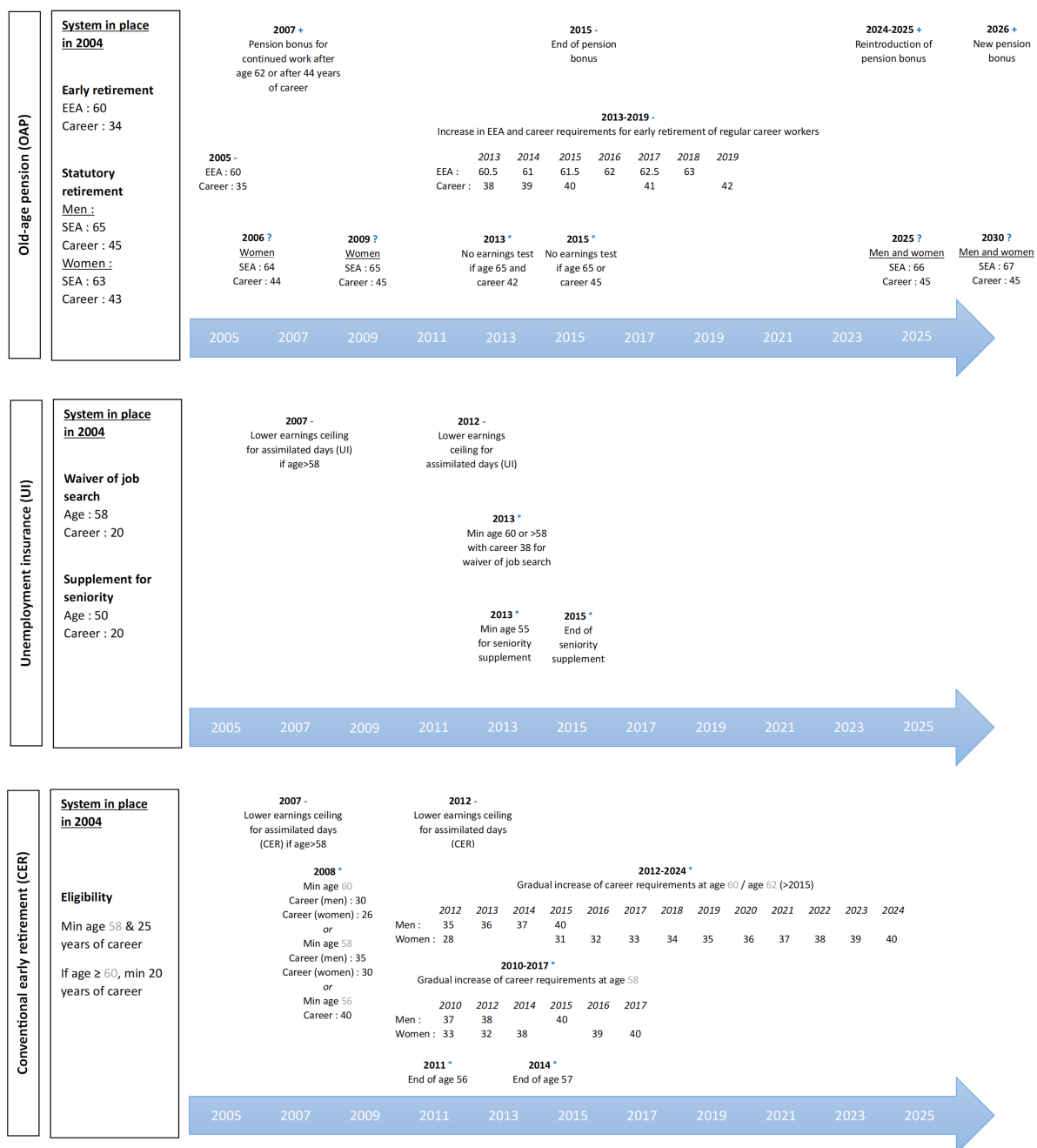
most notably the tension between budgetary pressures and social protection objectives. This institutional setting helps explain the gradual and incremental pace of pension reforms in Belgium, as well as their direction.

2.2 Structure, redistribution, and reforms in the Belgian public pension system for wage-earners

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). The following sections outline each of those exit routes as applicable in 2025 and reviews the reforms introduced in the various systems since 2005, with a focus on their redistributive features. Figure 2.1 summarizes this information and presents the timeline of reforms implemented in each of these systems.

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. (2021), 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 the data used for this thesis does not allow a more accurate reflection of preferential rules, the headline system is used as an approximation. This should be kept in mind when examining the analyses in the subsequent chapters.

Figure 2.1: Timing of reforms



Source: Author's compilation based on Fraikin et al. (2025).

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.

2.2.1 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 from 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. A worker can earn individual pension rights based on his/her own career and derived pension rights which originate from the (ex-)spouse's career. In the following, both types of pension rights are outlined.

Individual pension rights

The pension amount is based 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, certain periods of inactivity are assimilated to working periods and are credited at the last real wage in the pension calculation even though no contributions are paid during these spells. This concerns periods on replacement income such as for involuntary unemployment, conventional early retirement, illness and disability, work accidents and occupational illnesses, maternity and paternity leave, career breaks due to parental leave, palliative care, medical assistance and family care. Periods of absence from work without replacement income are not considered in the pension calculation³.

³However, in certain circumstances, they are still taken into account when determining if the person is eligible for early retirement, as it is the case for interruptions to raise a child under the age of 6.

Second, a higher replacement rate of 75% is applied in certain circumstances. This is the case if the individual has a dependent⁴ 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 and is 25% higher than the normal replacement rate (75% instead of 60%). But it is subject to an earnings test of the spouse. The spouse's pension may not exceed the difference between the individual's retirement pension at the household rate and the pension at the single rate. In case of benefits lower than this difference, the spouse's pension is deducted from the individual's pension calculated using the household rate. Being legally married is a prerequisite; simply cohabiting, even if legally recognized, does not entitle a retiree to the household rate.

Third, for past earnings, there are (indexed) floors⁵ and ceilings⁶ 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 adapted 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 pension⁷ that is applied if certain

⁴When referring to a dependent spouse, it indicates an individual with minimal or nonexistent lifetime earnings, resulting in limited or no pension entitlements accrued independently. Despite this, the person may have been engaged in unpaid work or sporadic paid employment, including during the partner's pension collection period.

⁵The earnings floor is only applied if a person proves a minimum career of 15 years as wage-earner with an intensity of at least 104 full-time days per year. As of 01/02/2025, it amounts to EUR 32764.09.

⁶For earnings in 2025, the normal ceiling is set to EUR 82608.94. Since 2007 a lower ceiling is applied to certain assimilated periods which amounts to EUR 74513.68 in 2025. The “minimum” ceiling exists since 2012 and is applied to long-term unemployment periods and time spent in CER. It is equal to EUR 32764.09 in 2025.

⁷In 2025 the minimum pension amounts to EUR 21705.29 for a full career. If the pensioner has a dependent spouse, the amount increases to EUR 27123.07. To be eligible for the minimum pension, the worker has to prove a career as wage-earner and/or self-employed that amounts to at least 2/3 of a full career, with each year containing at least 208 working days. Moreover, since 2025, the worker needs to have actually worked 5000 days over the course of her/his entire career, no matter under which employment status. Special rules apply to part-time workers and mixed careers.

career conditions are met. It is indexed using the CPI and further adapted to the career fraction. Occasional increases have allowed the minimum pension to grow faster than the average pension, leading more and more towards a flat-rate benefit.

Past earnings and the pension benefits are both indexed using the health index. Since the health index is in fact a slowed-down version of the CPI, this leads to a double loss for the pensioners. For past earnings, longer careers are penalized as the health index fails to mirror real wage growth. For pensions in payment, pensioners are not entirely shielded against inflation either. In addition to automatic indexation, pensions in payment may be further increased through the welfare envelope⁸.

The statutory eligibility age (SEA) is currently 66 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 January 1 2000, 2003, 2006, and 2009) – aligning it with the system for men⁹. The SEA then rose to 66 in 2025 and is scheduled to reach 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

⁸The welfare envelope (*enveloppe bien-être* / *welvaartsenveloppe*) is a budgetary mechanism allowing for periodic increases in social benefits, including pensions, beyond automatic indexation. This is done to ensure that income-replacement benefits evolve in line with general prosperity and do not lag behind wage developments (Moscufo, 2026). It is allocated within the framework of social concertation between the government and the social partners, meaning that trade unions and employer organisations play a central role in determining its distribution and use. As such, it reflects the embedded role of social partners in shaping the level and evolution of pension generosity in Belgium.

⁹With 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.

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. Because the pension calculation uses the most advantageous career years, low-earning years are effectively replaced by higher-earning ones. 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. Since 2024, a revised bonus is reinstated, which is replaced as of 2026.

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.

Derived pension rights

Next to individual pension rights, an individual can have derived pension rights which originate from the ex-spouse's or the deceased spouse's career.

First, the divorcee's pension is a benefit calculated using the ex-spouse's income earned during the marriage. The calculation method is the same as for the individual pension benefit except that only 62.50% of the ex-spouse's earnings are taken into account. Moreover, the own

earnings during this time are deducted from this amount. Once a person is eligible for the old-age pension, he/she has the right to get the divorcee's pension if a series of conditions¹⁰ are met.

Second, the survivor's pension is paid to a person after the death of his/her spouse. It compensates for the loss of economies of scale when sharing costs in a household and amounts to 80% of the deceased spouse's pension calculated using the household rate. If the deceased spouse was not retired yet, the pension is calculated based on the spouse's career applying the usual rules taking into account the career incompleteness because of premature death. If the spouse's career fulfills the conditions for being eligible for the minimum pension, the survivor's pension is calculated on that basis if it is more advantageous. To receive a survivor's pension, certain conditions need to be met: there is a minimum age which is equal to 50 in 2025. Moreover, the couple needs to have been married for at least 1 year¹¹. Once the surviving partner remarries, the survivor's pension is suspended. If the widow or widower does not fulfill the minimum age but all other conditions, a transition allocation is paid which is limited in time. Since 2021, the duration of those payments lies between 18 and 48 months and depends on the number of children and their age. The amount is calculated in the same way as the survivor's pension¹².

The higher replacement rate of 75% is not considered a derived pension right because it is attributed to the individual on whose career the calculation is based, and not to the spouse without (or with small) pension entitlements. However, the provision is meant to be shared between

¹⁰The person must not have been deprived of parental authority, must not have been convicted of attempting to take the life of the ex-spouse and must not be remarried, unless the new marriage was dissolved following death or divorce.

¹¹If the couple was married but not for a full year, the surviving partner might still be entitled to a survivor's pension if the situation before marriage is considered as similar to marriage. This is the case if the couple was legally cohabiting for a certain time before the marriage or had children.

¹²However, the cumulation rules with other earnings are different for the survivor's pension and the transition allocation. In case of the survivor's pension, other earnings need to be limited to a certain extent, otherwise the survivor's pension is reduced. This is not the case for the transition allocation.

spouses to offer a more adequate pension to the whole household. Hence a person benefits (or is supposed to benefit) from the spouse's pension entitlements even though nothing is formally attributed to them.

2.2.2 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. The first year is considered as the 1st period of unemployment. In the first 3 months, the replacement rate is equal to 65%, with earnings capped. Thereafter, until the 6th month, the replacement rate is lowered to 60%, with the same cap still applying. From month 7 till 12, the replacement rate remains at 60% of the wage but the cap is lowered by an amount corresponding to approximately 7%. 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 benefit from a (lower) benefit that is no longer earnings-linked, but still depends on the family situation¹³.

¹³The floor on monthly earnings is of EUR 2111.89 in 2025. During the 1st period of unemployment in months 1-6 the cap is of EUR 3432.38 per month, and for months 7-12 it is EUR 3199.04. In the 2nd period of unemployment, the cap is of EUR 2989.43 for cohabitants and of EUR 2924.37 for singles, all numbers for 2025.

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.

2.2.3 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 2877.46 in 2025. 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 further increase. In 2025, individuals are eligible at age 62 with a minimum career of 40 years for both men and 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.

2.2.4 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 at which the status “unable to work” is validated or withdrawn.

Disability insurance distinguishes between two phases : 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 may be eligible to enter the disability status for a fixed or open-ended term. Those 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 is 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.

2.3 Other pension regimes in Belgium: Self-employed and civil servants

2.3.1 Self-employed

In broad terms, the self-employed pension is calculated similarly to the wage-earner pension: the yearly pension benefit is equal to 60% of the average yearly gross income over the best 45 years of the self-employed career.

Similar to the wage-earner pension, there are redistributive corrections implemented in the system that render the system more progressive. Periods spent on replacement incomes are assimilated to working periods and are credited in the pension calculation. The higher replacement rate of 75% is applied in case of a dependent spouse. Past earnings are subject to a floor¹⁴ and ceiling¹⁵. A minimum pension¹⁶ is paid out if it is more advantageous than the pension based on the own income. Since 2025, a lumpsum bonus is reintroduced and paid out if a self-employed continues working even though he reached an age at which he is no longer required to do so. It is abolished as of 2026.

As it is the case for the wage-earner pension scheme, past earnings are indexed using the health index, resulting in early career years being less valued. The SEA is also at 66 years and early retirement is possible to the same conditions as in the wage-earner pension scheme.

¹⁴Contrary to the wage-earner system, there is no eligibility condition for the application of the floor. Self-employed pay each year contributions on a minimum income, even if they earn less. Therefore, the earnings floor is applied in any case. In 2025, it amounts to EUR 17008.88.

¹⁵In 2025, this ceiling is equal to EUR 77498.93.

¹⁶As for wage-earners, self-employed need to prove a total career of at least 30 years (2/3 of a full career) in order to be eligible for the minimum pension. In 2025, it equals EUR 21705.29 in case of a single rate and EUR 27123.07 for a household rate, both for a full career. This amount is adapted to the career fraction as self-employed.

However, slight deviations from the wage-earner pension scheme exist: Past earnings are multiplied by a coefficient that accounts for the differences in contribution rates of self-employed compared to wage-earners (both employee and employer contribution). Due to lower contributions into the social security fund, a certain income as self-employed leads to a lower pension than the same income as wage-earner¹⁷.

2.3.2 Civil servants

The calculation of the civil servant pension differs more substantially¹⁸, leading in general to higher pension payouts compared to the other two regimes. It is equal to the reference salary multiplied by the number of eligible service periods and the career fraction. In contrast to the other two schemes, the reference salary is determined exclusively on the basis of the last 10 career years, or, if the career as a civil servant is shorter, on the entire duration of service.

Eligible service periods primarily comprise time spent as a statutory civil servant. In certain cases, contractual and temporary services may also be taken into account. Compulsory military service is included in the calculation. Similar to the other schemes, specific periods of inactivity are assimilated to active service considered in the pension calculation. These include periods of absence with continued remuneration, periods of

¹⁷Until 1996, this coefficient was equal to the ratio between the contribution rate for the self-employed pension scheme and the total contribution rates (both employee and employer) for wage-earners. Since 1997, this coefficient has been fixed with adaptations along the years. For the years 2019-2020, it was fixed at 0.691542 and since then it has been changed to 1, so that it has practically no effect anymore.

¹⁸Recent reform projects aim to align the civil servant system more closely with the other regimes. Most of the changes are planned to take effect in 2027, with a few exceptions scheduled to come into force already in 2026. For example, the number of career years used to calculate the reference salary is planned to increase one year each year until 45 career years are reached. The favorable career fractions are expected to be no longer applied, and only the 1/60 career fraction will be used. The coefficient applied to career years to determine retirement eligibility is set to be 1. It is planned to raise the legal retirement age for preferential categories. Furthermore, the equalization (*péréquation*) of civil servant pensions is planned to be abolished. The agreement of the reform still needs to be discussed with social partners, be definitely approved by the Council of Ministers and be debated and voted on in Parliament.

availability provided that a waiting allowance was received, full or partial career breaks, part-time employment and other similar arrangements.

The career fraction, or *tantième*, is the portion of the reference salary that is taken into account for the pension calculation for each year worked as a civil servant. It is generally equal to $1/60$, allowing to reach a full pension after 45 service years. In specific cases, legislation provides a more favorable fraction, because certain positions are considered as more demanding (e.g., customs officers) or because it is not possible to achieve a full pension based on the standard career fraction (e.g., judges). A career fraction of, for example, $1/55$ is applied to non-university teaching staff, $1/50$ to active-duty personnel in the customs service, members of the operational cadre of the integrated police, and firefighters, and $1/48$ to operational staff of the Belgian Railways¹⁹. In certain cases, career years prior to 2012 are calculated with career fractions ranging from $1/35$ to $1/12$. However, for career years after 2012, this is no longer possible, and such cases are calculated at $1/48$.

Civil servant pensions are subject to two maxima. The relative maximum is equal to $3/4$ of the reference salary, although the amount is adjusted according to the completeness of the career. The absolute maximum is equal to EUR 99499.24 gross in 2025 and may not be exceeded, even if the pension is drawn from different schemes. Consistent with the other schemes, a minimum pension is applied if certain conditions are met²⁰. The amount depends on the marital status of the pensioner²¹ and is adjusted to the career length.

¹⁹This list is not exhaustive and is provided as an example. There are other services that may also be granted a favorable career fraction.

²⁰The individual needs to be a statutory civil servant at the time the pension is taken and he/she needs to be at least 60 years old and have at least 20 years of eligible service. Moreover, a career of at least 189 month during which it was actually worked is required.

²¹In 2025, the annual minimum pension amounts to EUR 21702.60 gross for singles and EUR 27127.20 if the pensioner is married.

The civil servant pension follows the evolution of active civil servants' salaries. This adjustment – called equalization (*péréquation*) – is done every two years and is carried out on the basis of baskets. Each pension is linked to the basket corresponding to the sector in which the civil servant ended their career, and all pensions within the same basket are automatically increased by a specific percentage. This percentage is determined based on increases in salary scales maximums, certain salary supplements, the holiday allowance and the end-of-year bonus in that sector²².

Consistent with the other regimes, the SEA for civil servants is also at 66 years, with exceptions for certain categories such as members of the military who have a lower legal retirement age. Early retirement is possible to the same conditions as in the wage-earner pension scheme. However, if the civil servant is entitled to a more favorable career fraction, their actual career is multiplied by a coefficient which is currently 1.05, making it easier to meet the conditions for early retirement.

2.4 Social assistance for the older population : GRAPA

Next to the old-age pension system, a social assistance program (GRAPA²³ for *Garantie de Revenus aux Personnes Agées*) provides a financial aid to people older than the SEA whose “resources” are below a certain threshold, with the meaning of “resources” determined through an elaborate asset and income test. In 2025, this threshold is equal to EUR 18964.44 per year for people living alone and EUR 12642.96 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

²²In total, there are 16 different baskets. These include among others the Federal Authority, the integrated police, the Belgian Railways, Education of the Flemish Community.

²³The Belgian social assistance program for older individuals is referred to as GRAPA (*Garantie de Revenus aux Personnes Agées*) in French and as IGO (*Inkomensgarantie voor Ouderen*) in Dutch. Throughout this thesis, the term GRAPA is used for consistency.

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 the SEA²⁴. Moreover, individuals must 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 2025, they would have been equal to EUR 12002.66 per year for an individual living alone and EUR 8001.77 per year for an individual living with other people.

When examining the analyses in the subsequent chapters, a word of caution applies regarding the eligibility conditions for the GRAPA. Where some essential data for determining eligibility are not available, simplified rules are applied.

²⁴The GRAPA follows the logic of social assistance, as it is means-tested and residency-based, in contrast to the OAP minimum pension, which is based on insurance-principles and therefore contribution-based.

Chapter 3

Past Social Security Reforms and Inequality in Old Age¹

Abstract

This chapter explores the effect of past reforms in the Belgian social security system 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 decile. Behavioral changes had a positive but orders of magnitude smaller effect. Overall, inequality decreased as a result of reforms.

¹This chapter is co-authored with Alain Joustien and Mathieu Lefebvre. It stems from the International Social Security (ISS) project of the NBER, which compares the experiences of several developed countries to study social security programs and retirement around the world. The chapter will be published as “Social Security and Inequality in Belgium” in *Social Security Programs and Retirement Around the World: The Effects of Pension Reforms on the Income Distribution of Retirees*, edited by Axel Börsch-Supan and Courtney Coile. Chicago, IL: University of Chicago Press.

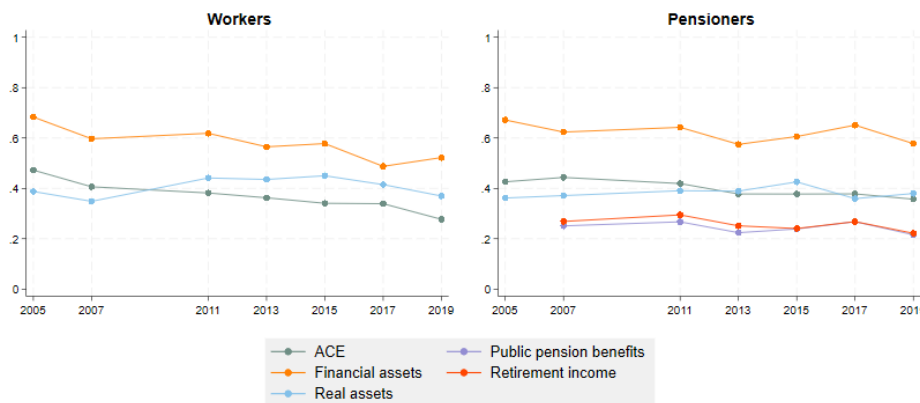
3.1 Introduction

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 older population in Belgium (see e.g., Pestieau and Stijns 1999; Dellis et al. 2004; Jousten and Lefebvre 2013, 2019; Fraikin et al. 2021, 2025). 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 3.1 presents the evolution of the Gini coefficient of various variables of Belgian workers and pensioners aged 55-64. Inequality is highest in financial assets, followed by labor income (ACE²) and real assets. Over time, both groups show similar patterns, but inequality in financial assets and ACE tend to decline more among workers. 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.

²Labor income is represented by the average career earnings (ACE). They are calculated by dividing the total earnings up to age 54 by the number of career years up to age 54.

Figure 3.1: 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.

This chapter 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). We restrict our attention to wage-earners aged 55-65 over the period 2005-2019 and 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 3.2 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 3.3 proceeds with the estimation of retirement probabilities needed for our analysis. In Section 3.4 we show the results of our counterfactual analysis to capture the effect of the reforms on inequality. Section 3.5 concludes.

3.2 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 ($ITAX$).

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

3.2.1 Data and sample

The analysis relies on the Belgian data from SHARE (Survey of Health, Ageing and Retirement in Europe). SHARE is a cross-national panel dataset that provides approximately 380,000 in-depth interviews with 140,000 people aged 50 or older from 28 European countries and Israel. Implemented every two years since 2004/2005, the questions 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 information³.

The analysis covers the years 2005-2019 and focuses on individuals that are about to leave the labor market. We select workers born between 1941 and 1964, yielding a sample of individuals aged 55-65 in the period of observation. 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. Table 3.1 shows some descriptive statistics of the sample.

Table 3.1: Summary statistics of sample, working wage-earners aged 55-65

	Total	Men	Women
Number of			
Observations	5875	3113	2762
Individuals	1422	756	666
Demographics			
Marital status			
married	56%	61%	52%
unmarried	44%	39%	48%
Employment			
Average years of career	37	38	35
Average ACE at age 54 (in 2025 EUR)	70359	84656	54246

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.

³Appendix A.1 offers a more detailed description of the career construction process.

3.2.2 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 earnings⁴. To validate our benefit calculations, pension entitlements are calculated and compared to the stated pension benefit in the SHARE dataset⁵. Figure 3.2 shows the distribution of the pension benefits declared in SHARE and the ones calculated with our simulation tool⁶. On average, we calculate a yearly net pension benefit of

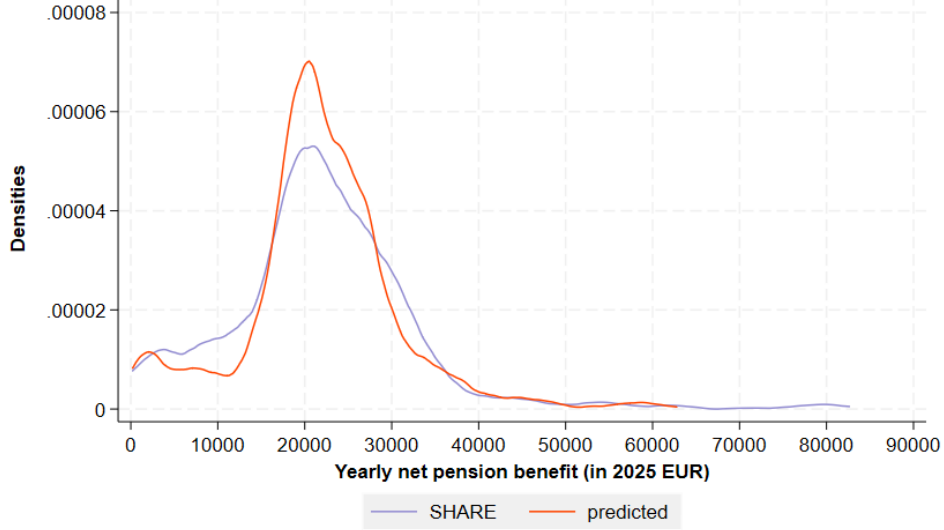
⁴Appendix A.1 offers a more detailed description of the calculation of pension benefits.

⁵SHARE 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.

⁶To end up with more observations, the validation of the calculator was done not exclusively for

EUR 21815 while respondents declare a yearly net pension benefit of EUR 21926 (expressed in 2025 EUR).

Figure 3.2: Distribution of the yearly net pension benefits – SHARE and predictions



Source: Authors' calculations based on SHARE data.

3.2.3 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:

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

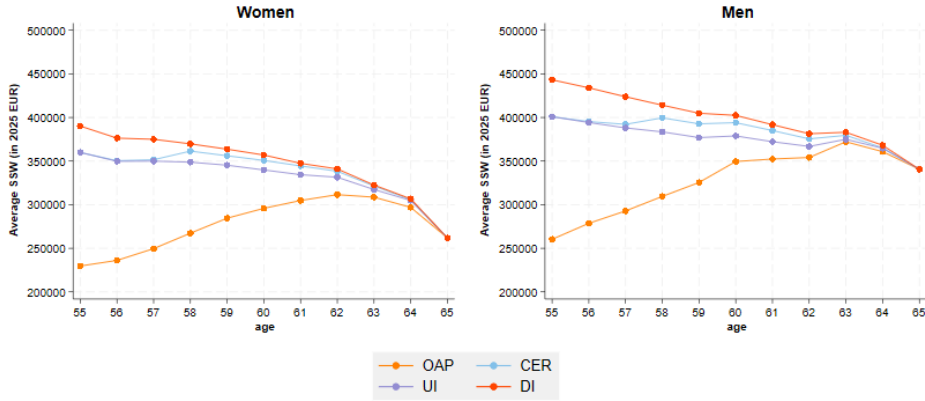
people from the sample but for all people born between 1941-1964. No matter at what age they exit the labor market or under which status. We have 915 matches.

Where $b_{k,a}$ denotes the yearly 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 which allows 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 Section 3.2.4. β^{a-R} is the time discount rate that is assumed to be equal to 3% real.

Figure 3.3 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 3.3 also shows that OAP SSW increases with exit age for lower ages for the same reason. Then as individuals reach the age range at which early retirement becomes available, SSW decreases slightly with exit 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 SSW s 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 SSW s in the four exit pathways at age 65.

Figure 3.3: Average SSW per age, exit route and gender

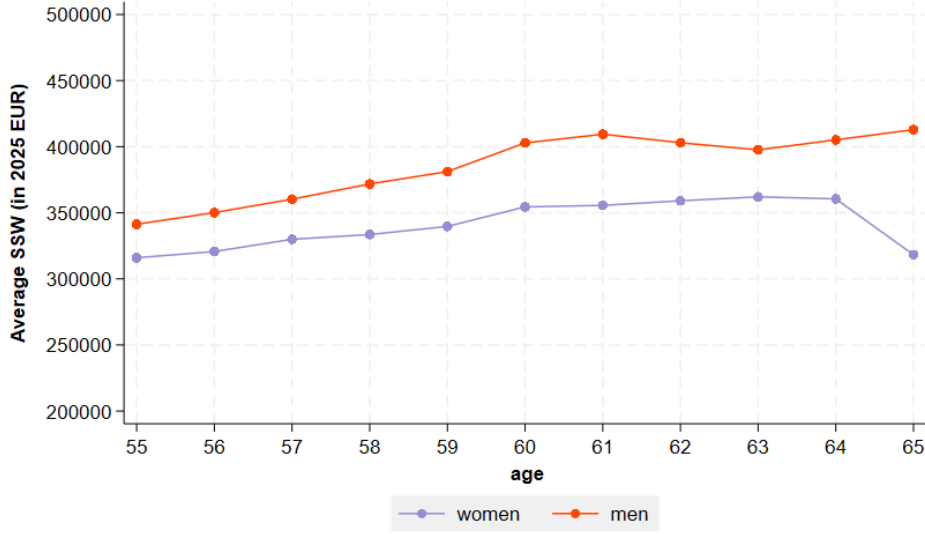


Source: Authors' calculations based on SHARE data.

Notes: 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 3.4 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 3.4: Average aggregated SSW per age and gender

Source: Authors' calculations based on SHARE data.

Notes: 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.

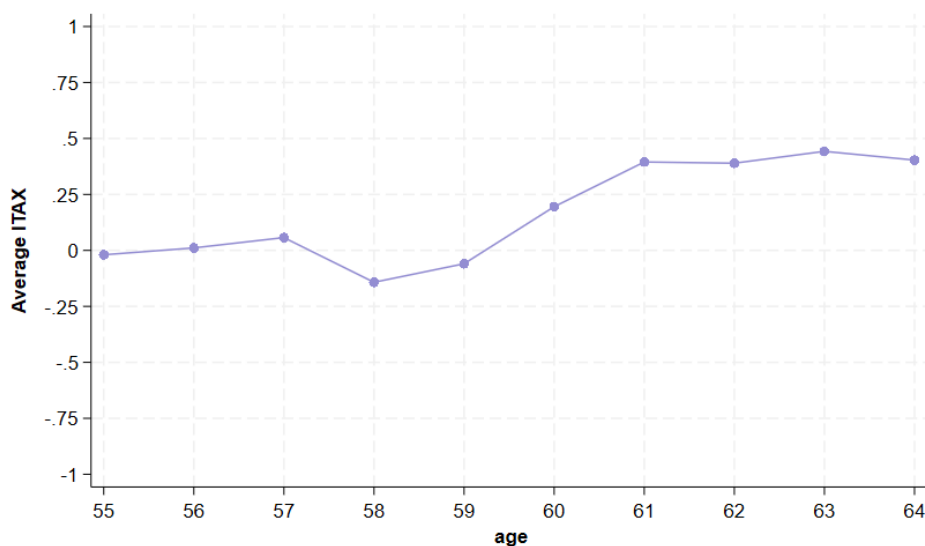
$$ACC(R, i) = SSW(R + 1, i) - SSW(R, i)$$

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 3.5 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 3.5: Average *ITAX* per age

Source: Authors' calculations based on SHARE data.

Notes: Full sample of person-year observations 2005-2019.

3.2.4 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. Accounting for these socio-economic differences in survival is an important input of our analysis of inequality at old age, as it contributes to differences in expected lifetime benefits across individuals. A well-documented mortality-earnings gradient shows that individuals with higher socio-economic status tend to live longer (OECD/European Commission, 2020; Murkin, 2017; Eggerickx et al., 2018), and therefore they receive pension benefits over a longer period. This reflects a combination of mechanisms such as differences in working conditions, access to healthcare, health knowledge, and material living conditions (Christiansen and Nielsen, 2009; Baeten et al., 2019; Berete et al., 2024). While lifestyle factors such as smoking, diet, and exercise also affect mortality and could in principle be used to condition survival rates, these behaviours are closely correlated with socio-economic

status and can be seen as one of the channels through which this gradient operates (Stringhini et al., 2010; Zhang et al., 2021). As a result, they are indirectly captured by the socio-economic differentiation used in this analysis. Moreover, in the subsequent analysis, individuals are divided into deciles of earnings, which constitute a key dimension of socio-economic status. Conditioning survival probabilities on socio-economic status is therefore consistent with the overall empirical framework.

In this section we present the data and the construction of the mortality tables that are used for this differentiation.

Data and definition of socio-economic status

To our knowledge, no income-stratified life tables covering a sufficiently long period 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 characteristics⁷. They group the Belgian population (inactive individuals included)

⁷See Eggerickx et al. (2018) for an outline 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.

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.

Table 3.2 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.

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.

Table 3.2: Life expectancy by social class and gender

	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)

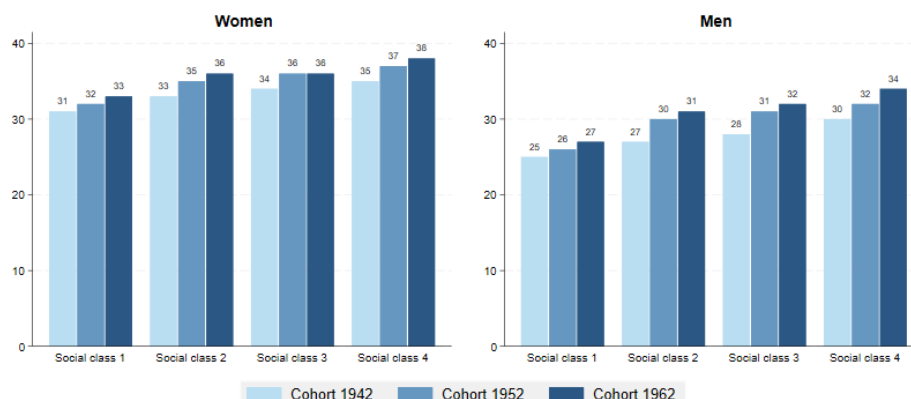
To match these mortality tables with our data from SHARE, we created a social class multidimensional score similar to Eggerickx et al. (2018) using the SHARE data and divided the Belgian SHARE population into 4 social quartiles. Each individual in SHARE can thus be associated with cohort-based mortality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

To emphasize the importance of using *cohort-based* mortality rates in the analysis, Figure 3.6 illustrates the life expectancy at age 50 for the four social classes⁸ and men and women, separately for three cohorts

⁸Social 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.

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



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

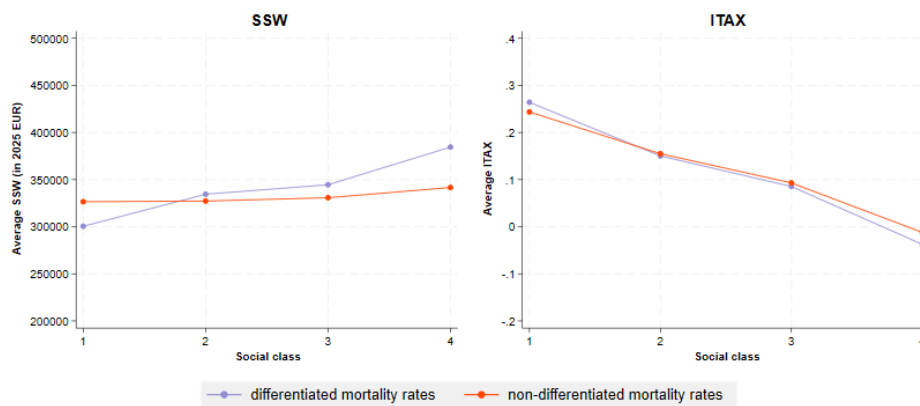
Differentiated mortality rates and incentive measures

Figure 3.7 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 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 3.7: Average aggregated *SSW* and *ITAX* per social class



Source: Authors' calculations based on SHARE data.

3.3 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 3.3 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 3.3: Regression results - labor market exit

	LPM		Fixed effects		Random effects		Probit	
ITAX	0.0068	*	0.0062	**	0.0068	*	0.0097	***
SSW / 100000	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 / 1000								
level	-0.0006	***	/		-0.0006	***	-0.0005	***
squared	0.0000	***	/		0.0000	***	0.0000	***
industry (base: manufact.)								
agric., forestry, hunting	-0.0228		-0.1050		-0.0228		-0.0236	
mining	-0.0722	*	0.1283		-0.0722	*	-0.0464	
electricity, gas	-0.0073		-0.1314		-0.0073		-0.0146	
construction	0.0241		0.0172		0.0241		0.0158	
wholesale	-0.0371	**	-0.0036		-0.0371	**	-0.0318	***
hotels	-0.0480		-0.0556		-0.0480		-0.0349	*
transport	-0.0362	*	-0.0142		-0.0362	**	-0.0288	*
financial	-0.0132		-0.0173		-0.0132		-0.0105	
real estate	-0.0539		-0.1357	**	-0.0539	**	-0.0409	
public administration	-0.0597	***	-0.0647		-0.0597	***	-0.0442	***
education	-0.0602	***	-0.0512		-0.0602	***	-0.0435	***
health	-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 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. For the Probit model, the marginal effect at the mean is presented.

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. (2025)⁹. In the fixed effect model, unobserved individual characteristics are removed (like demand for leisure and time preferences). In the other models, *SSW* might capture a positive effect on retirement because it is correlated with those unobserved characteristics.

⁹We obtain smaller coefficients for *ITAX* and *SSW* compared to what was found by Fraikin et al. (2025). The reason for this is the difference in our sample. We include younger birth cohorts who appear 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. (2025), we obtain coefficients that are larger compared to here and more similar in magnitude to what was found by Fraikin et al. (2025).

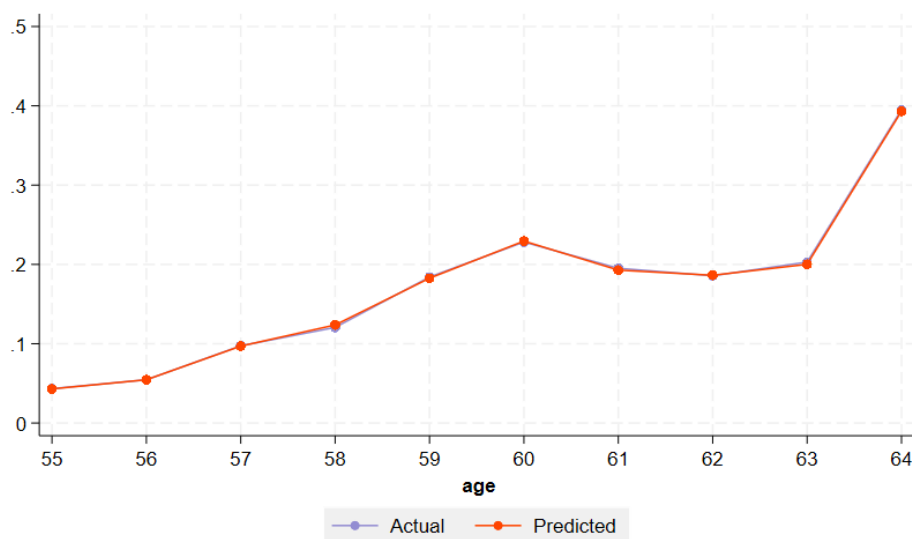
Looking at the other explanatory variables, individuals from the lowest social class have a higher probability to retire compared to the third social class. No significant difference can be found between the second and third social class. The probability to retire of the fourth social class is significantly 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. (2025) is actually due to industry differences¹⁰. Individuals that work part-time have on average a higher retirement probability in all models except in the fixed effects model. Fraikin et al. (2025) 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., 2025). 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,

¹⁰Fraikin et al. (2025) do not control for the industries but use a summarized measure of three sectors of activity.

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 3.8 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.

Figure 3.8: Instantaneous retirement probability per age – actual and predicted



Source: Authors' calculations based on SHARE data.

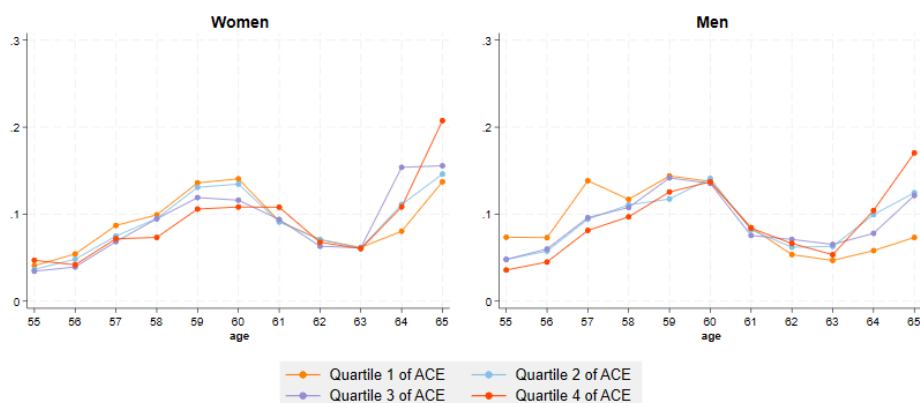
Notes: Full sample of person-year observations 2005-2019.

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/she remains in the labor market until that age - the hazard rates. 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.

Figure 3.9 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 3.9: Aggregated retirement probabilities per age, quartile of ACE and gender



Source: Authors' calculations based on SHARE data.

3.4 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.

3.4.1 Simulated reforms

Table 3.4: Reforms considered in the counterfactual analysis

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

Source: Authors.

Table 3.4 lists the reforms considered in the counterfactual analysis and their expected impact on inequality is indicated with a +/- on Figure 2.1 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.

In this analysis, we consider the full set of these pension and social security reforms as a single package, rather than simulating counterfactual scenarios for each individual reform. This approach allows us to capture the net effect of the reforms on income inequality at old age, including potential interactions across programs and measures, which would be missed if each reform were analyzed in isolation. By comparing actual outcomes with a counterfactual scenario in which the 2004 system remained in place, we provide a clear and tractable assessment of how the reform period as a whole shaped income distribution among older individuals¹¹.

3.4.2 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 sample¹². 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.

¹¹Note that the analysis estimates the effect of pension reforms in the context of realized macroeconomic conditions, including major shocks such as the financial crisis in 2008. The results therefore capture the impact of the reforms on income inequality in old age conditional on crisis-affected employment and earnings trajectories.

¹²For technical reasons, the sample changes slightly. More details are given in the Appendix A.2.

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.

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

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.

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

SSW without reforms - total effect

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

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

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.

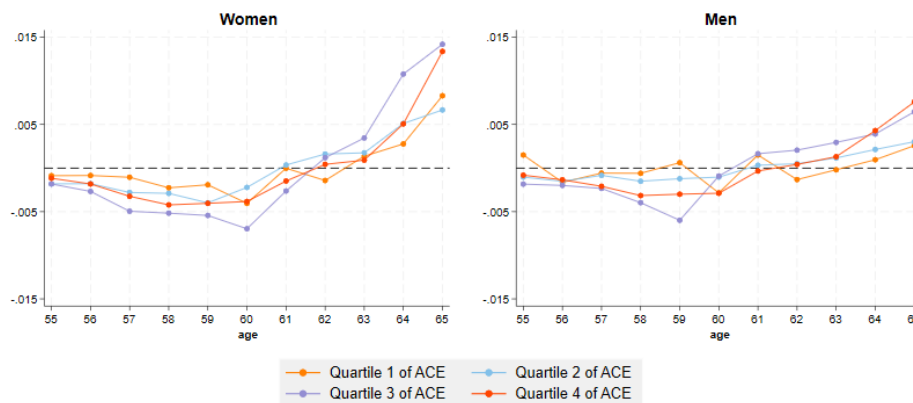
3.4.3 Results

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 3.10 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.

When comparing these results with those of previous studies analyzing the effects of both actual and hypothetical pension reforms in Belgium

Figure 3.10: Change in aggregated retirement probabilities per age, quartile of ACE and gender



Source: Authors' calculations based on SHARE data.

using similar incentive-based models, we find that the changes in retirement probabilities estimated in our analysis are smaller in magnitude¹³. Dellis et al. (2004) acknowledge that “incentive measures have only a very limited role to play in the decision on when to stop working” and they also report relatively modest variations in hazard rates in response to different hypothetical policy reforms. However, the estimated effects appear somewhat larger than those obtained in our setting. Similarly, Jousten and Lefebvre (2013) find only moderate effects of certain types of reforms on retirement age and hazard rates, while they observe larger impacts for more drastic reforms. The study most closely aligned with our approach, both in terms of methodology and sample, is Fraikin et al. (2025). Consistent with our findings, they report larger effects on hazard rates for women than for men following actual social security reforms. Nevertheless, the magnitude of their estimated effects is also larger than in our analysis. Finally, this is not surprising, given that we estimate smaller coefficients on the incentive measures in their association with the hazard rates, as briefly discussed in Section 3.3. Our analysis includes younger birth cohorts who

¹³The studies mentioned generally examine the effects of reforms on hazard rates rather than on retirement probabilities as presented here. To facilitate a comparison in terms of magnitudes, we therefore consider the changes in the estimated hazard rates induced by the reforms prior to their transformation into unconditional retirement probabilities, although these results are not reported.

appear to be less responsive to the *SSW* and *ITAX* in their retirement decisions. When restricting the sample to a population comparable to that used by Fraikin et al. (2025), we obtain larger coefficient estimates, closer in magnitude to those reported in their study, which would then also lead to stronger behavioral responses following the reforms.

In sum, while the broader literature generally does not find huge effects of reforms on hazard rates estimated using financial incentive models, our estimates are even smaller. This may be partly due to the inclusion of younger birth cohorts in our sample, who may respond differently to financial incentives when making retirement decisions.

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

To stress 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 3.2.4.) with the ones with non-differentiated mortality.

Table 3.5 presents the average *SSW* per decile of ACE for each of the three *SSW* as well as the decomposition of effects¹⁴. 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 reforms¹⁵. For the remaining deciles the opposite is true when considering the mechanical effect. It is

¹⁴Appendix A.3 illustrates the different *SSW* per decile of ACE that are presented in Table 3.5.

¹⁵Note that the analysis focuses on financial inequality, such that a higher *SSW* is generally interpreted as preferable. Later retirement, which increases *SSW*, is therefore presented as a positive outcome within this framework. However, individuals have heterogeneous preferences, and overall welfare also depends on non-financial components such as health and leisure, which may conflict with delayed retirement decisions. These considerations are beyond the scope of the present analysis.

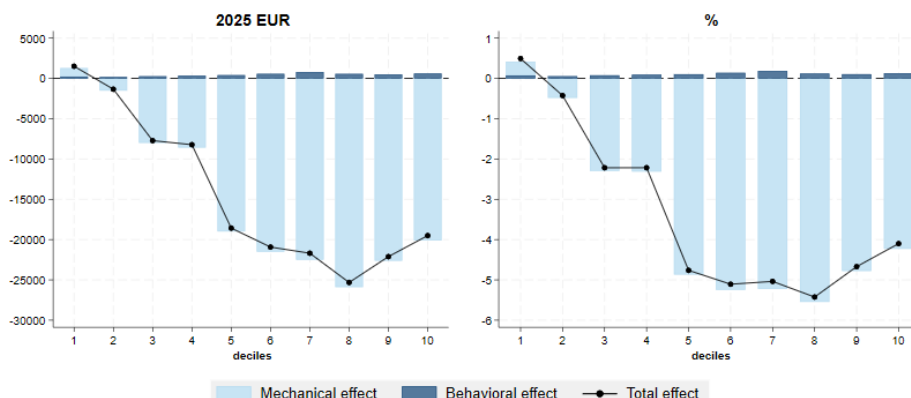
negative and they lose from the reform because of reduced benefits. But since the reforms push them to retire later, the behavioral effect is positive. However, as mentioned before, the magnitude of the behavioral effect is small and because the mechanical effect surpasses it, the upper deciles lose in total from the reforms. Figure 3.11 illustrates the average mechanical, behavioral and total effect for the different deciles, both in absolute values and relatively to the *SSW without reform – total effect*.

