The impact of taking up care tasks on pensions : results of typical-case simulations for several European countries

The impact of taking up care tasks on pensions: results of typical-case simulations for several European countries[1]

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Abstract

Informal care is often accompanied by a reduction or abandonment of professional activity by the caregiver. Therefore, caregiving might be associated with a lower pension for the former caregiver compared to people who did not have care obligations. There is a large gender difference in informal care responsibilities, and this might contribute to the Gender Pension Gap. As the impact of care-related labour market decisions depends on the design of the pension system, we carry out a cross-country comparison, in which we analyse the impact of care obligations in countries with high (Luxembourg), middle (Liechtenstein, Belgium, Portugal) and low (Slovenia) Gender Pension Gaps.

Using typical-case simulation models, we examine how the impact of care-related events is mediated by pension rules, given women's labour market decisions. To what extent does working part-time or interrupting the career at the age of 30 or 54 reduce the later pension benefit? How are these losses mitigated by pension credits that are conditional on care giving? We find that the mitigating effects are generally strongest in Belgium, followed by Luxembourg and Slovenia. Such credits hardly exist in Portugal, while in Liechtenstein they have only a small impact. However, the consequences of either working part-time or interrupting work can also be mitigated via general rules in the system that are unrelated to care giving (such as in Portugal and Liechtenstein). On the other hand, they can be aggravated by higher accrual rates for individuals who extend their careers like in Luxembourg and Slovenia.

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1.   Introduction

About 44 million adults in the European Union (EU) (12% of the adult population) frequently care for a disabled or infirm family member, neighbour or friend more than twice a week (Eurofound, 2020: 7). Women are more likely than men to provide informal care and they provide more hours of informal care (OECD, 2020: 3). In the EU, 59% of adult informal carers are women, ranging from 52% in Germany to about 65% in Poland, the Czech Republic and Lithuania. The gender difference is especially large in the age group 45-64 where, in most Member States, between 10% and 30% of men and between 20% and 40% of women provide informal care (European Commission and Social Protection Committee, 2021a: 75).

Because informal care is unpaid, yet often occurs over a long period of time and can be physically and mentally demanding, it is often accompanied by a reduction or abandonment of professional activity by the caregiver (Ciccarelli and Van Soest, 2018; European Commission and Social Protection Committee, 2021a; Evandrou and Glaser, 2003; Heitmueller, 2007; Henz, 2004), a lower probability to re-enter employment (Ehrlich et al., 2020), lower future and lifelong earnings, and lower-status occupations (Budig and England 2001; European Commission and Social Protection Committee, 2021a; Gash, 2009; Van Houtven et al., 2013). Care for young children also is associated with a reduction in working hours or an interruption of employment of mothers (Hofman et al., 2020). In most EU countries, the pension received during retirement is a function of past labour market income and some social insurance benefits. As care-related effects on wage income accumulate over the life course, caregiving might be associated with a lower retirement income compared to that of people without care obligations (Fasang et al., 2013; Möhring, 2018). Therefore, the unequal distribution between genders of informal care responsibilities contributes to the Gender Pension Gap (GPG) (Bettio et al., 2013), and could also be a factor in the higher poverty risk of older women compared to older men (European Commission and Social Protection Committee, 2021b: 30).

Demographic ageing is likely to exacerbate these issues. In many EU countries, the demand for care will increase in years to come (Eurofound, 2020). If formal care-work supply will not keep

pace with population ageing, there might be pressure on women to take up even more informal care tasks than today (see also Eurofound, 2020).

Acknowledging the importance of informal care tasks, many countries have created compensating "care credit" schemes for those that reduce their labour supply to take up a temporary care task. These schemes can provide a replacement income but can also partially compensate for the impact of reduced earnings on the later pension (Frericks, 2011; Pfau-Effinger, 2012). However, there is little evidence for the impact of these credits on the pension later on.

To fill this gap, we use typical-case simulations (i.e. of hypothetical female individuals) to simulate the impact of taking up care tasks for a child (at age 30) or an older relative (at age 54). We distinguish scenarios where taking up the care task results in part-time work and scenarios where it involves a full interruption of the career, both assumed to last for six years. In the latter case, we also assume that future wages are lower than they would be in the case of continuing full-time work – i.e. there is a wage penalty.

We compare the impact of care activities in five European countries: Belgium, Liechtenstein, Luxembourg, Portugal and Slovenia. Teams from those countries took part in the EU-funded research project MIGAPE (MIGAPE, 2021). The primary criterion for the choice of countries within MIGAPE was that the country team had a microsimulation model at its disposal. These countries include only a small proportion of the European population, but as the purpose of this paper involves a comparison of pension systems, the main consideration is that there is variation in these. While Belgium, Luxembourg, Portugal and Slovenia have all Bismarckian pension systems, they differ in important respects (see section 3 below and European Commission and Ageing Working Group, 2021). The Liechtenstein pension system (very similar to the Swiss one)[2] is an interesting case because of its specific multipillar nature, with a highly redistributive Beveridgean

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[2] See Kirn and Baumann (2021), Kirn and Dekkers (2023).

first pillar and private funded pensions in the second pillar.[3] Arguably even more important for this article is the fact (as revealed in this study) that the countries vary much in the way they mitigate (or do not mitigate) the pension consequences for time out of work due to care responsibilities. The variation in systems also shows up in their outcomes with respect to gender: the selection includes countries with a low, a middling and a high gender pension gap, and there is also variation in the gender difference in at-risk-of-poverty rates among the elderly (European Commission and Social Protection Committee, 2021b) Of course, as these outcomes reflect past employment patterns, they may turn out to be quite different in future decades.