Table 3.5: Average *SSW* and decomposition of reform effects, by decile of ACE

Decile of ACE	SSW (2025 EUR)			Mech. effect		Behav. effect		Total effect	
	With reform	Without reform mech. effect only	Without reform total effect	EUR	%	EUR	%	EUR	%
Differentiated mortality rates									
1	308869	307585	307350	1284	0.42	235	0.08	1519	0.49
2	312854	314359	314184	-1505	-0.48	175	0.06	-1330	-0.42
3	340404	348392	348121	-7988	-2.29	271	0.08	-7717	-2.22
4	362860	371430	371080	-8570	-2.31	349	0.09	-8220	-2.22
5	371424	390408	389999	-18984	-4.87	409	0.10	-18575	-4.76
6	388871	410370	409799	-21499	-5.25	571	0.14	-20928	-5.11
7	408808	431303	430497	-22494	-5.23	806	0.19	-21688	-5.04
8	441441	467332	466766	-25891	-5.55	566	0.12	-25325	-5.43
9	451306	473924	473420	-22618	-4.78	504	0.11	-22114	-4.67
10	456166	476285	475666	-20119	-4.23	618	0.13	-19500	-4.10
Non-differentiated mortality rates									
1	301104	299863	299623	1241	0,41	239	0,08	1481	0,49
2	301158	302999	302828	-1841	-0,61	171	0,06	-1670	-0,55
3	325696	333792	333520	-8095	-2,43	272	0,08	-7823	-2,35
4	345641	354263	353904	-8623	-2,44	359	0,10	-8264	-2,34
5	347669	366738	366322	-19069	-5,21	416	0,11	-18653	-5,09
6	369388	390744	390163	-21356	-5,47	580	0,15	-20776	-5,32
7	385809	408059	407229	-22251	-5,46	830	0,20	-21421	-5,26
8	414312	439797	439217	-25485	-5,80	580	0,13	-24905	-5,67
9	415624	437845	437314	-22221	-5,08	532	0,12	-21690	-4,96
10	423008	442756	442099	-19748	-4,47	658	0,15	-19091	-4,32

Source: Authors' calculation based on SHARE data.

Figure 3.11: Decomposition of reform effects – differentiated mortality rates



Source: Authors' calculations based on SHARE data.

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 sample¹⁶. 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.

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 lead to a reduction in inequality. As Table 3.6 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.

¹⁶See Appendix A.2 for more details.

Table 3.6: 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' calculation based on SHARE data.

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 equal¹⁷. 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.

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

¹⁷The 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.

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 distribution¹⁸.

Further analysis

The analysis considers all reforms together to capture their combined impact on income inequality. It suggests that income disparities decreased over the period 2005–2019 due to the reforms. To gain a more detailed understanding, we examine the different social security systems separately to assess whether the patterns observed in the overall analysis are broadly consistent across programs or whether some systems show more pronounced differences¹⁹. This approach allows us to explore which sets of reforms may have driven the observed decrease and whether other measures may have had offsetting effects. 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.

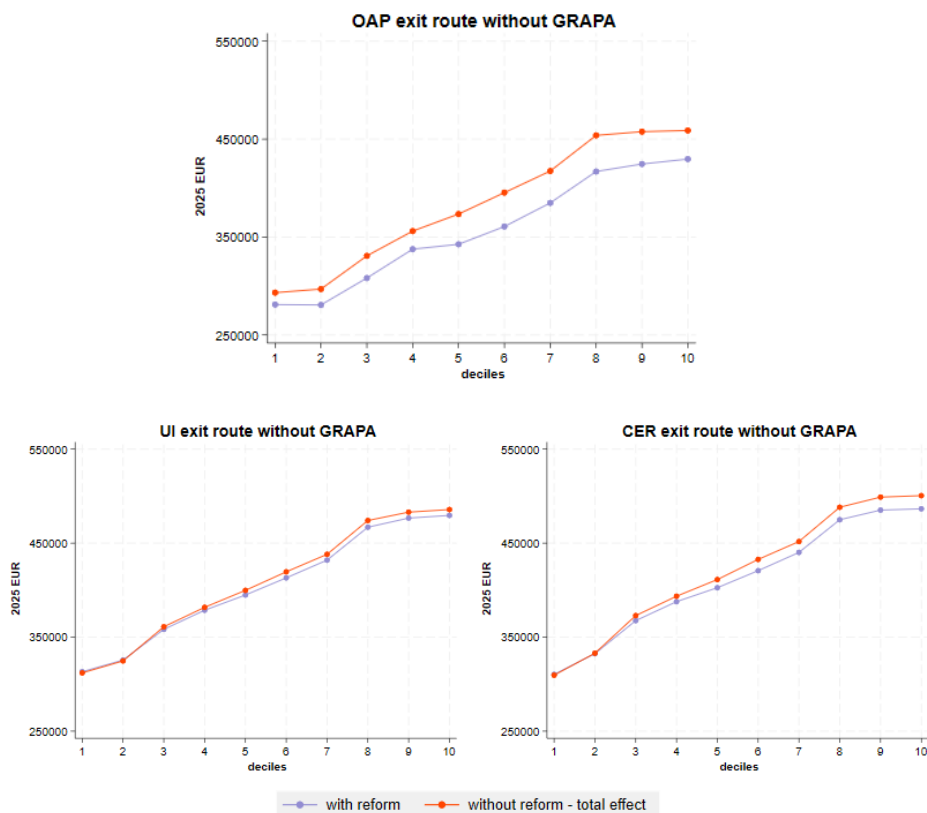
¹⁸These lower Gini coefficients of *SSW* are conceptually consistent with the Gini indicators of Figure 3.1.

¹⁹In this part we only consider differentiated mortality rates.

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.

In Figure 3.12, 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 in pension benefits when no longer meeting the conditions is larger for high-income individuals compared to low-income individuals.

Figure 3.12: Average *SSW* per decile of ACE – separately for OAP, UI and CER exit route without GRAPA

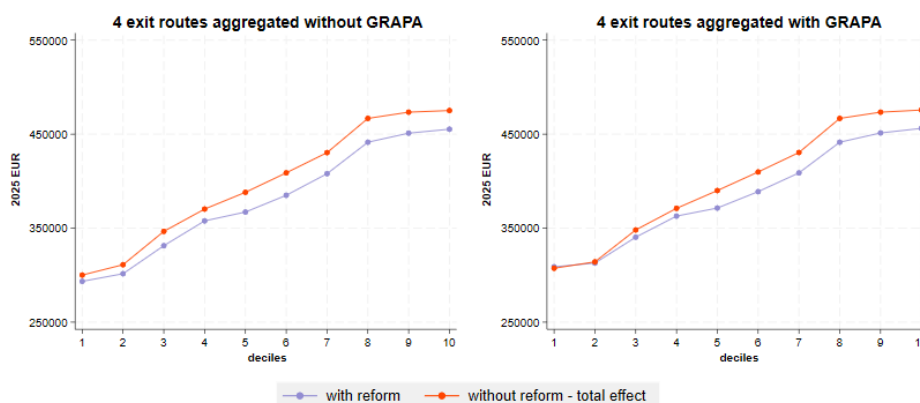


Source: Authors' calculations based on SHARE data.

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.

The comparison of the aggregated *SSW* without GRAPA with the one with GRAPA in Figure 3.13 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.

Figure 3.13: Average *SSW* per decile of ACE – agg. *SSW* without and with GRAPA



Source: Authors' calculations based on SHARE data.

The comparison of the Gini coefficients in Table 3.7 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.

Table 3.7: 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' calculation based on SHARE data.

3.5 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 as the reforms lead to later retirement. Because the behavioral effect is minimal, the reforms' impact on *SSW* is driven by the mechanical effect. Overall, the first decile's *SSW* increases slightly, and the upper deciles' *SSW* decreases, leading to a reduction in inequality. A more detailed look at the different exit routes shows that the more generous GRAPA offsets the negative effect of the other reforms for the first decile. Without this increase in the GRAPA, the first decile would also have lost 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 choice that proves crucial for analyzing 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.

Chapter 4

The Public Pension System and the Gender Pension Gap¹

Abstract

This chapter explores how the redistributive corrections implemented in the Belgian public pension system impact the gender pension gap (GPG). Special emphasis is placed on the variability of the GPG depending on the assumptions made regarding the attribution of the household supplement as well as the income concept used for the calculation. The results show that the redistributive corrections lead to a reduction in the GPG on average. This reduction is greater at the lower distribution compared to the upper part of the distribution. In general, the biggest impact comes from the derived pension rights. Furthermore, the GPG varies greatly depending on the assumptions made, suggesting that interpreting the GPG is not as straightforward as it initially appears, and that such sensitivity checks are important to better understand the situation at hand.

¹The chapter is published as "Le Système de Pension Public Belge et l'Écart de Pension entre les Hommes et les Femmes" in *Revue Belge de Sécurité Sociale*, 2/66e année, 267-313 (2025).

4.1 Introduction

Women's pensions are on average lower compared to men's. In 2024, there was a difference of 25% between the average pension of men and women in the EU countries. Belgium lied above this EU average with 31% in that year (Eurostat, 2025a). Even though the gender pension gap has declined in the last decades because of the large increase in female labor market participation, the gap still remains because of the tight link between employment and pension entitlements in many EU countries (OECD, 2019). As a consequence, women face a higher risk of falling into poverty at old age. (Eurostat, 2021).

In recent years, the gender pension gap (GPG) has received increased attention from organizations such as the OECD (2021) and the EU (SPC and DG EMPL, 2021). MIGAPE (MInd the GAp in PEnsions) is an international research project – funded by the European Union's Rights, Equality and Citizenship Programme – designed to improve the understanding of the GPG. In 2024, the GPG was also one of the focal points of the Belgian Presidency of the European Union. There was a recognition of the significance of identifying the underlying causes of this gap, exchanging successful strategies within this domain, and critically examining the structure of pension systems. Minister Clarinval, Belgian Minister for the Middle Classes and the Self-Employed stated: "The fight against gender inequality, with a view to a more egalitarian European society, must continue. We must work even harder to reduce the gender pension gap, in particular by stepping up the fight against gender inequalities in the labor market." (Council of the European Union, 2024). The issue remains of relevance and much still needs to be done to achieve true gender parity and financial equality.

The pension gap between men and women is caused by gender differences through a lifetime. One major aspect are differences in the labor market. Women participate less in the labor market and work fewer hours. They are still often responsible for the household and childcare. In order to fulfill all those tasks, women are more likely to take a career break or to work part-time, which is associated with lower wages and which reduces their chances to get promoted. In addition to this, women are more likely to work in low-paying sectors. All of this leads to a limited public pension. In addition to differences in the labor market, there are also inequalities in pensions caused by the structure of the pension system. In many countries the pension system is based on the male breadwinner model (full-time, lifelong employment). But since women do often not reach the required number of years of employment, disproportionately many women are not entitled to a full pension (EIGE, 2015). This emphasizes the importance of redistributive features for retirees that do not fit into the male-breadwinner model.

The purpose of this study is to analyze how the various redistributive corrections implemented in the Belgian public pension system impact gender inequality. The Belgian system contains many redistributive elements. Pensions are therefore less strongly linked to past earnings than in other countries. Recent studies done by the Federal Planning Bureau show the importance of the survivor and divorced spouse's pension as well as various minimum regulations and assimilated periods in reducing the gender pension gap in Belgium (Peeters and Schols, 2023; Peeters et al., 2024). The current chapter expands this analysis to more redistributive elements incorporated in the Belgian system, such as the wage ceilings applied in the pension calculation, the adjustments to long careers, the pension bonus as well as the social assistance supplement called GRAPA. The focus lies on wage-earners. More specifically, the GPG is calculated under different circumstances to capture the redistributive effect of the

different components implemented in the pension system using administrative data from the Belgian Crossroads Bank for Social Security (CBSS). Moreover, a particular emphasis lies on the effect of the increased replacement rate in case of a dependent spouse on the GPG and how it relates to the other redistributive corrections. This has so far received rather little attention in existing research in relation to the gender pension gap. The gender pension gap is a complex phenomenon that depends heavily on assumptions about the attribution of household pensions. The gap can vary considerably depending on which assumptions are taken into account. A comprehensive analysis and sensitivity check of different assumptions is therefore crucial in order to obtain a more accurate picture of gender inequality in the Belgian pension system.

The structure is as follows: Section 4.2 defines the gender pension gap and specifies the deviations made in this analysis. Section 4.3 proceeds with a description of the data as well as the calculation of pension benefits. While Section 4.4 describes the methodology, Section 4.5 provides the results of the counterfactual analysis to capture the effect of the different redistributive correction on gender inequality. Section 4.6 concludes.

4.2 The Gender Pension Gap

The following section provides a comprehensive overview of the gender pension gap (GPG), starting with its general definition. It then explores the drivers behind this gap and highlights the risk of poverty that arises as a consequence of the GPG. Lastly, the section hints at deviations from this general definition within the paper, suggesting that the study will delve deeper into specific aspects of the GPG beyond its broad definition.

4.2.1 General definition

The gender pension gap represents the difference between the average gross yearly retirement income of men and women expressed as a percentage of men's average gross yearly retirement income².

$$GPG = \frac{RI_M - RI_F}{RI_M}$$

“Retirement income” is a broad term and individuals can draw income from various sources in retirement. Generally, it encompasses the public pension, which is paid by social security, the occupational pension, which derives from employer-sponsored programs and the private pension initiated by the individual itself. Also included in the calculation are derived pension rights such as the divorced spouse's and survivor's pension. Lump-sum payments from a retirement savings plan as well as additional income from work are excluded from the calculation of the gender pension gap - the former because it is not considered as an income, the latter because it is not considered as a retirement income (OECD, 2021).

To make the gender pension gap comparable across countries, it is calculated for the population older than 65 (OECD, 2021). However, while including the same elements in the calculation, certain differences in interpretation persist due to country-specific features in the pension systems. Belgium for example considers the household dimension in its public pension system and offers a higher replacement rate if a person has a dependent spouse³. This leads to a higher pension for the working partner (generally the man) and therefore artificially increases the gender pension gap, even though the higher pension is supposed to be shared

²In the formula, RI is the average gross yearly retirement income. The index M and F stand for “male” and “female” respectively

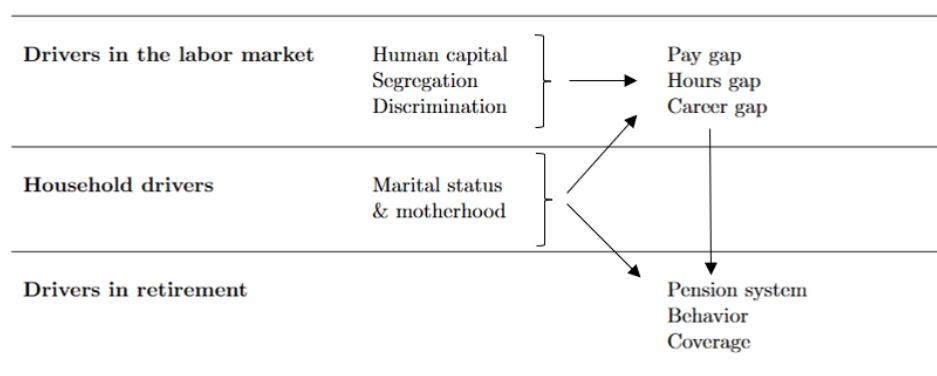
³A replacement rate of 75% is used instead of 60%.

within the household. When making country comparisons, such country-specific rules matter even more.

The GPG is frequently used as a metric to gauge gender inequality in retirement, yet it provides only a partial perspective as it overlooks a crucial factor, namely the differences in life expectancies. Women, on average, live longer than men and consequently collect pension benefits over an extended period. Viewing the pension system through the lens of insurance underscores that this higher life expectancy of women is not factored into the contributions they make, highlighting an imbalance. Considering pension wealth⁴ rather than annual pension benefits could likely reduce gender inequality in pensions because of the longevity dimension.

4.2.2 Drivers

Figure 4.1: Drivers of the gender pension gap



Source: Author.

Notes: The figure is designed to visually summarize the various elements discussed, though it is not exhaustive.

⁴The pension wealth represents the present discounted value of all future pension benefits, taking into account life expectancy.

Drivers in the labor market

The first category summarizes different drivers that lead to gender differences on the labor market that are translated later on into retirement income. To begin with, there is a pay gap between men and women that is partially rooted in differences in educational outcomes. While historically, this stemmed from discrimination that limited educational opportunities for women, today it more often results from divergent educational choices, with men and women selecting different fields of study. Men are overrepresented in STEM fields while women tend to choose majors in education, health and welfare (EIGE, 2018). These choices can have an impact on the development of specialized skills and the career opportunities that result. In addition, a certain part of the gender pay gap can be explained by sectoral segregation in the labor market. Women are more likely to work in relatively low-paying sectors (European Commission, 2023). However, most of the gender pay gap in the EU remains unexplained and cannot be linked to the characteristics of the worker or the workplace (European Commission, 2023).

Next to the pay gap, there is the hours gap. Women are more likely to work part-time and work on average less hours (in paid work) compared to men. In 2022, 27.8% of employed women worked part-time versus 7.6% of employed men (Eurostat, 2023b). One reason for this is that women are still often responsible for the household and care activities. In 2022, 29.2% of women gave “care of adults with disabilities or children” as reason for working part-time compared to 7.7% of men (Eurostat, 2023b). Those care activities often also lead to career interruptions which entails that women have on average shorter careers than men. In the EU in 2022, men have an expected career of 38.6 years, compared to 34.2 years for women (Eurostat, 2023a). And shorter careers imply smaller pensions in systems with a tight link between employment and pension entitlements. More-

over, working part-time and experiencing career interruptions contribute to lower earnings for women, exacerbating the gender pay gap as they are afforded fewer opportunities for career advancement and promotion. This illustrates the interdependencies between the various drivers.

Household drivers

The gender pension gap also differs by marital status and the number of children. In almost all EU Member States, the gap is the highest for married women, followed by divorced women and widows. The gap is substantially lower for single women (European Commission, 2013). This might be due to lower incentives for participation in the labor market and advancements in career for married women (European Parliament, 2016). However, as mentioned earlier, one should be careful with the interpretation of the gender pension gap as it relates to individual retirement income and does not consider a possible/likely pooling of income (and resources more generally) within a household.

Being married often correlates with having children, and this familial responsibility also significantly impacts the gender pension gap. A positive relationship exists between the gender pension gap and the number of children. The more children, the higher the gap, which can be explained by caring activities as already outlined above. The uneven division of those duties leads to a motherhood penalty in employment and remuneration. More women than men take a career interruption or reduce working hours due to care duties (European Parliament, 2016). In the EU in 2018, 82% of those who have reduced their working hours for childcare were women and every third women had a career interruption for childcare reasons, compared to only 1.3% of employed men (Eurostat, 2019).

This pattern is partly rooted in persistent social norms, whereby women are more likely to assume caregiving roles while men act as primary earners (Fortin, 2005). At the same time, economic considerations and opportunity cost optimization also play an important role, as such decisions are often made at the household level with the aim of maximizing joint welfare (Chiappori, 1988). Given wage differentials and career prospects, it can be financially more rational in the short term for the woman to reduce working hours, take career breaks, or prioritize flexibility, thereby allowing the household to allocate labor more efficiently. While this specialization may increase household resources and stability in the short run, it also has long-term consequences: reduced labor market attachment leads to slower career progression, lower lifetime earnings, and consequently lower individual pension entitlements. Over time, the partner who scales back employment - typically the woman - bears the negative effects of these jointly optimized decisions, which contributes to persistent disparities in retirement income.

Drivers in retirement

In addition to differences that arise on the labor market and due to the family situation, there are also drivers in retirement that result in inequalities in retirement income. In many countries the public pension system is based on the male breadwinner model - full-time and lifelong employment is needed to get a full pension. However, even though the labor market participation of women has increased, women do often not reach the required number of years of employment and are therefore not entitled to a full pension (EIGE, 2015). While the concept of not receiving a full pension due to insufficient contributions aligns with insurance principles, this can lead to issues of adequacy. This underlines the importance of redistributive features to provide a more adequate pension to retirees who do

not conform to the male-breadwinner model. Derived pension rights like the survivor's pension are one example of those redistributive corrections. It exists in almost all EU Member States and plays an important role in providing a retirement income to the surviving partner, hence most often the woman. Several Member States also provide care credits, measures designed to compensate for the impact of interrupted careers on women's pension by crediting care periods as pensionable years. There are major differences between countries when it comes to the duration and scope of these credits. Minimum pensions allow to top-up low pensions and provide some correction to women with low or no contribution histories. Such redistributive components can reduce the gender pension gap but they may have the counter effect of reducing the work incentive as well (European Parliament, 2016).

Moreover, women live on average longer than men and historically, they were allowed to retire earlier (and still do in some EU countries⁵). This leads to a collection of benefits over a longer period. This is as such beneficial for women. However, in many countries, pensions in payment are not fully protected against inflation because they are indexed inadequately relative to inflation. Belgium for example uses the health index – a slowed-down version of the CPI. This leads to an erosion of purchasing power⁶ over time, which affects women to a greater extent due to their higher life expectancy (European Commission, 2013).

Next to the structure of the pension system, women and men differ in retirement behavior which leads to differences in retirement income. However, since the increase in the statutory eligibility age for women in almost all Member States, the effective exit age of men and women are

⁵In Poland, the statutory eligibility age lies at 65 for men, and at 60 for women in 2022 (OECD, 2023).

⁶To mitigate this erosion of purchasing power, periodic upward shifts of pensions in payments were introduced in Belgium.

expected to converge (European Commission, 2015). The impact of this factor on the gender pension gap should therefore be reduced. At the same time, the literature on joint retirement shows that retirement decisions are often coordinated within couples rather than made individually (Hurd, 1990; Michaud et al., 2020; Hospido and Zamarro, 2014). In this context, spouses - particularly wives - are more likely to retire when their partner retires, reflecting complementarities in leisure and intra-household optimization. Given that women are on average younger than their partners, such coordination can lead them to exit the labour market earlier than they would individually choose, thereby shortening contribution periods and reducing pension entitlements. Consequently, even with equal statutory retirement ages, joint retirement behavior may continue to contribute to the persistence of the gender pension gap.

Furthermore, women are less likely to access an occupational pension⁷ for different reasons. The most obvious one is the employment gap. But women are often also underrepresented in the sectors that are more likely to provide such investment plans. In addition, women may face barriers to joining occupational schemes when access is subject to conditions of employment or remuneration. This shows once again the interdependencies between the different drivers. Gender differences also exist in investment behavior, with women participating less and accumulating less in private retirement savings plans. This gap widens over time due to compound interest, as larger pension funds earn higher returns than smaller ones. In addition, women tend to be more risk-averse and invest their money in more conservative plans while men choose generally riskier strategies (OECD, 2021). Gender inequalities are therefore more pronounced in the second and third pillar⁸. The role of retirement savings schemes in con-

⁷In Belgium, only 18% of the women in the working-age population is covered by an occupational pension plan compared to 27% of men (OECD, 2021).

⁸In Belgium, the gender gap reaches 50% in complementary pensions while being at 20% for the statutory pension (INASTI, 2023). It is important to note that the gap in complementary pension here

tributing to the overall pension gap between men and women depends on the importance of the second and third pillar in the overall pension system and whether they are paid out as a lump sum or as a steady stream as this affects their inclusion in the calculation of the GPG. Currently, in many European countries, retirement savings plans provide a steady stream of income for only a small proportion of retirees (OECD, 2021).

4.2.3 Financial dependency and risk of poverty

The GPG comes with a number of consequences. It results in increased financial dependency among women, as their lower pension benefits can necessitate reliance on external sources of support for financial stability. This dependency, commonly on a spouse or partner, poses significant challenges. Firstly, it can exacerbate the risk of gender-based violence, as financial reliance may result in limited autonomy and decision-making power within relationships (EIGE, 2015). Moreover, this reliance can lead to complications in the event of the partnership ending, whether through divorce/separation or the death of the spouse. Given that women are generally younger than their spouses and have longer life expectancies, the death of a partner is not an uncommon event in their lives. While the divorcee and survivor pension serve as compensation for the individual's loss of the partner's income, such events often still result in economic hardship. Women face thus a higher risk of poverty in retirement compared to men due to their lower pension benefits⁹.

reflects the gap in average capital between men and women, distinct from the income-based calculation of the GPG.

⁹17% of female pensioners older than 65 years were at risk of poverty in 2019 in the EU compared to 13% of men in the same age group (Eurostat, 2021). The phenomenon of poor old women is not unknown and has already been pointed out by several studies (EIGE, 2020; Ahonen and Kuivalainen, 2024).

4.2.4 Beyond the general definition

The aim of this study is to analyze the impact of the different redistributive corrections implemented in the Belgian pension system on the GPG. The Belgian system incorporates relatively many redistributive elements and pensions are less earnings-linked compared to other countries, making it an interesting case for analyzing how gender inequalities originating from the labor market are reflected in pension payouts.

Moreover, Belgium is one of a few countries¹⁰ that takes into account the marital dimension in its pension calculation. As highlighted before, the higher replacement rate in case of a dependent spouse affects the gender pension gap and its interpretation because the possible pooling/sharing of retirement income within a household is not considered in the common definition of the GPG. Special attention will be given to the effect of the household rate on the GPG by assuming different sharing rules of the family pension and how it relates to the other redistributive elements. In a further step, the idea of individualized pension income is fully abandoned and the total household pension income is considered as a base for the calculation of the GPG. More details are given in Section 4.4.

Due to data limitations, income from the second and third pillars are not considered in the GPG calculation for this analysis. While this is not considered a major limitation - firstly because the first pillar remains the main source of income for retirees in Belgium (OECD, 2019), and secondly because the focus here is on the public pension system - it should be noted that the analysis offers only a partial view of gender inequality in retirement, as occupational and private pensions exhibit larger gender disparities than the public system (INASTI, 2023; OECD, 2025).

¹⁰In Ireland, the IQA (Increase for a Qualified Adult) exists, an enhanced pension in case of a financially dependent spouse. In Cyprus, a dependent spouse leads to an increase of the replacement rate from 60% to 80%. It increases even further if there is more than one dependent person (SPC and DG EMPL, 2021).

4.3 Calculation of pension benefits

For the purpose of this analysis, the yearly gross public pension benefits are calculated. In the following, the data and the calculation of the pension benefit is outlined.

4.3.1 Data and sample

The analysis relies on an administrative panel dataset provided by the Belgian Crossroads Bank for Social Security¹¹ (CBSS). It contains detailed information on the working life of the sample and its socio-economic background, retrieved from the administrative records of various social security institutions and the national registry. Since the reference period of this study is the calendar year, the quarterly income data is merged into a single yearly observation, using the status of the last day of the last quarter of each year.

For the analysis, wage-earners which are present in the ONP¹² records in 2017 and which are born between 1939 and 1952 are selected¹³. They are thus aged between 65 and 78. Retirees with a mixed employment history as wage-earner, civil-servant and/or self-employed remain included in the sample. It is composed of 43518 individuals.

To situate the sample in the overall income distribution of the Belgian population, it is compared to the EU-SILC sample. The comparison is presented in the Appendix B.1.

¹¹Contract Art5/18/038.

¹²The ONP (Office National des Pensions) was responsible for managing and administering pensions for wage-earners and the self-employed in Belgium. Pensions for civil servants were handled by the SdPSP (Service des Pensions du Secteur Public). Since April 1, 2016, the ONP and the SdPSP have merged to form the Federal Pension Service (SFP for Service fédéral des Pensions).

¹³We have data spanning 1954–2017, allowing us to observe complete career trajectories - from ages 15 to 65 - for the relevant birth cohorts.

Table 4.1 shows some main characteristics of the individuals included in the sample in 2017. Note that the available administrative data provide detailed career information only for wage-earners. Consequently, the measures of average career length and average career earnings (ACE) consider only periods as wage-earners, excluding years and earnings as civil servants or self-employed. This limitation explains the relatively short careers observed in the full sample, which includes individuals with mixed careers. As a consistency check, we examined these measures for pure wage-earners, whose entire career consists of wage-earning employment, and found more plausible values for career length. The table shows that, on average, women have shorter careers and lower earnings, as expected.

Table 4.1: Summary statistics of sample, retirees aged 65-78

	Total	Men	Women
Number of individuals	43518	23204	20314
Demographics			
Marital status			
single, divorced or widowed	31%	21%	43%
with partner, not married	12%	11%	13%
married	57%	68%	44%
Employment			
Mixed career	39%	44%	33%
Average years of career	28	32	25
Average ACE (in 2025 EUR)	36512	43919	28044

Source: Author's calculations based on CBSS data.

Notes: Years of career refers to the career years worked as a wage-earner (assimilated periods included). ACE refers to individual average career earnings. They are calculated by dividing the total gross wage-earner earnings by the number of years actually worked as wage-earner (fulltime equivalent).

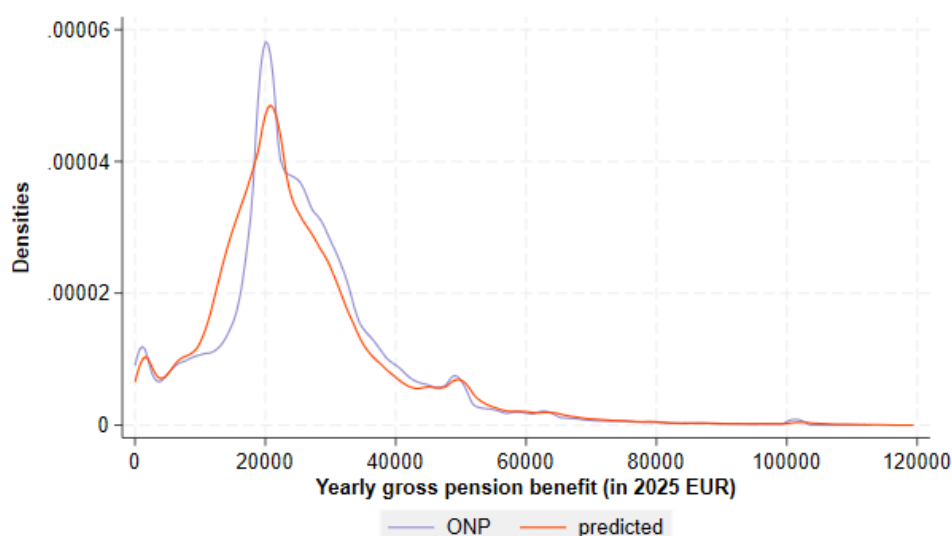
4.3.2 Yearly gross pension benefits

For each individual in the sample, the yearly gross pension benefit to which the person is entitled is calculated using a simulation tool, considering the

rules in place in the first year of benefit collection, the individual's career as wage-earner as well as the partner's income. As a reminder, only the public pension benefit is considered, leaving aside benefits from the second and third pillar. Due to data limitations, the derived pension rights, the GRAPA supplement, as well as the pensions stemming from civil servant and self-employed careers are taken directly from the ONP records and are considered as given. As mentioned, the administrative data available to us provide detailed career information only for wage-earners, not for civil servants or the self-employed. Consequently, only the pension benefits based on the individual's wage-earner career can be calculated using the simulation tool.

To validate the calculations, the predicted pension benefits are compared to the actual pension benefits from the ONP records¹⁴. Figure 4.2 shows the distribution of the actual pension benefits and the ones calculated with the simulation tool.

Figure 4.2: Distribution of the yearly gross pension benefits – ONP and predictions



Source: Author's calculation based on CBSS data.

¹⁴The validation of the calculator is done for all people in the CBSS data born between 1939 and 1952, not only the restricted sample. 77387 individuals are matched, 42146 men and 35241 women.

As presented in Table 4.2, on average, the calculated yearly gross pension benefit is EUR 25118 while the ONP records provide a yearly gross pension benefit of EUR 25802 (expressed in 2025 EUR). The predicted gender pension gap is 26.65% at the average, an underestimation of 1.39 percentage points. The comparison is also done at the 20th and 80th percentile to examine the accuracy of the calculator at the lower and upper distribution.

Table 4.2: Yearly gross pension benefits separately for men and women – ONP and predictions

	Total (expressed in 2025 EUR)	Men	Women	GPG (%)
Average				
ONP	25802	29579	21286	28.04
Predicted	25118	28586	20970	26.65
Difference	-684	-993	-316	-1.39
20th percentile				
ONP	17177	20332	11023	45.79
Predicted	14992	19190	10693	44.28
Difference	-2185	-1142	-330	-1.51
80th percentile				
ONP	33653	36457	28979	20.51
Predicted	32987	35170	29213	16.94
Difference	-666	-1287	234	-3.57

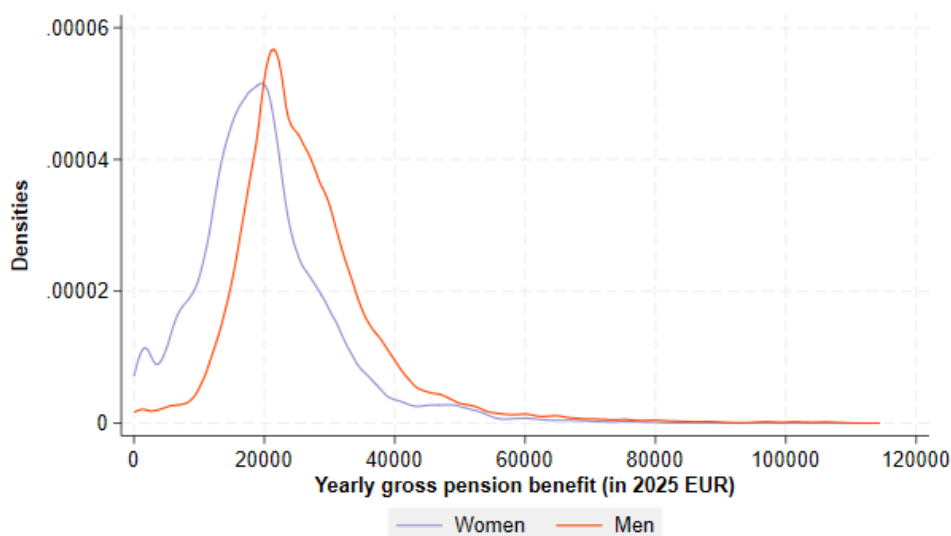
Source: Author's calculations based on CBSS data.

Notes: The pension benefit includes pension benefits originating from the wage-earner, self-employed and civil servant career, the divorced spouse's and survivor's pension as well as the GRAPA supplement. Amounts are expressed in 2025 EUR.

Figure 4.3 presents the distribution of the predicted yearly gross pension benefits for the sample, separately for men and women. Overall, the male distribution is more to the right, indicating higher pension benefits. Among men, there are hardly any workers with a benefit close to EUR 0. They cluster around a benefit of EUR 20000-25000. For women, the pic-

ture is different. Some receive pension benefits close to EUR 0, a situation that becomes even more pronounced when not factoring in derived pension rights¹⁵. This is not uncommon in the birth cohorts considered in this sample because women were less present in the labor market. Today, the labor market participation of women has significantly increased. This shift reflects broader societal changes, including advancements in gender equality, improvements in educational opportunities for women, and evolving cultural attitudes towards women in the workforce. The increased participation of women in the workforce will eventually reflect in the allocation of pension benefits. Consequently, the distribution of retirement benefits for present-day women engaged in the labor force is expected to be different.

Figure 4.3: Distribution of the predicted pension benefits separately for men and women



Source: Author's calculation based on CBSS data.

Regarding the household rate, 38% of married men in the sample get a pension based on the increased replacement rate, thus having a spouse with low or no lifetime earnings. In contrast, the corresponding share among married women is only 1.5%, reflecting the historical pattern in which women were much more likely to remain outside the labour market.

¹⁵See Appendix B.3 for a further analysis of the distributions across counterfactual situations.

The high incidence of the increased replacement rate among men in these cohorts reflects that one-earner households were common at the time. This dynamic is also likely to change for today's working population. Due to the increasing prevalence of dual-earner households and higher female labour force participation, more couples accumulate pension rights on an individual basis rather than relying on a single primary earner. As a result, the conditions that make the household rate relevant are becoming less common. Consequently, the household rate is expected to be used less frequently in the future.

4.4 Methodology

This chapter examines the effect of the different redistributive elements implemented in the Belgian pension system on the gender pension gap. To do this, a number of counterfactual pension benefits are calculated with the objective to remove the changes attributable to the different elements and to examine what would be the situation in the absence of those redistributive corrections. Additionally, the common assumptions made in the calculation of the gender pension gap are being challenged to assess their impact on the results, by considering alternative scenarios.

4.4.1 Redistributive corrections : eight features

The focus lies on the redistributive elements incorporated in the calculation of the pension entitlements namely (1) the assimilated periods, (2) the wage ceilings and (3) wage floor, (4) the long career adjustments, (5) the guaranteed minimum pension, (6) the pension bonus, (7) the derived pension rights and (8) the GRAPA supplement.

The analysis starts with a pension system without any redistributive element – pension benefits are proportional to lifetime earnings. Then the eight different elements mentioned above are added stepwise until the pension system in place is reached. The gender pension gap is analyzed throughout the different steps to see which elements have the biggest impact on gender inequality¹⁶.

It is important to note that the various elements interact with each other. For example, the wage floor and the minimum pension compensate each other. When one regulation is excluded, many people are absorbed by the other. Since the wage floor, the minimum pension as well as the pension bonus are tied to career conditions, they interact strongly with the assimilated periods. The interdependency between the different elements should therefore not be disregarded when analyzing the results.

4.4.2 Challenging assumptions : five scenarios

In the subsequent analysis, the common assumptions made in the calculation of the gender pension gap are being challenged to assess their impact on the results. For this, five alternative scenarios are considered.

Three scenarios are compared to examine how different attribution rules of the household supplement affect the gender pension gap¹⁷. In the

¹⁶The method described here is referred to as strategy 1 in the Appendix B. But path dependency is a possible concern since the results can depend on the sequence the different elements are added to the hypothetical proportional pension system. It is possible that elements added in the beginning will show a larger effect on inequality compared to the elements added in the end. A second strategy is used to verify whether the results are actually affected by the sequence as done by Halvorsen and Pedersen (2019) for the Norwegian case. In strategy 2, the pension system is kept as it is in place and one redistributive element is removed. Then it is looked at the impact on the gender pension gap of each element. Using both strategies will deliver a more reliable picture on which elements have the biggest importance in reducing gender inequality. Since the conclusions of both strategies are similar, the results of the second one are presented in the Appendix B.4

¹⁷As a reminder, the pensions based on the household rate are entirely attributed to the working partner (mostly the man) and the possible sharing of benefits within a household is not considered in the calculation of the GPG. This might artificially widen the gap and deliver a distorted picture.

first scenario (1), the household rate is ignored and the pensions are solely calculated using the single rate of 60%. The second scenario (2) presents the situation commonly implemented. A household rate of 75% is applied in case of a dependent spouse and the entire benefit is attributed to the working partner. The third scenario (3) shows an alternative attribution of the pension benefits based on the household rate. 60/75 of the benefit is attributed to the working partner and 15/75 to the dependent spouse. The working partner gets thus the full benefit based on the single rate and the supplement is supposed to be given to the partner.

Two more scenarios are added which consider an alternative income concept in the calculation of the GPG, which leads in total to five different scenarios. Instead of individualized income, the household income is used as base for calculating the GPG. It is assumed in general, that resources within a household are shared, whether partners get the household rate or not¹⁸. In the fourth scenario (4), household pension resources are pooled and equally divided between partners. The last scenario (5) also assumes an equal division of household pension resources, but resources in a two-person-household are transformed in a way to make it comparable to a one-person household by using the OECD-modified equivalence scale¹⁹. While the individual income is typically used when examining how pension benefits are distributed, especially concerning the gender pension gap, the equivalized household income is commonly chosen for research on poverty and income inequality.

¹⁸This approach reflects the idea that employment and retirement decisions are often made at the household level rather than by individuals in isolation, as discussed in an earlier section. As partners tend to optimize jointly over the life course, it is reasonable to assume that both benefit equally from the resources accumulated, including during retirement, even if these resources are not formally attributed equally to each partner.

¹⁹As the number of individuals in a household increases, its requirements also grow. However, this increase is not always directly proportional. Due to economies of scale in consumption, the needs for housing space, electricity, and other essentials generally do not increase in a proportional way for each additional household member. To take this into account and to compare the well-being of households of different sizes, the OECD-modified equivalence scale is used. This scale assigns a value of 1 to the head of the household, and of 0.5 to each additional adult member. The household resources are thus divided by 1.5 instead of 2 in the fifth scenario.

Any sharing rule between partners can appear problematic, be it the attribution of the household supplement to the dependent spouse (scenario 3) or the equal sharing of resources between partners in general (scenario 4 and 5). Even though it can be assumed that the household pension or household resources in general are shared to some extent among partners, the exact division between partners cannot be known. Therefore, whether financial autonomy exists remains uncertain, as the money rightfully belongs to the person it is registered to. An equal sharing can thus appear extreme and not necessarily accurate. But the general definition of the gender pension gap completely excludes the possibility of sharing of resources, which is another extreme. These sensitivity tests considering alternative attributions of household resources can thus provide an interesting insight into the variability of the GPG depending on the assumptions made. While the interpretation of the GPG remains difficult in all scenarios, comparing the different cases offers a more comprehensive understanding of the situation at hand.

As emphasized at an earlier point, the labor market behavior of women in the cohorts in this sample differs significantly from that of women currently active in the labor market, with women today being much more active in the labor market and therefore building up their own pension rights to a greater extent. Therefore, the use of the increased replacement rate of 75% will likely diminish considerably in the future, and with it its influence on the gender pension gap as well as the resulting limitations regarding the interpretation of the gender pension gap. The conclusions drawn from scenarios 1–3 are therefore somewhat less directly applicable to today’s working population. Nevertheless, conducting this analysis remains worthwhile, as it helps to shed light on gender disparities among today’s retirees. With regard to the comparison to scenarios 4 and 5, the topic remains relevant even to today’s working population, as couples are likely to share their resources, even in dual-earner households.

4.4.3 Distribution

The analysis is done at different points of the distribution. First it is looked at the average to get a general idea about how the system redistributes. However, it can be assumed that the lower and upper distribution is affected differently by the redistributive elements. Size and sign of the effects might change along the distribution. This is why the analysis is also done for the first and last quintile of the distribution to obtain a more complete picture about the redistributive characteristics of the different features in the system.

For this, the sample is divided into five quintiles using the EU-SILC quintile cutoff points of the general Belgian population²⁰. This allows to discern the impact of the redistributive components on retirees, distinguishing between those classified as economically disadvantaged and those deemed affluent. The Appendix B.1 presents more details about the division into the EU-SILC quintiles.

4.5 Counterfactual analysis

This section presents the results of the counterfactual analysis²¹. First it is looked at the impact of the various redistributive corrections and the different attribution rules of the household supplement on the GPG (scenario 1-3) and afterwards the sharing of resources within the household is considered and how it affects the GPG (scenario 4-5).

²⁰The division into five quintiles is the same across the five scenarios. Regardless of the income definition used in the calculation of the GPG, individuals are categorized into quintiles according to their equivalized disposable household income and using the EU-SILC quintile cutoff points of the general Belgian population. This approach offers two advantages: firstly, it simplifies the comparison of the five scenarios as the composition of the quintiles remains consistent, and secondly, it enables to assess the redistributive impact of the system across individuals identified as poor or wealthy, in accordance with EU-standards.

²¹The detailed tables with the GPG in the different scenarios are presented in the Appendix B.2. The analysis using strategy 2 is entirely presented in the Appendix B.4 since conclusions are similar.

Table 4.3 summarizes the different counterfactual situations. By adding stepwise the different redistributive elements, we move from a fully proportional pension system to the actual one.

Table 4.3: Counterfactual situations

A	Fully proportional pension system
B	Adding assimilated periods
C	Adding wage ceilings
D	Adding the wage floor
E	Adjusting for long careers
F	Adding the minimum pension
G	Adding the pension bonus
H	Adding the derived pension rights
actual	Adding the GRAPA supplement (= the actual pension system)

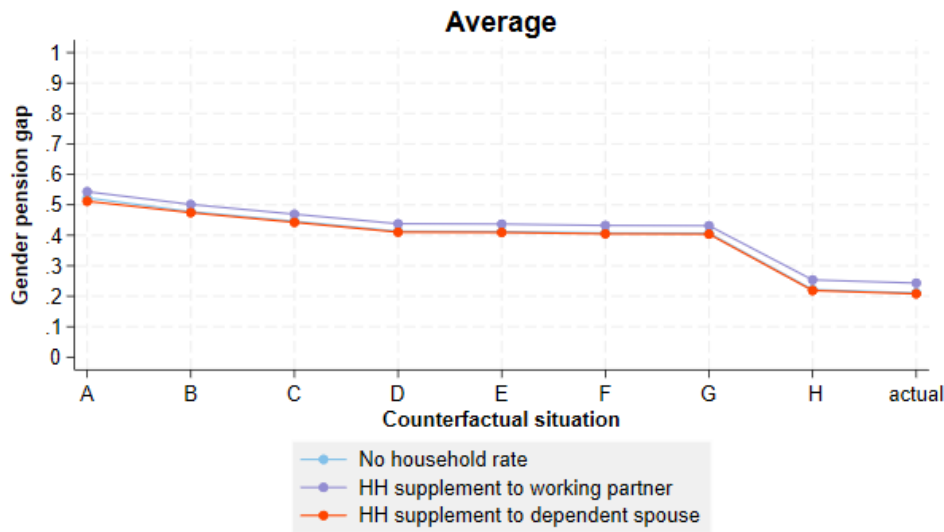
Source: Author.

4.5.1 Different attribution rules of the household supplement

Figure 4.4 presents the evolution of the GPG at the average when moving from the proportional system to the actual one, for the three scenarios regarding the household rate. Figure 4.5 shows the same evolution but for the first and fifth quintile to offer a targeted analysis at the lower and upper distribution.

Looking at the average, we see that the GPG is the highest when the household rate is applied and fully attributed to the working partner. Men are thus on average more often in the case of receiving the increased replacement rate. It follows the scenario that ignores the household rate and applies a replacement rate of 60% to everybody regardless the family situation. Gender inequality is reduced in the third scenario when the working partner continues to receive the benefits based on the single rate (60/75 of the household pension) while the supplement (15/75 of the household pension) is attributed to the dependent spouse. It can clearly be seen that different hypothesis on how the household supplement is attributed

Figure 4.4: Evolution of the GPG at the average - scenario 1-3



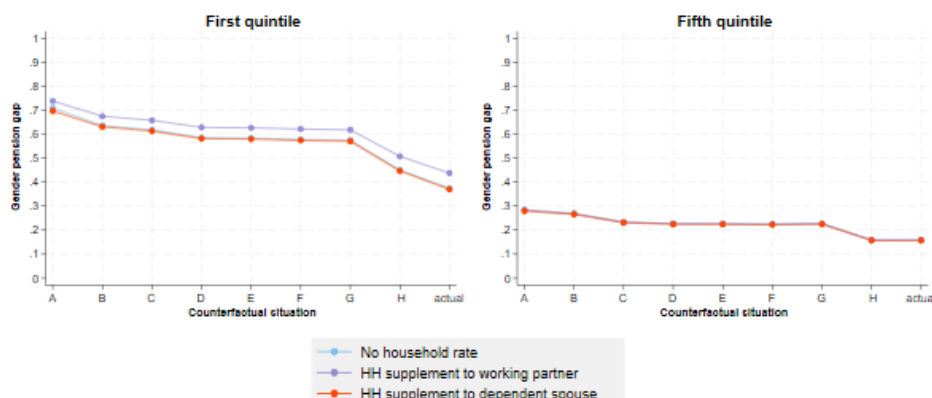
Source: Author's calculation based on CBSS data.

changes the size of the gender pension gap to some extent. A difference of 3.52 pp exists between the scenario that is commonly used in calculations of the GPG (household supplement attributed to the working partner – 24.32%) and the case that considers that the supplement is given to the dependent spouse (20.80%). Caution is therefore advised when examining the GPG because official numbers might not tell the whole story. However, as already mentioned earlier, despite the intention to offer women financial support through the household supplement, the reality remains that this pension arrangement often does not guarantee women's financial autonomy, as it is ultimately geared towards the man and thus dependency persists.