The remainder of the article is organised as follows. The next section discusses the interplay between informal care activities, pensions systems and pension accruals. It includes a brief literature review. In section three, we present the systems of care compensation benefits, with a particular focus on rules for pension accrual during care activities. Section four details the methodological approach of the typical-case simulations, while section five is devoted to the presentation of results. Section six concludes.

2. Informal care activities and the pensions system

The impact of informal care on pension accrual is influenced by the degree to which pensions are dependent on labour market participation, as informal caregivers often reduce or abandon gainful employment. However, this relationship can be mitigated by the presence of redistributive elements within state pension schemes, such as care credit systems. The interplay between public and private pension provisions may also play a significant role (Möhring, 2018).

In many pension systems, including Bismarckian systems but also Beveridgean systems with strong 2nd pillars (like in Liechtenstein), pension amounts are a function of the earnings and employment history. This implies that interruptions in employment can lead to lower pensions. However, compensation regulations or redistributive elements in the pension system can

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[3]   Bismarckian pension systems provide for earnings-related benefits, while in Beveridgean systems flat-rate basic pensions aim at poverty reduction but leave some room for filling income gaps by private means (Ebbinghaus, 2021).

mitigate the effects of interruptions in employment or reduced contribution payments. This can be done, for example, by basing the pension amount on a limited number of high earning years (Leitner, 2001), or by specifying fictitious "pseudo-earnings". Furthermore, interruptions or reductions in employment due to care tasks are often compensated by granting care credits (Frericks et al., 2014; Pfau-Effinger, 2012).

Using retrospective data, previous literature analysed the impact of informal care activities or childrearing across the life cycle on the retirement income of current pensioners (Bonnet et al., 2012; Evandrou and Glaser, 2003; Evandrou et al., 2009; Kuivalainen et al., 2020; Möhring, 2018; Veremchuk, 2020). Those results capture the complexities of people's lives and the evolving pension systems in which they were insured throughout their working lives. Still, given the changes in pension legislation over the past two decades, it is not clear how informative they are about the impact of current care activities on future pensions. Since later generations of retirees have different education and employment patterns, and lived in different institutional environments, the relevance of results based on retrospective data might be limited (Sefton et al., 2011).

There are fewer forward-looking studies of the impact of care responsibilities on later pension. The European Commission's 2021 Pension Adequacy Report (European Commission and Social Protection Committee, 2021b) assesses the impact of three years of childcare on future pensions (for a person starting her working career in 2019) in the form of so-called theoretical replacement rates (TRRs; see also OECD, 2019). Their analysis – limited to childcare activities – is related to our approach, though we do not focus on replacement rates and also assess the impact of a care task later in life. We also employ more detailed earnings trajectories in the analysis. Halvorsen and Pedersen (2019) use a stepwise analysis to investigate how various components of the Norwegian pension system, including the child credits system, impact the GPG and general inequality of pension income for one cohort of pensioners. Contrary to our study, the authors do not include care tasks for elderly people. Frericks et al. (2008) make a detailed comparative assessment of care credits in France and Germany. They however do not assess the impact of working part-time or interrupting work without these credit systems.

This study contributes to the existing literature by examining how either childcare at younger active age, or care for an older adult at an older active age, affects the later pension, allowing for mediating roles of a) pension rules, b) women's care-related labour market decisions and c) varying levels of earnings.

3. Pension systems and care compensation schemes in various countries

Four of the countries under consideration – Belgium, Luxembourg, Portugal and Slovenia – have Bismarckian pension systems; Liechtenstein has a Beveridgean system complemented by extensive second pillar pensions. Since Beveridgean systems are likely to have a zero or small gender gap in public pensions and a wide GPG in the second pillar, the second pillar is included in the analysis of Liechtenstein as well. For the other countries, the second pillar (which is less important) could not be covered due to lack of data. The statutory retirement age is currently 65 years in Slovenia and Luxembourg; it will be 67 years in Belgium from 2030 on and is expected to become 69.5 years in Portugal, where it is linked to the development in life expectancy.