Regarding the effect of the various redistributive corrections, the general evolution is a reduction in the GPG, in all three scenarios. Sign and size of the effects of the different elements are similar across scenarios. Each of the redistributive elements reduces the gap when added consecutively to the proportional system. The assimilated periods reduce the GPG to a rather large extent (around 4 pp). Women benefit therefore

on average more from those periods compared to men. This is because a larger proportion of women's careers usually consist of assimilated periods (Peeters et al., 2024). Men are more affected by the wage ceilings since they have on average higher earnings while women benefit more from the wage floor regulation due to their lower earnings on average. These two elements reduce the GPG by around 3 pp respectively. The effect of the long career adjustment is quite small but still negative. Men are thus more affected by it on average. What is a bit surprising is that the minimum pension reduces the GPG only to a small extent. A possible explanation for this rather small effect is that a lot of individuals already reach the minimum pension threshold thanks to the wage floor that is considered in the pension calculation. The effect of the pension bonus is negative as well, meaning that women benefit more from this regulation than men. This can appear unexpected since men have on average longer careers and are therefore more often eligible for the bonus. The explanation for this lies in the fact that the bonus is not proportional to income but a lumpsum amount that is paid for each additional working day. The bonus represents thus a higher percentage of income for women since their earnings are lower. However, the effect of the bonus on the GPG is small. The far biggest impact comes from the derived pension rights. They reduce the GPG by around 18 pp. This is consistent with the findings of Peeters and Schols (2023) considering that here it is looked at a rather younger sample of retirees. They find that the principal part of this reduction in the GPG is due to the survivor's pension. The GRAPA supplement reduces the GPG further by around 1 pp and has thus a rather small effect on gender inequality at the average.

Figure 4.5: Evolution of the GPG at different quintiles – scenario 1-3



Source: Author's calculation based on CBSS data.

The graph representing the first quintile shows that gender inequality is larger among individuals that are considered as rather poor compared to the average. The GPG ranges from 37.01% in the scenario that attributes the household supplement to the dependent spouse to 43.80% in the scenario that assigns it to the working partner.

Overall, the various redistributive corrections lead to a reduction in the GPG in the first quintile. The derived pension rights are still the most important element. However, the GRAPA supplement is also becoming very important in this segment, since it is a social assistance program dedicated to the poor. Compared to the average, the assimilated periods play a more important role in reducing the GPG among the economically disadvantaged. The wage ceilings affect inequality only to a smaller extent due to generally smaller earnings at this part of the distribution.

The graph at the fifth quintile shows a lower GPG among individuals that are considered as affluent. It is around 16% across the different scenarios dealing with the household supplement. The fact that there is almost no difference across scenarios indicates that the upper distribution mainly consists of people who rely on building their own pension entitlements and who do not have a dependent spouse. An additional explanation for this is

the composition of pension benefits. Within the last quintile, a significant proportion of individuals also worked as civil servants, entitling them to pension benefits from both schemes. As a result, the wage-earner pension constitutes a smaller portion of their total pension benefits compared to individuals in other quintiles. And since the different scenarios only pertain to the wage-earner pension, this leads to less variation observed across them.

Again, the redistributive corrections lead in total to a reduction in the GPG at his part of the distribution. The derived pension rights remain the most important element. However, there is a shift in the relative importance of the other elements. The wage ceilings become more important in reducing the GPG, as individuals are more affected by this regulation due to higher earnings. The gender differences in completing the career with assimilated periods are less pronounced among the rich which leads to a smaller redistributive effect coming from those periods. Due to higher earnings, the different minimum regulations such as the wage floor and the GRAPA supplement have hardly any influence on the GPG here. Contrary to what is observed at the average, the effect of the pension bonus turns slightly positive, increasing thus the GPG. This is related to the fact that the earnings are generally higher and that the income difference between men and women is no longer too great here. The fact that men are affected by the bonus more often than women therefore outweighs the fact that the lumpsum bonus is more significant for women (in proportion to income). However, the effect remains at about 0.

It can be concluded that the derived pension rights are the most important element in reducing the GPG. The respective importance of the other elements shifts depending on where it is looked in the distribution. While the assimilated periods, the wage floor and the GRAPA supplement play an important role at the lower distribution, the wage ceilings gain in

significance at the upper part of the distribution. The total effect is also significantly different. While in the first quintile, a total reduction of 30-34 pp can be observed, the GPG is reduced by around 12-13 pp in the fifth quintile depending on the scenario. Yet the magnitude of the effects hardly changes across scenarios, which suggests that the assumption regarding the attribution of the household supplement has no major influence on the effect of the redistributive corrections. However, it does have a slight effect on the level of the GPG.

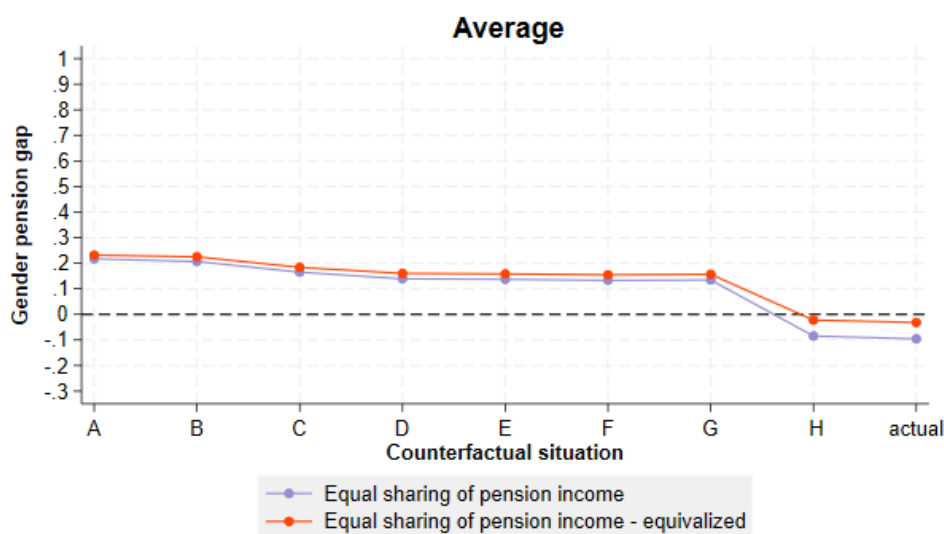
4.5.2 Alternative income definition: equal sharing of household pension resources

This section presents the results of the analysis considering an alternative income concept assuming the equal sharing of household pension resources between the partners (scenario 4 and 5). As a reminder, this concept of income is an extreme assumption about the sharing of pension incomes within a household and does not necessarily reflect the actual situation. It sheds light at the variability of the GPG when changing assumptions.

Figure 4.6 shows the evolution of the GPG at the average when moving from the proportional system to the actual one. Figure 4.7 presents the same evolution but again for the first and fifth quintile to get insights about how the elements redistribute between men and women at the lower and upper distribution.

When considering the equal sharing of household pension incomes, the GPG is substantially reduced and turns out to be negative at the average. It is equal to -9.56% and -3.15% when using the OECD-modified equivalence scale (compared to around 20-25% when using individualized income). According to this income concept, women have on average higher pension incomes than men.

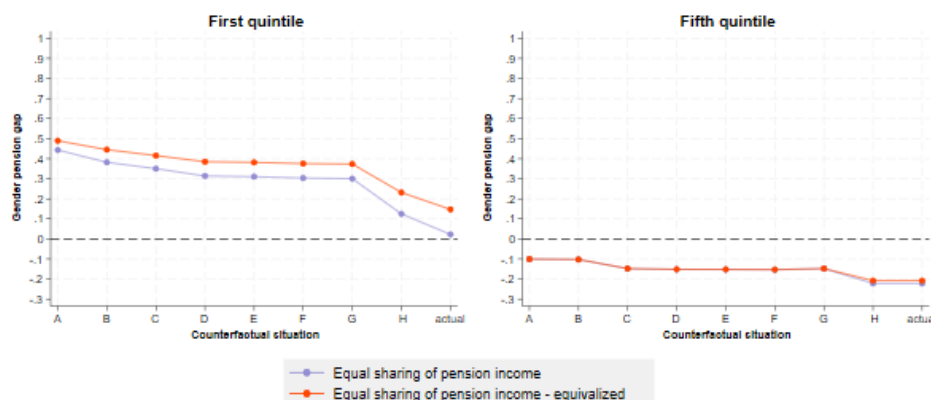
Figure 4.6: Evolution of the GPG at the average – scenario 4-5



Source: Author's calculation based on CBSS data.

Regarding the redistributive corrections, a shift in size and even in sign can be detected compared to the previous analysis that considers the individualized pension income. The role played by the assimilated periods in reducing the GPG is reduced. The wage ceilings and the wage floor remain relatively important elements for gender equality. The role played by the long career adjustments, the minimum pension and the pension bonus remains insignificant. The effect on the GPG is close to 0. However, the sign turns positive for the pension bonus. The same effect as observed at the upper distribution when applying the traditional income definition is found here. As the income gap between men and women is no longer as important in this context, the greater relative significance of the lump-sum bonus for women no longer outweighs the frequency with which men receive the bonus. The importance of the derived pension rights increases in this context. The effect of the GRAPA supplement on the GPG remains rather small at the average.

Figure 4.7: Evolution of the GPG at different quintiles – scenario 4-5



Source: Author's calculation based on CBSS data.

When looking at the first quintile, the GPG remains positive even when applying the alternative income concept. However, it is still reduced to a large extent. It is at 2.26% and 14.71% when equivalizing the household income (compared to around 40% when using individualized income).

The magnitude and sign of the effects of the redistributive corrections remain comparable to what was found with the traditional income definition. The assimilated periods as well as the wage floor are relatively important elements in reducing the GPG. The effect of the derived pension rights as well as the GRAPA supplement even increases when considering the sharing between partners. They reduce the gap by around 17 pp and 10 pp respectively.

At the fifth quintile, the GPG is at around -20% in this context. Among the affluent, women's pension income is thus higher than that of men. It is noticeable that the difference between the GPG in the shared household income and the GPG in equivalized shared household income is very small, suggesting that people in the upper range of the distribution are less likely to have a partner.

The conclusions made about the redistributive elements in the analysis using the individualized income remain valid here. Overall, the effects of the redistributive corrections are reduced. Most important drivers in reducing the GPG at the upper distribution are the wage ceilings and the derived pension rights. For the other elements, the effect is close to 0.

Overall, one can conclude from this second part of the analysis, that the assumptions made about the income measure used in the calculation of the GPG play a major role in the results. The GPG is reduced dramatically when the equal sharing of pension income is assumed between partners. At the average, it decreases from around 25% to -10% (-3.15% when using the OECD-modified equivalence scale) showing the variability of the GPG considering the assumptions made. The relative effect of the various redistributive corrections is less impacted by the income concept. It is more about a shift in levels.

4.6 Conclusion

In this analysis the gender dimension of the different redistributive elements incorporated in the Belgian pension system is examined using administrative panel data from the CBSS. Using a counterfactual analysis, the change in the gender pension gap due to the different redistributive corrections is calculated while considering different scenarios regarding the attribution of the household's pension. Moreover, it is looked at three different points of the distribution to consider disparities in the effects.

The analysis consists in adding the different redistributive elements stepwise to a hypothetical proportional pension system until the actual system is reached. The results show that the corrections lead to a reduction in the GPG of around 30 pp on average. This reduction is greater

at the lower part of the distribution compared to the upper part of the distribution. It becomes evident that derived pension rights and assimilated periods have the biggest impact in reducing gender inequalities in pensions. This highlights a critical driver of the gap: women often either lack their own pension entitlements and rely on their partner's, or they receive lower benefits due to shorter, interrupted careers. Thus, career disparities, largely influenced by caregiving responsibilities, account for a substantial portion of the pension gap.

Policy initiatives should therefore prioritize reducing career inequalities, especially those arising from caregiving responsibilities when children are young or parents require assistance. Promoting workplace flexibility and supporting shared caregiving responsibilities can reduce the career interruptions that contribute to pension disparities. Simultaneously, it remains essential to recognize and value the contributions many women make outside the labor market by continuing to credit caregiving periods in pension calculations. The question remains, however, whether these credits sufficiently capture the long-term career impacts of these responsibilities.

The comparison of the different scenarios regarding the attribution of the household's pension offers a more comprehensive picture of gender inequality in the system. It shows that the GPG varies significantly depending on the underlying assumptions, suggesting that they have a substantial impact on the GPG. One does not know which, if any, of these assumptions made in the analysis corresponds to reality. This shows that the interpretation of the GPG is not as straightforward as it initially appears and that it is important to conduct such sensitivity checks.

This study underscores that the policy relevance of the GPG should be approached with caution. While the GPG is a valuable measure for highlighting disparities in pension benefits between men and women, it has

limitations. It provides a snapshot of individual benefits but fails to account for resource-sharing within households, which can alter financial security in ways that individual metrics alone may not reveal. Consequently, relying solely on the GPG may overlook the complexities of household financial dynamics, potentially leading to an incomplete understanding of gender inequality in retirement.

Chapter 5

Pension Adequacy and Inequality under Reform Scenarios

Abstract

This chapter examines the effect of three potential reforms in the Belgian pension system and uses a counterfactual analysis to assess whether they improve pension adequacy and reduce inequality across various measures. To ensure budget neutrality, the yearly pension expenditure is held fixed by adapting the replacement rate accordingly, allowing for a direct comparison to the current system. In a second step, the average gain/loss in pension entitlements is examined by marital status and gender to analyze which groups are supported by these reforms. The total effect is further decomposed into two components: the effects observed before budget neutrality is applied and those after its implementation. Results show that all reforms lead to an improvement of the system, even though the effect remains rather small. The largest impact can be obtained with the reform that addresses directly the effect of having children on the parent's career.

5.1 Introduction

A robust pension system is characterized by 3 attributes: adequacy, equality, and sustainability (European Commission, 2017; International Monetary Fund, 2014). Adequacy ensures that retirees receive benefits that are sufficient to maintain a decent standard of living after retirement. Equality¹ implies that the distribution of pension benefits is fair and does not disproportionately favor certain groups or individuals, in a sense that they are tailored to the distinct circumstances of each person to address disparities. Sustainability is crucial to the long-term viability of the system, as it ensures that it can meet the needs of future generations without placing an excessive burden on the economy. A balance between these three features is crucial to support pensioners efficiently while preserving social and economic stability.

The financial sustainability of the retirement system has been a persistent concern, especially with increasing life expectancy and the retirement of the baby boomer generation, which threatens the funding stability of these systems. This issue has been widely discussed and examined over the years (European Commission, 2012, 2024; Grech, 2013; International Monetary Fund, 2014). In terms of age-related expenditure, Belgium lies slightly above the EU average². However, ageing costs are projected to increase substantially in Belgium until 2070, driven by a sharp increase in pension expenditure. Spending on pensions is projected to increase by 4.3

¹In the context of pensions, the concept of equality is complex and multifaceted. It can refer to treating individuals equally ex-ante, meaning that those with similar work histories and career earnings receive similar benefits (horizontal equity). Alternatively, it can signify the distribution of equal pension benefits ex-post, treating individuals according to their individual circumstances and their needs (vertical equity). Horizontal equity does not necessitate redistributing resources among individuals with different means, whereas vertical equity might require such redistribution (International Monetary Fund, 2014). In this chapter, references to (in)equality in the pension system specifically refer to ex-post pension benefits, focusing on the distribution of benefits received by individuals after retirement.

²Age-related expenditure covers public spending on pensions, health care, long-term care and education. In 2022, it was at 24.4% of GDP in the EU, while being at 26.8% of GDP for Belgium. Pension expenditures constitute the largest portion of this spending, significantly influencing the outcomes in the projections (European Commission, 2024).

pp of GDP in Belgium, compared to only 0.4 pp in the EU as a whole. This is due to a decline in the share of the working-age population while the share of retirees increases. Despite efforts to address this issue through reforms³ aimed at increasing the labor market participation among the older population, the projected rise is insufficient to counterbalance the effect coming from the demographic change (European Commission, 2024).

Over recent years, pension adequacy has received increased attention. The Social Protection Committee and the European Commission publish “The Pension Adequacy Report” every 3 years since 2012, examining different topics of pension adequacy in the EU countries. Belgium includes several minimum regulations in its pension system to achieve a certain level of adequacy, such as a wage floor applied in the pension calculation, a minimum pension and the social assistance program called GRAPA. In the last decade, the aggregate replacement ratio increased, an indication for an improvement of adequate pension provision. However, Belgium still performs below the EU average in terms of adequacy⁴ (SPC and DG EMPL, 2021).

(In-)Equality in pensions as well has become a popular discussion topic over the years. Especially gender inequality has attracted greater focus since the Belgian presidency of the European Union (Council of the European Union, 2024). Belgium implements relatively many redistributive elements in its pension system, to reduce inequality in pension entitlements. The effect of those corrections on gender inequality has been shown in several studies (Peeters and Schols, 2023; Peeters et al., 2024) as well as in Chapter 4 of this thesis. In terms of general income inequal-

³See Fraikin et al. (2025) to get an idea about the impact of incentive-based reforms as a key factor in explaining the observed changes in employment patterns among older Belgian workers.

⁴The aggregate replacement ratio represents the gross median individual pension income of the population aged 65-74 relative to the gross median individual earnings from work of the population aged 50-59. It excludes other social benefits. Between 2008 and 2019, it increased for Belgium by 4 percentage points to reach almost 50%. The EU-average aggregate replacement ratio lies at 58% in 2019 (SPC and DG EMPL, 2021).

ity among those aged 65+, Belgium performs better than the EU average (SPC and DG EMPL, 2021). The lower level of income inequality shows the moderating effect of the redistributive corrections, considering that the statutory pension scheme is earnings-related at the base.

However, despite the presence of various redistributive mechanisms and different minimum rules in the Belgian system, certain profiles still lag behind, indicating a “structural incapacity of the pension system to deal with certain life courses” (SPC and DG EMPL, 2021, p.12). Particularly women face lower pension entitlements compared to men due to their incomplete careers, which are often a result of the caregiving responsibilities they shoulder. Chapter 4 covers this topic in detail, showing that the Belgian pension system manages to reduce gender inequality in pensions to a large extent through its redistributive corrections. However, a significant gap remains, leaving women more vulnerable to financial difficulties in retirement compared to men.

This chapter deals with this issue, by analyzing the effect of three potential reforms in the Belgian pension system on inequality and adequacy. The reforms under evaluation are selected because they specifically target structural inequalities within the current system. They are expected to enhance fairness by reducing disadvantages for vulnerable groups, particularly women with relatively short and interrupted careers. The three reforms are: (A) revalorizing past earnings at their true value by wage-indexing instead of price-indexing them; (B) decreasing the number of career years required to be eligible for a full pension; and (C) granting additional career years to compensate for the impact of childbirth and child-rearing on the career. The analysis is done by keeping pension expenditure fixed, offering insights into whether such changes improve the pension system in terms of adequacy and equality without challenging sustainability. The focus lies on wage-earners and self-employed. Moreover,

special attention is placed on conducting a detailed analysis by gender and marital status to assess which groups are effectively benefiting from these reforms. The total effect is further decomposed into two components : the effects observed before budget neutrality is applied and those after its implementation. Furthermore, the long-term variability of the reforms' effect is discussed.

The structure is as follows: Section 5.2 describes the data and the calculation of pension benefits. Section 5.3 proceeds with a description of the methodology. Section 5.4 provides the results of the counterfactual analysis to capture the short-term effect of the potential reforms on inequality and adequacy. Section 5.5 assesses whether long-term effects differ significantly to the short-term results by giving an indication about the behavioral response due to the reforms. Section 5.6 concludes.

5.2 Calculation of pension benefits

In the subsequent analysis, the yearly pension benefit⁵ is used. Below, first the data is presented and then it is detailed how this measure is calculated for each individual in the sample.

5.2.1 Data and sample

The analysis is based on the Belgian data from SHARE⁶. The SHARE Job Episodes Panel is used to reconstruct each person's career on a yearly basis,

⁵This section presents the yearly net pension benefit. However, some measures in the analysis use the gross benefit. This is specified in the explanation of the various measures in Section 5.3.

⁶SHARE (Survey of Health, Ageing and Retirement in Europe) is a biennial, cross-national panel survey covering individuals aged 50+ in 28 European countries and Israel since 2004/05, providing detailed information on health, labor market status, and household economic and social conditions. Retrospective modules allow the construction of the SHARE Job Episodes Panel, which reconstructs individuals' labor market histories over the life course.

allowing for the calculation of their pension entitlements. As previously explained, the SHARE Job Episodes Panel provides wage information only for years when an individual started or left a job. A linear interpolation of real wages is used to fill in missing wage information⁷.

For the analysis, retirees aged 65+ and who worked as wage-earners and/or self-employed are selected from each SHARE wave from 2005 to 2019. This corresponds to individuals born before 1954. Since individuals can appear in multiple waves, it is possible that they appear more than once in the sample if they meet the age requirement in different years. Retirees with a mixed employment history as wage-earner, self-employed and/or civil servant remain included in the sample. It is composed of 7265 observations. Table 5.1 shows some descriptive statistics of the sample in the respective year in which the person was interviewed in SHARE.

Table 5.1: Summary statistics of sample, retirees aged 65+

	Total	Men	Women
Number of			
Observations	7265	3874	3391
Individuals	2229	1206	1023
Demographics			
Marital status			
Single	7%	6%	8%
With partner	30%	34%	25%
Married	30%	35%	24%
Divorced	12%	11%	13%
Widowed	21%	13%	29%
Employment			
Average years of career	33	40	26
Average ACE (in 2025 EUR)	65767	89857	38245

Source: Author's calculations based on SHARE data.

Notes: ACE refers to individual average career earnings. They are calculated by dividing the total gross earnings gained over the career (as wage-earner, self-employed and civil servant) by the number of career years.

⁷Appendix A.1 offers a more detailed description of the career construction process.

5.2.2 Yearly net pension benefit

For each observation in the sample, the net yearly pension benefit is calculated, considering the rules in place in the first year of benefit collection, the individual's career as well as the marital status and the partner's income. It includes the public pension benefit based on the individual's wage-earner, self-employed and civil servant career as well as the GRAPA supplement. The derived pension rights such as the survivor and divorcee pension are not included in this measure because of data limitations⁸.

To validate the calculations, Figure 5.1 compares the distribution of both, the net pension benefits declared in SHARE and the ones calculated with the simulation tool⁹. On average, a yearly net pension benefit of EUR 20782 is calculated while respondents declare a yearly net pension benefit of EUR 21374 in SHARE (expressed in 2025 EUR).

Figure 5.1: Distribution of the yearly net pension benefits – SHARE and predictions



Source: Author's calculations based on SHARE data.

⁸The career information of the deceased/divorced partner is not fully available, making it impossible to calculate those rights.

⁹To end up with more observations, the validation of the calculator was done not exclusively for people from the sample but for all retirees in SHARE, no matter their age. 846 individuals are matched, 403 women and 443 men.

Table 5.2 presents the average yearly net pension benefit of the sample by marital status and gender calculated by the simulation tool. As expected, women have on average lower benefits than men. It is noticeable that women without partner (single or divorced) have on average higher benefits than women with partner or who used to have a partner (with partner, married or widowed). This might be due to lower incentives for participation in the labor market and advancements in career for women in a relationship as they might rely on the partner's earnings while taking on other responsibilities outside the labor market such as care duties (European Parliament, 2016). For men, the differences in average pension benefits across marital status are less striking. However, it should be noticed that this measure relates to individual pension benefits and does not consider a pooling of resources within a household. If this were taken into account, the situation would probably look different, both between the genders as demonstrated in Chapter 4, as well as between the different marital statuses¹⁰.

Table 5.2: Calculated average yearly net pension benefit per category of marital status – in 2025 EUR

	Men	Women
Total	23715	13876
Single	23217	16705
With partner	23270	12917
Married	24531	13187
Divorced	24382	18007
Widowed	22386	12601

Source: Author's calculations based on SHARE data.

¹⁰To assess income poverty and to identify individuals or households at risk of financial hardship, the At-risk-of-poverty rate (AROP rate) is usually used. It measures the percentage of people whose income is below a certain poverty threshold, typically set at 60% of the median national income. The SPC and the European Commission detect a higher AROP rate among single and divorced women in Belgium (SPC and DG EMPL, 2021). However, when calculating the AROP rate, the equivalized disposable household income is used instead of individualized income, improving outcomes of women with partner. Moreover, the survivor pension is included in their measure. These factors explain the difference in findings and show the important difference the income definition can make in the results.

5.3 Methodology

This chapter examines the effect of three potential reforms in the Belgian pension system on inequality and adequacy. To do this, counterfactual pension benefits are calculated with the objective to assess what would be the situation if the different reforms were implemented.

The reforms simulated concern both, the wage-earner pension and the self-employed pension because those two pension schemes are closely related in terms of regulations. It would not make sense to reform one of the schemes without the other. However, the pension scheme of civil servants remains unaltered because it operates so differently. Even though it is linked to the other two schemes, the system design is very different in terms of benefit calculation, making it difficult to implement an equivalent reform. Any attempt to implement a comparable reform in the civil servant scheme would appear arbitrary. As a reminder, the civil servant pension is still calculated and added to the total pension for the analysis, to obtain a more realistic picture of the net pension for the individuals with mixed careers. However, the amount remains the same throughout the different simulations.

5.3.1 Reform scenarios

The Belgian pension system is built on the Bismarckian principle of earnings-related payouts: those who contribute more during their working lives receive higher benefits upon retirement, reflecting an insurance perspective. However, such a system assumes that all individuals have equal opportunities in the labor market to accumulate contributions and secure full pension rights. In practice, structural disadvantages arise for certain groups, justifying the use of redistributive mechanisms to mitigate these

inequalities. Nevertheless, certain profiles still lag behind. Women, for example, continue to receive lower pension payouts despite numerous policy measures such as time credits and various minimum regulations. This disparity largely results from their disproportionate involvement in caregiving responsibilities, which makes them more likely to work part-time or experience career interruptions, often leaving them without full pension entitlements¹¹. Importantly, these patterns are frequently not the result of individual preference; rather, they reflect household-level decisions¹² and are reinforced by social norms¹³. Yet, in retirement, women disproportionately bear the negative consequences of these often jointly made decisions, a situation that raises clear equity concerns, as already highlighted by the Belgian Commission for Pension Reform 2020-2040 (Schokkaert et al., 2020).

The reforms considered in this study are therefore designed specifically to make the pension system fairer for women by mitigating these structural disadvantages associated with childbirth and caregiving responsibilities, while preserving the insurance principle¹⁴.

¹¹These dynamics are also reflected in ongoing pension policy debates in Belgium. Recent reform proposals have increasingly emphasized strengthening the link between contributions and benefits, for instance by tightening minimum career requirements, placing greater weight on effectively worked years, and introducing a pension malus for individuals who do not meet certain career conditions. While such measures are generally justified in terms of financial sustainability and incentives to extend working lives, they have also sparked criticism. In particular, concerns have been raised that these reforms may reduce the system's capacity to compensate for structurally unequal labor market opportunities and could disproportionately affect women, who are more likely to have shorter or interrupted careers and to work part-time due to caregiving responsibilities (Struys, 2026).

¹²These joint decisions are often made to optimize family income, where it is economically rational for women to reduce working hours because male partners earn more.

¹³Despite significant progress in gender equality, traditional gender roles still influence how responsibilities are divided between men and women. In 2022, 27.8% of employed women worked part-time versus 7.6% of employed men (Eurostat, 2023b). In 2018, 82% of those who have reduced their working hours for childcare were women and every third women had a career interruption for childcare reasons, compared to only 1.3% of employed men (Eurostat, 2019). These statistics refer to the entire EU and not just Belgium.

¹⁴One could argue that flat-rate benefits, as in a Beveridgean system, would be most effective, as they eliminate earnings-related inequalities altogether. However, such a system would also abandon the insurance principle. The proposed reforms instead preserve this principle, albeit in attenuated form as the link between contributions and pension benefits is weakened.

Simulation A : wage-indexing of past wages

In the current Belgian pension system, past wages are revalued in the pension calculation using the health index. However, this can be misleading, as the health index does not reflect real wage growth. Past salaries often contribute very little to the pension calculation, as they are quite low. This can be a problem especially for women, who depend mainly on past salaries. They often work full-time at the start of their careers, but as they progress through different stages of life, it is common for them to take career breaks or shift to part-time work, to manage additional responsibilities.

In simulation A, instead of adjusting past wages using the health index, they are revalued according to real wage growth, which increases the influence of early-career earnings on the total pension benefit. For this, the average hourly earnings of Belgium are used as reported by the OECD. It is available from 1955 onwards¹⁵.

Simulation B : reducing the number of required career years

In the Belgian pension system, 45 years of career are required to qualify for a full pension, the amount of the pension depending on the average salary over these 45 years. Those with longer careers naturally accumulate higher contributions and thus receive larger pensions. While the principle that insufficient contributions lead to reduced benefits reflects the insurance logic of the system, it raises concerns about the adequacy of retirement income for certain groups. Women are particularly affected as they struggle the

¹⁵The data is extracted from the OECD Data Explorer and focuses exclusively on earnings in the manufacturing sector. While the OECD also provides data on the average annual wage, which offers broader coverage, this series is only available from 1990 onwards and thus cannot be used for the analysis due to its limited historical scope. To validate the manufacturing data, its growth rate has been compared to that of the average annual wage in Belgium, with both showing a similar trend over time. It is further assumed that the evolution of these two series was comparable even before 1990.

most to reach the required number of career years as additional responsibilities often limit their participation in paid work. While the assimilation of certain types of periods of “inactivity”¹⁶ help to mitigate this, they are not sufficient¹⁷.

However, the rules are different when looking at Belgium’s neighboring countries. For example, in France, benefits are calculated on the basis of the average annual salary for the best 25 years. In Germany, to be entitled to a full pension, the pensioner needs a credited career of at least 35 years (SPC and DG EMPL, 2021).

In simulation B, the number of required career years in order to be eligible for a full pension is reduced to 35 years. They will not be further reduced to remain compatible with other regulations in the Belgian pension calculation. For example, it is necessary to have a career of 30 years to be eligible for the minimum pension. It would therefore make no sense to go below this limit without also adapting other rules. To identify the effect of reducing the number of required career years without interference from other changes, everything else in the pension system is kept unchanged.

Reducing the number of required career years makes the assimilated periods that are currently used in the pension calculation less necessary. This simulation is therefore carried out in 3 versions. Simulation B1 – keeping all current assimilated periods; simulation B2 – the assimilated periods are reduced to the essential ones namely time spent outside the labor market for reason of sickness and/or disability; simulation B3 – dropping the entirety of the assimilated periods. This sensitivity test makes it possible to see to what extent the assimilated periods still make sense and have an effect in such a reformed system.

¹⁶Inactivity in a sense of being inactive on the labor market.

¹⁷In the EU in 2022, men have an expected career of 38.6 years, compared to 34.2 years for women (Eurostat, 2023a).

Simulation C : granting additional career years for childbirth and child-rearing

In the current Belgian pension system, time spent on maternity/paternity leave as well as parental leave is treated as assimilated periods. This ensures that parents are not penalized for taking time off to care for their children. The assimilated periods help accrue pension rights, preventing any negative impact from those leaves on the future pension benefits.

However, having a child not only directly impacts a career through these leaves, but also has significant indirect effects on the entire career path, particularly for women. After returning from leave, many mothers often reduce their working hours or switch to part-time roles to balance childcare responsibilities, as previously explained. This decision can affect long-term career development, such as slower promotions, fewer opportunities for advancement, or lower lifetime earnings, resulting in reduced pension benefits. But even when returning fulltime, women continue in most cases bearing the majority of the mental load associated with having children, which affects their professional behavior and choices (Flèche and Sénécal, 2021). There is no support for parents in this respect in Belgium.

In France, the MDA (majoration de durée d'assurance) exists, designed to compensate for the challenges of balancing work and raising children. These are extra insurance quarters granted to parents on a fixed basis when their pension is calculated, regardless of whether they interrupt or reduced their work activity. In the general scheme for wage-earners, for each child, the insured mother is entitled to four extra quarters for childbirth and four more for child-rearing. Since 2010, the four extra quarters for child-rearing can also be attributed to the father¹⁸ (Vie-publique.fr, 2021).

¹⁸In practice, these quarters are still mainly awarded to mothers: in 2020, 88% of women who have settled a pension under the general scheme have MDA, compared with only 0.5% of men (Guirriec, 2023).

Simulation C takes the French MDA as an example. Women are granted one additional career year in their pension calculation for each child to compensate for the impact of childbirth on their career. One more year is granted for child-rearing¹⁹. As explained above, in France, the option is given to credit this additional year either to the mother or the father. This is positive, as efforts should be made to involve men more in childcare to promote greater equality in caregiving responsibilities. However, the reality shows that, even today, it is still mostly women who take on this role. For this reason, this extra year will be systematically assigned to the mother in this simulation, as the data does not allow to identify the primarily caregiving parent. However, the reform should still provide for the option of assigning this extra year to men, as in some cases men take on this role, and this may be more common in the future.

The additional career years count in the calculation of the pension benefit as well as when assessing whether a person is eligible for the various minimum regulations. However, these years are not taken into account in the calculation of the pension bonus and when determining whether someone is eligible for early retirement as these regulations explicitly reward long employment on the labor market.

Budget-neutral reforms

The reforms outlined above make the pension system more generous and therefore less sustainable. In order to examine the effect of the reforms on inequality and adequacy without challenging sustainability, the reforms are made current-period budget-neutral at the level of the pension system.

¹⁹This is in line with the view of the Belgian Commission for Pension Reform 2020-2040, which emphasized that the pension system should be grounded in solidarity and should protect individuals who experience adverse outcomes during their working lives that cannot be fully attributed to personal responsibility, as well as those who make socially valuable contributions that are not directly rewarded by the market (Schokkaert et al., 2020).

To do this, the yearly gross pension expenditure²⁰ is calculated for the sample and kept constant throughout the simulations, by adapting the replacement rate²¹ accordingly.

The effect is then decomposed: The *pre-adjustment effect* represents the initial impact of the reforms on inequality and adequacy before any adjustments on the replacement rate are made. The *balancing effect* refers to the impact of the alteration of the replacement rate to ensure budget neutrality.

5.3.2 Inequality and adequacy measures

To assess the effect of the different reforms on pension adequacy and inequality, we look at different measures.

- (a) Gini: First, the Gini coefficient is analyzed. As a measure of overall inequality, its evolution indicates whether the reforms lead to a reduction or an increase in inequality. It is calculated using the yearly net pensions and ranges between 0 and 1. A higher Gini coefficient means higher inequality.
- (b) Gender pension gap (GPG): As the reforms described above might make a difference especially for women, the gender pension gap is examined to see if inequality between men and women is affected. The GPG represents the difference between the average gross yearly retirement income of men and women expressed as a percentage of men's average gross yearly retirement income. The measure calculated here limits "retirement income" to the public pension which is the main

²⁰The pension expenditure consists of the summed up yearly gross pension benefits of the sample.

²¹The single rate is adapted, and the household rate remains 25% higher than the single rate as it is currently the case.

income source of retirees in Belgium (OECD, 2019), leaving aside income from the second and third pillar. As a reminder, the derived pension rights are not included because of data limitations leading thus to a larger GPG as commonly observed for Belgium as demonstrated in Chapter 4. Despite this limitation, it can still be analyzed whether the GPG increases or decreases because of the reforms.

- (c) Headcount measures: To examine whether there is an improvement in pension adequacy due to reforms, we look at the percentage of the sample that is affected by the GRAPA supplement and/or the different minimum regulations implemented in the pension calculation. Usually, the AROP rate is analyzed to assess pension adequacy. However, as the derived pension rights cannot be included in the yearly pension measure, it is not possible to determine who is situated below the poverty line. This is why the headcount measures are used instead to get an idea about the occurrence of people that are in need for the minimum regulations and/or the GRAPA.
- (d) Average gain/loss by marital status and gender: To examine which profiles gain/lose due to the reforms, a more detailed analysis is done for different categories of marital status and gender. For this, the sample is divided into 5 categories : single, with partner, married, divorced, widowed. For each category, the average gain/loss in yearly net pension benefit due to the reforms is calculated. This is done to understand if the reforms benefit individuals that are more vulnerable²² to economic hardship in the current pension system and whether the reforms lead to a better coverage of those profiles.

²²In this context, vulnerable retirees are those with relatively low individual yearly pension entitlements.

5.3.3 Behavioral response

In this counterfactual analysis, it is assumed that no behavioral response follows the different reforms. The career of each individual in the sample remains thus unaltered throughout the different simulations. Even though it can be assumed that individuals would react to a change in the system by adapting their working and retirement behavior, such an adjustment does not happen immediately but over time, if one presumes that the reform is implemented unexpectedly. The results shown are therefore the short-term changes due to the reforms. The long-term results which include the behavioral changes are out of the scope of this analysis.

However, to assess whether long-term results may differ substantially from the short-term results presented, we conduct a regression analysis to gain insights into the extent of the behavioral response. We estimate retirement probabilities which allow to calculate the average retirement age in the different counterfactual situations to get an impression of whether the reforms will lead to earlier or later retirement. This is presented in Section 5.5.

5.4 Counterfactual analysis

This section presents the results of the counterfactual analysis. For each of the three reforms, it is first looked at the effect on the different inequality and adequacy measures, then the average gain (or loss) in net pension benefits is examined for different categories of gender and marital status and lastly the total effect is decomposed into a pre-adjustment and balancing effect.

5.4.1 Simulation A : wage-indexing past earnings

Effect on inequality and adequacy

Table 5.3 shows the inequality and adequacy measures in the actual system and the counterfactual one.

Table 5.3: Comparison of measures – simulation A

Measures	Actual system	Simulation A
Gini	0.2585	0.2558
GPG	46.88%	46.12%
Headcount measures		
Wage floor	42.53%	38.54%
Guaranteed minimum pension	20.77%	21.68%
GRAPA	7.25%	6.95%

Source: Author's calculations based on SHARE data.

General inequality is slightly reduced due to the change in indexing. The Gini decreases from 0.2585 to 0.2558. Individuals with lower pensions benefit on average more from wage-indexing than individuals with higher pensions. This makes sense considering the fact that wage ceilings are applied if wages are too high. For individuals earning above the ceiling, the wage-indexing does not make a difference. When looking at the GPG²³, one sees a reduction of 0.76 pp. Women benefit more from this reform than men which can be explained by the same reason. Men earn on average more and are thus more often in the case of being affected by the wage ceilings.

In terms of adequacy, results are mixed. Less individuals are dependent on the wage floor for the pension calculation since wages are better valorized due to the wage-indexing. However, due to the lowering of the replacement rate, more use is made of the guaranteed minimum pension. However, the GRAPA supplement is used slightly less after implementa-

²³As a reminder, the derived pension rights are not included in this measure, explaining a higher GPG than usually observed for Belgium. In terms of size, this GPG is consistent with the results found in Chapter 4 using administrative data when not including the derived pension rights.

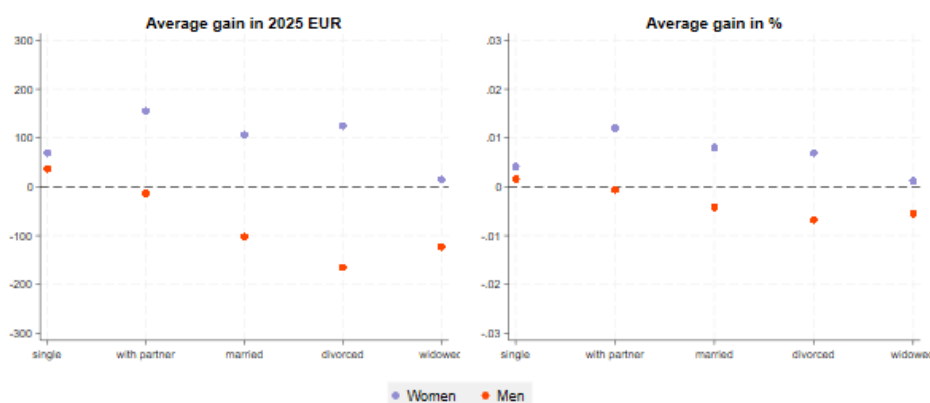
tion of the reform. There are thus less people in the sample in need for social assistance, speaking for an improvement in pension adequacy.

Overall, the wage-indexing appears to have a positive impact on both inequality and pension adequacy. However, the effects are very small in magnitude.

Analysis by marital status and gender

To get a better idea which profiles benefit/lose from the change in the system and to what extent, Figure 5.2 presents the average gain/loss in yearly net pension benefits by marital status and gender.

Figure 5.2: Average gain in yearly net pension benefits by marital status and gender – simulation A



Source: Authors' calculations based on SHARE data.

Notes: The average gain in % is relative to the pension benefit pre-reform.

In general, women benefit on average when past earnings are wage-indexed instead of price-indexed. Widowed women experience the smallest gain. This can be explained by the fact that they have the shortest careers in this sample²⁴ on average compared to the other types of women, and therefore, less earnings that are positively affected by this reform. As a consequence, they face a larger impact from the reduced replacement rate.

²⁴A table showing the average number of career years and average career earnings by marital status and gender can be found in Appendix C.1.

For men, the reform generally results in a reduction in pension benefits. However, the impact varies depending on marital status. Single men slightly gain in benefits due to the reform. Men with partner have an effect close to zero. The other types of men lose in benefits, with the largest effect for divorced and widowed men. Contrary to the women, this cannot be explained by differences in the career length. For men, the career length is more or less the same across marital status. As already hinted previously, the explanation lies in the level of earnings throughout their career. Single men have on average lower earnings and are therefore less affected by the earnings ceiling. The positive effect of the reform on past earnings is thus noticeable in the pension calculation, leading to increased pension entitlements. The other types of men have on average higher earnings. Wage-indexing those earnings leads to an increase which has, however, no effect in the pension calculation if earnings lied already above the ceiling pre-reform. Being more often in this case, those types of men notice the effect of the reduced replacement rate to a larger extent, leading to a decline in benefits on average.

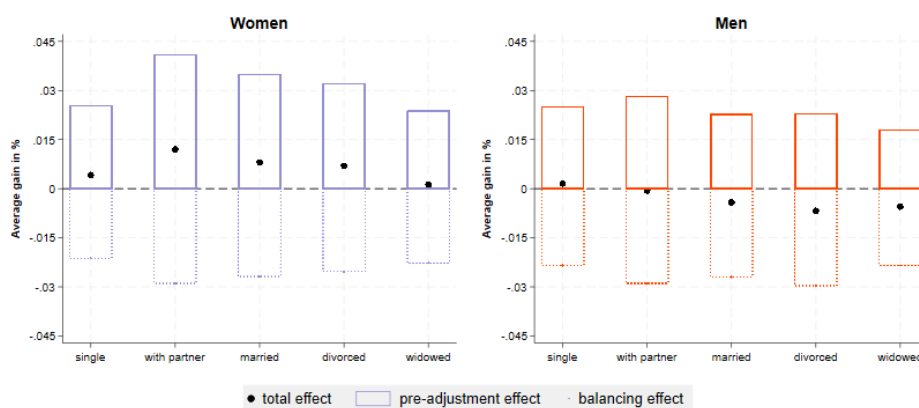
In general, one can conclude that this reform leads to an improvement in yearly pension benefits for women, conditional to the fact that their career reaches a certain length. If the career is too short, the positive effect of the increased valorization of past earnings just about offsets the negative effect of the reduced replacement rate. Hence, even though the reform achieves a fairer valorization of past earnings, it falls short in supporting the most vulnerable groups in the current system, namely women with relatively short career histories. This group is disproportionately composed of mothers who have reduced their working hours or taken career interruptions to care for children. The reform is thus not sufficient to mitigate the pension inequalities that often arise from child-rearing responsibilities.

Decomposition of the effect

In this section the total effect of the reform is decomposed into a pre-adjustment effect and a balancing effect. As a reminder, the pre-adjustment effect represents the initial impact of the reform before any adjustments on the replacement rate are made and the balancing effect refers to the impact of the alteration of the replacement rate to ensure budget neutrality.

Figure 5.3 shows the different effects of the reform, relative to the pre-reform pension benefits by category of gender and marital status.

Figure 5.3: Decomposition of the effect – simulation A



Source: Author's calculations based on SHARE data.

Notes: The average gain in % is relative to the pension benefit pre-reform.

As expected, wage-indexing instead of price-indexing the past earnings, leads to a more generous pension system *ceteris paribus*. Each category benefits from it on average, leading to a positive pre-adjustment effect. However, the relative gains are larger for women due to their lower earnings and the fact that they are less affected by the wage ceilings compared to the men, as previously explained. This reform leads to an increase in pension expenditure of around EUR 6 million for this sample (expressed in 2025 EUR).

In order to remain budget-neutral and have the same pension expenditure as pre-reform, the replacement rates are reduced by 6.67% (from

60% to 56% for the single rate and from 75% to 70% for the household rate). This leads to a reduction in net pension benefits. The balancing effect is thus negative. As can be seen on the graph, there is not much difference between men and women in the relative loss in benefits due to the lowering of the replacement rate.

Overall, the positive pre-adjustment effect is slightly larger for women, whereas the negative balancing effect is similar, showing no significant difference in its intensity for men and women. Consequently, the overall outcome for women remains positive, as the stronger pre-adjustment effect outweighs the negative impact of the balancing effect. For men, however, the influence of the balancing effect is more consequential, resulting in a net loss. For them, the positive contribution of the pre-adjustment effect is not sufficient to counterbalance the negative balancing effect.

This reducing effect in gender inequality becomes even more pronounced when looking at pension wealth²⁵ rather than just yearly pension benefits, as the longevity factor comes into play. Since women, on average, have a longer life expectancy, they typically collect their pension benefits over a more extended period than men. As a result, an increase in yearly pension benefits translates to a more significant impact on overall pension wealth.

²⁵The pension wealth represents the present discounted value of all future pension benefits, taking into account life expectancy.

5.4.2 Simulation B : reducing the number of required career years to 35 years

Effect on inequality and adequacy

Table 5.4 shows the inequality and adequacy measures in the actual system and the counterfactual ones.

Table 5.4: Comparison of measures – simulation B

Measures	Actual system	Simulation B		
		All assim. periods	Ess. assim. periods	No assim. periods
Gini	0.2585	0.2464	0.2515	0.2533
Gender pension gap	46.88%	44.36%	45.47%	45.84%
Headcount measures				
Wage floor	42.53%	56.79%	54.96%	54.41%
Guaranteed minimum pension	20.77%	36.53%	33.26%	31.91%
GRAPA	7.25%	6.25%	6.44%	6.61%

Source: Author's calculations based on SHARE data.

Regarding general inequality, the Gini coefficient decreases when reducing the number of required career years. However, the effect diminishes once assimilated periods are excluded, suggesting that these periods disproportionately benefit individuals with lower pension entitlements and remain a key mechanism for reducing inequalities, even in the reformed system. Gender inequality decreases as well in the counterfactual systems compared to the actual one, no matter what version of simulation B is used. This indicates that women benefit more from the reduction in required career years than men. Again, the more assimilated periods are dropped, the more the observed effect diminishes.