In Belgium, Luxembourg and Portugal, there are different pension schemes for different sectors (Table 1). To simplify the analysis, we adopted the modalities of the most prevalent scheme in each country. In Portugal, Slovenia, Luxembourg and Liechtenstein, the adopted general pension scheme covers both private and public sector employees and the self-employed. In Belgium and Luxembourg, civil servants have their own scheme, while in Belgium there is also a separate system for the self-employed. The pension system for new civil servants in Luxembourg is very similar to the general system for employees, so that simulations in Luxembourg describe both the system for the private sector and civil servants, but not for the self-employed (about 6% of the work force in 2017)

Table 1. Sectoral coverage of the study

	Belgium	Portugal	Slovenia	Liechtenstein/ Switzerland	Luxembourg
Sectoral coverage	Employees in the private sector, and employees in the public sector who are not civil servants.	Private and public sector employees; self-employed	Private and public sector employees; self-employed	First Pillar: employees, self-employed civil servants, inactive persons; Second Pillar: employees.	Employees, both in private and public sector (including civil servants)

Sources: Dekkers and Van den Bosch, 2020; Kirn and Thierbach, 2020; Kump and Stropnik, 2020; Liégeois and Vergnat, 2021; Moreira and Craveiro, 2020.

Care activities and pension compensation

All five countries have policies in place to compensate pension accrual for time spent caring for children, but systems crediting care for older relatives only exist in Belgium, Liechtenstein and Luxembourg, not in Slovenia or Portugal. This, however, does not necessarily mean that taking up these care tasks would result in pension reductions, as we will see later; other, more general, redistributive characteristics of the pension system can take over the role of "care credit" schemes.

The key elements of the care compensation systems are summarised in Table 2. Pension accrual during time off for childcare is covered in all five pension systems. However, there are large differences when it comes to the period for which childcare is covered by pension accrual. It ranges from a maximum of six months in Portugal up to 16 years in Liechtenstein.

Table 2. Regulations on compensation of care activities in the pension system.

Country	Measures to compensate for care activities (full-time or part-time) in the pension system
Belgium	Systems of time credit and thematic leave: parental leave: 3.75 months of maternity leave plus 51 months of Time Credit plus 4 months (8 in case of part time) . Care for older relatives: 51 months of Time Credit plus 12 months (24 in case of part time) Leave for medical reasons. For the part that one takes up a care activity, the pension accrual is based on average earnings in the 12 months before the start of the period, subject to a minimum and maximum.
Portugal	Earnings equivalent to full-time during parental leave (6 months). Pension accrual is based on the average annual earnings of the best 40 years in the individual's contributory career (after 2002). No credit available for care for a sick or disabled adult.
Slovenia	Pension credit for maternity and parental leave (12 months). Pension accrual is based on average earnings during the 12 months before entering. Part-time (at least 50%) work by parents of children below the age of 3 (7 if more children). Pension accrual for the non-worked hours equal to the minimum wage. Credited social contributions for parents of at least 4 children who exit the labour market. Duration until the youngest child completes the first grade of primary school. Pension accrual based on minimum wage. Additional accrual rate of 1.36% for taking care of each child (up to 3) in its first year. No credit available for care for a sick or disabled adult.
Liechtenstein	1st Pillar: Care credits are warranted for periods of caring for one or more children younger than 16, or for periods of caring for a sick or disabled adult. Pension accrual during care activities equals 48 times the amount of the minimum monthly old-age pension, which results in a notional income of CHF 55680 per year (about 75% of the average gross income of women). 2nd Pillar: No compensation schemes.
Luxembourg	20 weeks of maternity leave, with pension accrual based on the person's previous earnings, with an upper limit. During parental leave (up to 6 months or 12 months 50% part time), the pension accrual is based on average earnings (subject to a minimum and maximum) during the 12 months before entering. An additional "baby years" compensation scheme has a duration up to two years (parental leave included) if the parent stops working. Pension accrual is again based on average earnings during the 12 months prior to the leave. Finally, parents who have devoted themselves to the education of children but are not eligible for baby years can from the SPA on receive an additional benefit per month and per child of 86.54 euros. Finally, non-contributed periods during which a parent takes care of a child under 6 years of age may also be counted as a complementary period (with no fictitious income attributed). Periods of caring for a sick and disabled adult can contribute to pension rights if the long-term insurance administration recognises the non-retired person as "informal caregiver". Pension accrual then is based on the minimum social wage for the unlimited duration of care.

Sources: Dekkers and Van den Bosch, 2020; Kirn and Thierbach, 2020; Kump and Stropnik, 2020; Liégeois and Vergnat, 2021; Moreira and Craveiro, 2020. The descriptions refer to the rules in force on March 3rd, 2020.

In Slovenia, part-time work (at least at 50%) can be compensated in the pension system for up to two years (in case of one child below three). In Belgium, the combined systems of time credit and thematic leave (and including the mandatory maternity leave) provide pension credits for at most four years and 9.5 months in the case of a full work interruption, and five years and 1.5 months if working part-time at 50%. In Portugal, compensating care credits are included for the duration of parental leave, which is six months at most. In Luxembourg, in addition to the 20 weeks of maternity leave, parental leave can be taken up to six months full-time, one year if working part-time at 50%, or 20 months if working part-time at 80%. Furthermore, an additional compensation called "baby years" can complement the parental leave up to 2 years after maternity leave or birth if the parent stops working. If someone is not working and not eligible for "baby years", education periods can be added to the total career length, as long as the child is under 6 years of age. Liechtenstein has the most generous system of the five countries in terms of the period for which the credit system applies: child credits are available for up to 16 years, both to people in and out of employment. However, this system only applies to the first pension pillar, while the second pillar of the pension system does not include care credits.