When looking at the headcount measures, more individuals are benefiting from the wage floor. However, this is not because wages become lower, as they remain unchanged and the most advantageous earning years enter the pension calculation. The explanation lies in the regulation of the

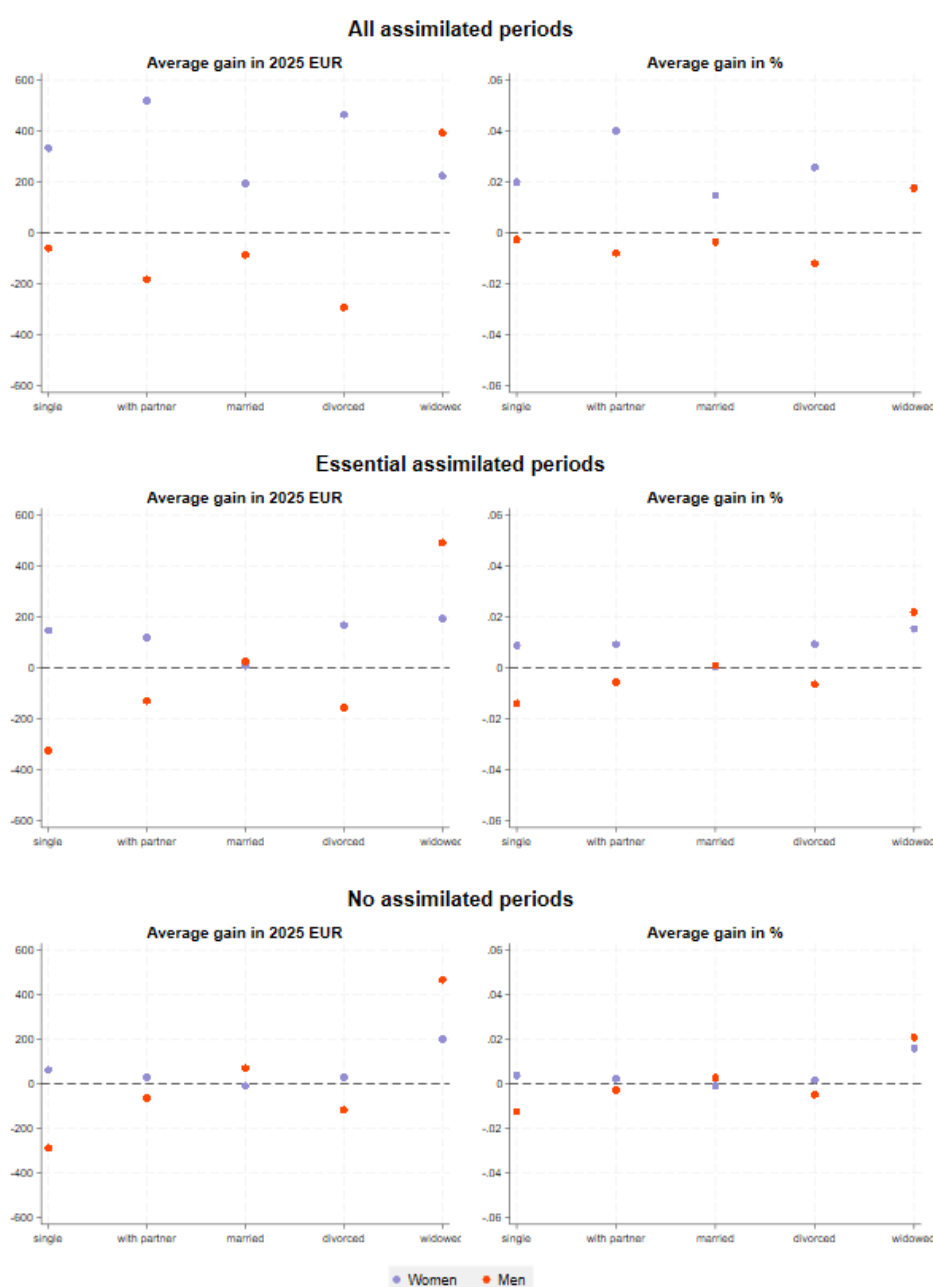
wage floor application. In the Belgian pension system, the pension is calculated once using the individual's own earnings and once using the wage floor, if the person is eligible. The most advantageous pension is chosen. However, there is a limit to the pension that can be obtained thanks to the wage floor, and this limit depends on the career fraction. By reducing the career years needed for a full pension, the career fraction increases, and thus the limit increases as well. This makes the pension calculated using the wage floor more advantageous than the pension based on earned wages in several cases, explaining a higher percentage of the sample affected. When gradually dropping the assimilated periods, the headcount decreases. On the one hand this can be explained by the same reasoning. Dropping the assimilated periods lowers the career fraction and consequently the limit of the pension when the wage floor is used. This makes the pension based on earned wages again more advantageous in some cases. On the other hand, dropping the assimilated days can also result in no longer meeting the career condition to be eligible for the wage floor, which lies at 15 years. More individuals also benefit from the guaranteed minimum pension which can be explained by the same logic, as the amount of the minimum pension is also adjusted to the career fraction. The headcount measure of the GRAPA decreases in the counterfactual systems, speaking for less individuals in need of social assistance.

Overall, this reform has a positive impact on both inequality and pension adequacy. In terms of magnitude, reform B delivers slightly larger effects than reform A but the overall impact remains moderate. Dropping the assimilated periods reduces this effect to a large extent, highlighting the importance of these periods in mitigating inequalities even in a system that requires less career years.

Analysis by marital status and gender

Figure 5.4 presents the average gain/loss in yearly net pension benefits by marital status and gender, to see which profiles benefit/lose from the reduction of the required career years and to what extent.

Figure 5.4: Average gain in yearly net pension benefits by marital status and gender – simulation B



Source: Author's calculations based on SHARE data.

Notes: The average gain in % is relative to the pension benefit pre-reform.

Broadly speaking, men lose while women gain in yearly pension benefits due to this reform, which explains the decrease in the Gini coefficient and the GPG. The effect declines when gradually dropping the assimilated periods, indicating that especially women benefit from them.

Due to the reduction in career years required to get a full pension, women are closer to a full career which leads to higher pension benefits. Men, however, were very close to a full career²⁶ already before the reform on average, which is why they feel the effect of the reform less in their pension benefits. Even though only the best earning years are selected in the pension calculation and the poorer ones are omitted in case of a full career, this can in most cases not offset the negative impact from the reduction in the replacement rate, which is why most men lose in pension benefits on average.

An exception are widowed men, who also win from the reform on average. This can be explained by the fact that the widowed men in this sample have higher average earnings²⁷ compared to the other men. They benefit thus more from the fact that lower earnings years are replaced by higher ones in the pension calculation which counterbalances the negative effect coming from the reduced replacement rate.

In general, it can be said that the reform does help the more vulnerable groups of the current system, as the reform benefits workers with shorter careers. However, the assimilated periods remain an important element to reduce inequalities even in the reformed system. It remains essential to recognize and properly value the contributions that many women make outside the formal labor market by continuing to credit caregiving periods in pension calculations. Otherwise, the positive impact of reducing the required career years is largely offset.

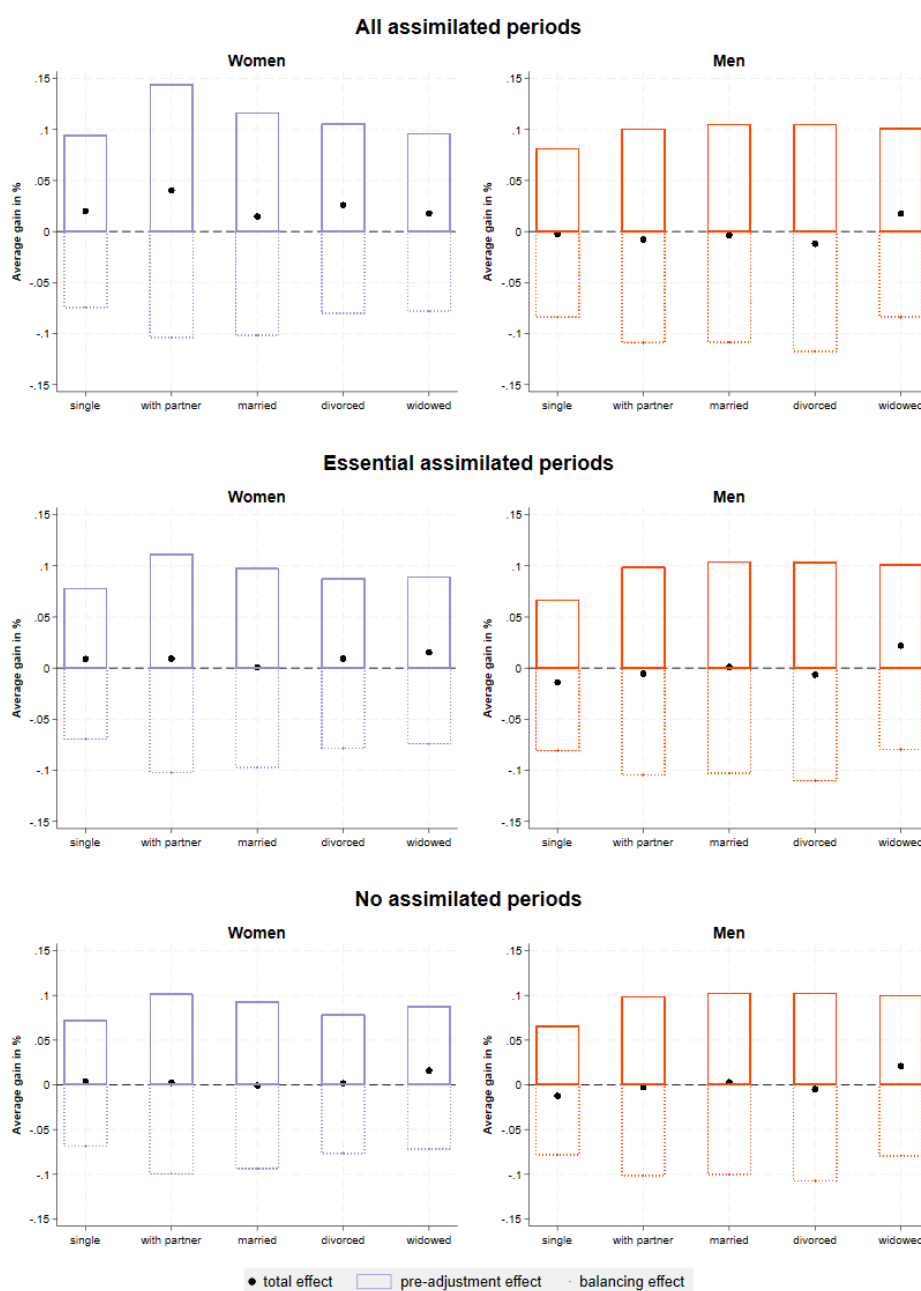
²⁶Appendix C.1 shows the average number of career years by marital status and gender.

²⁷See Appendix C.1 for the differences in average career earnings by marital status and gender.

Decomposition of the effect

The effect of the reform shown above is here decomposed into a pre-adjustment effect and a balancing effect. Figure 5.5 shows this decomposition for the three versions of the simulation.

Figure 5.5: Decomposition of the effect – simulation B



Source: Author's calculations based on SHARE data.

Notes: The average gain in % is relative to the pension benefit pre-reform.

Reducing the required number of career years to be eligible for a full pension to 35 years leads to fuller careers and consequently to higher benefits. Pension expenditure for this sample increases by EUR 23.3 million in the case where all assimilated periods are kept, and by EUR 21.7 million when all assimilated periods are dropped (expressed in 2025 EUR). The pre-adjustment effect is positive for all categories, but more pronounced for women in the first version where all assimilated periods are kept, as men are more often in the case to have already reached a full career. Gradually dropping the assimilated periods has little to no effect for the men, but it leads to a reduction in this positive effect for women, showing that they are the main beneficiaries of those periods.

In order to have the same pension expenditure for this sample as pre-reform, the replacement rates are reduced by 26.67% (from 60% to 44% and from 75% to 55% respectively) in the first version of this reform, keeping thus all assimilated periods. When keeping only the essential assimilated periods namely time spent outside the labor market for reason of sickness and/or disability, the single and household rates are reduced by 25% (to 45% and 56.25% respectively). In the third version in which all assimilated periods are dropped, the replacement rates are reduced by 24.17% (to 45.5% and 56.875% respectively). The gradual drop of assimilated periods makes the system less generous, which means that the replacement rate must be reduced less in order to keep expenditure constant. Reducing the replacement rate leads to lower benefits, thus a negative balancing effect. When moving from one version to the next of this simulation, this negative effect reduces slightly, which is expected as the replacement rates are lowered less. However, it shows no significant difference between men and women.

The comparison in the change of these two effects thus explains very well the pattern seen in the section above. Women benefit more from this

reform leading to a positive pre-adjustment effect that exceeds the negative balancing effect. For men this is not the case which is why the balancing effect more than offsets the positive effect coming from the reform. The gradual removal of the assimilated days then leads to a decrease in the positive effect for women.

5.4.3 Simulation C : granting additional career years for child-birth and child-rearing

Effect on inequality and adequacy

Table 5.5 shows the inequality and adequacy measures in the actual system and the counterfactual one where two additional career years are granted to mothers to compensate for the impact of child raising on the career.

Table 5.5: Comparison of measures – simulation C

Measures	Actual system	Simulation C
Gini	0.2585	0.2333
GPG	46.88%	39.45%
Headcount measures		
Wage floor	42.53%	52.33%
Guaranteed minimum pension	20.77%	30.46%
GRAPA	7.25%	6.92%

Source: Author's calculations based on SHARE data.

The reform leads to a reduction in general inequality. This is not a surprise since the reform, as it is executed in this simulation, is beneficial for women, who have on average lower pension benefits compared to men. The effect can also be seen very clearly in the GPG, which decreases by 7.50 pp.

In terms of adequacy, an increased percentage of the sample benefits from the wage floor regulation applied in the pension calculation as well as the guaranteed minimum pension, and that to a relatively large extent (10

pp each). This is because the additional years allow more women to meet the eligibility criteria for these minimum rules. In general, this reform results in fewer people having to claim social assistance, which speaks for an improvement in adequacy.

Overall, this reform leads to improvements in both inequality and adequacy, and, among the three considered reforms, it has the largest impact in terms of magnitude.

Analysis by marital status and gender

The analysis by gender and marital status, presented in Figure 5.6, shows clearly what has been stated previously. Women gain in average yearly net pension benefits due to the reform, while men lose. The gain is greatest in the categories that are more likely to have children, e.g. women with partner or married women. For single women, the effect is smaller. The loss that can be observed for men does not differ between the different categories of marital status.

Figure 5.6: Average gain in yearly net pension benefits by marital status and gender – simulation C



Source: Author's calculations based on SHARE data.

Notes: The average gain in % is relative to the pension benefit pre-reform.

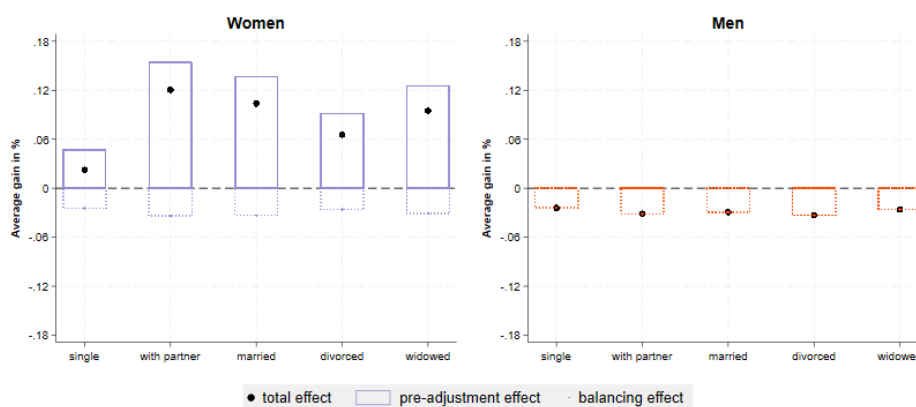
The reform's disproportional benefit to women can spark some debate, as it treats men and women differently. However, it should be made clear that the reform is not intended to create different rules for men and women. Instead, it aims to address a specific issue that can affect both men and women — the consequences of child-rearing on one's career. The reform is not designed to favor women but to ensure that caregiving and its consequences on the career are fairly acknowledged, regardless of whether the man or the woman or both take on this responsibility. While it is currently more common for women to bear the majority of childcare duties, the reform should be flexible enough to attribute these years to men when they are the primary caregivers, or to both, should it be equally divided between parents. As already mentioned previously, the available data lacks detailed information on who is primarily responsible for raising the children. The caregiving years are thus automatically attributed to the mother in this simulation, because for the birth cohort treated in this analysis, women bore most caregiving duties²⁸.

Decomposition of the effect

Figure 5.7 shows the total effect of the reform as well as its decomposition into the pre-adjustment and balancing effect by category of gender and marital status.

²⁸The current execution of the reform assumes that the primary caregiving parent, predominantly the mother in this cohort, experiences a significant impact on their career due to childbearing and child-rearing responsibilities. However, it is equally valid to argue that both parents face career disruptions from child-rearing, not solely the mother. To address this broader perspective, a second version of simulation C is conducted and presented in Appendix C.2. This alternative reform grants an additional career year to mothers for childbirth and one more year for child-rearing, with the latter applied equally to both parents. This adjustment would recognize shared responsibility for childcare, aligning with the ideal of equal caregiving roles. Nonetheless, data shows that, on average, fathers do not experience significant career disadvantages due to children, unlike mothers (Kleven et al., 2019). This supports the initial, more targeted execution of the reform, which, on the other hand, might inadvertently perpetuate unequal caregiving responsibilities. The alternative version of Simulation C provides insights into the implications of equally recognizing child-rearing responsibilities for both parents on inequality and adequacy.

Figure 5.7: Decomposition of the effect – simulation C



Source: Author's calculations based on SHARE data.

Notes: The average gain in % is relative to the pension benefit pre-reform.

There is only a pre-adjustment effect for women, because only women benefit from the extra years. The effect is positive because the reform leads to fuller careers and it is greater for women more likely to have children. The granting of extra years causes an increase in the pension expenditure for this sample of EUR 6.5 million (expressed in 2025 EUR).

In order to cover this increase in expenditure, the single and household replacement rates are reduced by 8.33% (from 60% to 55% and from 75% to 68.75%). The consequences of lowering the replacement rate is however shared by both, men and women. The balancing effect is negative and similar across gender and marital status.

Combined, this leads to women gaining in pension, as the positive pre-adjustment effect more than counterbalances the negative balancing effect. For men, there is only the negative balancing effect, which is why their pension is reduced by the reform.

5.5 Assessing long-term variability

5.5.1 Potential behavioral responses to pension reforms

As previously mentioned, the counterfactual analysis presented above displays the short-term effects of the reforms on inequality and pension adequacy, excluding the subsequent behavioral response. However, the behavior of the population will adapt in the long term, because the reforms have an impact on the incentive to continue working.

Reform A is likely to have limited direct effects on behavior, since the core structure of the pension calculation remains unchanged; only the method used to valorize past earnings is modified. However, by switching from price indexation to wage indexation, past earnings are effectively increased, making the pension system more generous overall. This higher expected pension wealth may generate indirect behavioral responses through an income effect, as individuals feel financially more secure and may therefore choose to retire earlier or reduce their labor supply toward the end of their careers.

Reform B is expected to trigger more substantial behavioral responses, as it represents a more fundamental and salient change to the pension system that is likely to be well understood by the public. By lowering the number of required career years from 45 to 35 and making full pension eligibility easier to attain, the reform reduces the marginal return to additional years of work beyond the threshold. This creates incentives for individuals to retire earlier and may lead to shorter overall careers. However, since the statutory retirement age and the eligibility conditions for early retirement remain unchanged, individuals who choose to stop working earlier may not immediately qualify for pension benefits. This constraint could dampen the overall behavioral impact of the reform,

as some workers may still need to remain in the labor force to secure a stable income until they meet the age-related eligibility requirements.

Reform C, which grants additional credited career years for child-birth and child-rearing, benefits mothers by mitigating the negative career and pension consequences associated with having children. This adjustment enhances pension entitlements without requiring additional labor market participation. This increases lifetime pension wealth for mothers, generating a positive income effect that may allow for greater financial security in old age. As a result, it could reduce the need to extend working life and may lead to slightly earlier retirement among mothers.

However, it should be noted that the reduction in the replacement rate required to ensure budget neutrality has not yet been taken into account in the previous considerations. Since all reforms make the pension system more generous - though to varying degrees - the replacement rate is reduced in order to contain costs. This adjustment also has behavioral consequences. By lowering the replacement rate, the system becomes less generous again, reducing pension payouts and therefore pension wealth. This generates an income effect in the opposite direction. As pension benefits decrease, individuals may choose to work longer and retire later. This may partially or even fully offset the behavioral effects discussed earlier.

The overall behavioral effect therefore depends on the strength of these offsetting effects and may differ across population groups, as they are affected to varying degrees by the reforms.

5.5.2 Regression analysis

To better understand the behavioral responses to these reforms and to assess whether the long-term effects differ significantly from the short-term effects presented previously, a Probit regression analysis is used to estimate the retirement probabilities at different ages which allows to calculate the average retirement age in the different counterfactual situations.

For this, the same model is used as in Chapter 3. The dependent variable is retirement which equals 1 if the individual exits the labor market at a certain age. It equals 0 if the individual remains active on the labor market. As explanatory variables are used two incentive measures: the social security wealth (SSW^{29}) and the implicit tax on continued activity ($ITAX^{30}$). In addition, it is controlled 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.

However, the sample is adjusted to correspond more closely to the sample in this analysis, as it is worked with a slightly older population compared to Chapter 3. Further details on the sample, the incentive measures, the regression and how results differ compared to Chapter 3 are given in the Appendix C.3.

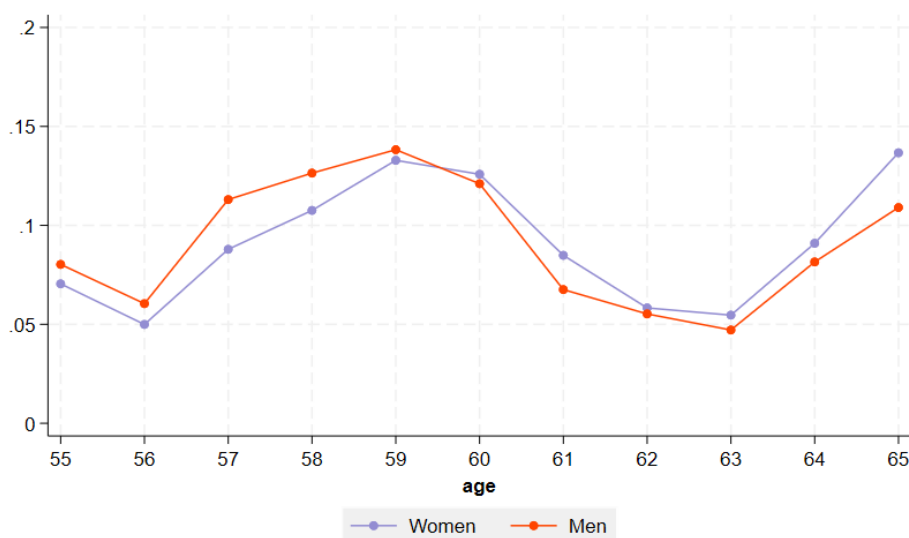
²⁹The SSW is the present discounted value of all future benefits. It is obtained by summing up the yearly net social security benefits up from retirement age until death. The discounting allows for mortality adjustments and time preferences.

³⁰The $ITAX$ is based on the accrual (ACC) which measures the change in SSW that is obtained if retirement is postponed by one year. By dividing the negative accrual by the after-tax earnings during the additional year of work, the $ITAX$ is obtained. 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 Probit regression allows to predict instantaneous retirement probabilities, which are then aggregated for each age from 55 to 65, separately for men and women. Due to a reduced sample size, it is not possible to differentiate further over the different marital status. The instantaneous retirement probabilities can be interpreted as the probability of an individual to retire at a certain age, *conditionally* that they have stayed in the labor market up to that point. However, in order to calculate the average retirement age, the *unconditional* retirement probabilities whose sum equals 1 (when adding age 55 to age 65) are needed. To transform the instantaneous retirement probabilities, the method described by Suresh et al. (2022) is used since it is operated in a discrete-time framework.

Figure 5.8 shows the transformed aggregated retirement probabilities separately for men and women in the actual pension system. In general, men tend to retire a bit earlier than women. However, the difference is small. For both genders, a peak can be detected around age 60, the age around which early retirement becomes available, and at age 65, the SEA in our observation period.

Figure 5.8: Aggregated retirement probabilities per age and gender

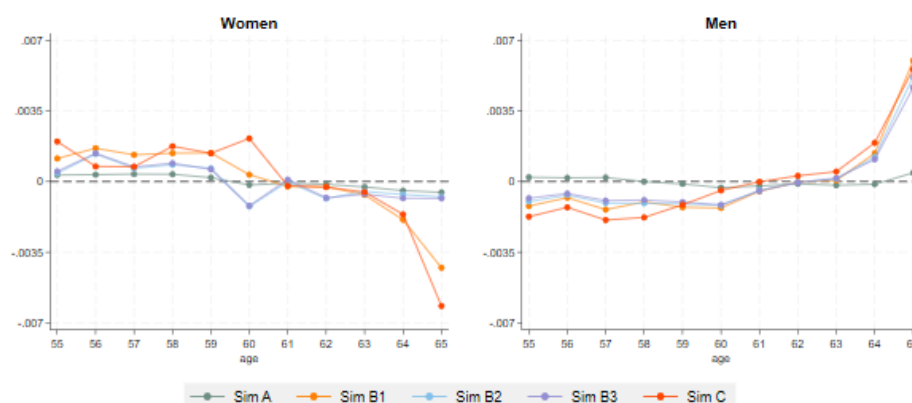


Source: Author's calculations based on SHARE data.

In order to examine the impact of the reforms on older adults' retirement behavior, counterfactual retirement probabilities are estimated. Those are also predicted with the Probit model, but based on the counterfactual *SSW* and *ITAX* which are calculated using the pension benefits that would be the case if the reforms were to enter into force.

Figure 5.9 presents the change in the aggregated retirement probabilities for men and women due to the different reforms. Women decide to retire earlier because of all the reforms. The retirement probabilities at the earlier ages increase, while it decreases for the older ages. The largest impact comes from reform B1, the reduction of the number of required career years while keeping all assimilated periods; and reform C, which grants 2 additional career years to mothers to compensate for the impact of childbirth and child-rearing on the career. For men, the opposite is the case, as all reforms lead to later retirement. Reform A, the wage-indexing of past earnings, is an exception and leads to earlier retirement for men. However, the effect is close to zero. Overall, the change in the retirement probabilities due to the reforms remains rather small for both women and men.

Figure 5.9: Change in aggregated retirement probabilities



Source: Author's calculations based on SHARE data.

The estimated retirement probabilities allow to calculate the average retirement age. It is obtained by taking the average of the ages 55-65 (A), weighted by the aggregated retirement probability ($p_{A,G,S}$). As a reminder, the predicted retirement probabilities are aggregated by age (A) and gender (G) and they differ according to the retirement system (S) that is considered, e.g. the actual system or simulation A-C.

$$\text{Average retirement age}(G, S) = \sum_{A=55}^{65} A \cdot p_{A,G,S}$$

Table 5.6 shows the average retirement age for men and women in the actual system, as well as in the counterfactual ones. It is even clearer here that the reforms only lead to a small behavioral response, as only a small change in the average retirement age can be observed, for both women and men. This suggests that the long run effects of the reforms on inequality and adequacy are very similar to the short run effects described in the previous analysis.

Table 5.6: Average retirement age

System	Men	Women
Actual	59.82	60.25
Sim A	59.82	60.24
Sim B		
All assimilation periods	59.87	60.20
Essential assimilation periods	59.86	60.23
No assimilation periods	59.86	60.23
Sim C	59.88	60.19

Source: Author's calculations based on SHARE data.

5.6 Conclusion

In this analysis, the effect of three potential reforms in the Belgian pension system is examined using the survey-data from SHARE. By applying a counterfactual analysis, it is assessed whether these reforms improve pension adequacy and inequality using various measures. To ensure budget neutrality, the yearly pension expenditure is held fixed by adapting the replacement rate accordingly, allowing for a direct comparison to the current system. In a second step, the average gain/loss in pension entitlements is examined by marital status and gender to analyze which groups are supported by these reforms. The overall effect is furthermore decomposed into a pre-adjustment and balancing effect. The regression analysis shows that the behavioral response due to the three reforms is rather small and suggests that long-term results are not so different to the short-term results presented in the analysis.

The first reform consists in revalorizing past earnings at their true value by wage-indexing instead of price-indexing them. The second reform envisions a decrease in the number of career years required to be eligible for a full pension. The third reform grants additional career years to compensate for the impact of childbirth and child-rearing on the parent's career.

Overall, all the considered reforms display positive features, notably in terms of reducing inequalities and improving adequacy, and can therefore be viewed as potential avenues for strengthening the pension system. However, the results point to effects that are rather modest. While these reforms are associated with improvements, their impact is constrained by financial considerations, with the lowering of the replacement rate significantly diminishing their effectiveness. This tension between policy ambition and financial constraints echoes the perspective of the Belgian Com-

mission for Pension Reform 2020-2040 (2014), which emphasizes that pension debates inherently operate between what is desirable and what is feasible. This result suggests that, from a policy perspective, these reforms are not sufficient on their own to produce meaningful changes. Among the options considered, the third reform yields the relatively largest effect, as it directly targets the career penalties associated with childbearing for women. Its comparatively stronger performance highlights the importance of highly targeted interventions rather than broad, generalized adjustments.

More broadly, the findings underscore the persistent difficulty of addressing labor market and household inequalities through pension policy. Even with mechanisms designed to enhance adequacy, individuals with weaker or more fragmented labor market histories - particularly women - continue to experience lower pension outcomes. Meaningful progress requires policies that address the underlying drivers of inequality in old age, such as disparities in employment opportunities, wages, job stability, and the unequal distribution of care responsibilities. Addressing these root causes is crucial, as greater equality in labor market outcomes and in the household sphere over the life course reduces the need for corrective adjustments within the pension system itself. As a result, a stronger and more direct link between working life and pension entitlements can be preserved, thereby helping to maintain work incentives and support the financial sustainability of the system.

Chapter 6

Trends in Health Inequalities among Retirees¹

Abstract

This chapter investigates the trend in health inequalities among Belgian retirees between 2005 and 2022. It situates these trends in the context of pension reforms during this period, which primarily raised the statutory eligibility age and reduced system generosity, with potential implications for health outcomes that may vary across socioeconomic groups and give rise to concerns about widening health inequalities. We assess health disparities across five distinct health measures and apply three complementary approaches to quantify socio-economic health differences. Our results provide no evidence of a significant increase in health inequalities over this period.

¹This chapter is co-authored with Alain Jousten and Mathieu Lefebvre. It stems from the International Social Security (ISS) project of the NBER, which compares the experiences of several developed countries to study social security programs and retirement around the world. The chapter will be published as “Trends in Health Inequalities Among Belgian Retirees” in *Social Security Programs and Retirement Around the World: Pension Reforms and the Health Distribution of Retirees*, edited by Axel Börsch-Supan and Courtney Coile. Chicago, IL: University of Chicago Press.

6.1 Introduction

Over the past four decades, pension systems across Europe have undergone profound reforms in response to demographic ageing and fiscal pressures. Belgium is no exception. Since the 1980s, successive reforms have changed benefit generosity and gradually raised the statutory retirement age. These changes were designed to contain rising pension costs and to support the financial sustainability of the system. Yet, they may also have unintended consequences for the health of retirees. Reductions in benefit generosity may limit retirees' ability to cover healthcare costs and invest in goods that support healthy living. At the same time, postponing retirement keeps individuals longer in occupations that can be physically demanding or otherwise detrimental to health. These mechanisms are unlikely to affect all groups equally, those with lower incomes typically being more exposed, as they rely more heavily on public pension income and are more often employed in jobs involving greater physical strain. This raises concerns of widening health disparities in older age.

A large body of literature documents strong socio-economic status (SES) gradients in health. Higher-SES individuals live longer on average (OECD/European Commission, 2020; Murtin, 2017; Eggerickx et al., 2018), experience fewer years of disability, and report better health outcomes compared to their lower-SES counterparts (Van Oyen, 2010). Lefebvre et al. (2018) point out a triple penalty for the lower SES individuals as they have shorter lives, higher risks of dependency, and longer durations in dependency. In Belgium, disparities are particularly visible for mental health (Sciensano, 2022). These inequalities emerge through multiple mechanisms. Lower-SES individuals face greater financial barriers to healthcare (Baeten et al., 2019) and a disproportionate burden of out-of-pocket costs. The main reason for self-reported unmet needs for medical

examination and care is the cost of services (Baeten et al., 2019). Differences in health literacy and education may also shape behaviors and navigation of healthcare systems (Berete et al., 2024). Furthermore, individuals face unequal exposure to physically demanding or stressful jobs (Christiansen and Nielsen, 2009) and to cumulative disadvantages starting in childhood, depending on family socio-economic circumstances (Cohen et al., 2010; Landös et al., 2019).

Pension reforms that alter financial security and working-life duration therefore intersect directly with these established health inequalities. At the same time, Belgium is a welfare state with strong social protection mechanisms: A universal healthcare system and a fairly redistributive pension design may cushion the adverse health effects associated with such reforms - particularly for those at the bottom of the income distribution - yet they may not fully offset them. Against this backdrop, it is not clear a priori whether concerns about widening health inequalities are warranted, motivating an examination of their trends.

The central question of this chapter is therefore whether health inequalities among Belgian retirees have widened over the past two decades, a period marked by pension system changes. To address this, we use data from SHARE covering the period 2005–2022. We examine five complementary measures of health outcomes and apply three distinct approaches to assessing health inequality, namely the evolution of the morbidity gradient, the concentration index and the difference in Health-Equivalent Age. This chapter provides thus a first step toward better understanding how pension systems may intersect with health disparities in older populations by documenting patterns over a period of pension system change. Our findings do not indicate a consistent or statistically significant increase in health inequality over this period.

The structure of this chapter is as follows. Section 6.2 highlights the potential role of the past reforms implemented in the Belgian pension system in shaping health inequality. Section 6.3 presents the data and the sample used for the analysis. In Section 6.4, 6.5 and 6.6 we present the results of our three different approaches. Section 6.7 concludes.

6.2 Linking pension reforms to health inequalities

Pension reforms are often designed with financial sustainability or labor force participation in mind, but they may also have unintended consequences for social and health inequalities. Specifically, they can shape how income and wealth is distributed in old age across socio-economic groups as shown in Chapter 3 of this thesis. Measures that tie pension payouts more strictly to lifetime contributions render the system less progressive, amplifying economic inequalities among retirees. Conversely, reforms that strengthen minimum pensions and expand redistribution make the system more progressive, helping to narrow economic gaps in old age. Since economic resources are closely linked to health outcomes, this raises the possibility that pension reforms may contribute to patterns of health inequality as well.

Beyond their impact on income and wealth, pension reforms may also exert more direct effects on the health outcomes of retirees. By changing retirement ages, altering eligibility conditions or in general modifying incentives to remain in the labor force, such reforms influence the timing and intensity of people's work trajectories (Fraikin et al., 2025). Postponed retirement prolongs the exposure to physically demanding jobs and occupational strain and stress with potential negative effects on health (Barschkett, 2022; Eibich, 2015). At the same time, continued employment can also provide social interaction, cognitive stimulation and daily

routines that help maintain physical and mental well-being (Bonsang et al., 2012; Mazzonna and Peracchi, 2017; Rohwedder and Willis, 2010). This suggests that pension reforms may shape health inequalities through more immediate pathways as well.

Belgium has undergone several pension reforms since the early 2000s, with potential implications for health disparities in old age². Pension reforms in Belgium can be broadly grouped into two categories. On the one hand, there are those that modify the generosity of benefits through changes in replacement rates, indexation rules, or minimum pension levels. And on the other hand, we have those that restrict eligibility, primarily by raising the statutory retirement age, tightening early retirement conditions, or increasing required career lengths.

One of the most significant changes concerns the statutory eligibility age (SEA). For women, the SEA was gradually raised from 60 in 1997 to 65 in 2009, in successive three-year steps, thereby aligning it with the system for men. Further increases have since been introduced for both sexes. The SEA rose to 66 in 2025 and is scheduled to reach 67 in 2030. In parallel, early retirement provisions have been progressively tightened. The minimum age for early exit, as well as the contributory career requirements, have been gradually increased, reflecting a deliberate policy shift towards later retirement and higher labor market participation among older workers.

Reforms have also reshaped the way in which non-employment periods are valued in the pension calculation. Traditionally, spells on replacement incomes such as unemployment or conventional early retirement were assimilated at the last real gross wage. Since 2007, however, a reduced salary ceiling has been applied, further lowered in 2012, thereby diminishing the generosity of credited rights and reinforcing the link be-

²For a more detailed presentation of reforms in the last decades in Belgium, see Chapter 2.

tween benefits and actual contributions paid. To further strengthen this benefit–contribution nexus, a pension bonus has been introduced on two occasions – once in 2007 and again in 2024 – but in both cases it was or will be subsequently abolished (in 2015 and 2026).

At the same time, policymakers have adopted measures that increased the system’s progressivity. Most notably, the introduction of the GRAPA in 2001 created a non-contributory minimum income guarantee for individuals at the SEA or older with insufficient household resources. Since its inception, the GRAPA thresholds have been adjusted more generously than inflation, progressively raising the benefit floor and enhancing the redistributive function of the system.

Taken together, these reforms have simultaneously modified the incentive structure of the pension system by encouraging longer working lives and tightening the link between contributions and benefits while reinforcing its redistributive dimension through minimum income protection. Such changes are likely to have far-reaching and not clearly signed implications not only for employment trajectories at older ages but also for the distribution of health outcomes across socio-economic groups.

6.3 Data

We use the Belgian data from SHARE³ to analyze the trends in health inequalities among retirees from 2005 to 2022.

³SHARE (Survey of Health, Ageing and Retirement in Europe) is a biennial, cross-national panel survey covering individuals aged 50+ in 28 European countries and Israel since 2004/05, providing detailed information on health, labor market status, and household economic and social conditions.

6.3.1 Variables of interest

Socio-economic status

To measure socio-economic status, we use the equivalized⁴ disposable household income. We rely on the imputed measure of total household income provided by SHARE, which consolidates all relevant income sources. Consequently, every member of a household is assigned to the same income. This choice rests on the assumption that individual health is more strongly associated with overall disposable household resources than with personal income considered in isolation. To mitigate potential bias arising from income changes linked to deteriorating health or retirement transitions, we classify individuals into income groups based on the first wave in which they are observed. This procedure ensures that subsequent health shocks do not affect their income classification. This measure serves as the basis to categorize the sample into income deciles and the position in the income distribution is always relative to all individuals of that wave.

Health

To monitor health inequalities over time, we look at five different measures of health. Health is a multidimensional concept that cannot be fully captured by a single measure. By analyzing multiple measures of health, we can see whether the trend in health inequalities is similar or varies significantly across different aspects of health. For each of them we define them as health capacities, such that a higher score reflects better health. This simplifies the graphical analysis when examining the results, making it easier to identify the trends in health inequalities across the different measures. Across all health measures used in this study, we adopt

⁴The OECD-modified equivalence scale is applied. This scale assigns a weight of 1 to the household head and 0.5 to each additional adult member. We adjust for purchasing power parity.

a consistent approach in which each component contributes equally to the overall measure. This reflects a deliberate modeling choice to avoid imposing arbitrary assumptions about the relative severity or importance of different health aspects, as assigning differential weights could introduce additional subjectivity into the construction of these indicators.

- (a) Functional health: Our measure of functional health is derived from 20 self-reported limitations included in SHARE. These encompass mobility restrictions, limitations with activities of daily living (ADLs), and limitations in instrumental activities of daily living (IADLs). Mobility items cover tasks such as walking, sitting, climbing stairs, and other fine motor activities. ADLs capture essential self-care functions, including bathing, dressing, and eating, while IADLs reflect more complex tasks required for independent living, such as preparing a hot meal or shopping. The complete list of limitations is provided in the Appendix D.1. We construct our health capacity indicator by subtracting the number of limitations reported by the respondent from the total of 20 items consistently available in SHARE⁵.
- (b) Diagnosed health: It is measured as the number of chronic diseases that has been diagnosed by a doctor. In SHARE, a list of 11 condition is presented and the respondents have to point out which one has been diagnosed. The complete list of conditions is provided in the Appendix D.1⁶. To construct a number that increases with better health, we subtract the actual number of conditions from 11.

⁵One could argue that certain limitations are more severe than others, particularly those affecting basic activities of daily living such as eating, bathing, or using the toilet, which directly reflect a loss of independence. In contrast, limitations related to mobility or more complex instrumental activities may represent earlier or less severe stages of functional decline. To account for this, we consider an alternative specification in which limitations are weighted according to their functional severity. More details of this alternative weighting scheme are provided in Appendix D.1. The results are robust to this alternative specification of the health measure. Where deviations arise, they are discussed.

⁶Although SHARE includes more than 11 conditions in its questionnaire across waves, we limit our measure to the subset of conditions that are consistently available across all waves to ensure comparability over time.

- (c) Comprehensive health: It is based on the health deficit index as proposed by Börsch-Supan et al. (2021) and Abeliatsky and Strulik (2019). It summarizes the individual health status by aggregating a set of self-reported health deficits, including chronic conditions, functional limitations and difficulties with daily activities. Each deficit is coded as present or absent, and the index is defined as the proportion of observed deficits relative to the total number of non-missing health indicators, hence a value between 0 and 1. To construct a number that increases with better health, we subtract the index from 1.

- (d) Mental health: We rely on the Euro-D scale, a standardized instrument for assessing depressive symptoms developed by Prince et al. (1999). The scale is designed to capture features of clinical depression and consists of 12 binary (yes/no) items related to mood and behavior, including sadness, pessimism, sleep problems, and loss of interest. Each affirmative response is scored as one, yielding a total between 0 and 12, where higher values denote greater depressive symptomatology. To construct a number that increases with better health, we subtract this measure from 12.

- (e) Cognitive health: It is a score that measures the ability of the respondent to recall words and perform mathematical operations. It is based on three cognitive function tests included in the SHARE survey: immediate word recall (from a list of 10 words, it is counted how many words a respondent can recall), delayed word recall (after about five minutes, the respondent is asked again to recall these words), and the serial 7s subtraction task (subtract 7 from 100, and then four times keep subtracting 7 from the result). The cognition score can only be constructed from wave 4 on. The total score ranges from 0 to 30, with higher scores indicating better cognitive functioning.

6.3.2 Sample

We use SHARE waves 1-9, excluding wave 3 that is solely dedicated to collecting retrospective information and is therefore not comparable to the other survey waves. In our analysis, we focus on retirees aged between 60 and 79, leading to a sample composed of individuals born between 1925 and 1962⁷. We consider retirees of all kinds, whether they worked as wage-earners, self-employed, or civil servants. Individuals may appear multiple times in the sample if they meet the age and retirement criteria in different years. We end up with 12595 observations which corresponds to 5115 distinct individuals.

Table 6.1 presents summary statistics of our sample. They are reported by income group, defined as follows: Group 1 comprises individuals from income deciles 1–3, Group 2 comprises deciles 4–7, and Group 3 comprises deciles 8–10. For the different health measures, the range of possible values is reported as well. A higher value indicates better health.

The sample is broadly balanced by gender, with women slightly over-represented in the lower income group. Marital status differs across income groups, as marriage is more common among higher-income respondents, while lower-income individuals are more likely to live alone and in smaller households. The average number of children shows little variation between income groups. Educational attainment varies systematically with income, with lower levels more frequent in the lower income group and higher levels more frequent in the higher income group.

⁷We select individuals as young as age 60 because in Belgium, an important number of individuals are retired well before the SEA. We also made all the analysis with a restricted sample of individuals aged 65 to 79 and it does not change the results.

Table 6.1: Summary statistics of sample, retirees aged 60-79

	Total	Income Group 1	Income Group 2	Income Group 3	
Number of					
Observations	12595	3597	4879	4119	
Individuals	5115	1584	1933	1598	
Demographics					
Women (%)	47.31	48.25	47.70	46.03	
Married (%)	64.36	55.40	64.91	72.91	
Living alone (%)	25.91	35.96	24.68	18.65	
Household size	1.84	1.79	1.84	1.89	
Number of children	2.03	2.08	1.94	2.09	
Lower educational attainment (%)	41.19	56.33	38.68	30.96	
Higher educational attainment (%)	33.20	18.31	34.12	45.08	
Income & Wealth					
Equivalized household income (in 2025 EUR)	44677	26385	37247	69387	
Equivalized household wealth (in 2025 EUR)	374756	273510	372421	465304	
Health					
Functional health	[0-20]	18.15	17.73	18.17	18.50
Diagnosed health	[0-11]	9.09	8.96	9.11	9.18
Comprehensive health	[0-1]	0.86	0.83	0.86	0.87
Mental health	[0-12]	9.69	9.42	9.70	9.92
Cognitive health	[0-30]	18.89	17.96	19.03	19.46

Source: Authors' calculations based on SHARE data.

Notes: Lower education indicates having completed only basic schooling, such as pre-primary, primary, or lower secondary education, without progressing to upper secondary or tertiary levels. Higher educational attainment refers to individuals who have completed tertiary education.

For the economic variables, the equivalized household income difference between the bottom and middle-income groups is about EUR 11000, while the gap between the middle and upper groups is larger, at around EUR 32000. Wealth differences follow a similar pattern: the contrast between the bottom and middle groups is approximately EUR 99000, and between the middle and upper groups about EUR 93000. Across the five health measures, average values show a clear gradient, with better health observed among individuals in higher income groups.

The sample should be viewed with some awareness of potential selection. The study is restricted to individuals who are observed in the survey, which requires them to be alive and sufficiently healthy to participate. This introduces a form of non-random sample selection, as individuals in poorer health - who are disproportionately located in lower income deciles - are more likely to be underrepresented due to mortality or non-response. As a result, the observed population may not be a random sample of the underlying population, but a selected subset that is, on average, healthier. This aspect should be kept in mind when engaging with the results, as it may contribute to a downward bias in the measurement of health inequalities.

6.4 The morbidity gradient

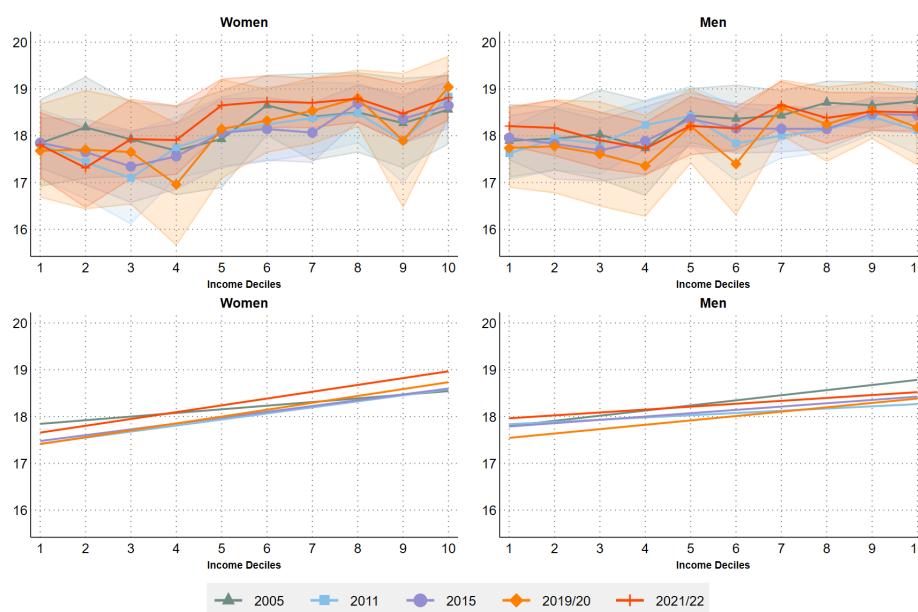
In order to assess the trend in health inequalities, we first look at the morbidity gradient which shows the variation in health outcomes across different socio-economic groups. To do so we plot the mean of the five health measures by income decile, and investigate how the gradient has changed over the last 20 years.

Figures 6.1-6.5 present this⁸. For each figure, the left panel corresponds to women and the right panel to men. The upper section displays the raw data together with 95 percent confidence intervals, while the lower section reports the fitted values from a linear regression. To maintain clarity, we focus on five survey waves (Wave 1 in 2005, Wave 4 in 2011, Wave 6 in 2015, Wave 8 in 2019/20, and Wave 9 in 2021/22). Each figure depicts the change in the health measure associated with a one-unit increase in income decile. For all measures, higher values indicate better health, and a steeper gradient reflects larger socio-economic disparities in health.

⁸To minimize potential biases arising from demographic heterogeneity across waves, the health variables are normalized, adjusting for differences in age and gender composition.