In Belgium, Luxembourg and Slovenia (during the period of parental leave and the "baby years" in Luxembourg), pension accrual is based on the earnings received during the last 12 months, subject to a minimum and maximum. In Luxembourg, education periods only add to the total career length. In Slovenia, in the case of part-time work after the parental leave (second and third year after childbirth), pension credits are based on the minimum wage[4]. In Liechtenstein, the first pillar pension is built up on the basis of earnings and care credits. Since compulsory (albeit small) contributions must be paid in the event of interruptions in employment, there is no loss of contribution years. In Portugal, the pension credits gathered during parental leave are based on

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[4] We should note that the Act Amending the Parental Protection and Family Benefits Act (passed on 29 October 2020) stipulates that from 1 January 2021 the contributions are to be paid from the base earnings (and no longer the minimum wage). The simulation results however do not include this change as the Act was published after the end of the project.

the "reference earnings", equal to the average annual earnings of the best 40 years in the individual's contributory career (after 2002).

For caring for a sick or disabled older relative later in the working life, there is no pension compensation mechanism in place in Slovenia and Portugal. In Luxembourg the long-term care insurance administration can accept to cover the pension contributions (up to a maximum) of a non-retired caregiver who has reduced his/her professional activity to provide care to a dependent person. In this case, no explicit maximum duration of the care credit system is imposed. Likewise, a programme for compensating pension contributions for the duration of the care period applies in Liechtenstein. In Belgium, the maximum duration is five years and three months in the case of a full career interruption, and six years and three months in the case of working part-time at 50%.

Other relevant aspects of the pension systems

All five countries have minimum pensions in place, which apply in some scenarios. Maximum pension amounts (or assessment bases) also exist in most countries. The exception is Portugal, where, instead, the pension accrual rate decreases for higher wages.

There are several specificities in the pension systems which have particularly important implications for our results. The pension system in Liechtenstein is a two-pillar system. The first pillar is a highly redistributive Pay-As-You-Go system for old-age, survival and disability insurance. The interaction of several factors ensures a relatively effective compensation of periods of care. First, compulsory contributions prevent contribution gaps in the event of non-employment. Second, childcare credits are granted for a long time (16 years) and also in the case of employment. Thus, in the case of a temporary reduction in employment, the loss of contributions can be compensated, despite the fact that care credits are not linked to previous income and are fixed at around 75% of the average gross wage for women. Thirdly, income and care credits are revalued comparatively generously when determining the relevant income. As the first-pillar has a Beveridgean character with a fairly low cap on the maximum pension, the maximum pension can also be reached in the case of care. However, as the maximum pension from the first pillar is

below the level of social assistance, the income from the second pillar is needed to maintain the standard of living. In terms of the average pension, the second pension pillar is far more important than the first pillar. The second pillar is a funded, mandatory occupational pension insurance, and there is no compensation for caring periods. Consequently, a loss of earnings due to caring leads to a lower pension in the second pillar, but not in the first pillar. The differences in simulated pension income are therefore due to differences in pension income in the second pillar.

In Portugal the 40 years with the highest earnings are taken into account, so for long careers, years of caring may 'drop out' from the pension base calculation and have no impact at all for the later pension. In Slovenia, only the best 24 consecutive years of earnings (indexed annually for the average nominal wage growth) serve as the basis for the final pension assessment. Still, years of caring have a large impact on the later pension, because the accrual rate per year is increased for those that work at older age after a long career. The regular accrual rate of 1.36% per year it is increased to 1.5% for each six months of continuing to work (for three years at most) if one is older than 60 and has at least 40 years of pension contribution. The implication is that shortening the contributory period (as is done in some of the scenarios presented) for those (otherwise) eligible to this higher accrual rate can have a strong negative impact on the pension outcome. For those not eligible for higher accrual rates, a negative impact on the pension outcome still exists, but it is weaker. The pension system in Luxembourg also provides some bonus accrual to encourage extending the working life. In 2020, the earnings-related part of the annual (new) pension is based on an accrual rate of 1.8% of total career earnings. The accrual rate is increased by 0.013 (with a cap of 2.05%) for each year that the sum of the retirement age and the career length exceeds a specific threshold (94 in 2020). Like in Slovenia, this may imply that reductions or interruptions of work early in the career have a negative effect on the pension that is disproportional to the loss in total earnings.

4. Methodology and pension models

We use typical-case simulation (also called standard - or model person simulations) to analyse the impact of current institutional settings on future pension benefits (Burlacu et al., 2014. A

well-known example of this technique are the prospective theoretical replacement rates (TRRs) published by the OECD (2019) in "Pensions at a Glance". Standard simulations are calculations of income packages (or other outcomes) for a hypothetical individual, solely based on the applicable tax and benefit rules and the characteristics of the individual. The stylised assumptions make the interpretation of the results easier but come at the price of limited representativeness. We address this issue by simulating several scenarios. The simulations were carried out using the pension modules of existing microsimulation models, which were used and validated in earlier studies (Dekkers et al., 2022).