Figure 6.1 presents functional health. The results show that, among women, health outcomes improved for individuals in higher income deciles but worsened for those in lower deciles, leading to a widening of health inequalities over time. Among men, by contrast, a modest narrowing of disparities is observed, as indicated by a flattening of the gradient.

Figure 6.1: Health by income decile – Functional health

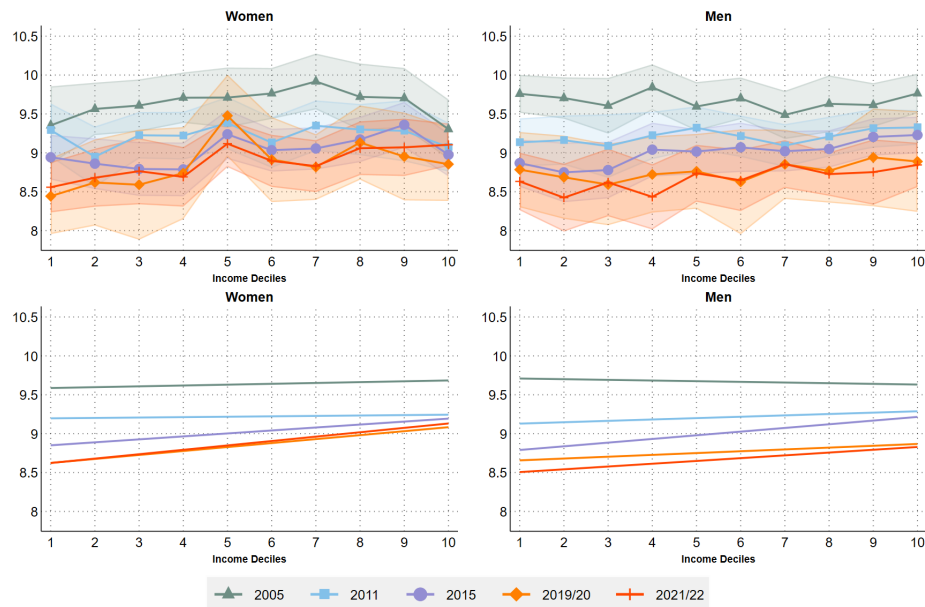


Source: Authors' calculations based on SHARE data.

Diagnosed health presents a different picture in Figure 6.2. Overall, the gradient is a lot less steep which means that health inequalities are less pronounced in this dimension of health. Over time, health deteriorates for all income deciles but this reduction is larger for the disadvantaged group, meaning that inequalities increased. This is the case for both women and men although this evolution is more pronounced for women.

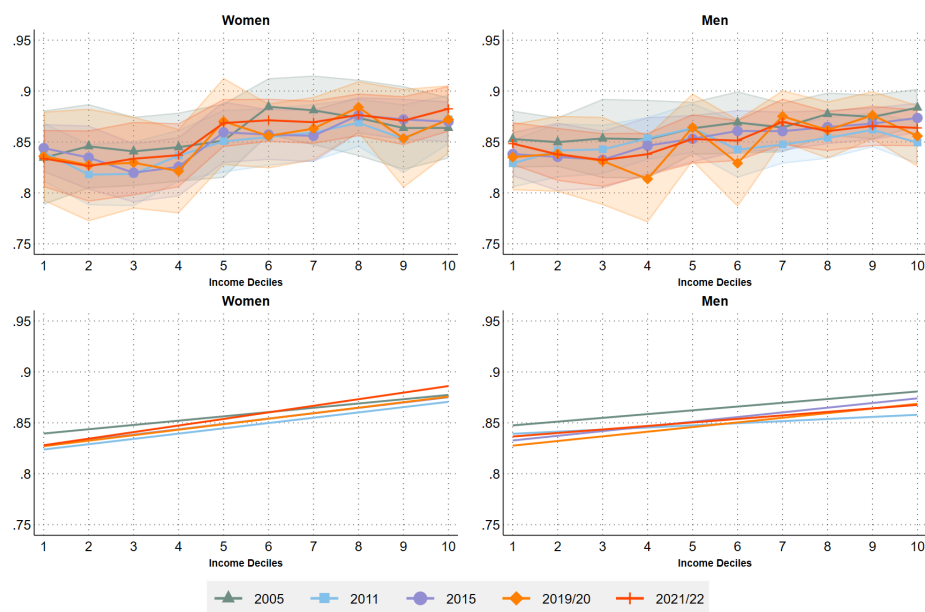
In Figure 6.3, comprehensive health shows a similar picture than functional health. Among women, health slightly improved for the affluent and deteriorates for the disadvantaged. Hence, health inequalities increased which can be seen by the steeper gradient. Among men, health inequalities first decreased but came back to the initial level by 2021/22.

Figure 6.2: Health by income decile – Diagnosed health



Source: Authors' calculations based on SHARE data.

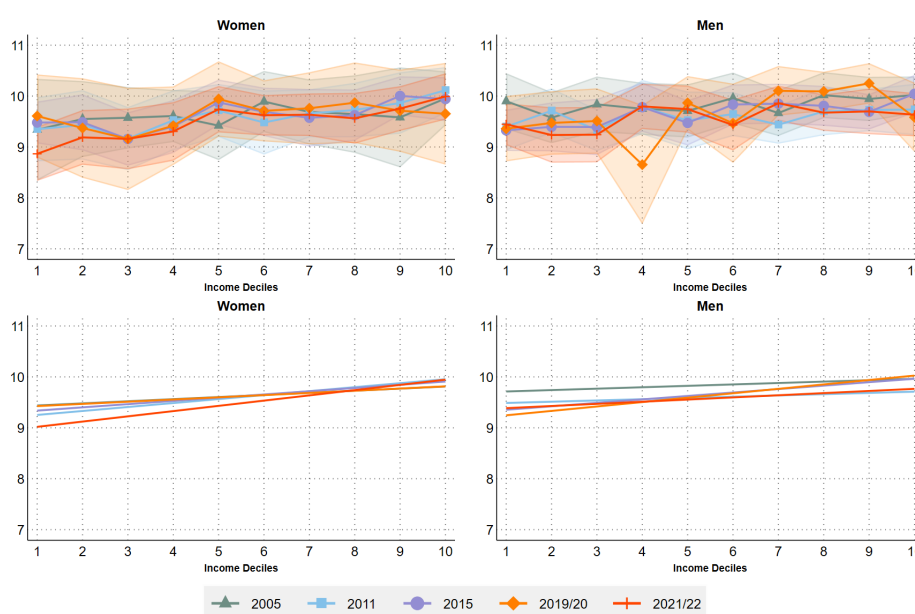
Figure 6.3: Health by income decile – Comprehensive health



Source: Authors' calculations based on SHARE data.

When looking at mental health, Figure 6.4 shows a different evolution for men and women. Among women, inequalities first decrease between 2005 and 2019/20, but increase substantially in 2021/22. This increase more than offsets the initial change. Among men, the opposite is true and inequalities increase until 2019/20 before going back to their initial level in 2021/22.

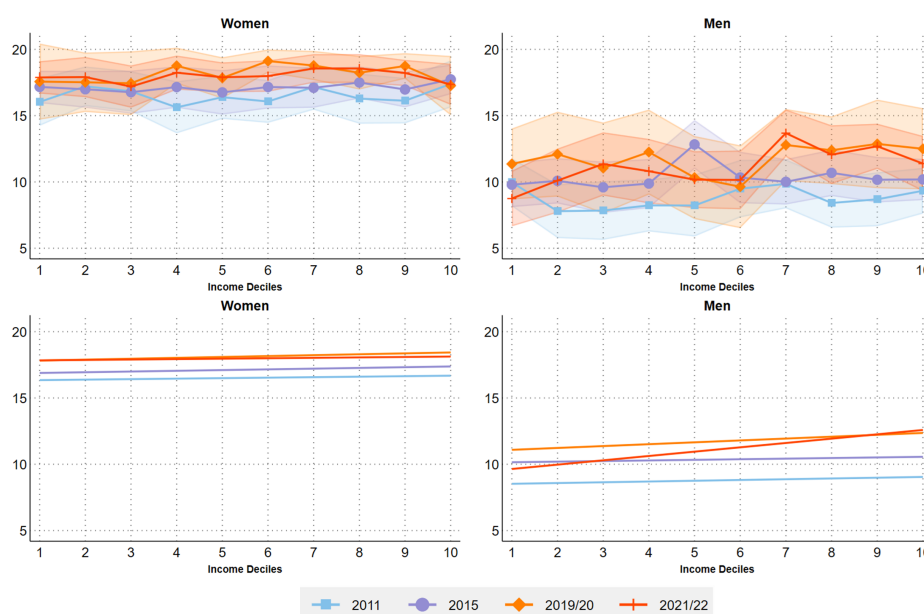
Figure 6.4: Health by income decile – Mental health



Source: Authors' calculations based on SHARE data.

Finally Figure 6.5 displays how the distribution of cognitive health by income decile has developed over time. Note that we only have consistent data from 2011 (Wave 4) onwards. Health seems to have improved over time in this dimension for both men and women. In regards to the evolution of health inequalities, this measure is an exception to the other four measures. Among women, no substantial change can be seen over time in the slope. However, for men, we see a gradual increase in the slope, speaking for an increase in inequalities.

Figure 6.5: Health by income decile – Cognitive health



Source: Authors' calculations based on SHARE data.

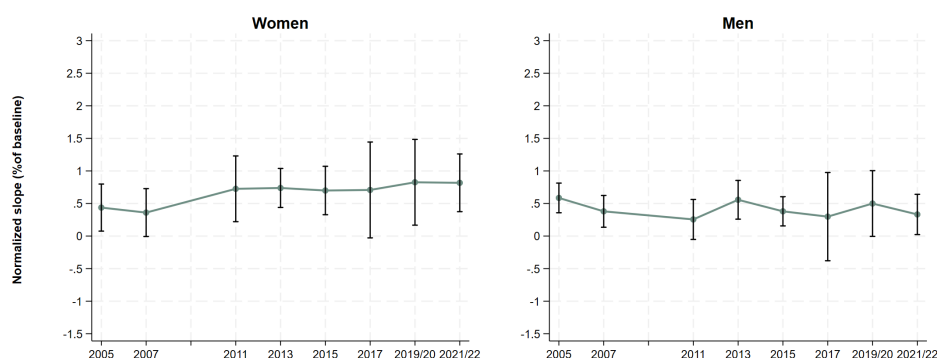
Overall, while Figures 6.1-6.5 reveal differing patterns across the various dimensions of health, a clear overall trend emerges among women. Health inequalities have generally widened over time. However, among men, the conclusions are rather ambiguous, with slight decreases, increases or no change at all in health inequalities for the different measures.

From these Figures 6.1-6.5, we take the estimated slopes for each health measures and each wave. We normalize the slopes by dividing them by the mean of the health measure in Wave 9 (the last wave of observation). This makes the income-health gradients comparable over time by ensuring that changes in the gradient reflect changes in inequality and not changes in the average level of the health outcome. By anchoring it to a fixed wave, we prevent shifts in population health from distorting the interpretation of the slope. The normalized gradient can be interpreted as the percent change in the health variable (relative to Wave 9) associated with a one unit increase in the income decile.

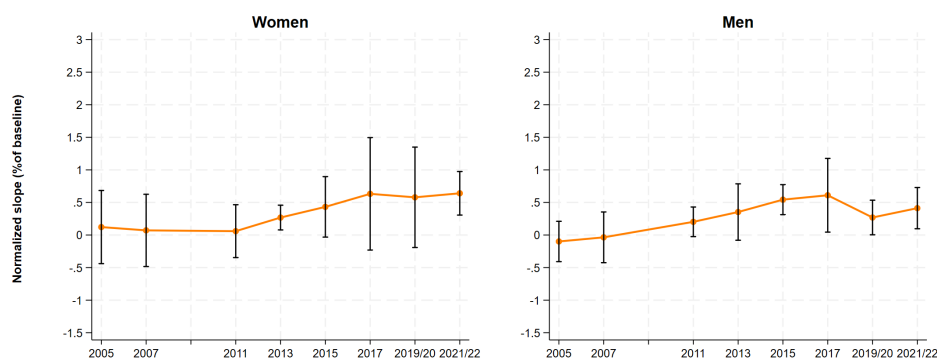
Figure 6.6 displays the normalized gradients and their confidence intervals over time for women and men, for each of the five health variables. It highlights the increase in the slope for women for most health measures, as observed in the previous figures. However, this increase is not significant in a sense that a flat line would still fit into the range of the 95% confidence intervals. The same applies to men. The analysis of the morbidity gradient reveals thus no significant increase of the slope over time that would indicate an increase in health inequalities, neither among women, nor among men.

Figure 6.6: Normalized gradient over time

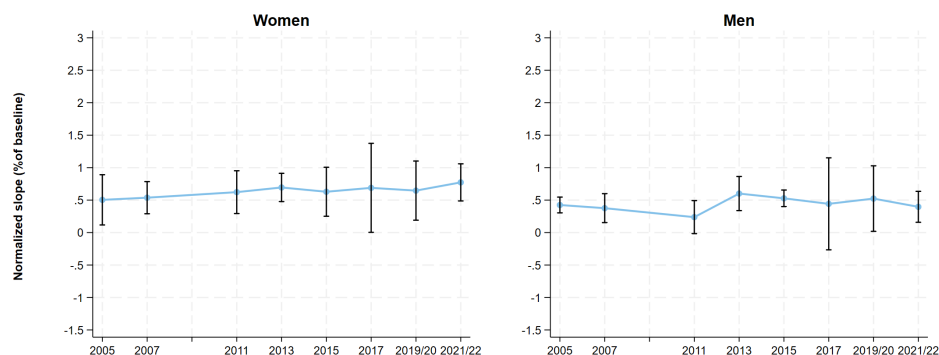
(a) Functional health



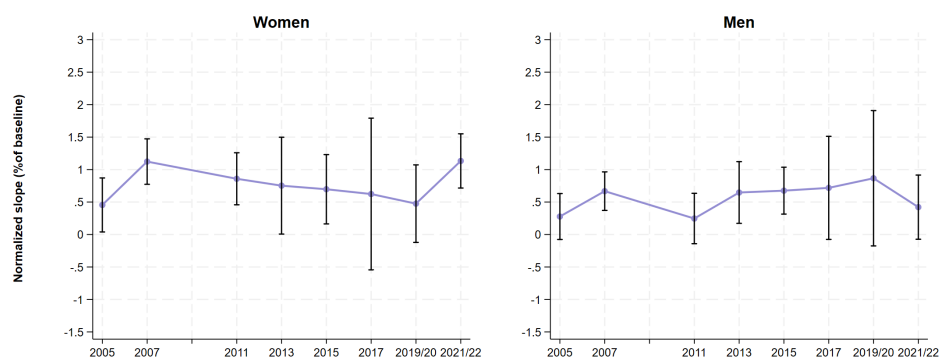
(b) Diagnosed health



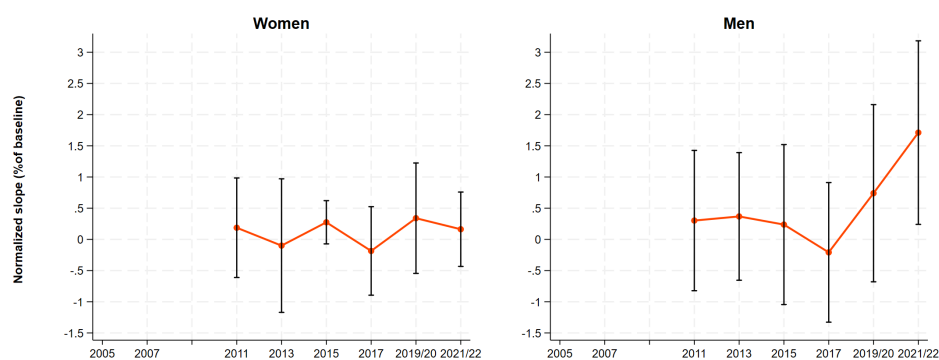
(c) Comprehensive health



(d) Mental health



(e) Cognitive health



Source: Authors' calculations based on SHARE data.

Notes: We depict the slopes and the 95% confidence intervals over the years, which we retrieve from a linear regression of the health status on income deciles. The slopes are normalized by dividing them by the mean of the health outcome in 2021/22 (Wave 9).

6.5 Concentration indices

Another way to measure inequality is based on the concentration index. It is derived from the illness concentration curve which shows the cumulative distribution of illness across the population ranked by socioeconomic status. This reveals whether illness is disproportionately concentrated among the poor or the rich. If illness is more concentrated among the poor, the concentration curve lies above the 45° line that represents an equal distribution. If it is more concentrated among the rich, the curve lies below the 45° line. We define ill-health by being in the lowest 25% of the health distribution in a wave and rank people over percentiles of the same income variable used for the morbidity gradient.

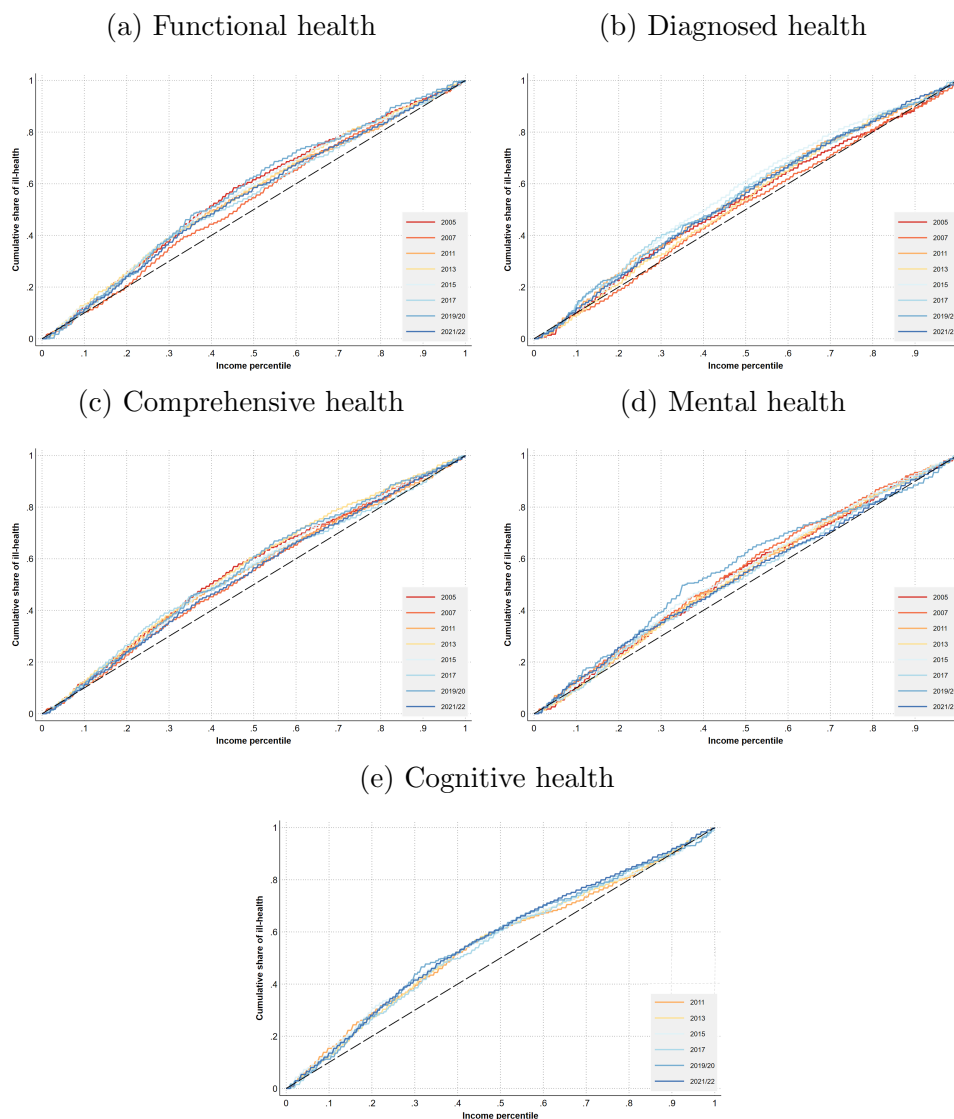
Formally, the concentration index, CI , is defined as

$$CI = \frac{1}{n} \sum_{i=1}^n \frac{h_i}{\bar{h}} (2R_i - 1)$$

where h_i and R_i are respectively the health status and the income percentile of individual i . A negative value indicates health inequalities to the detriment of the poor, whereas a positive value indicates health inequalities to the detriment of the rich.

Figure 6.7 presents the concentration curves for each wave of the SHARE data. A movement of the concentration curve further to the left of the 45° line indicates increasing health inequality. At first sight, a comparison over years suggests no noticeable shifts for diagnosed, comprehensive, or cognitive health. In contrast, functional health and mental health display changes over time, though the trends move in opposite directions.

Figure 6.7: Concentration curves

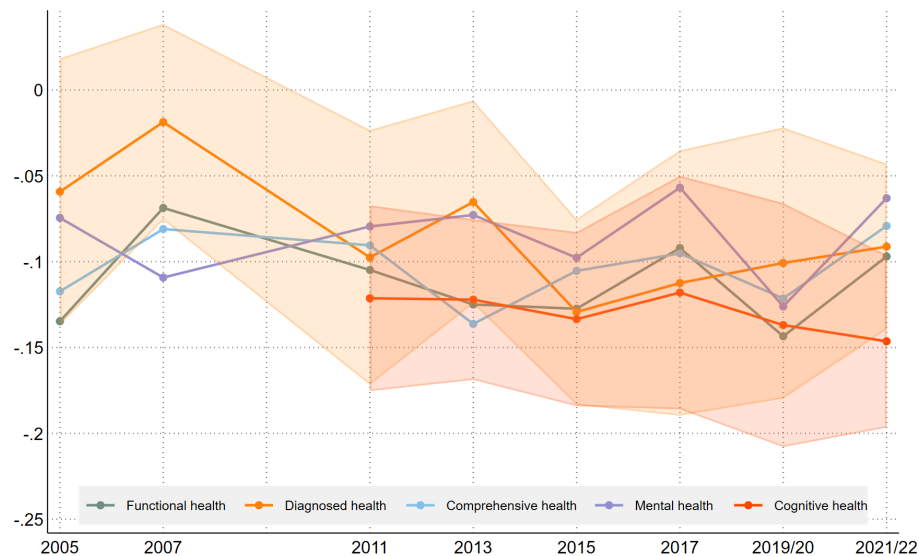


Source: Authors' calculations based on SHARE data.

Notes: These graphs display concentration curves, which trace the cumulative proportion of individuals in poor health across income percentiles. The 45-degree line represents perfect equality. The further a curve lies to the left of this line, the greater the degree of inequality it indicates.

Figure 6.8 displays the evolution of the concentration indices over time for the five health measures⁹. An index value of zero implies perfect equality and a larger inequality to the detriment of the poor implies a more negative value of the concentration index. We see that all indices are negative which confirms that bad health is more concentrated among the less advantaged. Only the concentration index based on diagnosed and cognitive health show an increase in health inequalities. The indices decrease all along the period. However, the 95-percent confidence intervals are large, and the hypothesis that the change of diagnosed and cognitive health from 2005 to 2021/22 is flat cannot be rejected. All three other health measures are more erratic and do not show a clear trend¹⁰. Therefore, the findings do not indicate a significant increase in health inequalities.

Figure 6.8: Concentration indices over time



Source: Authors' calculations based on SHARE data.

Notes: This graph shows the concentration indices over years by health outcome. Lower values indicate more inequality. We depict the 95%-confidence interval only for diagnosed and cognitive health, as those are the variables that appear to have a clear trend over time.

⁹A detailed table with the concentration indices is presented in the Appendix D.2.

¹⁰When using an alternative specification for functional health in which different weights are assigned to various types of limitations, we observe a more consistent decline in the concentration index over time, suggesting increasing health inequalities, in contrast to the more volatile series obtained here under the equal-weight specification. However, the 95% confidence interval remains wide, and the hypothesis of no change over time cannot be rejected. Figure D.1 in Appendix D.2 presents this alternative result.

6.6 Difference in Health-Equivalent Age

Finally, we convert health inequalities into a metric that is more intuitive. The idea is to transform health inequality into differences in Health-Equivalent Age. For this we proceed in different steps. Results are presented in Figure 6.9 and panel a) that is based on functional health will serve as an example.

(1) We define “very good” functional health as having a health score above the 66th percentile of the overall distribution of men and women aged 60-89 in 2005 (Wave 1). Within our sample, we then identify the individuals that are in very good functional health based on this threshold.

(2) We fit a regression model of the probability to be in very good health on age. This gives us an empirical health-age gradient that will serve as the benchmark. The predictions of this model provide us with probabilities to be in very good health for each age a between 60 and 89 : c_a . The left panel of Figure 6.9 shows how the share of respondents with very good health declines with age.

(3) Within each wave, we calculate the probability to be in very good health for the different deciles : $p_{d,w}$. The right panel of Figure 6.9 shows this over time for the 2nd, 5th and 9th decile. In general, the probability to be in very good health is larger for upper deciles.

(4) We compare the probabilities calculated in step 3 with the age specific ones in step 2 to assign a Health-Equivalent Age (HEA) to each decile d in a specific wave w using the following formula¹¹.

¹¹Example: The probability to be in very good health in decile 2, wave 5 : $p_{2,5} = 0.3904$
 The probability to be in very good health at age 73 in the overall population : $c_{73} = 0.3981$
 The probability to be in very good health at age 74 in the overall population : $c_{74} = 0.3808$
 $HEA_{2,5} = 73 + (0.3904 - 0.3981) / (0.3808 - 0.3981) = 73.44$
 A typical person from decile 2 in wave 5 has a health-status equivalent to a 73.44-year-old.

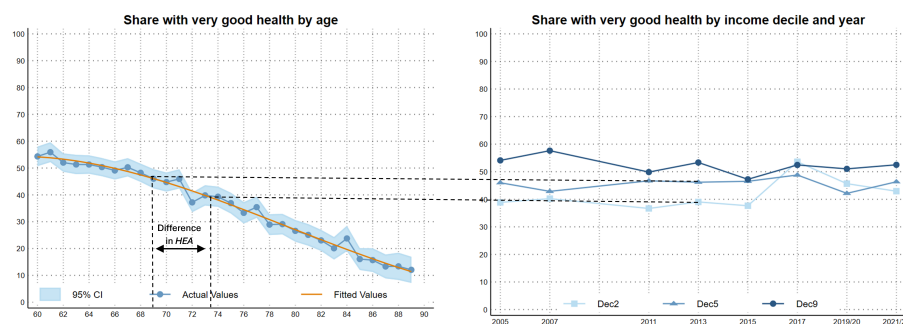
$$HEA_{d,w} = a + \frac{p_{d,w} - c_a}{c_{a+1} - c_a} \quad \text{if } c_{a+1} < p_{d,w} < c_a$$

Put simply, the measure translates the health of a typical individual from an income decile in a specific wave into an age equivalent based on the health profile of the general population. In our example, the share of respondents in very good health in wave 5 is 0.3904 for decile 2 and 0.4619 for decile 5. This corresponds to a Health-Equivalent Age of 73.44 and 68.92 respectively, a difference of 4.52 years. Individuals in income decile 2 reach the same health status about 4.5 years earlier in life than those in decile 5.

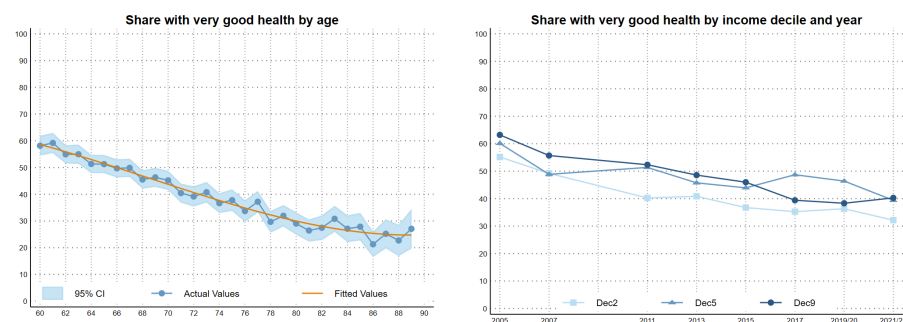
We do the same exercise for the difference between the 2nd and 9th deciles, and between the 5th and 9th deciles. Figure 6.9 shows the same analysis for the four other health measures in panel b) through e).

Figure 6.9: Share of individuals with very good health

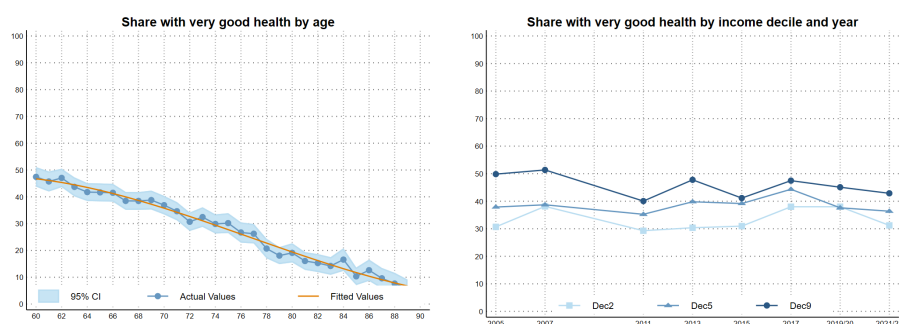
(a) Functional health



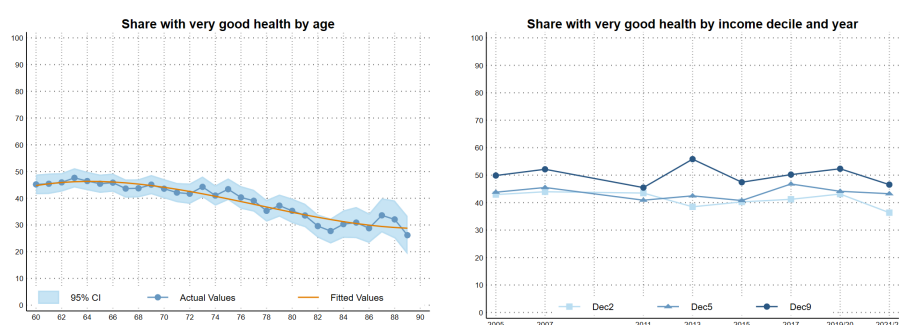
(b) Diagnosed health



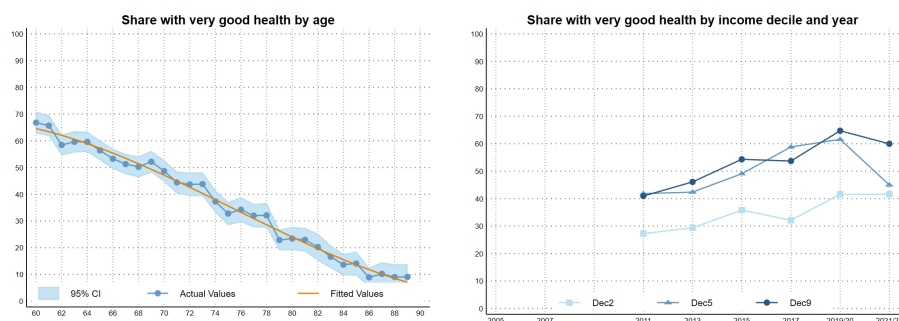
(c) Comprehensive health



(d) Mental health



(e) Cognitive health



Source: Authors' calculations based on SHARE data.

Table 6.2 summarizes the findings by presenting the differences in *HEA* between the 2nd, 5th and 9th decile, for all five health measures. We focus on the years 2005 (Wave 1), 2013 (Wave 5) and 2021/22 (Wave 9). Moreover, in addition to “very good” health (i.e. health in the top 34 percent of the health distribution), we also display results for only “good” health as defined by the upper 67 percent of the health distribution. Keep in mind that cognitive health is not available for Wave 1 in 2005.

Table 6.2: Differences in Health-Equivalent Age

	2005				2013				2021/22			
	2nd-5th	2nd-9th	5th-9th		2nd-5th	2nd-9th	5th-9th		2nd-5th	2nd-9th	5th-9th	
Very good health (>66th percentile)												
Functional health	4.47	13.34	8.86		4.52	11.50	6.97		2.29	7.90	5.61	
Diagnosed health	2.51	2.51	0.00		3.17	4.97	1.81		5.26	5.84	0.59	
Comprehensive health	4.69	13.23	8.55		6.28	13.42	7.14		3.31	8.31	5.00	
Mental health	1.10	11.52	10.41		4.20	16.28	12.08		7.25	18.39	11.13	
Cognitive health	–	–	–		5.55	7.19	1.64		1.49	9.08	7.59	
Good health (>33rd percentile)												
Functional health	6.98	13.14	6.15		2.32	5.63	3.31		4.27	7.50	3.22	
Diagnosed health	0.00	0.00	0.00		2.87	6.19	3.32		2.98	5.35	2.37	
Comprehensive health	5.41	9.31	3.90		3.07	14.38	11.31		4.14	5.17	1.02	
Mental health	3.13	14.79	11.65		10.55	19.10	8.55		18.66	8.41	-10.25	
Cognitive health	–	–	–		2.68	6.31	3.63		5.24	12.16	6.91	

Source: Authors' calculations based on SHARE data.

Notes: The table displays the difference in Health-Equivalent Age for the 2nd, 5th and 9th decile in 2005, 2013 and 2021/22. It can be read as follows : For respondents in 2005 (Wave 1), the difference in functional health between the 2nd and 5th income deciles would amount to 4.47 years of ageing.

While some of the differences are remarkably large, the overall pattern of change is mixed as shown in Table 6.3. An upward trend in the difference in *HEA* is evident for diagnosed and mental health, in contrast to a downward trend for functional and comprehensive health. Hence, the results do not point to a consistent rise in health inequalities.

Table 6.3: Change in differences in Health-Equivalent Age from 2005 to 2021/22

	2nd–5th decile	2nd–9th decile	5th–9th decile
Very good health (>66th percentile)			
Functional health	-2.18	-5.44	-3.25
Diagnosed health	2.75	3.33	0.59
Comprehensive health	-1.38	-4.92	-3.55
Mental health	6.15	6.87	0.72
Good health (>33rd percentile)			
Functional health	-2.71	-5.64	-2.93
Diagnosed health	2.98	5.35	2.37
Comprehensive health	-1.27	-4.14	-2.88
Mental health	15.53	-6.38	-21.90

Source: Authors' calculations based on SHARE data.

Notes: This table summarizes how the difference in *HEA* changed between 2005 and 2021/22. Cognitive health is missing from this table as it can be measured only from 2011 onward.

6.7 Conclusion

This chapter provides a descriptive analysis of the evolution of socio-economic health inequalities among Belgian retirees over the past 20 years. For this, the analysis uses data from SHARE and employs multiple complementary approaches : (1) the morbidity gradient, which shows the variation in health outcome across different income deciles; (2) the concentration index, which is a measure of the degree of socio-economic inequality in illness; and (3) differences in Health-Equivalent Age, a more intuitive measure of health inequalities. To provide a more holistic picture of health, five different health measures are used capturing different aspects of health.

The motivation behind this analysis is to examine whether the period of pension reforms - primarily characterized by increases in the statutory eligibility age and reduced system generosity - coincided with differential trends in health outcomes across socio-economic groups, in particular with widening health inequalities. Our findings provide little empirical support for these concerns. The results do not reveal significant evidence of rising health inequality over the period considered.

Some caveats should be acknowledged. First, the analysis relies on a sample of individuals who are alive and sufficiently healthy to remain in the survey, implying positive selection in terms of health. This selection is likely more pronounced among lower-income groups, where mortality and attrition rates tend to be higher. As a result, individuals in poorer health may be underrepresented, which can lead to a downward bias in the estimated level of health inequalities. In this context, the absence of an observed increase in health disparities over time may partly reflect survivorship bias rather than underlying population dynamics. Moreover, the analysis is purely descriptive and therefore has inherent limitations. In particular, we are unable to directly link specific pension reforms to changes in health inequalities. Furthermore, various other factors may exert an influence on health inequalities over that period as well. A more rigorous analytical approach will be needed in future work to disentangle the underlying mechanisms and to identify which design features of the pension system most strongly influence health outcomes. Such evidence would enable policymakers to better anticipate and mitigate unintended negative effects on vulnerable groups, and to align social and health programs more effectively with pension policy.

Chapter 7

Gender Differences in the Use of Disability Insurance as an Exit Pathway into Retirement¹

Abstract

This chapter investigates the gender-differences in the use of disability insurance (DI) as a pathway into retirement and its evolution over time in Belgium. By employing a Fairlie decomposition, we examine how much of the observed difference in DI exits between men and women, as well as the sharp rise in DI exits among women over time, can be explained by observables. Our findings suggest behavioral differences between men and women. Women's exits from the labor market through DI appear to be more affected by institutional and policy conditions. Hence, the comparatively easier access and greater generosity of the DI exit pathway appear to have contributed to the sharp increase in DI exits among women, a pattern that is less evident for men.

¹This chapter is co-authored with Alain Joustien and Mathieu Lefebvre.

7.1 Introduction

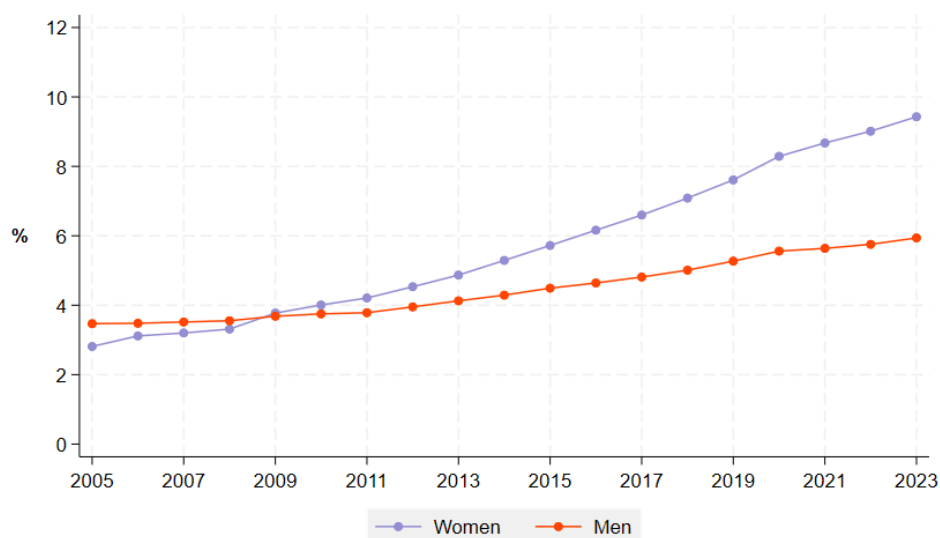
Over the last two decades, Belgium has witnessed a marked and sustained rise in the number of individuals receiving disability insurance (DI) benefits. This trend has attracted growing academic and policy attention, given its implication for public finances, labor market participation and social protection. While previous work (e.g. De Brouwer and Tojerow, 2023) documents the increase in Belgium’s DI reciprocity rate among the working-age population, this chapter focus on the older workers and examines the trend in DI used as an exit pathway into retirement.

A striking feature of this evolution is the emergence of large gender differences in the use of the DI exit route. Figure 7.1 presents the proportion of older wage-earners recognized as disabled by Belgium’s National Institute for Health and Disability Insurance (INAMI) relative to the total employed wage-earners in the private sector, over time. In general, it shows that there has been a significant increase in this proportion over the last 20 years, but with gender differences. In the early 2000s, the proportion of disabled wage-earners was higher among men, but the increase over time was considerably stronger among women, so that this proportion eventually became higher for women².

These gender-based differences in trends raise important questions about the underlying drivers. A first explanation could lie in differences in health trajectories, with older women potentially experiencing a greater deterioration in work capacity (Fors et al., 2022; Low and Pistaferri, 2025). A second possibility is institutional. Successive social security rules have altered the relative attractiveness and accessibility of different exit routes

²In Figure 7.1, we report the stock of disabled individuals aged 55-64 in a given year, measured relative to the stock of total employed wage-earners. In the subsequent analysis, however, we focus on the DI exit rate in a given year, which is the percentage of working wage-earners aged 55-64 who exit the labor market through disability insurance.

Figure 7.1: Proportion of disabled wage-earners aged 55-64 relative to total employed wage-earners in the private sector over time, by gender



Source: INAMI - Service des indemnités - Direction finances et statistiques and ONSS.

Notes: The reported numbers about disabled persons come from INAMI and concern wage-earners in the private sector and unemployed persons who have been unable to work, and who are recognized as disabled (registered in the system for more than one year). This figure excludes persons in primary incapacity (less than one year in the system). Data about employed wage-earners in the private sector comes from ONSS and include all workers with an active employment contract, even if they are absent due to illness, accident, maternity leave or temporary unemployment. Workers on a full career break or full time-credit suspension are excluded. Numbers for each year are as of December 31.

from employment. Some reforms, such as the tightening of early retirement, have been gender-neutral, while others – like the increase in the statutory eligibility age (SEA) – have affected women only during specific periods (Jousten et al., 2014; Fraikin et al., 2025; De Brouwer and Tojerow, 2024).

This chapter examines the role of various factors in explaining gender differences in the use of DI as a pathway into retirement in Belgium and its evolution. Belgium provides a particularly informative setting, given the coexistence of multiple exit routes from employment (e.g., disability, unemployment, conventional early retirement and old-age pension) that have undergone a series of reforms. This combined with persisting gender gaps

in health and work capacity allow for an assessment of how institutional arrangements and health conditions jointly shape the use of DI at older ages. To examine these dynamics, we use data from SHARE covering the period 2004–2022. Similar to De Brouwer and Tojerow (2023), we apply a modified version of the Blinder-Oaxaca (1973) decomposition for binary outcomes, as developed by Fairlie (2005). Our findings suggest behavioral differences between men and women. Women’s decisions to exit the labor market through disability insurance (DI) appear to be strongly influenced by the institutional and policy framework in place, which seems to be less the case for men. Thus, the relatively easier accessibility and increased generosity of the DI exit route appear to have played a role in the rise of DI exits among women, a pattern that is less evident for men.

The structure of this chapter is as follows: Section 7.2 highlights social security reforms that might have influenced the ways individuals exit the labor market. Section 7.3 presents the data and the sample used for the analysis as well as the observed exit patterns of men and women over time. Section 7.4 is devoted to a Logit regression to assess the different factors associated with exiting the labor market via DI. In Section 7.5, we examine how much of the observed difference in DI exits between men and women, as well as the sharp rise in DI exits among women over time, can be explained by observables, using a Fairlie decomposition. Section 7.6 concludes.

7.2 Exit pathways into retirement and policy reforms

As a reminder there are four main exit routes into retirement for Belgian wage-earners, each with different eligibility requirements and benefits: (1) The old-age pension (OAP) is the standard route, available to individuals who have reached the required number of career years and the statutory eligibility age (or early eligibility age). (2) The unemployment insurance (UI) can serve as a route for those who lose their job before reaching the (early) retirement age, providing income support until they qualify for the old-age pension. (3) The conventional early retirement (CER) is a system of early exit from the labor market that is organized outside of the old-age pension system and provides financial support through a special UI benefit, supplemented by an additional payment from the former employer. (4) The disability insurance (DI) is targeted at individuals no longer able to work (in their current job) for reasons of long-term sickness or accidents. Regardless of the chosen exit route, once older adults reach the statutory eligibility age (SEA) they are automatically rolled over into the OAP system.

The present chapter focuses on the DI exit route. However, as the various pathways are interrelated and can serve as substitutes for one another, reforms in one system may influence the utilization of the remaining exit routes and therefore cannot be disregarded.

Over the past two decades, several reforms have been implemented in the social security system, which may have influenced the ways individuals exit the labor market. One major change concerned the statutory eligibility age (SEA) for the old-age pension for women, which was gradually increase from 60 to 65 between 1997 and 2009 to align with the system for men. At the same time, the eligibility conditions for early exit through OAP and CER – both in terms of minimum age and required ca-

reer length – have become increasingly stringent, making it more difficult for older workers to retire via these pathways. Moreover, the valorization of periods spent on replacement income in the pension calculation has changed. In 2007, a special lower salary ceiling was introduced for certain periods on UI and CER, and this limit was further reduced in 2012. By contrast, this reform did not affect periods spent in DI, for which the regular earnings ceiling remained in place, making this exit route relatively more generous³.

Collectively, these reforms are likely to have shaped patterns of labor market exit over time, potentially increasing reliance on DI while reducing early exits via the other routes. Because the reforms have not been identical for men and women, they may partly account for the differing evolutions in labor market exit patterns across genders.

7.3 Data and exit patterns

7.3.1 Sample and descriptive statistics

We use the Belgian data from SHARE⁴ for our analysis. The SHARE Job Episodes Panel is used to construct the career of each person on a yearly basis in order to determine the year the respondent exits the labor market as well as the chosen exit route.

For the purpose of our analysis, we select working wage-earners aged between 55 and 64, leading to a sample composed of individuals born between 1939 and 1967 that are about to leave the labor market. Individuals

³See Chapter 2 for more details about the reforms.

⁴SHARE (Survey of Health, Ageing and Retirement in Europe) is a biennial, cross-national panel survey covering individuals aged 50+ in 28 European countries and Israel since 2004/05, providing detailed information on health, labor market status, and household economic and social conditions. Retrospective modules allow the construction of the SHARE Job Episodes Panel, which reconstructs individuals' labor market histories over the life course.

may appear multiple times in the sample if they meet the age and employment criteria in different years. The self-employed and civil servants are outside the scope of this analysis.

Because we are interested in the change of DI exits over time, we divide our sample into two time periods. Period 1 includes the years 2004-2009, while period 2 contains the years 2016-2022⁵. We end up with 2240 observations in period 1 and 2457 observations in period 2. Table 7.1 presents summary statistics of our sample by gender for the two time periods.

In period 1, men represent the majority of the active population within the age group 55-64. However, in period 2, the proportion of women increases, slightly surpassing that of men. As a result, the overall sample becomes more balanced in terms of gender, reflecting a shift toward more equality in participation.

There are slight gender-differences in the demographic characteristics of our sample. Women are more likely to live alone, but the proportion increases slightly for both gender over time. The proportion of being married is larger among men, although a shift is observed between the two time periods for both gender with the proportion decreasing. The average age is balanced across gender, but the sample is slightly older in period 2. In terms of educational attainment, there are no significant differences. The educational level increases slightly in period 2. For health, we use an aggregated indicator because SHARE data contains a large number of health measures. The health deficit index summarizes the individual health status by aggregating a set of self-reported health deficits, including chronic conditions, functional limitations and difficulties with daily activities, as well as mental health. Each deficit is coded as present or absent, and the index is calculated as the proportion of observed deficits relative to the to-

⁵Period 1 corresponds to SHARE wave 1-3, while period 2 includes wave 7-9.

Table 7.1: Summary statistics of sample, working wage-earners aged 55-64

	Period 1: 2004–2009			Period 2: 2016–2022		
	Total	Men	Women	Total	Men	Women
Number of						
Observations	2240	1350	890	2457	1174	1283
% in total sample		60%	40%		48%	52%
Individuals	714	433	281	655	309	346
Demographics						
Living alone (%)	15	11	19	18	14	21
Married (%)	74	79	66	48	58	39
Average age	57.70	57.70	57.70	58.91	58.88	58.94
Average educational level [0–6]	3.16	3.20	3.10	3.65	3.74	3.57
Average health deficit index [0–100]	9.78	9.26	10.47	9.36	8.69	9.99
Employment						
ACE at age 54 (in 2025 EUR)	73675	89656	49434	68610	82245	56132
Average number of career years	37.00	38.37	34.93	38.01	38.66	37.41
Full time (%)	83	95	64	73	89	59
Blue collar (%)	24	34	8	18	29	8
Industry (%)						
Primary sector	3	5	1	1	2	1
Secondary sector	28	41	8	26	40	13
Tertiary sector: market	31	31	30	31	35	28
Tertiary sector: non-market	38	23	61	42	23	58

Source: Authors' calculations based on SHARE data.