Our basic scenarios involve wage profiles for three levels of educational attainment: up to lower secondary education (ISCED 0-2), medium (upper and post-secondary, ISCED 3-4) and higher education (tertiary, ISCED 5+). All scenarios involve individuals born in 2000. These hypothetical persons are assumed to work full-time and continuously from the time they leave school until the statutory retirement age (see section 3), except for the periods of care. The age of entering the labour market and starting the pension accrual differ by educational attainment, varying between 19 and 24. Alternative scenarios are distinguished by 1) the kind of care taken up (childcare at the age of 30 or care for an older relative at the age of 54), and 2) the labour supply response (part-time work 50%, or complete interruption with wage penalty). All interruptions are assumed to last for six years at ages 30 and 54, after which the person resumes full-time work.[5] We furthermore assume that the person meets any eligibility conditions for care compensation schemes, both in terms of employment history and in terms of the relationship to, and characteristics of, the person cared for. These schemes are used to the maximum extent.

The earnings profiles over the model individuals' lifetime are estimated using cross-sectional data for recent years about working women: EU-SILC data for Portugal and Luxembourg and

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[5] These ages were chosen based on two considerations, apart from the need for comparability. First, the age bracket for carers for elderly relatives had to be completely within the active age period, i.e. before retirement, including early retirement. Second, the age of childbirth had to be late enough so that women in all scenarios in all countries were eligible for any care-related pension credits. In any case, it is unlikely that the results would be much affected if these ages were changed by a few years. The period of six years for all countries was chosen independently of the maximum durations of care compensation schemes.

administrative data for Belgium, Slovenia and Liechtenstein. The wage profiles are smoothed by using simulated values from regression equations of full-time equivalent gross earnings on the individual's age and age squared. Separate equations were specified for the three educational attainment levels distinguished above. This results in three different earnings trajectories for full-time continuous employment by education. Finally, these simulated cross-sectional age-earnings profiles were adjusted for real wage growth over the period 2020-2067, using the projections of average wages by the Ageing Working Group of the Economic Policy Committee of the European Council (European Commission and Ageing Working Group, 2021). Figure 1 illustrates the estimated and uprated wage profiles, where for comparison, those of men are added.

Figure 1: Projected age-wage curves by gender and level of education of persons born in 2000.
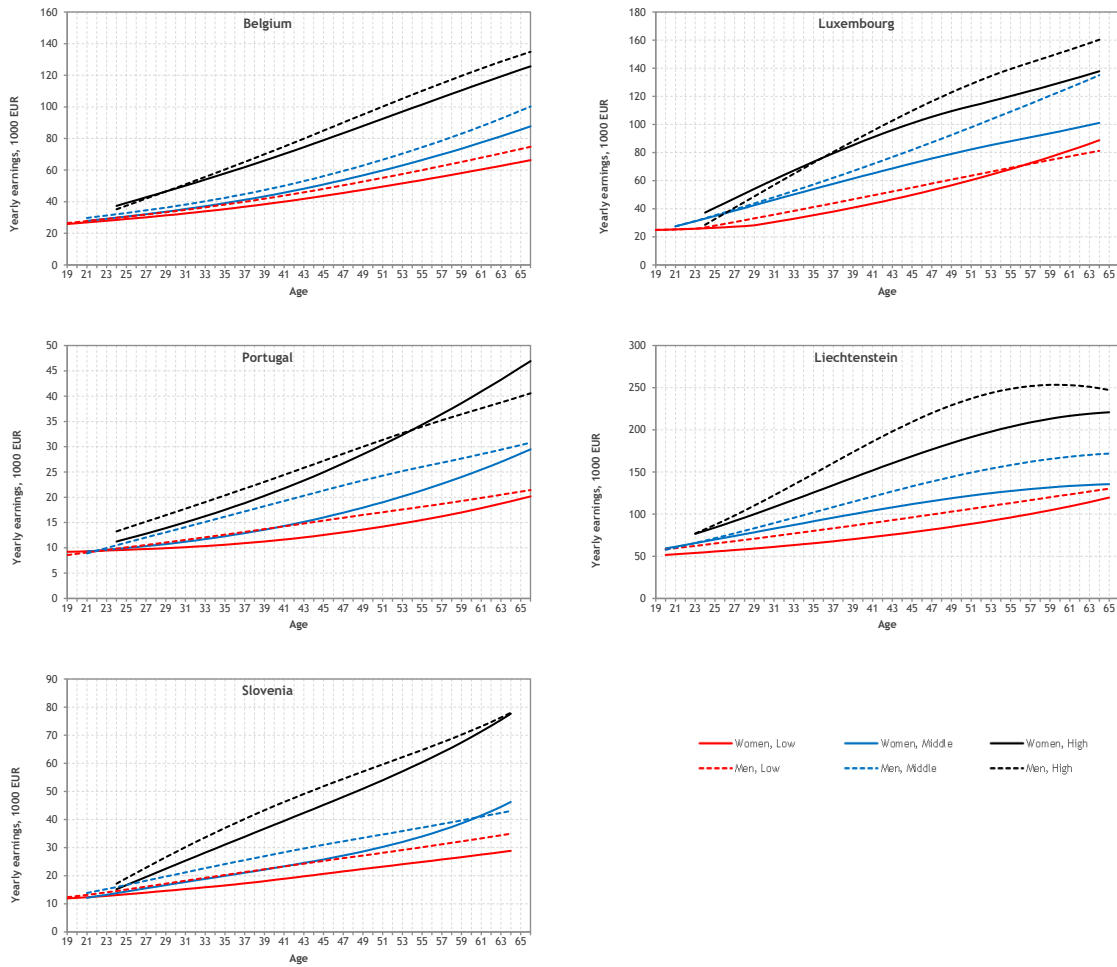
Women with higher education start from somewhat higher wage levels than those with low or medium education, and in addition tend to experience much steeper wage growth during their first 20 years in work. This has implications for the relative impact of care activities across earnings trajectories.