Notes: Educational level: SHARE uses the 1997 International Standard Classification of Education (ISCED-97) which ranges from 0-6. A higher value means a higher educational level. Level 0 corresponds to pre-primary education; level 1 to primary education; level 2 and 3 to lower and upper secondary education respectively; level 4 to post-secondary non-tertiary education; level 5 to the first stage of tertiary education; and level 6 to second stage of tertiary education; ACE: 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. No distinction is made between years worked full-time or part-time; both are counted as a single career year; Blue collar: Blue collar workers are defined as workers with the following job description : skilled agricultural or fishery workers, crafts of related trades worker, plant/machine operator or assembler and unskilled workers in agriculture, mining, manufacturing, electricity and gas supply, construction as well as the transport and storage industry; Industry: The primary sector contains agriculture, hunting, forestry, fishing as well as mining and quarrying. The secondary sector encompasses manufacturing, electricity, gas and water supply, as well as construction. The tertiary sector covers services. We distinguish between market services such as wholesale and retail trade, hotels and restaurants, transport and storage, financial intermediation, and real estate; and non-market services such as public administration and defense, education, as well as health and social work.

tal number of non-missing health indicators, hence a value between 0 and 100. It is based on the health deficit index as proposed by Börsch-Supan et al. (2021) and Abeliatsky and Strulik (2019)⁶. We observe that the health among active older adults is slightly better among men, as measured by a lower health deficit index. In period 2, the overall health in the sample improves.

Gender-differences are more evident in employment-related factors. In terms of average career earnings (ACE), we see a larger amount for men compared to women. Over time, a slight increase in wages is observed for both genders. Men have on average longer careers than women. However, a significant increase is observed for women over time, narrowing the gap. Men are also more likely to work fulltime. But the proportion of fulltime employed decreases for both genders over time. Regarding job types, men are more frequently employed in manual occupations, although this share decreases slightly over time. Men tend to work predominantly in the secondary sector, while women are disproportionately represented in non-market service occupations such as the healthcare sector, education or the public administration. Although differences across the blue-collar status as well as the sectors provide some indication of the types of jobs men and women perform, gender distinctions also exist within the same sector. While gender norms have evolved over time, such gender differences still persist to some extent. For example, in the health care sector – one of the most gender-segregated industries – women make up the majority of the workforce and are predominantly concentrated in patient-facing and caregiving occupations such as nursing or midwifery. Men by contrast, are more often found in technical, managerial or support roles within the

⁶We opt for a health deficit index because health cannot be captured as a single-dimensional concept. Combining various indicators into one measure provides a more holistic assessment of an individual's health status. This method enables us to reflect overall health stock instead of concentrating on specific conditions, making it particularly well-suited for evaluating general health across individuals or over time. However, this approach also comes with certain limitations. Appendix E.1 assesses this matter in more detail.

same sector (OECD, 2024). Similar patterns are observed across many industries. According to ILO statistics (2020), women globally remain concentrated in a set of occupation such as clerical work, teaching, and care-related roles – while men dominate in technical, craft, and managerial positions, even when both genders are employed in the same broad industry. This illustrates that gendered occupational stratification persists within industries and is not merely the result of sectoral sorting. However, the available data do not allow for a more detailed categorization of job types within individual industries for our analysis.

7.3.2 Gender differences in DI exits over time

To look at DI exits over time, we first define an exit out of the labor market based on an individual's employment status and an earnings criterion. Individuals answering to be inactive but still earning an income above a specified threshold are not considered to have exited the labor market. The threshold corresponds to the maximum allowable earnings alongside pension benefits before reaching the statutory eligibility age (SEA) or completing a 45 career years⁷.

To determine the chosen exit route, we analyze the individual's situation in the years following the exit from the labor market, the stated reason for leaving, as well as potential social security payments. Individuals classified as sick or disabled, those who reported ceasing work for health-related reasons, or those who received disability insurance benefits are considered to have exited through the disability insurance (DI) route⁸. Similarly, individuals classified as unemployed or who received unemployment benefits are regarded as having exited through the unemployment

⁷In 2025, a person receiving the old-age pension without having reached the SEA and without having completed 45 career years may earn up to EUR 10117 without his pension being reduced.

⁸We include thus both phases of DI : primary incapacity and disability.

insurance (UI) route. Due to data limitations, it is not possible to distinguish between exits through the conventional early retirement (CER) and old-age pension (OAP) route, therefore, these two categories are combined into a single exit route.

Table 7.2 presents the proportion of individuals in the sample that exit through the different exit routes, disaggregated by gender and time period.

Table 7.2: Chosen exit routes over time, by gender

	Period 1 2004-2009	Period 2 2016-2022	Change
Men			
Active	1350	1174	
Remaining active	84.22%	88.67%	+4.45 pp
Exiting via DI	2.00%	2.30%	+0.30 pp
Exiting via UI	3.19%	1.02%	-2.16 pp
Exiting via CER or OAP	10.59%	8.01%	-2.59 pp
Women			
Active	890	1283	
Remaining active	86.74%	88.15%	+1.41 pp
Exiting via DI	0.90%	2.96%	+2.06 pp
Exiting via UI	2.47%	0.47%	-2.00 pp
Exiting via CER or OAP	9.89%	8.42%	-1.47 pp

Source: Authors' calculations based on SHARE data.

The overall time trend shows that more individuals in this age group remain active. During this period, numerous reforms took place, with one of the main objectives being to increase the labor market participation among older adults. These reforms could provide a possible explanation for this trend. Regarding those that exit, we see a shift in the chosen exit routes over time. The proportion of people exiting via DI increases, while it decreases for the remaining exit routes. The 2007 and 2012 reform, which increased the generosity of DI relative to UI and CER for the pension calculation as well as the stricter eligibility criteria for early exit

through OAP and CER, may be potential reasons for this shift, prompting a substitution of exit routes.

Looking closer at the DI exits, we see significant differences between men and women. In period 1, men are twice as likely to use this pathway into retirement compared to women. A *t*-test reveals that this difference is statistically significant. Over time, the increase in the use of this exit route is barely noticeable for men, while the increase is substantial for women. The proportion of DI exits among active women rises from 0.90% to 2.96%, rendering them more likely than men to use this exit route in period 2. In this regard, women not only close the initial gap, but surpass their male counterparts. A *t*-test indicates that the increase in the use of the DI exit route is significant among women, but not among men.

7.4 Factors associated with DI exits

7.4.1 Logit regression

We aim at examining which individual characteristics are most strongly associated with exiting the labor market through DI and whether these associations have changed over time. To do so, we estimate a logistic regression model in which a dummy of DI exit is regressed on a set of covariates. To capture the potential changes in these relationships over time, we interact each covariate with a dummy variable indicating the second period (2016-2022). The following covariates are included: the health deficit index, the average career earnings, the number of career years, whether the individual had a blue-collar contract and whether she/he worked fulltime⁹.

⁹The following variables were tested as well in the regression analysis: age, whether the individual is married, whether the individual is living alone, and the sector of employment. In particular, marital status and the living arrangement were included to account for the fact that retirement decisions are often coordinated within couples rather than made individually (Hurd, 1990; Michaud et al., 2020; Hospido and Zamarro, 2014). However, no significant effect could be detected for any of these variables. When the

We also add a series of system-related factors. First, a variable capturing the change throughout the years in the generosity of the DI exit route compared to UI and CER. It measures the ratio of the earnings ceiling applied in the pension calculation for time spent in DI to the earnings ceiling applied for time spent in UI or CER, for which the ceiling was reduced in 2007 and 2012. Second, as we expect a relation between the retirement decision and the generosity of the pension system in general, we add a variable reflecting this. We take the average pension replacement rate¹⁰ from the OECD reports "Pensions at a glance" throughout the years to create a dummy which captures whether the general generosity of the pension system increased. Specifically, the variable takes the value one when the replacement rate exceeds the median of its distribution. Finally, we add the statutory eligibility age (SEA), which gradually increased for women over the observation period and the early eligibility age (EEA) which increased for both men and women over the years.

Table 7.3 presents the result of the Logit regression. It is also done separately for men and women, in order to assess whether there are significant gender differences.

As expected, the results show a strong significant effect from the health deficit index. A higher index, indicating more health problems, is associated with a higher probability to exit the labor market via DI. However, no significant difference can be found for the second period.

No significant association can be found with the average career earnings and the number of career years. Having a blue-collar contract is asso-

educational attainment of the individual is added, a significant effect can be found, with more educated people being less likely to exit via DI. However, in this case, a series of other employment-related variables such as the blue collar status are no longer significant. Hence they appear to capture similar underlying effects.

¹⁰The net pension replacement rate represents the ratio of an individual's net pension benefits to their net earnings before retirement, after accounting for income taxes and social security contributions for both workers and retirees. It indicates how well a pension system replaces employment income.

Table 7.3: Logit regression - labor market exit via DI

	Total		Men		Women	
Individual-level factors						
Health deficit index	0.14	***	0.16	***	0.12	**
Period 2	-0.01		-0.03		0.02	
Employment-related factors						
Average career earnings	-0.01		-0.01		-0.01	
Period 2	0.01		0.01	**	-0.01	
Number of career years	0.01		0.01		0.01	
Period 2	-0.01		-0.01		-0.01	
Blue collar	0.02	***	0.02		0.03	**
Period 2	-0.01		0.01		-0.04	**
Full-time	0.06		/		0.05	
Period 2	-0.06		-0.03		-0.05	
System-related factors						
DI generosity	0.08	*	0.05		0.15	**
Increased generosity of OAP	0.02	**	0.02		-0.01	
SEA	0.01		/		0.04	**
EEA	0.02	**	0.02		0.05	***
Wave fixed effect	-0.01	***	-0.01		-0.04	***
Constant	-102.45	**	-79.60		-570.44	***
Number of observations	3247		1516		1572	

Source: Authors' calculations based on SHARE data.

Notes: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. SEA: Statutory eligibility age. EEA: Early eligibility age. SEA is omitted in the regression for men, as there was no change in the period of observation. The SEA was gradually increased only for women. Fulltime is omitted in the regression for men, as failure could be predicted perfectly. The reported coefficients are the average marginal effects.

ciated with a higher chance to exit through DI among women. However, this difference between blue and white collar workers vanishes in period 2. Working full time is not significantly associated with exiting the labor market via DI.

When looking at the system-related factors, we see a positive effect coming from the measure of the generosity of the DI exit route compared to the other exit routes. This indicates that an increased generosity leads to more exits through DI. However, the results reveal gender-differences,

as this association is only significant among women, but not among men. When looking at the whole population, we see a positive significant effect coming from an increased generosity of the pension system. However, this is no longer holds when the regression is conducted separately for men and women. The SEA and EEA is positively associated with DI exits among women. The higher the eligibility age, the more women exit via DI. However, such association is not significant among men.

Overall, we observe that among women, a large number of factors are significantly associated with exiting the labor market via DI. In particular, system-related factors show a strong level of significance, suggesting that women's decision to exit through DI are strongly influenced by the institutional and policy framework in place. In contrast, among men, apart from health, no variables – whether employment-related or system-related – show significant associations with DI exits. This pattern may indicate that men's exits are driven primarily by individual health limitations rather than external or systemic factors¹¹.

7.4.2 Unobserved screening and gatekeeper behavior

The empirical model estimates the probability of exiting the labour market via DI as a function of individual health, employment characteristics, and institutional incentives. However, this approach primarily captures the demand-side of DI participation - namely, individuals' propensity to select into this pathway given their circumstances and the relative attractiveness of DI compared to alternative exit routes.

¹¹The time period under study includes two major economic crises: the financial crisis in 2008/2009 and the Covid-19 crisis in 2020. These crises may have influenced people's behavior as well as the relationship between various factors and the decision to exit via DI. To assess the impact of these crisis years, we conduct a sensitivity analysis in Appendix E.3, excluding them from the model. The results of the Logit regression remain largely unchanged for men. For women, however, the association between system-related factors and exits via DI becomes weaker. This may reflect a genuine strengthening of this link during crisis years, or it may be a consequence of the reduced sample size, which lowers the statistical power of the model. Further details can be found in the Appendix sub-section E.3.2.

In reality, entry into DI is the outcome of a two-stage process: individuals must first apply, and then be approved through a medical screening procedure requiring certification of a substantial loss in earnings capacity. This second stage introduces a supply-side constraint governed by gatekeepers such as general practitioners and insurance physicians. Their behaviour - ranging from strict enforcement to more accommodating practices - plays a crucial role in determining access to DI.

A key limitation is that screening strictness is not directly observable. It is a latent and potentially endogenous factor, influenced by institutional context, policy changes, and applicant composition. Common proxies, such as approval rates are difficult to interpret because they reflect both demand and supply forces simultaneously. The absence of explicit measures of gatekeeping constitutes an important limitation of the model and should be taken into account when interpreting the results.

7.5 Fairlie decomposition

To further disentangle the sources of gender disparities and because the aim of our analysis is to examine the potential factors driving the rise in the DI exit route, we apply a modified version of the Blinder-Oaxaca decomposition method designed for binary outcomes, as developed by Fairlie (2005). This approach allows us to quantify the extent to which observed differences in DI participation between men and women (or over time) can be explained by differences in observable characteristics, such as health, employment history or system-related factors, versus differences in the estimated coefficients reflecting behavioral and other unobserved factors.

7.5.1 Methodology

In the traditional Blinder-Oaxaca decomposition approach (Oaxaca, 1973; Blinder, 1973), regression analysis is used to break down the average difference in an outcome variable between groups (in our case two time periods or men/women) into two parts : (1) one representing differences in average characteristics of the groups (i.e., the health status), (2) and another capturing differences in the estimated coefficients of these explanatory variables as well as any residual difference unexplained by the model (i.e., the likelihood to exit via DI given a particular health status). The following equation expresses this decomposition formally, where $\bar{Y}^{P_p}$ is the DI exit rate in period p , $\bar{X}^{P_p}$ is a row vector of average values of the independent variables in period p , and $\hat{\beta}^{P_p}$ is a vector of coefficient estimates for period p .

$$\bar{Y}^{P_2} - \bar{Y}^{P_1} = \left[\left(\bar{X}^{P_2} - \bar{X}^{P_1} \right) \hat{\beta}^{P_2} \right] + \left[\bar{X}^{P_1} \left(\hat{\beta}^{P_2} - \hat{\beta}^{P_1} \right) \right]$$

However, this technique can only be applied if the coefficients come from a linear regression model. Fairlie modified this approach for binary variables by employing a Logit regression model instead of OLS. Formally, the non-linear decomposition can be expressed as the following, with N^{P_p} being the sample size in period p and $F(.)$ being the cumulative distribution function of a logistic distribution.

$$\begin{aligned} \bar{Y}^{P_2} - \bar{Y}^{P_1} = & \left[\sum_{i=1}^{N^{P_2}} \frac{F(\bar{X}_i^{P_2} \hat{\beta}^{P_2})}{N^{P_2}} - \sum_{i=1}^{N^{P_1}} \frac{F(\bar{X}_i^{P_1} \hat{\beta}^{P_2})}{N^{P_1}} \right] \\ & + \left[\sum_{i=1}^{N^{P_1}} \frac{F(\bar{X}_i^{P_1} \hat{\beta}^{P_2})}{N^{P_1}} - \sum_{i=1}^{N^{P_1}} \frac{F(\bar{X}_i^{P_1} \hat{\beta}^{P_1})}{N^{P_1}} \right] \end{aligned}$$

The first term in brackets represents the portion of the difference explained by average differences in individual characteristics, whereas the second term denotes the portion that remains unexplained. Calculating the contribution of each factor to the total explained difference is more complicated for non-linear models than in the traditional Blinder-Oaxaca method. Nonetheless, once these contributions are determined, they can be interpreted in the same way¹².

It is important to note that the approach of Fairlie does not establish causal relationships. The decomposition of differences into “explained” and “unexplained” components captures associations between observed characteristics and outcomes, rather than causal effects of those characteristics. In other words, the “explained” portion should be interpreted as the share of observed disparities that correlates with differences in factors such as health, employment, or system-related conditions, without implying that altering these factors would necessarily change outcomes.

7.5.2 Assessing gender differences in DI exits in period 1

In Section 7.3.2, we see a significant difference in the use of the DI exit route between men and women in period 1 that no longer holds in period 2. The Fairlie decomposition is used to assess how much of this difference in period 1 can be explained by differences in observables. Men serve as the reference group, meaning that the coefficients from the Logit regression estimated for men are used as the basis for the decomposition¹³.

¹²For a detailed explanation of how to derive these individual contributions, see Fairlie (2005).

¹³The Fairlie decomposition is implemented within a nonlinear probability framework and is based on the estimation of a Logit regression for a selected reference group. The estimated coefficients from this reference-group Logit model define the underlying functional relationship between covariates and the predicted probability of the outcome and are subsequently used to decompose differences in mean outcomes across groups. Appendix E.2 presents the results of the underlying Logit regression.

We first perform the decomposition separately for each covariate to assess the marginal contribution of each factor independently. This serves as a diagnostic step, showing how much of the gap each variable can explain on its own. Afterwards, the decomposition is done jointly including all variables to estimate their combined and net contributions to the gap. In this case, the contribution of each factor to the total explained component is reported. The sign and magnitude of these contributions may vary between factors. For both decompositions, the same individual-level and employment-related variables of the Logit regression in Section 7.4 are used, although some are specified differently¹⁴. The system-related factors are left aside, because we are focusing on period 1, during which there are hardly any differences between men and women in the system, except for the SEA¹⁵. Table 7.4 presents the results.

Table 7.4: Fairlie decomposition – men vs. women in period 1

	N	DI exit rate Men	DI exit rate Women	Diff.	Total expl- ained	Contrib. to total explained
Separately						
Health deficit index	1326	2.51%	1.23%	-1.28 pp	0.55 pp	***
Average career earnings	2240	2.00%	0.90%	-1.10 pp	0.73 pp	
Number of career years	2240	2.00%	0.90%	-1.10 pp	-0.46 pp	***
Blue collar	2240	2.00%	0.90%	-1.10 pp	-0.25 pp	***
Jointly						
Health deficit index	1326	2.51%	1.23%	-1.28 pp	0.16 pp	
Average career earnings						0.50 pp
Number of career years						0.52 pp
Blue collar						-0.60 pp
						-0.27 pp

Source: Authors' calculations based on SHARE data.

Notes: *** p<0.01, ** p<0.05, * p<0.1. Fulltime is omitted in the decomposition, as failure could be predicted perfectly for men in period 1. In the joint decomposition, the contribution of each factor to the total explained is reported in the last column.

¹⁴See Appendix E.2 for more details.

¹⁵The decomposition was also performed with SEA to examine whether the difference in SEA significantly contributed to the difference in DI exits between men and women in period 1. This was not the case.

The results show a negative difference, meaning that women have a lower DI exit rate compared to the male reference group in period 1. When looking at each covariate separately, we see a significant contribution coming from the health deficit index. However, it is of opposite sign. Hence, based on the health-difference between men and women, women should be more likely to exit via DI, as they are of worse health. The difference in the career length between men and women also explains part of the gender-difference in DI exits. Since men have longer careers, they are more likely to exit via DI. This difference can explain 42% of the observed difference in DI exits (0.46 pp out of 1.10 pp). The difference in blue-collar contracts between men and women can explain part of the difference in DI exits as well. As men are more likely to work in a blue-collar job, they are more likely to exit the labor market via DI. The contribution is equal to 23% (0.25 pp out of 1.10 pp).

When doing the decomposition jointly with all covariates, we see that none of the variables remains significant. Based on the observables we include in the model, we are thus unable to explain the difference in DI exits between men and women in period 1. This suggests that other factors such as behavioral differences may be at play.

However, it should be noted that the health measure used in this decomposition has certain limitations. As a reminder, we use an aggregated indicator - the health deficit index. It summarizes the individual health status by aggregating a set of self-reported health deficits¹⁶. We use this measure because health is multidimensional; combining indicators gives a more comprehensive view of overall health rather than focusing on specific conditions. However, this approach also has some constraints. In the index, all health deficits are weighted equally, meaning each contributes the same to the overall measure, even though some conditions may more

¹⁶Each deficit is coded as present or absent, and the index is calculated as the proportion of observed deficits relative to the total number of non-missing health indicators, hence a value between 0 and 100.

strongly affect an individual's ability to remain in the labour market and thus better explain transitions into DI. In addition, aggregating multiple dimensions into a single indicator inevitably results in some loss of detail. Different underlying health profiles can result in the same index value, which means that the measure may not fully capture important differences in the type and composition of health conditions across individuals. In the context of explaining gender differences in DI exits, this may matter, as some diagnoses are more common among men or women and may more strongly influence the likelihood of exiting the labour market through DI, even when overall index scores are similar. Appendix E.1 assesses this matter in more detail.

7.5.3 Assessing the rise in DI exits among women over time

The same decomposition exercise is done to assess how much of the rise in DI exits among women can be explained by differences in observables between the two time periods¹⁷. Period 1 serves as the reference model, meaning that the coefficients from the Logit regression estimated for period 1 are used as the basis for the decomposition¹⁸. As in the previous section, we first look at the different covariates separately, then the decomposition is done jointly. As there were several reforms in the system between the two periods, the system-related factors are now added to the analysis. Results are presented in Table 7.5.

¹⁷Because no significant change in the DI exit rate among men was observed over the observation period, no decomposition is presented for this subgroup. The decomposition was nonetheless performed to verify that no offsetting effects were present. None were found, so the results are not reported.

¹⁸The Fairlie decomposition is implemented within a nonlinear probability framework and is based on the estimation of a Logit regression for a selected reference group. The estimated coefficients from this reference-group Logit model define the underlying functional relationship between covariates and the predicted probability of the outcome and are subsequently used to decompose differences in mean outcomes across groups. Appendix E.2 presents the results of the underlying Logit regression.

Table 7.5: Fairlie decomposition – women in period 1 vs. period 2

	N	DI exit rate Period 1	DI exit rate Period 2	Diff.	Total expl- ained	Contrib. to total explained
Separately						
Health deficit index	1666	1.23%	2.37%	1.14 pp	0.02 pp	
Average career earnings	2173	0.90%	2.96%	2.06 pp	0.31 pp	
Number of career years	2173	0.90%	2.96%	2.06 pp	0.18 pp	
Blue collar	2173	0.90%	2.96%	2.06 pp	-0.16 pp	**
DI generosity	2173	0.90%	2.96%	2.06 pp	-0.69 pp	**
OAP generosity	2173	0.90%	2.96%	2.06 pp	-0.31 pp	
SEA	2173	0.90%	2.96%	2.06 pp	-0.44 pp	
Jointly						
Health deficit index	1666	1.23%	2.37%	1.14 pp	0.16 pp	0.28 pp
Average career earnings						1.00 pp
Blue collar						-0.50 pp
DI generosity						17.71 pp ***
OAP generosity						-30.96 pp ***
SEA						12.63 pp ***

Source: Authors' calculations based on SHARE data.

Notes: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Fulltime and EEA are omitted in the decomposition because of collinearity. In the joint decomposition, the contribution of each factor to the total explained is reported in the last column. We exclude the number of career years from the joint decomposition, as its inclusion resulted in substantial distortions and inconsistencies relative to the outcomes of all other model specifications.

The results show a positive difference, meaning that the DI exit rate among women increased since period 1, which is used as the reference period. When doing the decomposition separately, hardly any variable is significant. Exceptions are the variables accounting for blue-collar jobs and for the generosity of the DI exit route. However, the sign is negative for both of them. It means that the reduced number of blue-collar workers among women in period 2 compared to period 1 has led to less DI exits over time and that the difference in relative DI generosity between the two time periods has led to less DI exits as well among women. However, the latter is not intuitively plausible, given that the generosity of DI relative to other exit pathways has risen over time and, as indicated by the results of the Logit regression in Section 7.4, is positively related to exit via DI.

When doing the decomposition jointly, the individual-level and employment -related factors remain insignificant. However, all system-related factors significantly contribute to the change in the exit rate via DI among women. Overall, 14% of the observed growth can be explained by observables (0.16 pp out of 1.14 pp). The rise in the SEA and the generosity of the DI exit route both positively contributed to the change. Differences in the general generosity of the pension system across periods negatively contributed.

The limitations¹⁹ inherent in the use of the health deficit index are also relevant in this context and should therefore be acknowledged and discussed. Changes over time in the composition of health conditions - such as a shift toward more severe or more DI-relevant diagnoses - may not be fully reflected in the index. In other words, the index may fail to fully capture how changes in the types of health conditions, beyond their overall prevalence, are linked to the increase in DI exits over time.

¹⁹Appendix E.1 assesses this matter in more detail.

7.6 Conclusion

This chapter examines the rise in the use of disability insurance (DI) as a pathway out of the labor market over the past 20 years in Belgium, with a particular focus on gender differences. For this, we use the data from SHARE and divide our sample of older adults into two time periods : period 1 encompasses the years 2004-2009, period 2 the years 2016-2022. We observe that in period 1, men were significantly more likely to exit via DI, being roughly twice as likely as women. Over time, DI exits for men increased only slightly, whereas women experienced a substantial rise, leading to a convergence in DI exit rates by period 2.

To understand the difference between men and women, we start by doing a Logit regression to assess the factors that are associated with DI exits. It includes a series of individual-level, employment-related and system-related factors. Results show that among women, in particular, system-related factors such as the generosity of the DI exit route in comparison to the other exit routes and the early and statutory eligibility ages show a strong level of significance, indicating that women's decision to exit through DI may be influenced by the institutional and policy framework in place. On the other hand, the results suggest that men's exits are driven primarily by individual health limitations rather than external or systemic factors.

The analysis further investigates the factors contributing to the difference in DI exits between men and women as well as to the substantial rise in DI exits among women. For this, we use a Fairlie decomposition to assess how much of the difference can be explained by differences in average characteristics of the two groups. Based on the observables we include in the model, we are unable to explain the difference in DI exits between men and women in period 1, suggesting that other factors such

as behavioral differences may be at play. Regarding the rise in DI exits among women over time, 14% of the observed growth can be explained by observables. The gradual increase in both the SEA and the generosity of the DI exit route over the observation period both positively contributed to the rise. Differences in the general generosity of the pension system across periods negatively contributed.

Overall, the results suggest that women and men behave quite differently when choosing to exit via DI. For women, changes in the social security system appear to play a role in shaping exit pattern, whereas for men, these institutional factors have little observable impact. These behavioral differences likely help explain the divergent trend observed between the two groups over time. Specifically, reforms during this period made certain exit routes less accessible while simultaneously increasing the generosity of DI, contributing to a marked rise in DI exits among women, but leaving men's exit behavior less affected.

Chapter 8

General Conclusion

8.1 Research objective

The scope of debates surrounding social security systems has progressively expanded. While financial sustainability has long dominated policy discussions, concerns related to inequality and benefit adequacy have become increasingly salient. This shift reflects a broader context of heightened awareness of social inequalities and profound demographic changes, which have in turn driven successive pension reforms with non-negligible distributive consequences. In this setting, older individuals constitute a particularly vulnerable group, as they rely heavily on transfers from public social security systems and are therefore directly affected by institutional design choices.

Public pension systems make use of a set of mechanisms such as minimum pension thresholds, survivor's pension, and pension credits for career interruptions, to secure income in old age. Such measures also help to cushion disparities arising from unequal life-course trajectories, which allows pension systems to serve not only as sources of retirement income but also as instruments for enhancing social equality in old age.

The objective of this thesis is to gain a better understanding of the impact of pension system design on social inequalities at old age, with a focus on the Belgian system. With its numerous redistributive mechanisms and several reforms in the social security system, Belgium offers a compelling case study for examining how specific components of the pension system contribute to redistribution.

8.2 Key findings and policy implications

Throughout this thesis, various insights emerge concerning the relationship between pension system design and social inequalities in old age.

Chapter 2 provides an overview of the Belgian social security system relating to individuals about to retire and retirees. The focus lies on the redistributive aspects, and the evolution of the system over time since the early 2000s. It highlights that the Belgian pension system incorporates numerous redistributive mechanisms, reflecting the long-standing importance of addressing inequality. Measures such as derived pension rights, assimilated periods, various minimum rules, wage ceilings, and a social assistance program independent of career history all serve to correct disparities and mitigate inequalities that partly originate in the labor market and the household. These provisions promote greater equality in retirement income, positioning Belgium among the more equal countries in old age. The system has undergone multiple reforms over time, reflecting evolving policy priorities. A common trend across these reforms has been the gradual increase in the statutory eligibility age alongside reductions in overall benefit generosity, measures primarily aimed at containing costs and enhancing financial sustainability. Although these reforms were not explicitly designed with redistribution as a central objective, they nonetheless entail distributive implications across different groups.

Chapter 3 examines the redistributive effects of past social security reforms on the income distribution of retirees. By distinguishing between a mechanical effect and a behavioral effect, the analysis reveals that the reforms since the early 2000s have generally reduced the system's overall generosity. However, an important exception is observed for the first income decile, which has benefited from increased support, ultimately contributing to a reduction in inequality. This heterogeneous impact is largely driven

by the enhanced generosity of the GRAPA, which has strengthened the financial position of the lowest-income retirees. These findings highlight the effectiveness of mechanisms like GRAPA in reducing inequality, suggesting that further strengthening targeted support for the lowest-income retirees could enhance equality in the pension system. However, policymakers must carefully balance redistribution with incentive concerns. Expanding means-tested benefits could discourage workforce participation or private savings if individuals perceive that additional earnings or contributions will reduce their eligibility for support. To mitigate these unintended effects, reforms should ensure that targeted benefits remain generous enough to protect the most vulnerable while maintaining incentives for individuals to contribute to the system. Gradual phase-out mechanisms and well-designed eligibility criteria can help strike this balance, ensuring that redistribution enhances fairness without creating disincentives for work and savings.

Since this analysis considers pension wealth rather than annual benefits, it is crucial to acknowledge that life expectancy varies across social classes. Individuals with lower incomes tend to have shorter lifespans, meaning they receive pension benefits for a shorter period compared to wealthier individuals. This factor amplifies existing inequalities arising from differences in earnings and career histories. Importantly, this analysis accounts for these variations in life expectancy, ensuring a more accurate assessment of the redistributive effects of the reforms.

Chapter 4 examines the gender dimension of the Belgian public pension system. Using a counterfactual analysis, the change in the gender pension gap due to the various redistributive corrections implemented in the system is calculated while considering different scenarios regarding the attribution of the household's pension. The findings indicate that the redistributive adjustments in the pension system have significantly narrowed

the gender pension gap, with a reduction of around 30 percentage points on average. Derived pension rights and assimilated periods play a crucial role in reducing gender inequalities in pensions. The gap is thus largely driven by women's shorter, more interrupted careers, often due to caregiving responsibilities. To address this, policy initiatives should focus on reducing career disparities, particularly by promoting workplace flexibility and encouraging shared caregiving duties. Additionally, it is important to continue recognizing caregiving periods in pension calculations, as this acknowledges the value of non-market labor. However, the challenge remains in ensuring that such credits truly capture the long-term impacts caregiving has on career trajectories and pension outcomes.

The comparison of different scenarios regarding the allocation of household pensions provides a more nuanced understanding of gender inequality within the pension system. It reveals that the gender pension gap (GPG) can vary significantly depending on the assumptions made, highlighting the substantial influence these assumptions have on the results. Interpreting the GPG is thus more complex than it may initially seem, which underscores the importance to approach the policy implications of the GPG with caution. While the GPG is a useful tool for highlighting pension disparities between men and women, it has its limitations. It provides a snapshot of individual benefits but does not consider how resources are shared within households, which can affect financial security in ways that individual metrics may not capture. As such, relying exclusively on the GPG may overlook the complexities of household financial dynamics, leading to an incomplete picture of gender inequality in retirement.

Chapter 5 analyzes the impact of three potential pension reforms on different measures of inequality and adequacy, seeking to identify strategies that could improve the Belgian social security system. The effect is examined by marital status and gender to analyze whether the reforms

support individuals that are considered as more vulnerable in the current system. To directly compare the reformed systems with the current one, a budget neutrality approach is adopted. The reforms being tested are chosen because they appear to have the potential to make the system fairer by addressing certain inequalities.

The results indicate that the first reform which revalues past earnings by wage-indexing them, instead of price-indexing, can improve the pension system in terms of both inequality and adequacy. However, this reform alone is not enough to support those with interrupted careers, often mothers, who face challenges in building sufficient pension entitlements. To directly address incomplete careers, a second reform is tested that reduces the number of required career years for a full pension. The findings show that this reform also has a positive impact on the system, though assimilated periods remain crucial in reducing inequalities and improving adequacies. The third reform, which grants additional career years to compensate for the effects of childbirth and child-rearing on a parent's career, has the most significant positive effect on pension adequacy and equality.

These findings emphasize the need for targeted reforms that specifically address the long-term career disruptions caused by caregiving responsibilities. However, tackling the inequalities originating from the labor market through the pension system remains a major challenge. Despite various measures aimed at ensuring pension adequacy for everyone, women and, more broadly, individuals with irregular or limited participation in the labor market often continue to fall behind. The reforms tested in this analysis lead to improvements in the system, but the effects are still limited if one aims to avoid placing an additional burden on the economy. To make more significant progress, it is essential to address the underlying causes, such as unequal access to job opportunities, wage disparities, employment instability, and caregiving responsibilities. Addressing these

issues is vital, as maintaining a link between one's working life and pension benefits is key to preserving incentives to work. However, until such equality exists in the labor market and within households, it is necessary to maintain such corrective mechanisms within the pension system.

Chapter 6 sheds light on the potential link between pension reforms and health inequalities in later life. As stated previously, pension reforms may have distributional consequences, regardless of whether this is an explicit policy goal. In Belgium, reforms over the past 20 years – including reductions in benefit generosity and gradual increases in the statutory retirement age – have raised concerns that lower-income individuals could be disproportionately affected, potentially amplifying health inequalities. This chapter assesses the trend in health disparities across five distinct health measures by applying three complementary descriptive approaches. Contrary to concerns, the findings show no significant increase in health disparities over this period.

Even though our results show no significant rise in health inequalities over the observation period, our purely descriptive approach cannot rule out the existence of a link between pension reforms and health inequalities. For this reason, it remains important for policy makers to monitor the distributional effects of reforms, particularly on lower-income and potentially vulnerable groups, and to keep potential health impacts in mind when designing pension policies. By doing so, reforms can better balance economic objectives with the well-being of older adults and help prevent unintended adverse consequences.

Chapter 7 addresses the issue of rising labor market exits via the disability insurance program, with the growth being far more pronounced among women than men. The analysis aims to understand both the gender gap in DI usage and the differing trends over time. The Logit regression

results indicate that, for women in particular, system-related factors – such as the relative generosity of the DI exit route and the early and statutory retirement age – play a significant role in shaping exit decisions, suggesting that institutional and policy features influence women’s retirement behavior. In contrast, men’s exits through DI appear to be primarily driven by individual health limitations rather than structural incentives. The Fairlie decomposition further explores the gender disparity and the notable rise in DI exits among women. While observable characteristics fail to explain the gender difference in DI exits in the late 2000s – implying potential behavioral or unobserved factors – the increase in DI use among women over time can be partly attributed to evolving features of the system itself.

These results suggest that policy reforms cannot be assumed to affect men and women uniformly, with important implications for policy design. Even broadly framed institutional changes may produce different outcomes across genders, highlighting the need to account for gender-specific responses when evaluating retirement and disability policies.

Overall, this thesis emphasizes the need of a holistic approach to inequality when addressing socio-economic disparities in old-age. Pension inequalities do not arise in isolation but are shaped by multiple, interconnected factors – such as unequal labor market participation, prevailing social norms and household dynamics, and the structure of the pension system itself. Therefore, pension reforms should be accompanied by complementary policies that tackle inequalities at its roots. Measures such as improving access to stable employment, ensuring fair and equal wages, and fostering greater equality within the household sphere are crucial to create more equitable outcomes over the life course. While the structure of the pension system and its redistributive features can play an important role in mitigating existing inequalities and protecting vulnerable groups, it cannot, on their own, resolve the broader structural causes of inequality.

8.3 Limitations and directions for further research

Due to data limitations and other constraints, the analyses conducted in this thesis have certain caveats that should not be overlooked. These restrictions may have influenced the results and should be considered when interpreting the findings. However, rather than being seen solely as drawbacks, these limitations can serve as inspiration for future research, encouraging further exploration to address these challenges.

First, in these analyses, simplified rules are sometimes applied due to data limitations that prevent a more detailed assessment. The social security rules and reforms considered are those applicable to a standard wage-earner who does not benefit from any preferential regimes. Since the available data does not allow for a precise reflection of preferential rules, the headline system is used as an approximation. Similarly, missing data necessitate the use of simplified rules for determining GRAPA eligibility. These approximations, while necessary, should be kept in mind when interpreting the results.

Second, due to data limitations, it is not always possible to include the derived pension rights, as the full career history of ex-partners or deceased partners is unavailable. When pension amounts of the survival or divorcee pension are available, they are used but taken as given, meaning that changes in the rules for these types of pensions cannot be simulated. However, derived pension rights play a crucial role, particularly in the context of gender inequality, making them an important subject for further research. A more detailed analysis could also enable the testing of alternative policies, such as pension splitting. Yet, obtaining this type of information is highly challenging, as it requires not only complete career data for individuals but also comprehensive career histories for their partners over their entire lifetime.

Third, this thesis focuses on wage-earners in most chapters. While the benefit calculation system for the self-employed is similar in many aspects, the system for civil servants is significantly different. Examining other employment statuses would be valuable, not only because the rules differ but also because individuals in these groups may exhibit different behavioral responses to similar mechanisms or reforms. Moreover, the civil servant regime consists of multiple sub-systems, each with distinct eligibility criteria and benefit calculation rules, making it a particularly complex yet fascinating area of study. This is especially relevant now, as various reform projects aim to align the civil servant system more closely with the other regimes. This moment presents a unique opportunity to analyze these changes and assess their impact on inequality within the civil servant regime and also in comparison to the other employment statuses.

Fourth, the analyses presented in this thesis focus on overall trends and do not specifically address differences between household types. While Chapter 4, which examines the gender pension gap, acknowledges the limitations of assessing individual pension income in isolation and explores how results vary when this assumption is challenged, it only hints at the broader issue. A more in-depth analysis in the future could provide valuable insights into the financial dynamics within a household. Disparities could also exist between households with different structures. For instance, single-earner households may function differently from dual-earner households, which in turn differ from single-person households in response to certain mechanisms and policy reforms. Understanding these variations is a relevant and understudied topic that warrants further investigation.

Fifth, this thesis primarily focuses on economic inequality and economic well-being in old age. However, when discussing decent aging, it is crucial to also consider other dimensions such as health. While Chapter 6 hints at the potential interconnection between the pension system

and health inequalities, the analysis remains at an exploratory stage, relying on a purely descriptive approach. We are unable to directly attribute changes in health disparities to specific pension reforms, and other factors may also have contributed to the observed trends. Future research employing more rigorous analytical methods will be necessary to disentangle the underlying mechanisms and to determine which aspects of pension design most affect health outcomes. Such evidence could help policymakers anticipate and mitigate unintended negative consequences for vulnerable groups, while better aligning social and health policy with pension reforms.

Sixth, the behavioral differences in how men and women respond to reforms are highlighted in Chapter 7 of this thesis. Further analysis of the root causes behind these differences, as well as a deeper exploration of how social security reforms influence the retirement behavior of different population groups, would be a valuable addition to the existing literature.

Seventh, this thesis focuses on the first pillar of the pension system, namely public pensions provided through social security, leaving the second and third pillar aside. For the analyzed cohort, this is less of a concern, as public transfers constitute the primary source of income for retirees in Belgium (OECD, 2019). However, this dynamic may shift in the future. Growing uncertainty about the sustainability of the public pension system could lead individuals to worry about whether it will provide sufficient financial security in retirement. As a result, the second and third pillars – occupational and private pension schemes – may become increasingly important in ensuring adequate retirement income. Therefore, it would be valuable to explore these aspects in greater depth, including potential inequalities in coverage, benefits, and accessibility, as well as the underlying causes of such disparities. Additionally, examining potential government policies to encourage participation in these savings plans could provide further insights into securing financial well-being in retirement.

Finally, it is important to consider that the cohort analyzed in this thesis differs significantly from today's working population. In the past, one-earner households were more common, whereas today, fewer women stay at home for extended periods and remain dependent on their spouse, and two-earner households have become the norm. As a result, the findings of this thesis are not universally applicable and will likely change over time. Conducting an analysis to compare these results with today's working population would be highly valuable. However, such a study would take time, as many years remain before this generation reaches retirement age. Predicting these differences would require numerous assumptions about future labor market exit strategies, making it difficult to obtain a reliable answer on generational changes at this stage.

Appendix A

Additional Material of Chapter 3

A.1 Career construction and benefit calculation with SHARE data

A.1.1 Career construction

To reconstruct the career information of the sample for the purpose of calculating pension benefits, a multi-step procedure is implemented combining several data sources from the SHARE database.

First, the Job Episodes Panel (JEP) serves as the backbone of the career reconstruction. This dataset is derived from retrospective information collected in SHARELIFE (waves 3 and 7) and organizes individuals' life histories into a panel structure with one observation per individual for each year from birth until the year of interview. It includes detailed personal characteristics - such as birth year, gender, marital status, household composition, and children - as well as annual labor market status (e.g. education, employment, unemployment, sickness, retirement, or home care). For employed periods, the dataset further specifies employment type (wage earner, self-employed, or civil servant), job transitions, starting and ending wages, and working time. We harmonize the available wage information to a yearly basis.

Second, the JEP data are enriched with additional retrospective information from SHARELIFE interviews. This step is necessary because some relevant details are not fully captured in the panel dataset. In particular, the birth years of children are brought in to identify maternity periods, transitions between part-time and full-time work are added to better capture working-time dynamics, and job descriptions are incorporated to distinguish between different occupational categories, such as white-collar and blue-collar employment.

Third, the career histories are extended using data from regular SHARE waves, which provide information on individuals' current or recent situations. Since respondents interviewed in SHARELIFE wave 3 report their careers only up to 2008-2009, their employment histories are updated using subsequent waves (waves 4 to 8). Similarly, for individuals interviewed in SHARELIFE wave 7 (2017), additional information from wave 8 (2019) is used. This step results in a longitudinal dataset covering individuals' full careers up to 2019 (or until death or attrition), including both personal and employment information. However, wage data remains incomplete at this stage.

Finally, wage information is completed and harmonized. All available wages are converted into euros (accounting for the transition from Belgian francs prior to 2001) and further adjusted to constant 2019 euros using the CPI. Net wages are transformed into gross wages based on the applicable tax rules over time. The gaps in wage trajectories are filled using linear interpolation: wage observations are available only at job entry and exit, we assume a constant annual increase in absolute terms between these points.

A.1.2 Calculation of pension benefits and GRAPA supplements

Given the reconstructed and complete career histories, pension benefits can be calculated for each individual in the sample. The simulation tool applies the statutory social security rules in force in each year, taking into account individual career trajectories, marital status, and partner income.

As a first step, all past earnings are converted into constant 2019 euros using the health index. Periods not covered by actual but replacement earnings (e.g. unemployment, sickness, or career breaks) are assigned fictitious wages so that they are included in the pension calculation (assim-

ilation). In addition, wage ceilings and floors are applied where relevant. For individuals with careers exceeding 45 years, only the most advantageous 45 years are retained, in line with the standard full career length in the Belgian pension system.

Next, the pension benefit is computed. For the wage-earner and self-employed pension, we sum both actual and fictitious earnings over the relevant career years and divide this total by 45, corresponding to the reference career length. A replacement rate is then applied to this average: 60% as the standard rate and 75% for married individuals with a dependent spouse. The applicable replacement rate is determined based on the income of the partner, allowing the identification of dependency status.

For civil servants, the pension calculation follows a different methodology. The reference salary is determined based on the average earnings over the last five or ten years of the civil servant career, depending on the individual's birth cohort, reflecting changes in the applicable legislation over time. This reference salary is then multiplied by the total career length as civil servant and by a career fraction. In this analysis, we apply a standard fraction of $1/60$, as the available data do not allow us to distinguish between preferential regimes that may apply to specific categories of civil servants. Then, both relative and absolute maxima are imposed on the resulting pension benefit.

Subsequently, eligibility for the minimum pension is assessed for all three categories of workers. If the minimum pension entitlement exceeds the calculated benefit, it replaces the initially computed pension amount. Next, for individuals who continue working beyond the statutory retirement age or required career length, pension bonuses are calculated for the periods during which such incentives were in place.

Finally, the simulated gross pension benefits are converted into net amounts, taking into account the relevant tax rules and social security contributions applicable at the time of benefit collection.

Lastly, the potential entitlement to the GRAPA supplement is assessed. First, the individual's living arrangement is examined as different GRAPA thresholds apply to individuals living alone versus those cohabiting. Next, total household resources are calculated¹. For this purpose, 90% of gross pension income of both partners is taken into account; in the case of cohabitation, this amount is divided by two, assuming full sharing of resources within the household. In addition, 75% of labor income of both partners is included, from which a lump-sum exemption of EUR 5000 is deducted. Financial assets are incorporated into the resource test according to a progressive scheme: the first EUR 6200 is exempt; assets between EUR 6200 and EUR 18600 are imputed at a rate of 4%; and assets exceeding EUR 18600 are imputed at 10%. The GRAPA supplement is then calculated as the difference between the applicable threshold and the total of resources. In the official GRAPA rules, real estate is also included in the means test. However, due to the absence of information on cadastral values in the data, it is not possible to fully replicate these rules. To nevertheless account for housing wealth, a simplifying assumption is adopted whereby homeowners are considered ineligible for the GRAPA supplement.

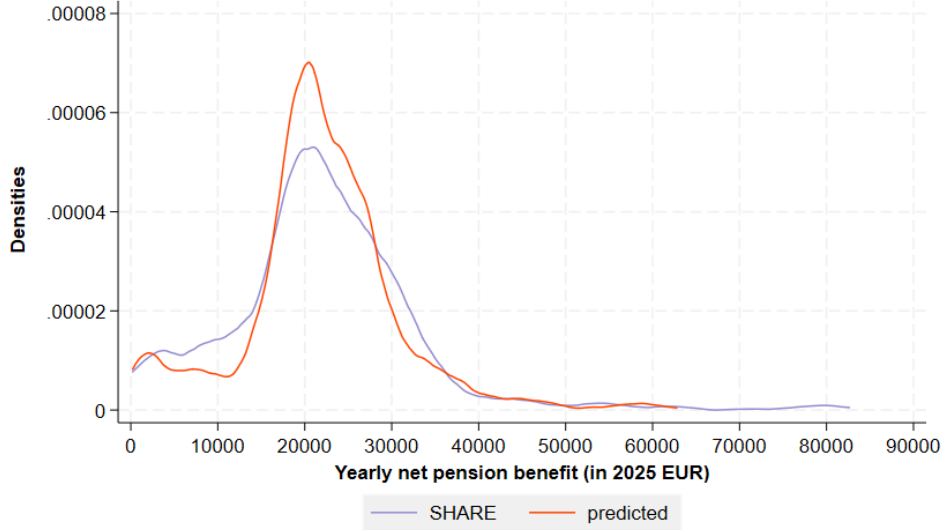
To validate our benefit calculations, pension entitlements are calculated and compared to the stated pension benefit in the SHARE dataset². Figure A.1 shows the distribution of the pension benefits declared in

¹For data availability reasons, our calculation of household resources is based on simplified rules that incorporate the main components.

²SHARE 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.

SHARE and the ones calculated with our simulation tool³. On average, we calculate a yearly net pension benefit of EUR 21815 while respondents declare a yearly net pension benefit of EUR 21926 (expressed in 2025 EUR).

Figure A.1: Distribution of the yearly net pension benefits – SHARE and predictions



Source: Authors' calculations based on SHARE data.

A.2 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.

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

³To 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 915 matches.

For this calculation, we need 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 people born between 1946 and 1964 for the analysis and end up with 1132 individuals in the sample.

Table A.1 shows some descriptive statistics of the individuals that are kept in our sample for the analysis, at age 54.

For the analysis, we divide our sample into 10 deciles based on the individuals' ACE at age 54, comparing thus the relatively poor to the relatively rich of our sample. However, since we only select individuals still active at age 54, we likely face a selection issue with a sample that is not necessarily representative of the Belgian population. Indeed, Table A.2 reveals 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

Table A.1: Summary statistics of sample, working wage-earners aged 54

	Total	Men	Women
Number of individuals	1132	612	520
Demographics			
Marital status			
married	72%	76%	68%
unmarried	28%	24%	32%
Employment			
Average years of career	34	35	33
Average ACE at age 54 (in 2025 EUR)	68484	79869	55084

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.

38% come from the advantaged social class. Our sample is thus composed of the more advantaged individuals. Examining the first and last deciles separately, we see that the composition differs. 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 while it increases for the higher social classes. Hence, in the analysis, we compare 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

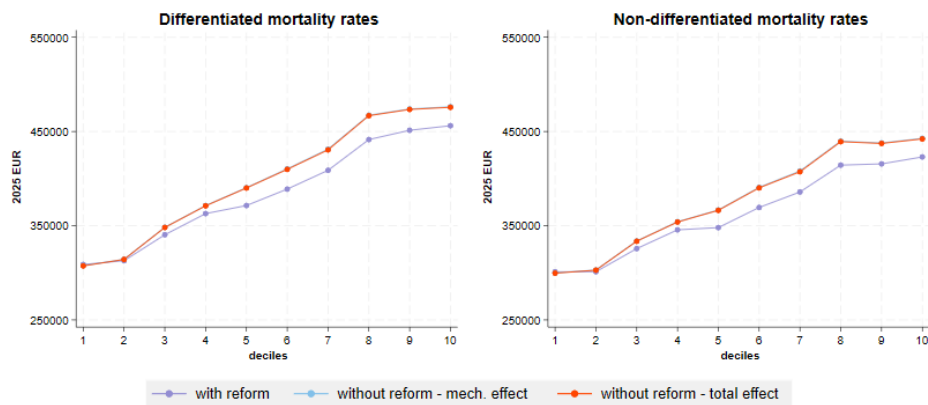
	Social class 1	Social class 2	Social class 3	Social class 4
Total	10%	22%	30%	38%
Decile 1	21%	35%	26%	18%
Decile 10	5%	11%	35%	49%

Source: Authors' calculations based on SHARE data.

A.3 Illustration of the average SSW presented in Table 3.5

Figure A.2 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.

Figure A.2: Average SSW per decile of ACE



Source: Authors' calculation based on CBSS data.

Appendix B

Additional Material of Chapter 4

B.1 Comparison of income distribution - sample of analysis vs. EU-SILC

The comparison of the sample's income distribution to the EU-SILC income distribution of the broader Belgian population offers a better understanding of the sample and where it is situated in the general population.

EU-SILC uses the equivalized disposable income in its presentation of the income distribution of the general population. It refers to the total household income post-tax and deductions which can be used for spending or saving. This includes all financial incomes acquired from any source, be it from work, investment, or social benefits. This amount is then divided by the number of household members, adjusted to represent equalized adults.

In order to situate the sample in the general income distribution of EU-SILC, a measure of the equivalized disposable income is calculated using the administrative data from the CBSS for the individuals in the sample. For each individual, the total household income from 2017, the reference year for this analysis, is taken. The measure includes the old-age pension, the survivor and divorced spouse's pension, the GRAPA supplement, income from work and replacement income of the individual as well as the partner. The recorded earnings are transformed from gross into net terms. Income from other sources such as the second and third pillar of the pension system are unfortunately not available in the dataset and can therefore not be included in the calculated income measure. However, this is less of a concern, because public transfers are the main income source of retirees in Belgium (OECD, 2019).

Table B.1 presents the percentage of the sample contained in the different EU-SILC quintiles from 2017. These quintiles are used to examine effect heterogeneity at the lower and upper ends of the distribution.

Table B.1: Percentage of sample contained in the different EU-SILC quintiles

EU-SILC income quintile	Percentage of sample (%)
1	27.96
2	36.34
3	23.82
4	7.85
5	4.04

Source: Author's calculations based on CBSS data and EU-SILC.

Notes: The quintile cutoff points of the 2017 EU-SILC income distribution are used.

Retirees are disproportionately represented in the lower income brackets, making them among the poorer segments of the general population. This is an expected outcome, as retired individuals typically have lower earnings compared to the overall population. In 2016, the Belgian population aged 65+ had an average income that was 79.7% of the average income of the total population (OECD, 2019). In this sample the average income represents 75.9% of the average income of the total population. Other values as well are comparable to those of EU-SILC when considering the population older than 65, as can be seen in Table B.2, suggesting that the sample reflects the older Belgian population

Table B.2: Comparison EU-SILC 65+ and sample

	EU-SILC 65+	Sample
Median income (in 2017, expressed in 2017 EUR)	18828	17386
(in 2017, expressed in 2025 EUR)	24445	22573
At-risk-of-poverty rate (%)	15.80	14.60

Source: Author's calculations based on CBSS data and EU-SILC.

B.2 Evolution of the GPG at different points of the distribution using strategy 1

Table B.3: Strategy 1 - Gender pension gap - average

		Individualized pension income: attribution of household supplement				Household pension income					
		Scenario 1		Scenario 2		Scenario 3		Scenario 4		Scenario 5	
		GPG (%)	Δ GPG (pp)	GPG (%)	Δ GPG (pp)	GPG (%)	Δ GPG (pp)	GPG (%)	Δ GPG (pp)	GPG (%)	Δ GPG (pp)
A	Fully proportional pension system	52.28		54.31		51.19		21.72		23.18	
B	Adding assimilated periods	47.78	-4.50	50.14	-4.17	47.43	-3.76	20.67	-1.05	22.52	-0.66
C	Adding wage ceilings	44.63	-3.15	46.94	-3.20	44.25	-3.18	16.50	-4.17	18.39	-4.13
D	Adding the wage floor	41.32	-3.31	43.79	-3.15	41.04	-3.21	13.90	-2.60	16.03	-2.36
E	Adjusting for long careers	41.22	-0.10	43.68	-0.11	40.93	-0.11	13.70	-0.20	15.84	-0.19
F	Adding the minimum pension	40.77	-0.45	43.24	-0.44	40.48	-0.45	13.31	-0.39	15.48	-0.36
G	Adding the pension bonus	40.72	-0.05	43.16	-0.08	40.39	-0.09	13.45	0.14	15.67	0.19
H	Adding derived pension rights	22.15	-18.57	25.36	-17.80	21.86	-18.53	-8.44	-21.89	-2.22	-17.89
Actual	Adding GRAPA (= actual system)	21.09	-1.06	24.32	-1.04	20.80	-1.06	-9.56	-1.12	-3.15	-0.93
Total change in GPG		-31.19		-29.99		-30.39		-31.28		-26.33	

Source: Author's calculations based on CBSS data.

Table B.4: Strategy 1 - Gender pension gap - quintile 1

	Individualized pension income: attribution of household supplement						Household pension income			
	Scenario 1		Scenario 2		Scenario 3		Scenario 4		Scenario 5	
	GPG (%)	Δ GPG (pp)	GPG (%)	Δ GPG (pp)	GPG (%)	Δ GPG (pp)	GPG (%)	Δ GPG (pp)	GPG (%)	Δ GPG (pp)
A	70.92		73.84		69.72		44.31		48.94	
B	63.63	-7.29	67.49	-6.35	63.10	-6.62	38.20	-6.11	44.50	-4.44
C	61.88	-1.75	65.79	-1.70	61.31	-1.79	35.03	-3.17	41.54	-2.96
D	58.58	-3.30	62.86	-2.93	58.18	-3.13	31.38	-3.65	38.46	-3.08
E	58.39	-0.19	62.68	-0.18	57.99	-0.19	31.04	-0.34	38.15	-0.31
F	57.83	-0.56	62.17	-0.51	57.42	-0.57	30.33	-0.71	37.56	-0.59
G	57.53	-0.30	61.84	-0.33	57.08	-0.34	30.04	-0.29	37.35	-0.21
H	45.13	-12.40	50.77	-11.07	44.67	-12.41	12.47	-17.57	23.14	-14.21
Actual	37.48	-7.65	43.80	-6.97	37.01	-7.66	2.26	-10.21	14.71	-8.43
Total change in GPG		-33.44		-30.04		-32.71		-42.05		-34.23

Source: Author's calculations based on CBSS data.

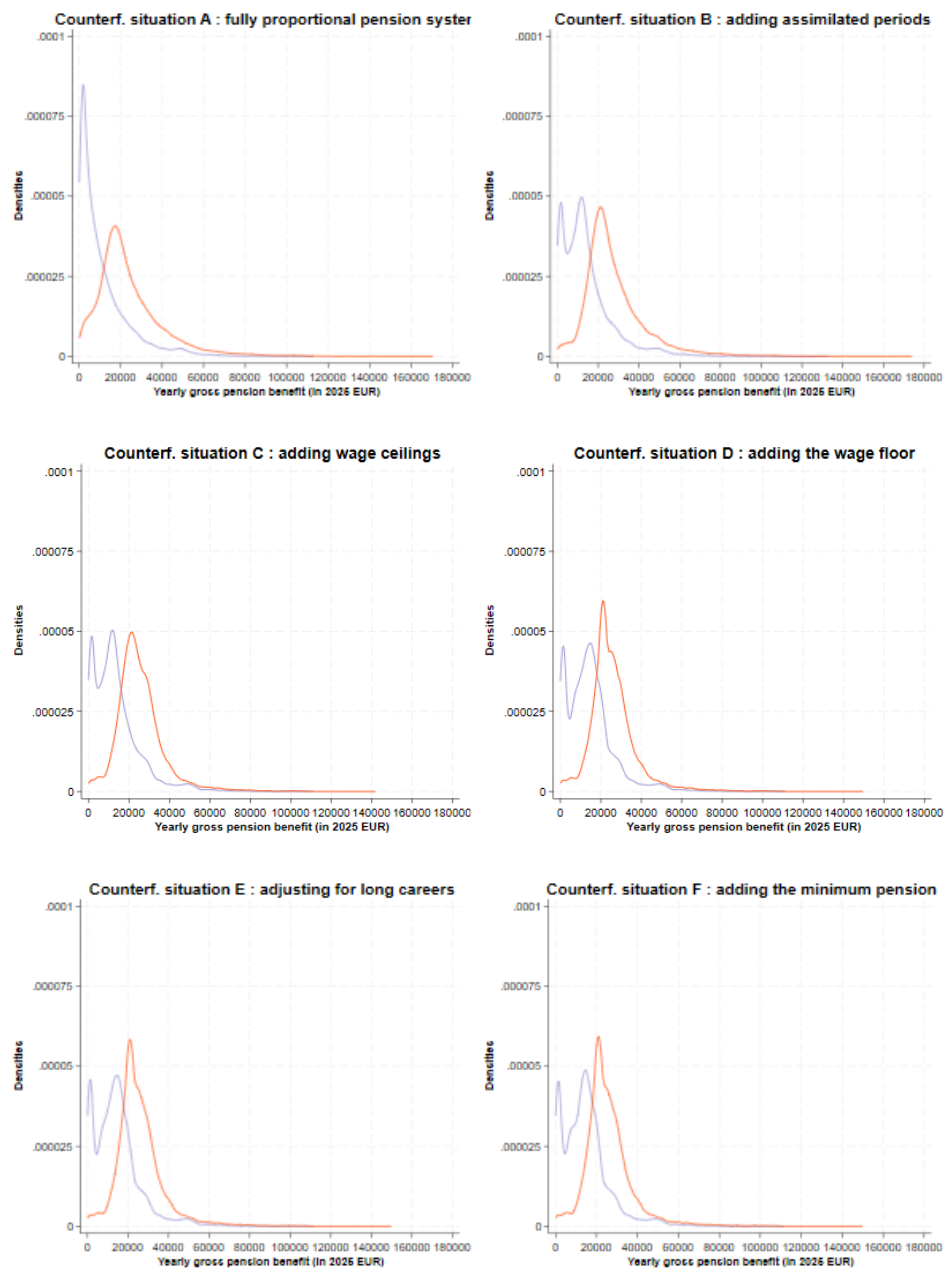
Table B.5: Strategy 1 - Gender pension gap - quintile 5

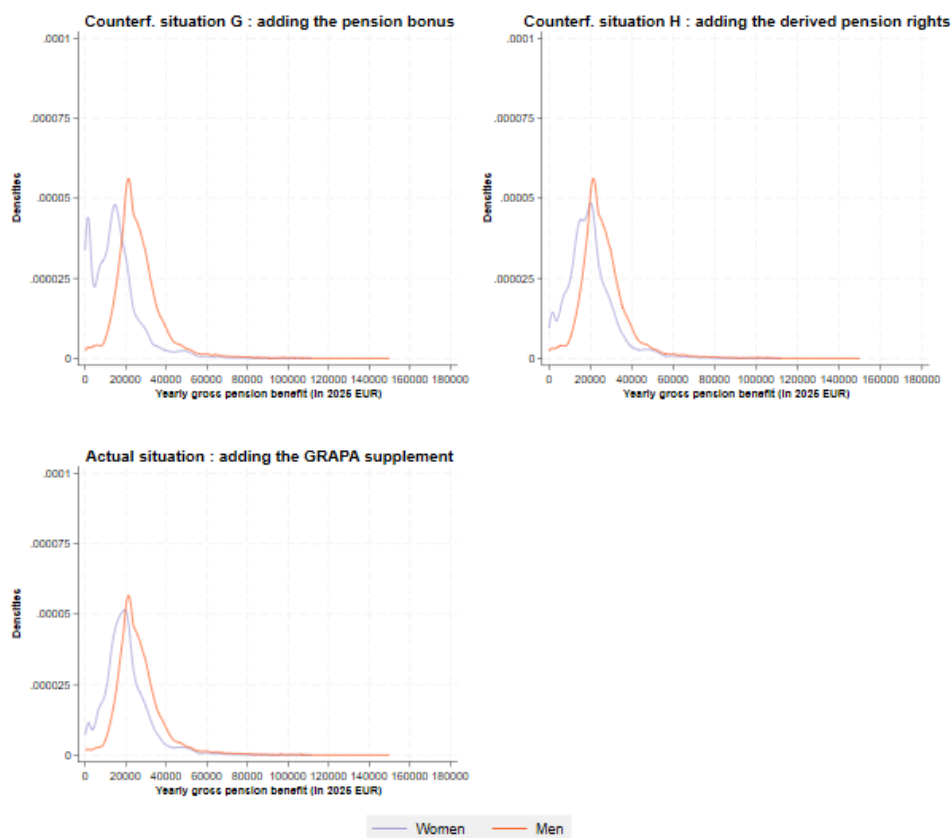
	Individualized pension income: attribution of household supplement						Household pension income			
	Scenario 1		Scenario 2		Scenario 3		Scenario 4		Scenario 5	
	GPG (%)	Δ GPG (pp)	GPG (%)	Δ GPG (pp)	GPG (%)	Δ GPG (pp)	GPG (%)	Δ GPG (pp)	GPG (%)	Δ GPG (pp)
A	Fully proportional pension system	28.23	28.50	27.93	-10.07	-10.05	-10.17	-10.22	-0.17	-0.17
B	Adding assimilated periods	26.74	-1.49	27.01	-1.49	26.57	-1.36	-10.26	-0.19	-10.22
C	Adding wage ceilings	23.30	-3.44	23.43	-3.58	23.09	-3.48	-14.82	-4.56	-14.79
D	Adding the wage floor	22.62	-0.68	22.76	-0.67	22.44	-0.65	-15.19	-0.37	-15.16
E	Adjusting for long careers	22.59	-0.03	22.73	-0.03	22.40	-0.04	-15.25	-0.06	-15.21
F	Adding the minimum pension	22.43	-0.16	22.57	-0.16	22.25	-0.15	-15.34	-0.09	-15.31
G	Adding the pension bonus	22.66	0.23	22.80	0.23	22.48	0.23	-14.82	0.52	-14.77
H	Adding derived pension rights	15.83	-6.83	15.99	-6.81	15.66	-6.82	-22.19	-7.37	-20.80
Actual	Adding GRAPA (= actual system)	15.82	-0.01	15.97	-0.02	15.65	-0.01	-22.19	0.00	-20.80
Total change in GPG		-12.41	-12.53	-12.28	-12.12	-10.75	-10.75	-10.75	-10.75	-10.75

Source: Author's calculations based on CBSS data.

B.3 Change in the distribution of pension income throughout the counterfactual situations of strategy 1

Figure B.1: Distribution of yearly gross pension benefits, separately for men and women





Source: Author's calculation based on CBSS data.

Notes: The common assumptions are used here, using individualized pension benefits and attributing the household supplement to the working partner.

B.4 Counterfactual analysis using strategy 2

Table B.6 summarizes the different counterfactual situations considered in the second strategy. In this strategy, the pension system is kept as it is in place and one redistributive element is removed. Then it is looked at the impact on the gender pension gap of each element. This is done to verify whether the results found with the first strategy are affected by the sequence the different elements are added to the hypothetical proportional pension system. Since the conclusions of both strategies are similar, the second one is presented here in the Appendix B.4 and not in the main analysis.

Table B.6: Counterfactual situations - strategy 2

Actual	Benchmark: the actual pension system
A	Benchmark but removing assimilated periods
B	Benchmark but removing wage ceilings
C	Benchmark but removing the wage floor
D	Benchmark but removing long-career adjustment
E	Benchmark but removing the minimum pension
F	Benchmark but removing the pension bonus
G	Benchmark but removing derived pension rights
H	Benchmark but removing the GRAPA supplement

Source: Author.

One important note must be added here. As mentioned earlier, the derived pension rights as well as the GRAPA supplement cannot be predicted using the simulation tool because of data limitations. This is why the amounts are taken from the ONP records. However, this leads to not being able to capture the interaction effects between the derived pension rights / GRAPA supplement and the other elements. In strategy 1, this is not a concern, because the derived rights and the GRAPA are added in the end, the other elements already being included in the system. However, in strategy 2, when removing one element, the others remain included in the system. When thus removing one of the redistributive corrections (counterfactual situation A-F), this removal shall have an impact on the amount of the GRAPA supplement as well as the derived pension rights. While adjusting the derived pension rights would likely amplify the effect of the removal of a certain element, adjusting the GRAPA supplement would probably cushion the effect. Not being able to take these adjustments in the amounts into account constitutes a disadvantage related to strategy 2.

Moreover, the effects of the different elements no longer add up to the combined effect of all redistributive corrections as it is the case in the first strategy.

B.4.1 Different attribution rules of the household supplement

The results are very similar to the ones found in strategy 1, concluding that the sequence in which the different elements are added does not have a crucial impact on the effects.

At the average, the sign of the effect of the pension bonus switches. The bonus increases gender inequality here. This makes sense since the derived pension rights are already included which was not the case in strategy 1 when it was looked at the bonus. Those derived rights increase the average pension income of women a lot. The significance of the lump sum bonus for women in relation to their income no longer surpasses the frequency of men being impacted by the bonus. Nevertheless, the overall impact remains negligible, hovering around zero.

In terms of magnitude, some elements differ from the results under strategy 1. The importance of the assimilated periods in reducing the GPG decreases. Hence, they make a much more significant contribution to reducing the gender pension gap in a proportional system compared to a system that already includes various redistributive elements. Moreover, the effect is slightly smaller for the wage floor regulation in this strategy which can be explained by the fact, that the minimum pension regulation remains active in counterfactual situation C. This will thus cushion some workers on low wages who no longer benefit from the wage floor as already emphasized by Peeters et al. (2024).

When looking at the first quintile, the sign of the effects remains unchanged compared to what is found with strategy 1. Size-wise, the same differences as detected at the average are also the case here with a reduced effect for the assimilated periods and wage floor regulation. In the fifth quintile, there are no significant differences to the results from strategy 1 worth mentioning, neither in terms of the sign nor the magnitude.

B.4.2 Alternative income definition : equal sharing of household pension resources

Also when the equal sharing of the household pension is considered, results do not change considerably to the ones using strategy 1.

At the average, the sign of the bonus switches for the same reason explained previously. Moreover, the assimilated periods increase gender inequality here. This can be explained by the fact, that the individuals especially benefiting from the assimilated days are women with partner. This leads to the partners of these women automatically benefiting as well. However, the opposite is true for men. It is primarily the men without partners who, on average, have more assimilated days in their careers. This leads on average to a higher increase in men's pension income and therefore to a higher GPG. Size-wise, the same differences as previously explained are also present when the alternative income concept is used.

In the first quintile, there is also a switch in the sign of the effect of the pension bonus. In terms of magnitude, the decrease in the effect of the assimilated periods and the minimum pension are also present here. In the fifth quintile, the results remain unchanged compared to strategy 1.

Table B.7: Strategy 2 - Gender pension gap - average

		Individualized pension income: attribution of household supplement					Household pension income				
		Scenario 1		Scenario 2		Scenario 3		Scenario 4		Scenario 5	
		GPG (%)	Δ GPG (pp)	GPG (%)	Δ GPG (pp)	GPG (%)	Δ GPG (pp)	GPG (%)	Δ GPG (pp)	GPG (%)	Δ GPG (pp)
Actual	Benchmark: actual pension system	21.09		24.32		20.80		-9.56		-3.15	
A	Removing assimilated periods	23.84	2.75	26.64	2.32	22.87	2.07	-9.94	-0.38	-3.43	-0.28
B	Removing wage ceilings	25.96	4.87	29.25	4.93	25.69	4.89	-3.91	5.65	2.20	5.35
C	Removing the wage floor	22.90	1.81	26.01	1.69	22.50	1.70	-8.23	1.33	-1.92	1.23
D	Removing long-career adjustments	21.30	0.21	24.54	0.22	21.02	0.22	-9.25	0.31	-2.88	0.27
E	Removing the minimum pension	21.51	0.42	24.73	0.41	21.23	0.43	-9.20	0.36	-2.82	0.33
F	Removing the pension bonus	20.81	-0.28	24.10	-0.22	20.58	-0.22	-10.00	-0.44	-3.57	-0.42
G	Removing derived pension rights	39.52	18.43	41.99	17.67	39.20	18.40	12.17	21.73	14.63	17.78
H	Removing the GRAPA supplement	22.15	1.06	25.36	1.04	21.86	1.06	-8.44	1.12	-2.22	0.93

Source: Author's calculations based on CBSS data.

Table B.8: Strategy 2 - Gender pension gap - quintile 1

	Individualized pension income: attribution of household supplement										Household pension income			
	Scenario 1			Scenario 2			Scenario 3			Scenario 4			Scenario 5	
	GPG (%)	Δ GPG (pp)	GPG (%)	Δ GPG (pp)	GPG (%)	Δ GPG (pp)	GPG (%)	Δ GPG (pp)	GPG (%)	Δ GPG (pp)	GPG (%)	Δ GPG (pp)	GPG (%)	Δ GPG (pp)
Actual	37.48		43.80		37.01		2.26		14.71					
A	42.09	4.61	47.37	3.57	40.75	3.74	4.26	2.00	16.07	1.36				
B	40.64	3.16	46.87	3.07	40.21	3.20	7.18	4.92	19.14	4.43				
C	39.50	2.02	45.53	1.73	38.82	1.81	4.20	1.94	16.39	1.68				
D	37.78	0.30	44.10	0.30	37.33	0.32	2.76	0.50	15.15	0.44				
E	37.99	0.51	44.28	0.48	37.54	0.53	2.90	0.64	15.25	0.54				
F	37.49	0.01	43.89	0.09	37.09	0.08	2.20	-0.06	14.64	-0.07				
G	49.55	12.07	54.61	10.81	49.09	12.08	19.25	16.99	28.53	13.82				
H	45.13	7.65	50.77	6.97	44.67	7.66	12.47	10.21	23.14	8.43				

Source: Author's calculations based on CBSS data.

Table B.9: Strategy 2 - Gender pension gap - quintile 5

Individualized pension income: attribution of household supplement															Household pension income																													
Scenario 1															Scenario 2					Scenario 3					Scenario 4					Scenario 5														
GPG (%)															Δ GPG (pp)					GPG (%)					Δ GPG (pp)					GPG (%)					Δ GPG (pp)									
Actual															Benchmark: actual pension system					15.82					15.97					15.65					-22.19					-20.80				
A	Removing assimilated periods														17.24	1.42				17.39	1.42				16.95	1.30				-21.99	0.20				-20.59	0.21								
B	Removing wage ceilings														19.76	3.94				20.06	4.09				19.62	3.97				-17.30	4.89				-15.98	4.82								
C	Removing the wage floor														16.18	0.36				16.33	0.36				15.99	0.34				-22.00	0.19				-20.62	0.18								
D	Removing long-career adjustments														15.86	0.04				16.02	0.05				15.69	0.04				-22.13	0.06				-20.74	0.06								
E	Removing the minimum pension														15.97	0.15				16.13	0.16				15.80	0.15				-22.10	0.09				-20.70	0.10								
F	Removing the pension bonus														15.49	-0.33				15.65	-0.32				15.31	-0.34				-22.80	-0.61				-21.40	-0.60								
G	Removing derived pension rights														22.64	6.82				22.78	6.81				22.46	6.81				-14.82	7.37				-14.77	6.03								
H	Removing the GRAPA supplement														15.83	0.01				15.99	0.02				15.66	0.01				-22.19	0.00				-20.80	0.00								

Source: Author's calculations based on CBSS data.

Appendix C

Additional Material of Chapter 5

C.1 Average career characteristics by marital status and gender

Table C.1: Average career length and earnings by marital status and gender

	Average career length (in years)		Average career earnings (in 2025 EUR)	
	Men	Women	Men	Women
Total	40	26	89857	38245
Single	40	29	73588	39954
With partner	40	26	79729	36636
Married	40	25	90137	35815
Divorced	39	32	105429	44457
Widowed	40	22	109533	38323

Source: Author's calculations based on SHARE data.

C.2 Alternative version of Simulation C : granting additional career year for child-rearing to both parents

The reform tested in Simulation C assumes that the primary caregiving parent, predominantly the mother in this cohort, experiences a significant impact on their career due to care duties. To compensate for this, two additional career years are granted for each child – one for childbirth and one for child-rearing. However, it is equally valid to argue that both parents face career disruptions from child-rearing, not solely the mother. To address this broader perspective, a second version of simulation C is conducted, which grants an additional career year to mothers for childbirth and one more year for child-rearing, with the latter applied equally to both parents. Although the data show that, on average, fathers do not experience significant career disadvantages due to children, unlike mothers (Kleven et al., 2019), this adjustment in the reform would recognize shared responsibility for childcare and promote equal caregiving roles.

Appendix C.2 presents this alternative version of Simulation C and provides insights into the implications of equally recognizing child-rearing responsibilities for both parents on inequality and adequacy.

C.2.1 Effect on inequality and adequacy

Table C.2 shows the inequality and adequacy measures in the actual system and the counterfactual ones. The initial reform where two additional career years are granted to the mother is compared to the alternative reform which also grants one additional year to the father to compensate for the impact of child-rearing on the career.

Table C.2: Comparison of measures – simulation C alternative

Measures	Actual system	Simulation C	
		Add. career years to mothers	Add. career years to both parents
Gini	0.2585	0.2333	0.2355
Gender pension gap	46.88%	39.45%	41.42%
Headcount measures			
Wage floor	42.53%	52.33%	54.51%
Guaranteed minimum pension	20.77%	30.46%	37.16%
GRAPA	7.25%	6.92%	6.74%

Source: Author's calculations based on SHARE data.

In general, the effects of the alternative reform are similar to the ones found with the initial reform. General and gender inequality decreases. However, the positive outcome on inequality is slightly reduced. This result is unsurprising, given that the alternative reform benefits both mothers and fathers, with fathers having higher average pension entitlements.

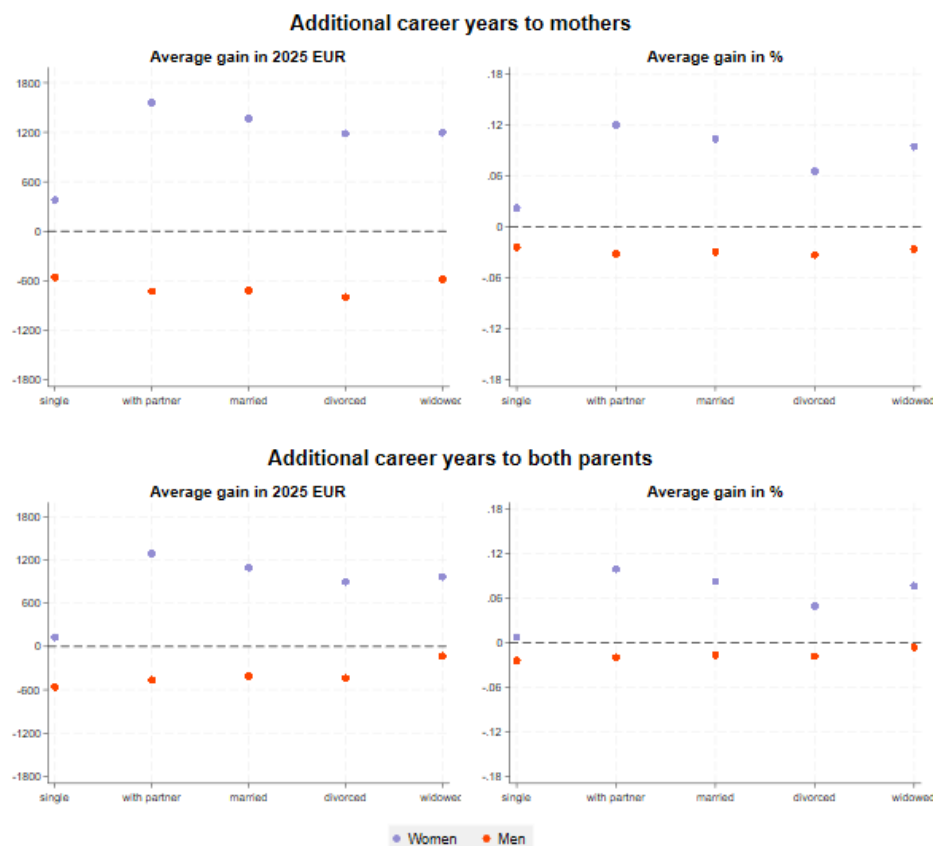
In terms of adequacy, the effect previously observed has been further amplified. An increased percentage of the sample benefits from the wage floor regulation applied in the pension calculation as well as the guaranteed minimum pension. The additional career years granted lead to more

people meeting the eligibility criteria for these minimum rules. This results in fewer people having to claim social assistance, which speaks for an improvement in adequacy.

C.2.2 Analysis by marital status and gender

Figure C.1 shows that women are still net beneficiaries of this reform, although the positive effect is reduced; the loss for men is less pronounced. The decomposition into pre-adjustment and balancing effects provides greater insight into this result.

Figure C.1: Average gain in yearly net pension benefits by marital status and gender – simulation C alternative



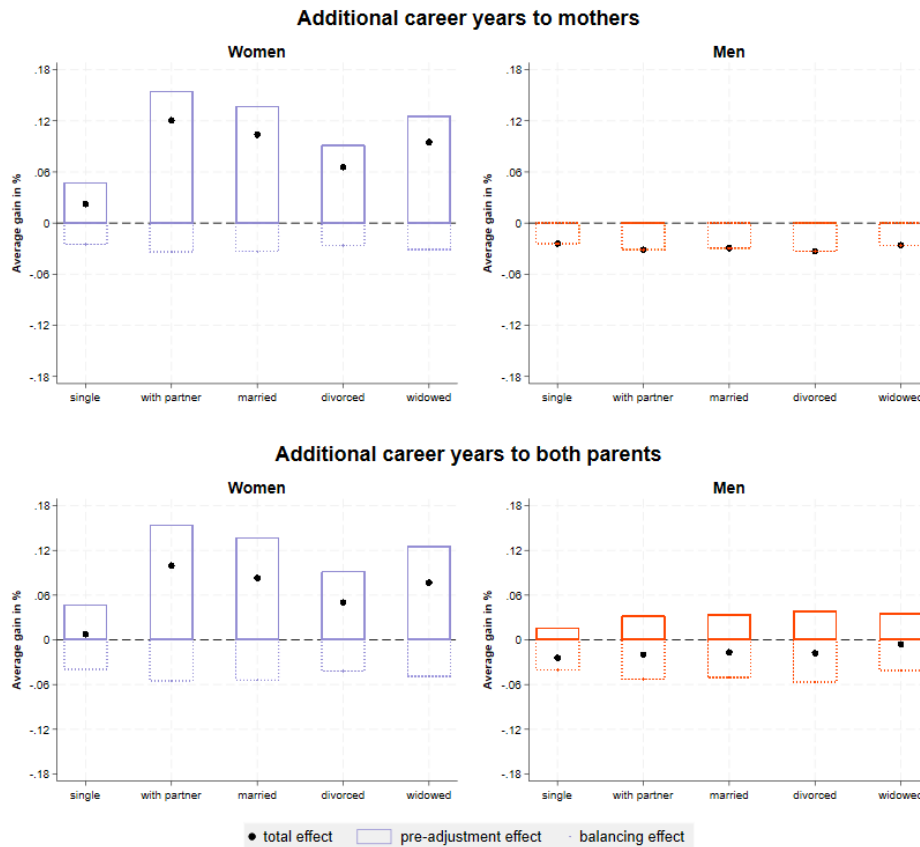
Source: Author's calculations based on SHARE data.

Notes: The average gain in % is relative to the pension benefit pre-reform.

C.2.3 Decomposition of the effect

Figure C.2 shows the decomposition into pre-adjustment and balancing effect.

Figure C.2: Decomposition of the effect – simulation C alternative



Source: Author's calculations based on SHARE data.

Notes: The average gain in % is relative to the pension benefit pre-reform.

The alternative reform leads to a positive pre-adjustment effect to both, mothers and fathers. The observed effect is still larger for women due to the extra career year for childbirth which is not granted to fathers. Since more career years are granted, pension expenditure increases more compared to the initial version of this reform (by EUR 11 million instead of EUR 6.5 million)(expressed in 2025 EUR).

In order to cover this increase in expenditure, the single and household replacement rates are reduced to a greater extent: by 14.17% (from

60% to 51.50% and from 75% to 64.38% respectively). The consequences of lowering the replacement rate are again shared by both, men and women. The balancing effect is negative and similar across gender and marital status.

Combined, this still leads to women gaining and men losing in pensions. For women, the positive pre-adjustment effect can still more than counterbalance the negative balancing effect, even though the latter is more pronounced. For men, the pre-adjustment effect now cushions the negative balancing effect, but it is not enough to offset it.

C.3 Estimation of retirement probabilities

In order to estimate the retirement probabilities at the different ages, the same model as in Chapter 3 is used. Appendix C.3 reiterates the key components of this model, presents the deviations made for this analysis and shows the regression results and how they differ compared to Chapter 3.

C.3.1 Sample for regression

In Chapter 3 we select into the sample individuals that are born between 1941-1964, such that they have an age between 55 and 65 in the period of observation (2005-2019). This sample includes thus individuals that are younger than the sample in the present analysis. As shown in Chapter 3, the younger birth cohorts have an impact on the regression results. This is why they will be excluded here, leading to a sample composed of individuals born between 1941-1954, aged 55-65. This leads to a reduced sample size, but to results that are more appropriate for this chapter.

Table C.3 shows some descriptive statistics of the sample.

Table C.3: Summary statistics of sample, working wage-earners aged 55-65

	Total	Men	Women
Number of			
Observations	3466	1929	1537
Individuals	762	436	326
Demographics			
Marital status			
Single	5%	6%	4%
With partner	15%	14%	16%
Married	56%	61%	49%
Divorced	20%	16%	24%
Widowed	5%	3%	7%
Employment			
Average years of career	38	39	36
Average ACE at age 54 (in 2025 EUR)	73063	89728	52148

Source: Author's 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.

It should be noted that the characteristics of this sample differ to what was shown in Table 5.1. There are three reasons for this. First, the sample for the regression excludes the older individuals (born before 1941) because they are aged 55-65 before 2005, hence outside the period of observations. They are well present in Table 5.1. Second, the individuals included in the regression, are the ones that are still active on the labor market at age 55, such that their exit can be observed. Table 5.1 also includes individuals that exit the labor market before that age, which are especially individuals with very short careers such as housewives. Lastly, the two tables show the characteristics at different points in time. Table C.3 summarizes the information of the sample at the ages 55-65, hence before retirement, whereas Table 5.1 shows the characteristics after the age 65, thus when they are already retired. These variations lead to some

differences in the characteristics of the regression sample compared to the ones showed in Table 5.1 such as a lower rate of widows/widowers and a substantially longer career for women.

C.3.2 Incentive measures

The incentive measures¹ used in this regression are the social security wealth (SSW) and the implicit tax on continued activity ($ITAX$). Those measures are calculated in the same way as in Chapter 3.

The SSW is the present discounted value of all future benefits. Four exit routes are considered for this : Exit via the old-age pension system, the conventional early retirement, the unemployment insurance and the disability insurance. The 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 $b_{k,a}$ represents the yearly 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 which allows 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. β^{a-R} is the time discount rate that is assumed to be equal to 3% real.

¹This section reiterates only the key aspects of how the measures are calculated, providing clarity to make the regression easier to understand. For more detailed information, refer directly to Chapter 3.

The four SSW by exit route are then aggregated into a single aggregated SSW by weighting them according to the number of observed exits into the different exit pathways.

Using the SSW , the second incentive measure can be calculated: the $ITAX$. It is based on the accrual (ACC) which measures the change in SSW when retiring one year later. Postponing retirement by one year 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 waived because claiming is postponed by one year. But this is only the case if the individual was eligible for immediate payments of benefits.

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

Using the ACC , the implicit tax rate can be calculated by dividing the negative accrual by the after-tax earnings during the additional year Y_i .

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

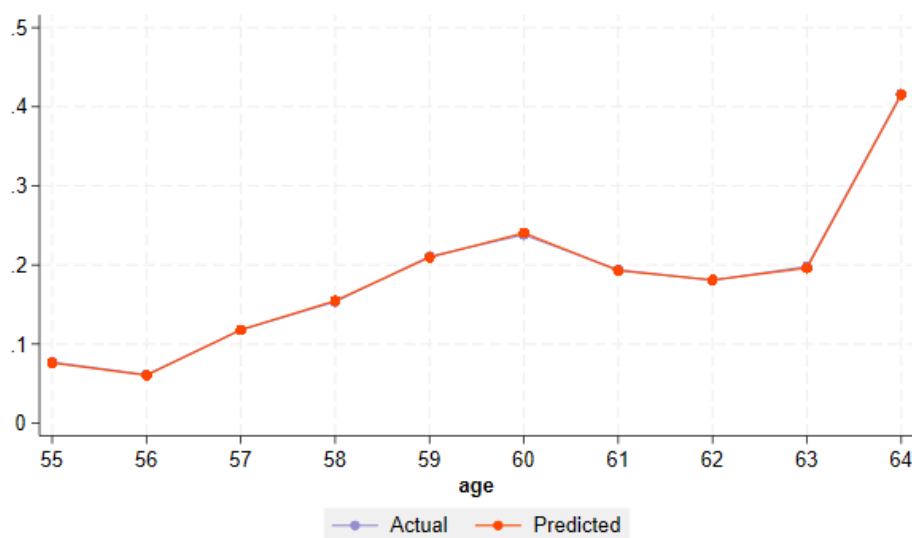
A positive value means that there is an extra implicit tax on working longer beyond income taxes and social insurance contributions originating on the benefit side of social security, a negative value represents an implicit subsidy for working longer.

C.3.3 Regression

Table C.4 presents the results for the same four regression models that were used in Chapter 3, but using the adjusted sample. Even though the sample has changed slightly, the results are consistent with the findings in Chapter 3. The main difference lies in the slightly larger coefficients on the incentive measures, indicating that the sample in this analysis responds more strongly to changes in *SSW* and *ITAX*. This is expected, since Chapter 3 finds that younger individuals, who are excluded here, respond less to *SSW* and *ITAX*.

Figure C.3 compares observed instantaneous retirement probabilities with those predicted by the Probit model, showing a close alignment that confirms the model's strong predictive performance. The probability increases with age, showing a notable spike at age 60 – when early retirement becomes available for many years within the observation period – and again at age 64.

Figure C.3: Instantaneous retirement probability per age – actual and predicted



Source: Author's calculations based on SHARE data.

Notes: Full sample of person-year observations 2005-2019.

Table C.4: Regression results - labor market exit

	LPM		Fixed effects		Random effects		Probit	
ITAX	0.0140	***	0.0113	**	0.0140	**	0.0124	**
SSW / 100000	0.0272	**	-0.1122	***	0.0272	**	0.0294	**
social class (base: 3)								
1	0.0620	**	/		0.0620	***	0.0647	***
2	0.0084		/		0.0084		0.0096	
4	-0.0610	***	/		-0.0610	***	-0.0622	***
female	-0.0205		/		-0.0205		-0.0215	
part-time	0.0340	**	-0.0040		0.0340	**	0.0364	**
ACE54 / 1000								
level	-0.0006	***	/		-0.0006	***	-0.0005	**
squared	0.0000	***	/		0.0000	***	0.0000	***
industry (base: manufact.)								
agric., forestry, hunting	-0.0706		-0.2277	***	-0.0706		-0.0633	
mining	-0.0905	**	/		-0.0905	**	-0.0726	*
electricity, gas	0.0009		0.0590	***	0.0009		-0.0102	
construction	0.0052		-0.0299		0.0052		0.0030	
wholesale	-0.0551	**	-0.0538		-0.0551	**	-0.0509	***
hotels	-0.0705	*	-0.1242		-0.0705	*	-0.0530	*
transport	-0.0644	**	-0.1116		-0.0644	**	-0.0543	**
financial	-0.0091		-0.0114		-0.0091		-0.0057	
real estate	-0.0619		-0.1975	*	-0.0619		-0.0590	
public administration	-0.0679	**	-0.2110	**	-0.0679	**	-0.0569	**
education	-0.0721	***	-0.0627		-0.0721	***	-0.0587	**
health	-0.0450	**	-0.0780		-0.0450	**	-0.0410	**
other community	-0.0896	***	-0.0823		-0.0896	***	-0.0757	***
partner	0.0191		-0.0668		0.0191		0.0159	
partner's salary / 1000								
level	-0.0006	***	-0.0012	***	-0.0006	***	-0.0007	***
squared	0.0000	**	0.0000	***	0.0000	*	0.0000	**
age (base: 55)								
56	-0.0069		0.0103		-0.0069		-0.0182	
57	0.0547	***	0.0449		0.0547	***	0.0718	**
58	0.1038	***	0.0776		0.1038	***	0.1438	***
59	0.1548	***	0.1182		0.1548	***	0.2062	***
60	0.1760	***	0.1628		0.1760	***	0.2406	***
61	0.1283	***	0.1412		0.1283	***	0.1757	***

62	0.1074	***	0.1049		0.1074	***	0.1508	***
63	0.1569	***	0.1265		0.1569	***	0.2197	***
64	0.3538	***	0.3323		0.3538	***	0.4767	***
year (base: 2005)								
2006	0.0186		0.1892	***	0.0186		0.0144	
2007	-0.0760	***	0.1902	***	-0.0760	***	-0.0761	***
2008	0.0188		0.3098	***	0.0188		0.0148	
2009	-0.0425	*	0.3277	***	-0.0425	*	-0.0407	*
2010	0.0394		0.4597	***	0.0394		0.0317	
2011	-0.1198	***	0.3563	**	-0.1198	***	-0.1049	***
2012	-0.0144		0.4913	**	-0.0144		-0.0148	
2013	-0.1604	***	0.3800	*	-0.1604	***	-0.1098	***
2014	0.1232	***	0.6788	***	0.1232	***	0.0812	**
2015	-0.1221	***	0.4932	*	-0.1221	***	-0.0845	***
2016	0.1241	**	0.7690	**	0.1241	**	0.0816	*
2017	-0.1937	***	0.5024		-0.1937	***	-0.1097	***
2018	0.3392	**	1.0607	***	0.3392	**	0.2557	*
cons	0.0812	*	0.1866	*	0.0812	*	/	
R ² / Pseudo R ² (Probit)	0.1213		0.0329		0.1213		0.1372	
Number of observations	3466		3466		3466		3466	

Source: Author's calculations based on SHARE data.

Notes: Full sample of person-year observations 2005-2019. *** p<0.01, ** p<0.05, * p<0.1. For the Probit model, the marginal effect at the mean is presented.

Appendix D

Additional Material of Chapter 6

D.1 Further details on the construction of the health measures

D.1.1 Functional health

Table D.1: Functional health – list of variables used

Variable	Activity
ph048d1	Walking 100 meters
ph048d2	Sitting for about two hours
ph048d3	Getting up from a chair after sitting for longer periods
ph048d4	Climbing several flights of stairs without resting
ph048d5	Climbing one flight of stairs without resting
ph048d6	Stooping, kneeling, or crouching
ph048d7	Reaching or extending your arms above shoulder level
ph048d8	Pulling or pushing large objects like a living room chair
ph048d9	Lifting or carrying weights over 10 pounds/5 kilos, like a heavy bag of groceries
ph048d10	Picking up a small coin from a table
ph049d1	Dressing, including putting on shoes and socks
ph049d2	Walking across a room
ph049d3	Bathing or showering
ph049d4	Eating, such as cutting up your food
ph049d5	Getting in or out of bed
ph049d6	Using the toilet, including getting up or down
ph049d7	Using a map to figure out how to get around in a strange place
ph049d8	Preparing a hot meal
ph049d9	Shopping for groceries
ph049d10	Making telephone calls

Source: SHARE.

We construct our health capacity indicator by subtracting the number of limitations reported by the respondent from the total of 20 items consistently available in SHARE. They are presented in Table D.1. We adopt an approach in which each limitation contributes equally to the overall measure of functional health. This reflects a deliberate modeling choice to avoid imposing arbitrary assumptions about the relative severity or importance of different limitations, as assigning differential weights could introduce additional subjectivity into the construction of the indicator.

However, one could argue that certain limitations are more severe than others, particularly those affecting basic activities of daily living such as eating, bathing, or using the toilet, which directly reflect a loss of independence. In contrast, limitations related to mobility or more complex instrumental activities may represent earlier or less severe stages of functional decline. To account for this, we consider an alternative specification in which limitations are weighted according to their functional severity.

More specifically, we group the items into three categories. First, limitations in basic activities of daily living - including dressing, walking across a room, bathing, eating, getting in or out of bed, and using the toilet (ph049d1-ph049d6) - capture fundamental self-care abilities and directly reflect an individual's capacity to live independently; these are assigned the highest weight of 2. Second, limitations in more complex instrumental activities - such as using a map, preparing a hot meal, shopping for groceries, and making telephone calls (ph049d7-ph049d10) - represent more complex tasks required for independent living and are assigned an intermediate weight of 1. Finally, mobility and physical functioning limitations - including difficulties with walking longer distances, climbing stairs, sitting, standing up, lifting, or performing fine motor tasks (ph048d1-ph048d10) - reflect underlying physical capacity and often represent earlier stages of functional decline; these are assigned a lower weight of 0.5. Following this alternative weighting scheme¹, the resulting measure ranges from 0 to 21, instead of 0 to 20 as under the equal-weight specification.

The results are robust to this alternative specification of the health measure. For both the morbidity gradient and the difference in Health-Equivalent Age, the findings remain very similar. Regarding the concentration index, a more consistent decline over time is observed, suggesting

¹This weighting reflects the hierarchical nature of functional decline documented in the literature, whereby limitations in basic self-care activities typically occur at more advanced stages of disability than limitations in instrumental activities (see e.g. Morris et al., 2013).

an increase in health inequalities². However, the 95% confidence interval remains wide, and the hypothesis of a flat change between 2005 and 2021/22 cannot be rejected. Figure D.1 in Appendix D.2 presents this result. The conclusions thus remain unchanged and are not sensitive to the specification of the functional health measure.

D.1.2 Diagnosed health

Table D.2 presents the health conditions that are consistently available across all SHARE waves and that are used for the construction of the diagnosed health measure.