The wage curves define income by age in the case of full-time continuous employment. In the periods of caring, earnings are adjusted in proportion to the reduction in working time. After the caring period, earnings are assumed to revert to the original wage curve in the case of part-time work. In the scenarios with a full interruption and a wage penalty, earnings remain below the level they would have reached had there been no interruption.

The above profiles differ from previous studies discussed in section 2. In the theoretical replacement rates, the wage profiles are not specified by age, but represent the projected average earnings of the corresponding year. OECD (2018) does use wage profiles by age, but they do not uprate the wages to future years. Hence, their approach is cross-sectional and not prospective, such as the one used in this study.

Modelling the wage penalty

A so-called wage penalty, also referred to as wage scarring, is an important component of the impact of care responsibilities on the later pension, in addition to the earnings foregone during the period of care. Caregivers may earn a lower wage compared to men and women without care responsibilities once they return (full-time) to the labour market (e.g. Blau and Kahn, 2017; Earle and Heymann, 2012; Van Houtven et al., 2013). Following the birth of the first child, women's wages are markedly lower than those of men; and this effect is lasting beyond ten years after birth (Angelov et al.l, 2016; Kleven et al., 2019). The wage differences are driven by a loss of job-related skills during interruptions (Budig and England, 2001), a lower accumulation of experience due to fewer working hours or an interruption of employment (Aisenbrey et al., 2009), or by

employers' perception of less commitment at work of these workers (Gregg and Tominey, 2004; Nielsen and Reiso, 2011; Staff and Mortimer, 2012). England et al. (2016) find that highly skilled women, who have a higher rate of return to experience and a steep wage trajectory, face a higher wage penalty when they lose work experience due to childrearing. The wage penalty – which we model as persistent over the life course – results in lower pension accrual. Moreover, since wages increase most strongly at younger ages, the opportunity cost of caregiving varies over the life course.

In modelling the wage penalty, we assume that during the interruption of employment, the hypothetical person does not accumulate age-specific wage increases, which is equivalent to assuming no gain in experience or seniority. However, the person's potential wage still increases with the average economy-wide growth in wages (e.g. because of collective wage agreements). After the interruption, it is assumed that the wage increases at the rate that a person of the same age with an uninterrupted career would experience (see Dekkers and Van den Bosch, 2020).[6]

Figure 2 illustrates the impact of earnings penalty on simulated earnings trajectory in the case of model individuals with low (left-hand side) and high (right-hand side) education in Belgium. The curves indicate the size of the wage penalty for one career interruption for six years at age 30 (full red line) and with an additional six-year career interruption at age 54 (dashed red line). As the lines indicate, the impact of an interruption is assumed to be persistent throughout the remaining working life and thus on pension income. The impact of the wage penalty is larger for women with higher education, since their wage curve is steeper.

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[6] Formally, for the uninterrupted career, wage growth follows the process
$$w_{a,t}^u = w_{a,t-1}^u \times g_t \times \alpha_{a,t}$$
where $w_{a,t}^u$ denotes the wage (w) of an individual aged a years (given level of education) with an uninterrupted career at time t, g denotes the general economy wide growth in wages at time t, and $\alpha_{a,t}$ is age-specific wage increase at age a at time t. For the wage level of an individual with similar level of education, however, a career interrupted by full-time caring, superscript c, (with an interruption of x years at time T), follows for the wage level:
$w_{a,t}^c = w_{a,t-1}^u \times g_t \times \alpha_{a,t}$ before the interruption (t < T)
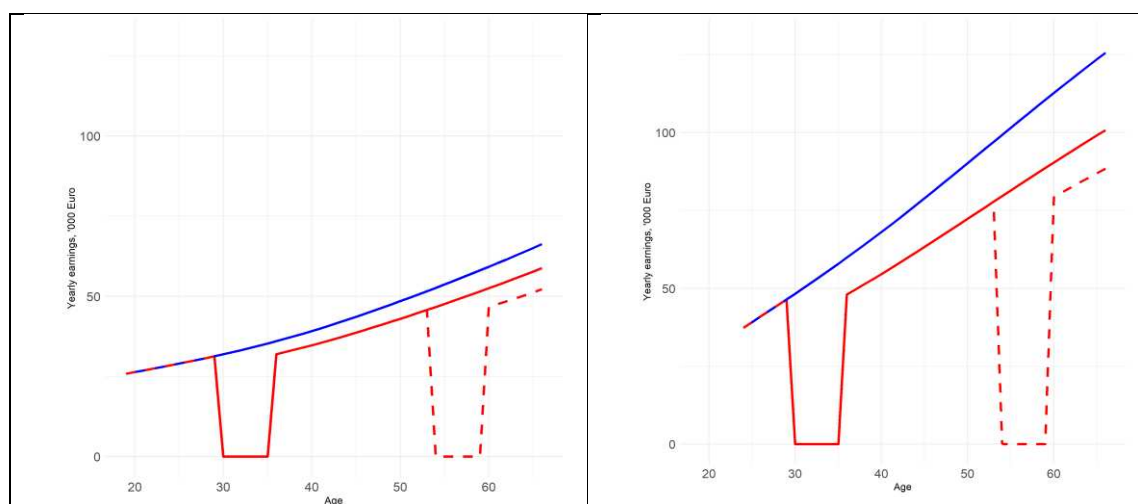$w_{a,t}^c = 0$ during the interruption (T <= t <T+x)
$w_{a,t}^c = w_{a,t-x}^c \times g_t$ in the year after the interruption (t = T+x)
$w_{a,t}^c = w_{a,t-1}^c \times g_t \times \alpha_{a,t}$ in subsequent years (t > T+x)