Table D.2: Diagnosed health – list of variables used

Variable	Health condition
ph006d1	A heart attack including myocardial infarction or coronary thrombosis or any other heart problem including congestive heart failure
ph006d2	High blood pressure or hypertension
ph006d3	High blood cholesterol
ph006d4	A stroke or cerebral vascular disease
ph006d5	Diabetes or high blood sugar
ph006d6	Chronic lung disease such as chronic bronchitis or emphysema
ph006d10	Cancer or malignant tumour, including leukaemia or lymphoma, but excluding minor skin cancers
ph006d11	Stomach or duodenal ulcer, peptic ulcer
ph006d12	Parkinson disease
ph006d13	Cataracts
ph006d14	Hip fracture or femoral fracture

Source: SHARE.

D.2 Concentration indices

Table D.3 presents the concentration indices and the corresponding 95% confidence intervals.

²In contrast, the equal-weight specification produced a more volatile series, with no clear trend.

Table D.3: Concentration indices

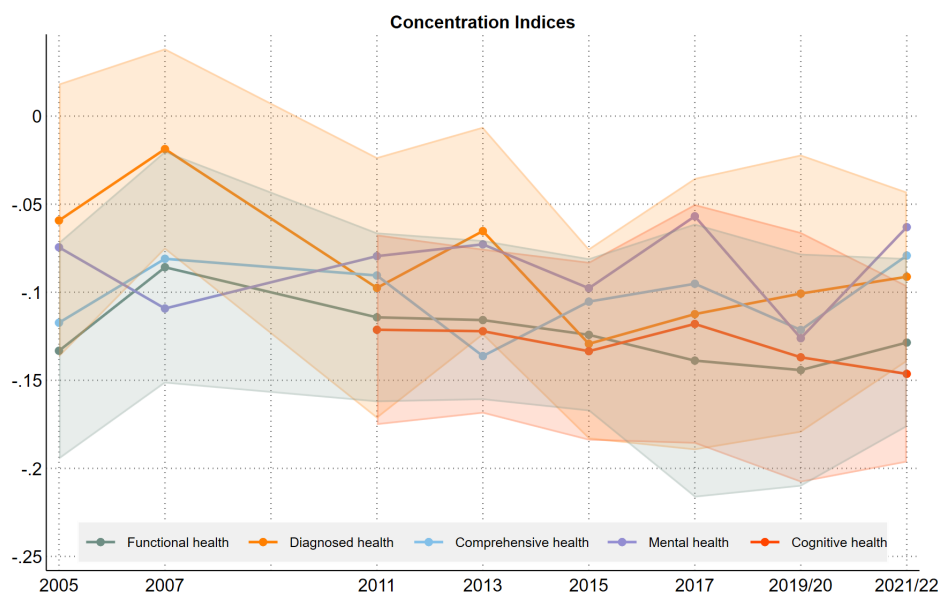
Year	Functional health	Diagnosed health	Comprehensive health	Mental health	Cognitive health
2005	-0.13 [-0.19, -0.08]	-0.06 [-0.14, 0.02]	-0.12 [-0.17, -0.06]	-0.07 [-0.13, -0.02]	-
2007	-0.07 [-0.12, -0.01]	-0.02 [-0.08, 0.04]	-0.08 [-0.14, -0.02]	-0.11 [-0.17, -0.05]	-
2011	-0.10 [-0.16, -0.05]	-0.10 [-0.17, -0.02]	-0.09 [-0.14, -0.05]	-0.08 [-0.14, -0.02]	-0.12 [-0.18, -0.07]
2013	-0.12 [-0.17, -0.08]	-0.07 [-0.12, -0.01]	-0.14 [-0.18, -0.09]	-0.07 [-0.11, -0.03]	-0.12 [-0.17, -0.08]
2015	-0.13 [-0.18, -0.08]	-0.13 [-0.18, -0.08]	-0.11 [-0.14, -0.07]	-0.10 [-0.15, -0.05]	-0.13 [-0.18, -0.08]
2017	-0.09 [-0.16, -0.03]	-0.11 [-0.19, -0.04]	-0.10 [-0.16, -0.03]	-0.06 [-0.12, 0.01]	-0.12 [-0.19, -0.05]
2019/20	-0.14 [-0.22, -0.07]	-0.10 [-0.18, -0.02]	-0.12 [-0.18, -0.06]	-0.13 [-0.21, -0.04]	-0.14 [-0.21, -0.07]
2021/22	-0.10 [-0.14, -0.06]	-0.09 [-0.14, -0.04]	-0.08 [-0.12, -0.04]	-0.06 [-0.12, -0.01]	-0.15 [-0.20, -0.10]

Source: Authors' calculations based on SHARE data.

Notes: This table lists the concentration indices and the 95%-confidence intervals for the five health measures over years. Cognitive health is only available from 2011 (Wave 4) onward. Lower values indicate more inequality.

Figure D.1 displays the evolution of the concentration indices over time for the five health measures, but using the alternative specification of functional health as presented in Appendix D.1.

Figure D.1: Concentration indices over time - alternative specification for functional health



Source: Authors' calculations based on SHARE data.

Notes: This graph shows the concentration indices over years by health outcome. Lower values indicate more inequality. We depict the 95%-confidence interval for functional, diagnosed and cognitive health, as those are the variables that appear to have a clear trend over time.

Appendix E

Additional Material of Chapter 7

E.1 Health deficit index

E.1.1 Description and limitations

To measure health we use an aggregated indicator - the health deficit index. It summarizes the individual health status by aggregating a set of self-reported health deficits, including chronic conditions, functional limitations and difficulties with daily activities, as well as mental health. Each deficit is coded as present or absent, and the index is calculated as the proportion of observed deficits relative to the total number of non-missing health indicators, hence a value between 0 and 100. It is based on the health deficit index as proposed by Börsch-Supan et al. (2021) and Abeliatsky and Strulik (2019).

We choose to use this measure because health is not a one-dimensional concept. By aggregating multiple indicators into a single measure, we obtain a more comprehensive view of individual health. This approach allows us to capture overall health stock rather than focusing on specific diagnoses, and it is particularly useful for assessing general health across individuals or over time.

However, this approach also comes with certain limitations. In the index, each health deficit is assigned the same weight and therefore contributes equally to the final measure, even though some conditions may have a stronger impact on an individual's ability to remain in the labour market and are therefore more relevant for explaining exits into DI. In addition, by aggregating multiple dimensions into a single indicator, some detail is inevitably lost. Different underlying health profiles can result in the same index value, which means that the measure may not fully capture important differences in the type and composition of health conditions across individuals. In the context of explaining gender differences in DI

exits, this may be relevant, as certain diagnoses may be more prevalent among men or women and may have a stronger impact on the likelihood of exiting the labour market via DI than others, even if the overall index score appears similar. Even so, changes over time in the composition of health conditions - such as a shift toward more severe or more DI-relevant diagnoses - may not be fully reflected in the index. This means that the index could understate or misrepresent how changes in the type of health problems, rather than just their overall prevalence, are associated with the observed increase in DI exits over time.

E.1.2 Decomposition into distinct dimensions of health

To assess the extent of the limitations inherent in the health index, we conduct a more detailed analysis by decomposing it into four components. Specifically, we construct four alternative versions of the index, each based on a grouping of similar variables. Each version thus represents a subset of the overall index, capturing distinct dimensions of health. This approach allows us to examine whether the overall trend observed in the health deficit index is consistent across different aspects of health, or whether these dimensions exhibit divergent patterns.

The first version considers only variables capturing health conditions diagnosed by a doctor. It includes variables related to heart problems such as heart attack, congestive heart failure, or other cardiac conditions. It also covers high blood pressure (hypertension), high blood cholesterol, stroke or cerebrovascular disease, diabetes or elevated blood sugar, and chronic lung diseases such as chronic bronchitis or emphysema. In addition, it includes cancer or malignant tumors (including leukemia or lymphoma, but excluding minor skin cancers), stomach or duodenal ulcers (peptic ulcers), Parkinson's disease, cataracts, and hip or femoral fractures.

The second version focuses on mental health variables. It includes indicators capturing whether the person feels depressed, has wished they were dead, experiences sleep or concentration problems, and whether they have recently felt enjoyment.

The third version considers variables capturing limitations in activities of daily living (ADLs) and instrumental activities of daily living (IADLs). It includes mobility tasks (e.g., walking, sitting, climbing stairs, reaching, lifting), self-care activities (e.g., dressing, bathing, eating), and instrumental tasks such as navigating with a map, preparing meals, and making telephone calls.

The fourth version captures biometric variables that reflect objective physical characteristics and performance measures of the individual, including indicators such as vision, body mass index, mobility and grip strength.

Table E.1 presents the average indices for the different subgroups of the sample.

Table E.1: Decomposition of the health deficit index

	Period 1: 2004–2009			Period 2: 2016–2022		
	Total	Men	Women	Total	Men	Women
Health deficit index [0–100]	9.78	9.26	10.47	9.36	8.69	9.99
v1 - diagnosed health variables only	8.52	9.02	7.87	9.19	9.45	8.95
v2 - mental health variables only	15.79	14.21	17.9	17.46	13.85	20.85
v3 - functional health variables only	4.13	3.37	5.13	4.47	3.60	5.78
v4 - biometric health variables only	20.69	19.99	21.61	18.77	18.47	19.06

Source: Authors' calculations based on SHARE data.

When considering the index as a whole, we observe that women, on average, exhibit poorer health compared to men in both periods. Over time, overall health appears to improve for both genders, as indicated by a lower value of the index.

Examining the different dimensions of health separately through the decomposed versions of the index reveals a consistent pattern: across most dimensions, women experience worse health outcomes than men. This suggests that the observed gender gap is not driven by a single dimension, but rather reflects a broad-based difference in health status. An exception arises in version 1 of the index, which focuses exclusively on diagnosed health conditions. In this case, men exhibit a higher average value of the diagnosed health index than women. However, this analysis still focuses on relatively broad health dimensions, which provide an initial overview but are not sufficient to obtain a detailed picture. In particular, we still do not capture gender differences within each dimension, which may vary considerably and differ in their relevance for the study of DI exits.

Regarding the evolution of health status over time, greater deviations from the overall index emerge. While the overall index suggests an improvement in health for both genders, the decomposed analysis across the various health dimensions reveals a more nuanced picture: In versions 1 and 3 (diagnosed and functional health), a deterioration in health status is observed for both men and women. In contrast, mental health displays a divergent trend by gender. It improves for men while deteriorating for women. Finally, only the biometric health dimension shows an improvement over time for both genders. This finding illustrates that aggregating multiple health dimensions into a single index can conceal important opposing trends across those dimensions. And given that different health aspects may vary in their relevance for an individual's ability to remain active in the labour market and, consequently, for potential DI exits, this may lead to distortions in the analysis, as important and nuanced developments in health are not necessarily captured by the index¹.

¹This analysis decomposes the index into four sub-indices. However, even within a given dimension, there may be substantial differences in the relevance of individual health deficits for DI exits.

In conclusion, while the index provides a useful summary measure of overall health and allows for straightforward comparisons across individuals and over time, the results highlight its inherent limitations: It can mask important heterogeneity. This suggests that future research should examine the sensitivity of the results to alternative health measures, analyse individual health dimensions separately, and consider different methodological choices, including alternative weighting schemes that reflect the relevance of specific deficits for labour market participation and DI exits. Such extensions would help assess the robustness of the findings and provide a more nuanced understanding of the role of health dynamics in explaining observed trends in DI exit rates.

E.2 Underlying Logit regressions for the Fairlie decomposition

The Fairlie decomposition is implemented within a nonlinear probability framework and is based on the estimation of a Logit regression for a selected reference group. The estimated coefficients from this reference-group Logit model define the underlying functional relationship between covariates and the predicted probability of the outcome and are subsequently used to decompose differences in mean outcomes across groups. While the main text reports only the resulting decomposition to maintain brevity and focus, the underlying Logit regression estimates for the reference group are not shown there. For the sake of transparency and completeness, these regression results are presented in this appendix.

The variables used in the decomposition are based on those introduced in Section 7.4, where we examine the factors associated with exiting the labour market via the DI exit route. However, for the decomposition,

they are incorporated in a different form, as all variables are specified as sets of dummy variables. To construct these, each variable is divided into four classes (and three in the case of SEA), using the quartile cutoff points of its distribution as thresholds. Accordingly, the Logit regressions presented here report coefficients for each dummy variable (except for the base category). In the subsequent decomposition, however, dummy variables derived from the same underlying variable are grouped together to capture the combined contribution of that factor on DI exit differences. Consequently, Tables 7.4 and 7.5, which report the decomposition results, do not display the contributions of individual dummy variables separately, but only their combined contribution, as this is of greater interest.

E.2.1 Assessing gender differences in DI exits in period 1

When assessing gender differences in DI exits in period 1, men serve as the reference group for the decomposition. Table E.2 reports the results of the underlying Logit regression from which the coefficients used in the decomposition are obtained.

The results indicate a statistically significant association for the dummy variables capturing the Health Deficit Index (HDI), as well as for the indicator distinguishing white-collar from blue-collar occupations. Men in lower HDI categories - i.e., those with fewer health deficits - are less likely to exit the labour market via the DI route. Similarly, men employed in white-collar occupations exhibit a lower likelihood of DI exit compared to their blue-collar counterparts. No statistically significant associations are found for the remaining variables.

Table E.2: Logit regression - labor market exit via DI - men only period 1

	Men period 1	
Individual-level factors		
Class of HDI (base: 4)		
1	-2.33	**
2	-1.73	**
3	-2.03	***
Employment-related factors		
Class of ACE (base: 2)		
1	1.15	
3	0.78	
4	-0.02	
Class of career length (base: 3)		
2	1.10	
4	1.05	
White collar	-1.53	**
Constant	-3.26	***
Number of observations	619	

Source: Authors' calculations based on SHARE data.

Notes: *** p<0.01, ** p<0.05, * p<0.1. HDI: Health deficit index. ACE: Average career earnings. Fulltime is omitted, as failure could be predicted perfectly for men in period 1. Class 1 of career length is omitted, as failure could be predicted perfectly. The reported coefficients cannot be interpreted as marginal effects.

E.2.2 Assessing the rise in DI exits among women over time

When assessing differences in DI exits among women over time, period 1 serves as the reference group for the decomposition. Table E.3 presents the results of the underlying Logit regression that provides the coefficients used in the decomposition.

The results indicate significant effects for both employment-related and system-related factors. Women in period 1 working in blue-collar occupations are more likely to exit the labour market via DI. A reduction in the generosity of the DI exit pathway is associated with fewer exits through

DI, while greater generosity in the overall pension system is associated with an increase in DI exits.

Table E.3: Logit regression - labor market exit via DI
- women only period 1

	Women period 1	
Individual-level factors		
Class of HDI (base: 2)		
1	0.81	
3	0.91	
4	1.60	
Employment-related factors		
Class of ACE (base: 3)		
1	-2.34	*
2	-1.20	
Blue collar	1.90	**
System-related factors		
DI generosity (base: 3)		
2	-17.75	***
Increased generosity of OAP (base: 1)		
2	17.40	***
3	17.14	***
SEA (base: 3)		
2	-15.84	
Constant		
	-4.72	***
Number of observations		
	509	

Source: Authors' calculations based on SHARE data.

Notes: *** p<0.01, ** p<0.05, * p<0.1. HDI: Health deficit index. ACE: Average career earnings. Fulltime and EEA are omitted because of collinearity. We exclude the number of career years as its inclusion resulted in substantial distortions and inconsistencies relative to the outcomes of all other model specifications. Class 4 of ACE is omitted, as failure could be predicted perfectly. Class 1 of DI generosity, class 4 of OAP generosity and class 1 of SEA are omitted because of collinearity. The reported coefficients cannot be interpreted as marginal effects.

E.3 Sensitivity analysis: Impact of crisis years

The original analysis spans two distinct periods : Period 1, which includes the global financial crisis, and Period 2, which encompasses the Covid-19 pandemic. These crises may have influenced people’s behavior. To assess how the years associated with major economic crises affects the observed outcomes, we re-estimate the model while excluding those years. For this, Period 1 is now restricted to 2004-2007 instead of 2004-2009, reducing the time span from six to four years, while period 2 is shortened to 2016-2019 instead of 2016-2022, reducing the coverage from seven to four years. This adjustment inevitably decreases the number of observations substantially, which may pose challenges for the estimation and interpretation of the results, as will be addressed in the subsequent sections.

This segment follows a similar structure as in the paper. Section E.3.1 first examines the exit patterns observed in the two time periods and the changes over time to determine whether the general trend remains similar regardless of whether the crisis years are included in the analysis. Section E.3.2 re-estimates the Logit regression to identify the factors associated with exits via DI and to assess whether these relationships change when the crisis years are excluded. Section E.3.3 and E.3.4 conduct the Fairlie decomposition to, first, examine the observed differences in DI exits between men and women in period 1 and, second, analyze the increase in DI exits among women, in order to evaluate the potential impact of the crisis years on the outcomes.

E.3.1 Exit patterns

We first look whether the overall exit patterns observed over time remain similar when excluding the crisis years. As shown in Table E.4, a similar

trend can be observed, characterized by an increase in older individuals remaining active and those exiting through DI, while a smaller share exits via UI, CER or OAP. However, the rise in the share of those remaining active is less pronounced, and for women, there is even a slight decline. In contrast, the increase in exits via DI is more substantial for both men and women. This indicates, that the crisis years are characterized by a higher proportion of individuals aged 55-64 remaining active in the labor market.

Focusing on DI exits, men continue to be more likely than women to exit the labor market through DI in period 1. However, the difference between the two groups is less pronounced. The *t*-test indicates that this difference is no longer statistically significant. For both, men and women, the increase in the share of people exiting through DI is more pronounced when excluding the crisis years. The rise is however still insignificant for men, while it is significant for women, as confirmed by the *t*-test results.

Table E.4: Chosen exit routes over time, by gender - sensitivity analysis

	Period 1 2004-2007	Period 2 2016-2019	Change
Men			
Active	859	785	
Remaining active	84.40%	86.19%	+1.79 pp
Exiting via DI	1.75%	2.81%	+1.07 pp
Exiting via UI	3.49%	1.15%	-2.34 pp
Exiting via CER or OAP	10.36%	9.85%	-0.51 pp
Women			
Active	544	847	
Remaining active	85.66%	85.36%	-0.30 pp
Exiting via DI	1.29%	3.66%	+2.37 pp
Exiting via UI	2.57%	0.59%	-1.98 pp
Exiting via CER or OAP	10.48%	10.39%	-0.09 pp

Source: Authors' calculations based on SHARE data.

E.3.2 Factors associated with DI exits

As in Section 7.4, we use a Logit regression to assess the factors that are associated with exiting the labor market through the DI pathway. Results are presented in Table E.5.

When excluding the crisis years, results remain similar for men, with a strong link coming from the health status exclusively. As before, men's decision to exit via DI appears to be unrelated to changes in the system.

For women, larger changes are observed. Previously we found a strong association especially with the system-related factors, suggesting that women's decision to exit through DI are strongly influenced by the institutional and policy framework in place. Now when excluding the crisis years, certain system-related factors are no longer statistically significant. There are different potential explanations for this change. First, it is possible that the crisis years genuinely strengthens the link between the system-related factors and women's decision to exit via DI. It is possible that during periods of economic crisis, characterized by more uncertainty, the individuals' exit decision tends to become more sensitive to the incentives and constraints embedded within the social security system. In such contexts, institutional features such as the generosity or accessibility of a system gain greater relevance, as individuals seek the most stable and predictable source of income. Second, it is also possible that the reduced sample size, which results from the shortening of our periods, has led to a reduction in the statistical power of our model. The standard errors of estimated coefficients tend to increase with fewer observations, making it harder for effects to reach statistical significance. As a result, some variables may no longer appear significant, not necessarily because their true relationship with DI exits disappears, but because the smaller sample size provides less precision in estimation.

Table E.5: Logit regression - labor market exit via DI - sensitivity analysis

	Total		Men		Women	
Individual-level factors						
Health deficit index	0.22	***	0.24	**	0.29	**
Period 2	-0.05		-0.08		-0.10	
Employment-related factors						
Average career earnings	-0.01		-0.01		-0.01	
Period 2	0.01		0.01		-0.01	**
Number of career years	0.01	**	0.01		0.01	*
Period 2	-0.01		-0.01		-0.01	*
Blue collar	0.04	***	0.04	*	0.04	**
Period 2	-0.03		-0.01		-0.05	**
Full-time	0.29		/		0.28	
Period 2	-0.29		0.59		-0.28	
System-related factors						
DI generosity	-0.78	*	-0.51		2.64	
Increased generosity of OAP	1.17		/		-2.04	
SEA	-0.01		/		0.18	
EEA	0.01		0.02		0.13	*
Wave fixed effect	0.01		0.01		-0.16	
Constant	3.53		-36.40		-1416.69	
Number of observations	1919		916		929	

Source: Authors' calculations based on SHARE data.

Notes: *** p<0.01, ** p<0.05, * p<0.1. SEA : Statutory eligibility age. EEA : Early eligibility age. SEA is omitted in the regression for men, as there was no change in the period of observation. The SEA was gradually increased only for women. Fulltime is omitted in the regression for men, as failure could be predicted perfectly. The reported coefficients are the average marginal effects.

E.3.3 Assessing gender-differences in DI exits in period 1

Table E.6 presents the results of the Fairlie decomposition, when excluding the crisis years. We obtain similar results: the difference in DI exits between men and women in period 1 remains unexplained by the observable characteristics included in the model. This suggests that other unobserved factors, such as behavioral differences, may be contributing to the observed disparity.

Table E.6: Fairlie decomposition – men vs. women in period 1 - sensitivity analysis

	N	DI exit rate Men	DI exit rate Women	Diff.	Total expl- ained	Contrib. to total explained
Separately						
Health deficit index	745	2.38%	1.85%	-0.53 pp	0.88 pp	**
Average career earnings	1403	1.75%	1.29%	-0.46 pp	0.44 pp	
Number of career years	1403	1.75%	1.29%	-0.46 pp	-0.36 pp	**
Blue collar	1403	1.75%	1.29%	-0.46 pp	-0.32 pp	***
Jointly						
Health deficit index	745	2.38%	1.85%	-0.53 pp	1.10 pp	1.55 pp
Average career earnings						0.44 pp
Number of career years						0.13 pp
Blue collar						-1.02 pp

Source: Authors' calculations based on SHARE data.

Notes: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Fulltime is omitted in the decomposition, as failure could be predicted perfectly for men in period 1. In the joint decomposition, the contribution of each factor to the total explained is reported in the last column.

E.3.4 Assessing the rise in DI exits among women over time

Table E.7 presents the results of the Fairlie decomposition in order to assess the large increase in DI exits among women over the observation period, this time excluding the crisis years.

In the previous analysis, certain variables, such as EEA, were already omitted due to collinearity, although most key variables could still be retained. However, when excluding the crisis years from the sample, an even larger number of variables – particularly those that were significant in the earlier analysis and therefore especially of interest for us – are now omitted. This increased omission makes it challenging to fully assess the sensitivity of our previous results to the crisis years, as the decomposition relies on a reduced set of predictors.

Collinearity occurs when two or more explanatory variables are highly correlated with each other. In other words, one variable can be almost perfectly predicted from the others. This creates a problem because the model cannot clearly separate the individual effect of each variable, therefore omitting certain variables. Excluding the crisis years may have reduced the variation in some variables. The omitted years included periods of system reforms – for example, in 2009, the SEA for women was increased to 65 – which introduced additional variation in key factors. By leaving out these years, the remaining sample exhibits less variation, causing some variables to move more closely together and increasing correlations among them. This, in turn, exacerbates the problem of collinearity in the analysis.

When using the same specification as in the earlier analysis, we are no longer able to include the variable accounting for the generosity of the DI exit route as well as the SEA. Among the remaining variables, none of them is significant.

The observed distortions are most likely attributable to the reduced sample size resulting from the shortened time period, rather than to the crisis years themselves. When the period is shortened from the other end – while still including the crisis years – similar issues arise. This suggests that the small sample size prevents a proper assessment of the impact of the crisis years on the results. With a larger dataset, a more accurate evaluation would likely be possible. Nevertheless, this exercise remains valuable, as it provides insight into the data's limitations.

Table E.7: Fairlie decomposition – women in period 1 vs. period 2 - sensitivity analysis

	N	DI exit rate Period 1	DI exit rate Period 2	Diff.	Total expl- ained	Contrib. to total explained
Separately						
Health deficit index	984	1.85%	2.88%	1.03 pp	0.22 pp	
Average career earnings	1391	1.29%	3.66%	2.37 pp	0.47 pp	
Number of career years	1391	1.29%	3.66%	2.37 pp	0.22 pp	
Blue collar	1391	1.29%	3.66%	2.37 pp	-0.22 pp	*
DI generosity	omitted					
OAP generosity	1391	1.29%	3.66%	2.37 pp	0.05 pp	
SEA	1391	1.29%	3.66%	2.37 pp	-0.81 pp	
Jointly						
Health deficit index	984	1.85%	2.88%	1.03 pp	3.05 pp	0.04 pp
Average career earnings						3.01 pp
Blue collar						-2.24 pp
DI generosity						omitted
OAP generosity						2.24 pp
SEA						omitted

Source: Authors' calculations based on SHARE data.

Notes: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Fulltime, EEA, DI generosity and SEA are omitted in the decomposition because of collinearity. In the joint decomposition, the contribution of each factor to the total explained is reported in the last column. We exclude the number of career years from the joint decomposition, as its inclusion resulted in substantial distortions and inconsistencies relative to the outcomes of all other model specifications.

Bibliography

Abeliansky, A.L., and Strulik, H. (2019). Long-run improvements in human health: Steady but unequal. *The Journal of the Economics of Ageing*, 14, 100189. DOI: 10.1016/j.jeo.2019.01.003.

Ahonen, K., and Kuivalainen, S. (2024). Gender differences in old age poverty in 14 EU countries: exploring the role of household structure. *International Review of Economics*. DOI: <https://doi.org/10.1007/s12232-024-00455-w>

Baeten, R., Spasova, S., and Vanhercke, B. (2019). Access to health-care in the EU : An overall positive trend but important inequalities persist. *Revue Belge de Sécurité Sociale*, 1/2019, 199-219.

Barschkett, M., Geyer, J., Haan, P., and Hammerschmid, A. (2022). The effects of an increase in the retirement age on health - Evidence from administrative data. *Journal of the Economics of Ageing*, 23, 100403. DOI: <https://doi.org/10.1016/j.jeo.2022.100403>

Belgian Commission for Pension Reform 2020–2040. (2014). *Un contrat social performant et fiable : Propositions de la Commission de réforme des pensions 2020–2040 pour une réforme structurelle des régimes de pension*. Bruxelles: SPF Sécurité sociale. URL: <https://socialsecurity.belgium.be/sites/default/files/rapport-commission-pensions-2040-fr.pdf>

Berete, F., Gisle, L., Demarest, S., Charafeddin, R., Bruyère, O., Van den Broucke, S., and Van der Heyden, J. (2024). Does health literacy mediate the relationship between socioeconomic status and health related outcomes in the Belgian adult population?, *BMC Public Health*, 24(1): 1182.

Blinder, A. S. (1973). Wage discrimination: Reduced form and structural estimates. *Journal of Human Resources*, 8(4), 436–455. DOI: <https://doi.org/10.2307/144855>

Bonsang, E., Adam, S., and Perelman, S. (2012). Does retirement affect cognitive functioning? *Journal of Health Economics*, 31(3), 490–501. DOI: <https://doi.org/10.1016/j.jhealeco.2012.03.005>

Börsch-Supan, A., Brandt, M., Hunkler, C., Kneip, T., Korbacher, J., Malter, F., Schaan, B., Stuck, S., and Zuber, S. (2013). Data Resource Profile: The Survey of Health, Ageing and Retirement in Europe (SHARE). *International Journal of Epidemiology*. DOI: 10.1093/ije/dyt088.

Börsch-Supan, A., Ferrari, I., and Salerno, L. (2021). Long-run health trends in Europe. *The Journal of the Economics of Ageing*, 18, C.

Brugiavini, A., Orso, C.E., Genie, M. G. , Naci, R., and Pasini, G. (2019). Combining the retrospective interviews of wave 3 and wave 7: the third release of the SHARE Job Episodes Panel. *SHARE Working Paper Series (36-2019)*. Munich: MEA, Max Planck Institute for Social Law and Social Policy.

Chiappori, P.-A. (1988). Rational household labor supply. *Econometrica*, 56(1), 63–90. DOI: <https://doi.org/10.2307/1911842>

Christiansen, R.H., and Nielsen, H.O. (2009). *Disparities in quality of work linked to education and socioeconomic status*. URL: <https://www.eurofound.europa.eu/en/resources/article/2009/disparities-quality-work-linked-education-and-socioeconomic-status>

Cohen, S., Janicki-Deverts, D., Chen, E., and Matthews, K.A. (2010). Childhood socioeconomic status and adult health. *Annals of the New York Academy of Sciences*, 1186, Issue 1: The Biology of Disadvantage : Socioeconomic Status and Health.

Council of the European Union (2024). *Tackling gender inequality after retirement*. URL: <https://wayback.archive-it.org/12710/20241019024108/https://belgian-presidency.consilium.europa.eu/en/news/tackling-gender-inequality-after-retirement/>

De Brouwer, O., and Tojerow, I. (2023). The Growth of Disability Insurance in Belgium: Determinants and Policy Implications. *IZA Discussion Paper No. 16376*. URL: <https://docs.iza.org/dp16376.pdf>

De Brouwer, O., and Tojerow, I. (2024). Old-age unemployment and labour supply: An application to Belgium. *Empirical Economics*, 67(1), 253-287.

Decancq, K., and Panagamuwa Gamage, S. (2024). Un regard multidimensionnel sur les inégalités de bien-être. In Decoster, A., Decancq, K., De Rock, B., and Gobbi, P. (Eds.), *Inégalités en Belgique. Un paradoxe?*, 280-296. LannooCampus.

Dellis, A., Desmet, R., Jousten, A., and Perelman, S. (2004). Analyse de la cessation d'activité en Belgique. *Revue française d'économie*, 18(1), 99-132.

De Mulder, J., Olivera, J., Piette, Ch., and Zachary, M.-D. (2024). *NBB Economic Review 2024 No 11. Household wealth and wealth inequality in Belgium and the euro area: an overview..* URL: https://www.nbb.be/doc/ts/publications/economicreview/2024/ecorevi2024_h11.pdf

Desmet, R., Jousten, A., Perelman, S., and Pestieau, P. (2007). Micro-Simulation of Social Security in Belgium. In Gruber, J., and Wise, D. (Eds.), *Social Security Programs and Retirement Around the World: Fiscal Implications of Reform*, 43-82. University Chicago Press and National Bureau of Economic Research.

Eggerickx, T., Sanderson, J-P., and Vandeschrick, C. (2018). Les inégalités sociales et spatiales de mortalité en Belgique : 1991-2016. *Espace populations sociétés, 2018/1-2*. DOI: <https://doi.org/10.4000/eps.7416>

Eibich, P. (2015). Understanding the effect of retirement on health: Mechanisms and heterogeneity. *Journal of Health Economics, 43*, 1–12. DOI: <https://doi.org/10.1016/j.jhealeco.2015.05.001>

EIGE (2015). *Gender gap in pensions in the EU: Research note to the Latvian Presidency*. DOI : 10.2839/221006

EIGE (2018). *Study in the EU: set apart by gender*. URL: https://eige.europa.eu/sites/default/files/documents/20182510_mh0218556enn.pdf

EIGE (2020). *Gender Equality Index 2020: Digitalisation and the future of work*. Publications Office of the European Union: Luxembourg. URL: https://eige.europa.eu/publications-resources/toolkits-guides/gender-equality-index-2020-report/grave-risk-poverty-harsh-reality-older-women-and-every-second-lone-mother?language_content_entity=en

European Commission (2012). The 2012 Ageing Report. Economic and budgetary projections for the 27 EU Member States (2010-2060). *European Economy 2/2012*. Publications Office of the European Union: Luxembourg.

European Commission (2013). *The Gender Gap in Pensions in the EU*. DOI: 10.2838/43810 URL: <https://www.social-protection.org/gimi/Media.action;jsessionid=kWqCTQczBqoRcFU0mDEmYB0cvXATYs8SOtjLTJOPowNY7PlW6950!1945465934?id=13384>

European Commission (2015). The 2015 Ageing Report. Economic and budgetary projections for the 28 EU Member States (2013-2060). *European Economy 3/2015*. Publications Office of the European Union: Luxembourg. DOI: 10.2765/877631

European Commission (2017). *European semester thematic factsheet. Adequacy and sustainability of pensions*. URL: https://commission.europa.eu/document/download/0cb613ec-cdda-4c2c-a60e-f0c9f579fe47_en?filename=european-semester_thematic-factsheet_adequacy-sustainability-pensions_en.pdf&prefLang=fr

European Commission (2023). *The gender pay gap situation in the EU*. URL : https://commission.europa.eu/strategy-and-policy/policies/justice-and-fundamental-rights/gender-equality/equal-pay/gender-pay-gap-situation-eu_en#:~:text=Sectoral%20segregation%3A%20Around%2024%25%20of,tend%20to%20be%20systematically%20undervalued

European Commission (2024). 2024 Ageing Report. Economic and budgetary projections for the EU Member States (2022-2070). *European Economy 24/2024*. Publications Office of the European Union: Luxembourg. DOI: 10.2765/022983

European Parliament (2016). *The gender pension gap : differences between mothers and women without children*. URL: [https://www.europa.eu/regdata/etudes/STUD/2016/571363/IPOL_STU\(2016\)571363_EN.pdf](https://www.europa.eu/regdata/etudes/STUD/2016/571363/IPOL_STU(2016)571363_EN.pdf)

Eurostat (2019). *Reconciliation of work and family life - statistics*. URL: https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Reconciliation_of_work_and_family_life_-_statistics&oldid=454330#Childcare_responsibilities_effect_work_arrangements

Eurostat (2020). *4 in 10 women aged 65 or over live alone*. URL: <https://ec.europa.eu/eurostat/web/products-eurostat-news/-/DDN-20200623-1>

Eurostat (2021). *Closing the gender pension gap?* URL: <https://ec.europa.eu/eurostat/web/products-eurostat-news/-/ddn-20210203-1>

Eurostat (2023a). *Duration of working life – statistics*. URL: https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Duration_of_working_life_-_statistics#:~:text=Highlights&text=In%202022%2C%20the%20expected%20duration,with%20more%20than%2040%20years.

Eurostat (2023b). *Part-time and full-time employment – statistics*. URL: https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Part-time_and_full-time_employment_-_statistics#Main_concept

Eurostat (2025a). *Gender pension average gap by age group*. DOI:10.2908/ilc_pnp13 URL : https://ec.europa.eu/eurostat/databrowser/view/ilc_pnp13_custom_19668937/default/table

Eurostat (2025b). *Income quintile share ratio S80/S20 for disposable income by sex and age group*. DOI:10.2908/ilc_di11 URL : https://ec.europa.eu/eurostat/databrowser/view/ilc_di11__custom_19607663/default/table

Fairlie, R. W. (2005). An Extension of the Blinder-Oaxaca Decomposition Technique to Logit and Probit Models. *Journal of Economic and Social Measurement*, 30(4), 305-316.

Flèche, S., and Sénécal, L. (2021). *How the Mental Load for Women is Twofold*. URL: <https://www.dialogueseconomiques.fr/en/article/how-mental-load-women-twofold>

Fors, S., Illinca, S., Jull, J., Kadi, S., Phillips, S. P., Rodrigues, R., Vafaei, A., Zolyomi, E., and Rehnberg, J. (2022). Cohort-specific disability trajectories among older women and men in Europe 2004-2017. *European Journal of Ageing*. 19(4), 1111-1119.

Fortin, N. M. (2005). Gender role attitudes and the labour-market outcomes of women across OECD countries. *Oxford Review of Economic Policy*, 21(3), 416-438. DOI: <https://doi.org/10.1093/oxrep/gri024>

Fraikin, A. L., Jousten, A., and Lefebvre, M. (2021). Social Security Incentives in Belgium: An Analysis of Four Decades of Change. In Börsch-Supan, A., and Coile, C. (Eds.), *Social Security Programs and Retirement around the World: Reforms and Retirement Incentives*, 43-78. University of Chicago Press and National Bureau of Economic Research.

Fraikin, A. L., Jousten, A., and Lefebvre, M. (2025). Trends in Social Security Incentives in Belgium. In Börsch-Supan, A., and Coile, C. (Eds.), *Social Security Programs and Retirement around the World: The Effects of Reforms on Retirement Behavior*, 33-65. University of Chicago Press and National Bureau of Economic Research.

Grech A. G. (2013). Assessing the sustainability of pension reforms in Europe. *Journal of International and Comparative Social Policy*. 2013;29(2), 143-162. DOI: 10.1080/21699763.2013.836980

Guirriec, R. (2023). *Retraite : parmi les femmes bénéficiant de majorations de durée d'assurance pour enfants, trois sur quatre voient leur pension augmenter grâce à ces trimestres*. URL: <https://drees.solidarites-sante.gouv.fr/sites/default/files/2023-10/ER1283MAJ1210.pdf>

Halvorsen, E., and Pedersen, H. W. (2019). Closing the gender gap in pensions: A microsimulation analysis of the Norwegian NDC pension system. *Journal of European Social Policy* 29(1), 130-143. DOI: 10.1177/0958928717754296

Hospido, L., and Zamarro, G. (2014). Retirement Patterns of Couples in Europe. *IZA Discussion Paper No. 7926*. URL: <https://docs.iza.org/dp7926.pdf>

Hurd, M.D. (1990). The Joint Retirement Decision of Husbands and Wives. In Wise, D. A. (Ed.), *Issues in the Economics of Aging*, 231–258. University of Chicago Press and National Bureau of Economic Research. URL: <http://www.nber.org/chapters/c7119>

INAMI (2023). *Statistiques sur l'invalidité des travailleurs salariés et chômeurs en 2023*. URL: <https://www.inami.fgov.be/fr/statistiques/statistiques-indemnites/statistiques-2023/statistiques-sur-l-invalidite-des-travailleurs-salaries-et-choeurs-en-2023#nombre-de-salaries-et-de-choeurs-en-invalidite>

INASTI (2023). *Pension gap de 23% : l'écart de pension entre les femmes et les hommes détaillé sur PensionStat.be*. URL: <https://www.inasti.be/fr/actualites/pension-gap-de-23-lecart-de-pension-entre-les-femmes-et-les-hommes-detaille-sur>

International Labour Organization (2020). *These occupations are dominated by women*. URL: <https://ilostat.ilo.org/these-occupations-are-dominated-by-women/>

International Monetary Fund (2014). *Equitable and sustainable pensions : challenges and experience*. URL: <https://www.elibrary.imf.org/downloadpdf/display/book/9781616359508/9781616359508.pdf>

Jousten, A., and Lefebvre, M. (2013). Retirement Incentives in Belgium: Estimations and Simulations Using SHARE Data, *De Economist*, 161(3), 253-276.

Jousten, A., Lefebvre, M., and Perelman, S. (2014). Health status, disability, and retirement incentives in Belgium. In Wise, D. (Ed.), *Social Security Programs and Retirement Around the World: Disability Insurance Programs and Retirement*, 179-209. University of Chicago Press and National Bureau of Economic Research.

Kleven, H., Landais, C., and Søgaaard, J. (2019). Children and Gender Inequality: Evidence from Denmark. *American Economic Journal: Applied Economics*, 11 (4), 181–209. DOI: 10.1257/app.20180010

Kuypers, S. (2024). Inégalités parmi les composantes du revenu disponible. In Decoster, A., Decancq, K., De Rock, B., and Gobbi, P. (Eds.), *Inégalités en Belgique. Un paradoxe?*, 280-296. LannooCampus.

Landös, A., von Arx, M., Cheval, B., Sieber, S., Kliegel, M., Gabriel, R., Orsholits, D., van der Linden, B., Blane, D., P Boisgontier, M., Courvoisier, D., Guessous, I., Burton-Jeangros, C., and Cullati, S. (2019). Childhood socioeconomic circumstances and disability trajectories in older men and women: a European cohort study, *European Journal of Public Health*, 29, Issue 1, 50–58.

Lefebvre, M., Perelman, S., and Schoenmaeckers, J. (2018). Inégalités face à la mort et au risque de dépendance. *Revue française d'économie*, XXXIII(2), 75-111.

Low, H., and Pistaferri, L. (2025). Disability Insurance: Error Rates and Gender Differences. *Journal of Political Economy* 133:9, 2962-3018.

Mazzonna, F., and Peracchi, F. (2017). Unhealthy retirement? *Journal of Human Resources*, 52(1), 128–151. DOI: <https://doi.org/10.3368/jhr.52.1.0914-6627R1>

Michaud, P.-C., Van Soest, A., and Bissonnette, L. (2020). Understanding joint retirement. *Journal of Economic Behavior & Organization*, 173, 386–401. DOI: <https://doi.org/10.1016/j.jebo.2019.07.013>

Morris, J. N., Berg, K., Fries, B. E., Steel, K., and Howard, E. P. (2013). Scaling functional status within the interRAI suite of assessment instruments. *BMC Geriatrics*, 13, 128. DOI: <https://doi.org/10.1186/1471-2318-13-128>

Moscufo, N. (2026). L'enveloppe bien-être : une conquête sociale aujourd'hui menacée. *Parti du Travail de Belgique*. URL/ <https://www.ptb.be/actualites/lenveloppe-bien-et-re-une-conquete-sociale-aujourdhu-i-menacee>

Murtin, F., Mackenbach, J., Jasilionis, D., and Mira d'Ercole, M. (2017). Inequalities in longevity by education in OECD countries: Insights from new OECD estimates, *OECD Statistics Working Papers*, 2017/02. OECD Publishing: Paris.

Oaxaca, R. (1973). Male–Female Wage Differentials in Urban Labor Markets. *International Economic Review*, 14(3), 693–709. DOI: <https://doi.org/10.2307/2525981>

OECD (2019). *Pensions at a Glance 2019: OECD and G20 Indicators*. OECD Publishing: Paris. DOI: <https://doi.org/10.1787/b6d3dcfc-en>

OECD (2021). *Pensions at a Glance 2021 : OECD and G20 Indicators*. OECD Publishing: Paris. DOI: <https://doi.org/10.1787/ca401ebd-en>

OECD (2021). *Towards Improved Retirement Savings Outcomes for Women*. OECD Publishing: Paris. DOI: <https://doi.org/10.1787/f7b48808-en>

OECD (2023). *Pensions at a Glance 2023: Country profiles - Poland*. OECD Publishing: Paris. URL: https://www.oecd.org/content/dam/oecd/en/publications/support-materials/2023/12/pensions-at-a-glance-2023_4757bf20/PaG2023-country-profiles.pdf

OECD (2024). *Society at a Glance 2024: OECD Social Indicators*. OECD Publishing: Paris, DOI: <https://doi.org/10.1787/918d8db3-en>

OECD (2025). *Pensions at a Glance 2025. OECD and G20 Indicators*. OECD Publishing: Paris. URL: <https://doi.org/10.1787/e40274c1-en>

OECD/European Commission (2020). *Health at a Glance: Europe 2020: State of Health in the EU Cycle*. OECD Publishing: Paris. DOI: <https://doi.org/10.1787/82129230-en>

OECD/European Commission (2024). *Health at a Glance: Europe 2024: State of Health in the EU Cycle*. OECD Publishing: Paris. DOI : <https://doi.org/10.1787/b3704e14-en>

ONSS (2023). *Emploi salarié pour le quatrième trimestre 2023*. URL: <https://www.onss.be/stats/analyse-du-marche-de-lemploi-donnees-trimestrielles-detaillees#archives>

Peeters, H., and Schols, J. (2023). *Les droits dérivées et l'écart de pension. Importance des pensions de survie et de conjoint divorcé dans les revenus de pension des femmes et des hommes*. URL: https://www.plan.be/sites/default/files/documents/REP_PensionCEP17_FR.pdf

Peeters, H., Schols, J., and Tarantchenko E. (2024). *Minimum-regelingen, gelijkgestelde periodes en de pensioenkloof tussen mannen en vrouwen*. URL: https://www.plan.be/publications/publication-2434-nl-minimumregelingen_gelijkgestelde_periodes_en_de_pensioenkloof_tussen_mannen_en_vrouwen

Pensionstat (2025). Pensionnés. URL: <https://www.pensionstat.be/fr/chiffres-cles/pension-legale/pensionnes>

Pestieau, P., and Stijns, J. P. (1999). Social Security and Retirement in Belgium. In Gruber, J., and Wise, D. (Eds.), *Social Security and Retirement around the World*, 37-71. University of Chicago Press and National Bureau of Economic Research.

Prince, M. J., Beekman, A. T. F., Deeg, D. J. H., Fuhrer, R., Jonker, C., Kivela, S.-L., Lawlor, B. A., Lobo, A., Magnusson, H., Meller, I., van Oyen, H., Roelands, M., Skoog, I., Turrina, C., and Copeland, J. R. (1999). Development of the EURO-D Scale: A European Union Initiative to Compare Symptoms of Depression in 14 European Centres. *British Journal of Psychiatry* 174 (4), 330–338. DOI: 10.1192/bjp.174.4.330.

Rohwedder, S., and Willis, R. J. (2010). Mental retirement. *Journal of Economic Perspectives*, 24(1), 119–38. DOI: 10.1257/jep.24.1.119

Schokkaert, E., Devolder, P., Hindriks, J., and Vandenbroucke, F. (2020). Towards an equitable and sustainable points system: A proposal for pension reform in Belgium. *Journal of Pension Economics & Finance*, 19(1), 49–79. DOI: <https://doi.org/10.1017/S1474747218000112>

Sciensano (2022). *Health Status Report 2021 – The State of Health in Belgium*. URL: https://www.sciensano.be/sites/default/files/hsr2021_en.pdf

SPC and DG EMPL (2021). *The 2021 Pension Adequacy Report: current and future income adequacy in old age in the EU: Country profiles*. Publications Office of the European Union: Luxembourg. DOI: 10.2767/765944

SPC and DG EMPL (2024). *2024 Pension Adequacy Report: Current and future income adequacy in old age in the EU*. Publications Office of the European Union: Luxembourg. DOI: 10.2767/909323

Statbel (2023). *Tables de mortalité et espérance de vie*. URL: <https://statbel.fgov.be/fr/themes/population/mortalite-et-esperance-de-vie/tables-de-mortalite-et-esperance-de-vie#figures>

Stringhini, S., Sabia, S., Shipley, M., Brunner, E., Nabi, H., Kivimäki, M., and Singh-Manoux, A. (2010). Association of socioeconomic position with health behaviors and mortality. *JAMA*, 303(12), 1159–1166. DOI: 10.1001/jama.2010.297

Struys, J. (2026). *Meteen kritiek op pensioenakkoord: “Dit gaat de kloof tussen mannen en vrouwen alleen maar verdiepen”*. In *De Standaard*. URL : <https://www.standaard.be/politiek/meteen-kritiek-op-pensioenakkoord-dit-gaat-de-kloof-tussen-mannen-en-vrouwen-alleen-maar-verdiepen/139689908.html?.com>

Suresh, K., Severn, C., and Ghosh, D. (2022). Survival prediction models: an introduction to discrete-time modeling. *BMC Medical Research Methodology*, 22, 207 (2022). DOI: <https://doi.org/10.1186/s12874-022-01679-6>

Van Oyen, H., Deboosere, P., Lorant, V., and Charafeddine, R. (2011). *Sociale ongelijkheden in gezondheid in België*. Academia: Gent. URL: <https://www.belspo.be/belspo/ta/publ/academia-sociale.ongelijkenheden.u1577.pdf>

Vie-publique.fr (2021). *Qu'est-ce que la majoration de durée d'assurance?* URL: <https://www.vie-publique.fr/fiches/37973-la-majoration-de-duree-dassurance-mda>

Zhang, Y.-B., Chen, C., Pan, X.-F., Guo, J., Li, Y., Franco, O. H., Liu, G., and Pan, A. (2021). Associations of healthy lifestyle and socioeconomic status with mortality and incident cardiovascular disease: Two prospective cohort studies. *BMJ*, 373, n604. DOI: <https://doi.org/10.1136/bmj.n604>