Figure 2: The wage penalty for individuals with low and high educational attainment in Belgium.

Source: Own calculations based on estimated earnings trajectories for Belgium.
Note: The figure shows the estimated full-time earnings trajectories (blue line) for a woman with low (ISCED 0-2) (left) and high (ISCED 5+) (right) education. The full red line shows the impact on the earnings trajectory of full-time childcare from age 30 to age 35 when an earnings penalty is applied (see main text). The dashed red line shows the impact on the earnings trajectory of full-time childcare from age 30 to age 35 *and* full-time caring for an older relative from age 54 to age 59 when an earnings penalty is applied.

Our modelling of the earnings penalty is necessarily ad hoc. The main goal is to analyse the relative effect of an earnings penalty on pensions rather than the exact mechanisms behind the earnings penalty. Given the wage profiles and our assumptions regarding the wage penalty, total relative loss in annual earnings over the six years at age 30 is around 10% in the low education case and 20% in the high education case. Kleven et al. (2019), who studied the wage effect for women of having a child, report earnings losses of between 20% and 60% in six countries (Denmark, Sweden, Germany, Austria, UK and the USA) persistent for 10 years, and with little evidence of a mitigation of the earnings loss over time. So our modelled earnings losses are near the lower end of their reported range.

5. Results

We present results for different scenarios involving care activities and care duration. The base scenario refers to women with three different levels of education working full-time and continuously between the age of leaving school and the statutory retirement age. The various

scenarios consist of six-year spells of working part-time or interrupting work, either at the age of 30 (in the case of childcare) or 54 (in the case of care for an older relative), or both. Finally, in the case of a full-time interruption, we assume a wage penalty after returning to the labour market.[7]
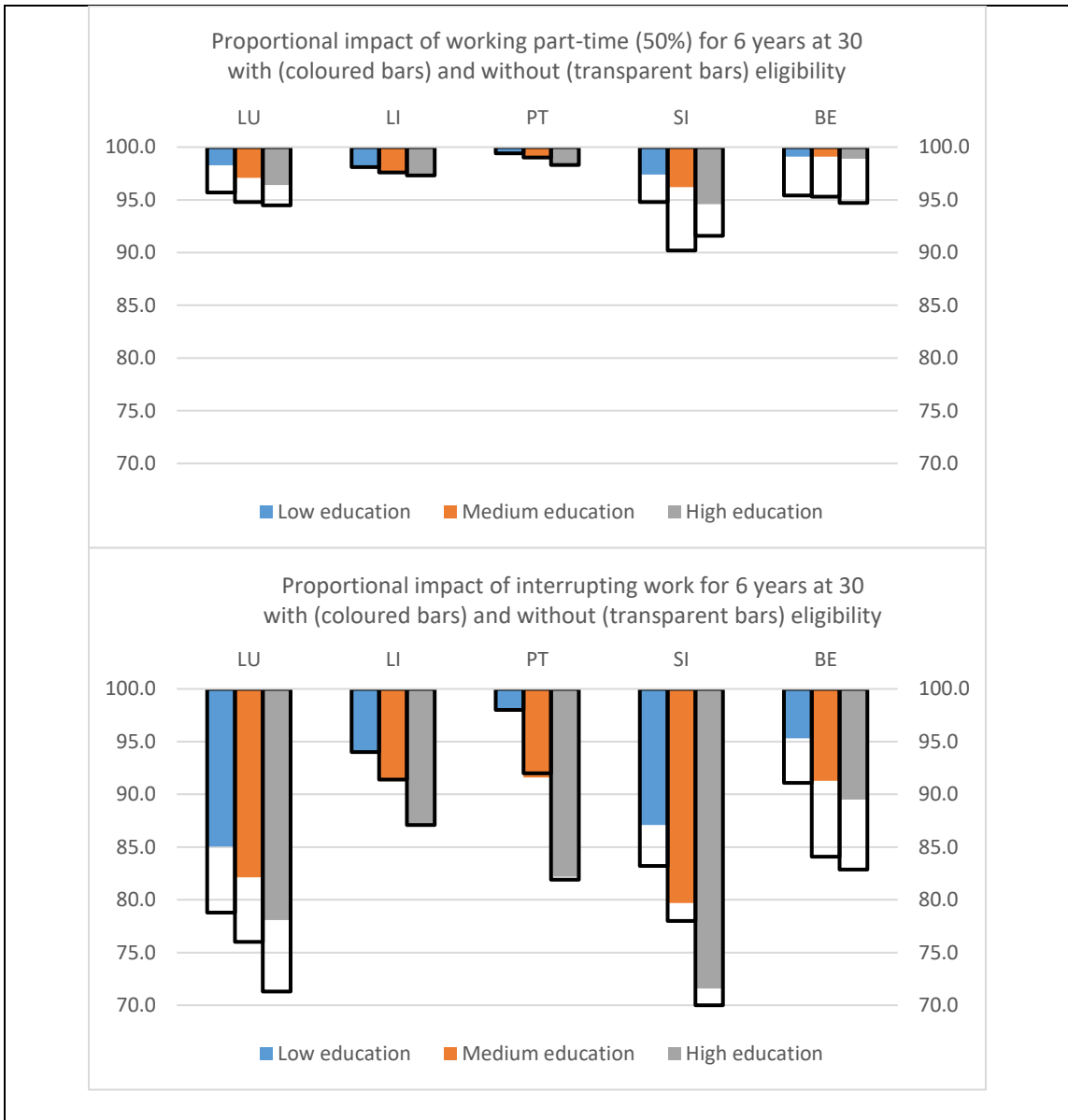
Childcare scenario

We first look at the variants where the woman decides to partially or completely interrupt work to take up a childcare task for six years at the age of 30. In the case of part-time work, wages are reduced proportionally during the period where the model person is aged 30 to 35 years, whereafter earnings return to the level of the estimated earnings trajectory for the relevant age. When the model person stops working entirely, their wage during the interruption period is reduced to zero. Upon returning to work at age 36, the person is then subject to a wage penalty. Figure 3 displays the findings.

Figure 3. Effect on retirement pension of working part-time (50%) or interrupting work for six years due to childcare, relative to the pension in the case of continuous full-time work, with and without eligibility for care compensation schemes.

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[7] The national and comparative reports on www.migape.be show in addition results for variants with part-time work at 80% and full-time interruption without a wage penalty.

Proportional impact of working part-time (50%) for 6 years at 30 with (coloured bars) and without (transparent bars) eligibility

Proportional impact of interrupting work for 6 years at 30 with (coloured bars) and without (transparent bars) eligibility

Source: Typical-case simulations, see text. Note: The coloured bars show pension outcomes by average earnings for three educational attainment groups for a woman working part-time (upper graph) or interrupting work (lower graph) for six years from age 30 and caring for a child, as a percentage of the pension outcomes in the case of uninterrupted full-time work. It is assumed that pension credits for childcare are utilised as per current legislation. The transparent monochrome bars show the equivalent impact in the case of non-eligibility, i.e. when the woman does not take up an eligible care task.

Without eligibility for care compensation schemes, pension losses (indicated by the transparent bars) due to working half-time for six years are limited in Liechtenstein and Portugal, around 5%

in Belgium (which is nearly proportional to the loss in life-time earnings) and Luxembourg, and relatively large in Slovenia (up to 10%). Both in Luxembourg and Slovenia, one loses a bonus accrual at the end of the working life if the career is reduced. In Liechtenstein, the loss is relatively small due the redistributive mechanisms of the first-pillar pension scheme, in particular the revaluation factor. This means that the maximum pension from the first pillar is reached whether the woman works part-time or not, and the limited pension loss is only due to the second-pillar pension. The Portuguese old-age pension is calculated on the 40 career years with the highest wages, and therefore (in our scenarios) the years with half-time wages are replaced by earlier or later years with full-time wages, resulting in only a minor loss in pension.

The pattern of pension losses across countries is rather different if the person is eligible for compensating measures (coloured bars). It is small in Belgium (around 1%), Portugal (less than 2%) and Liechtenstein (less than 3%), somewhat larger in Luxembourg (between 2% and 4%), and Slovenia (up to more than 5%). The difference between the transparent and the coloured bars indicates the compensating impact of the pension credits related to care compensation schemes. In Belgium, this compensating impact is large because care compensation schemes can be granted for a maximum of 59 months. Furthermore, the pension credits related to the care compensation scheme during the part-time work period are based on the last full-time wage. In Slovenia, this compensating impact is smaller than in Belgium, because the pension credits are based on a shorter period (second and third year after childbirth), but also because they are based on the minimum wage. In Luxembourg, pension credits (related to maternity leave, parental leave, "baby years" and "education" periods) compensate about half of the impact of the loss in earnings. Finally, in Liechtenstein and Portugal, the dampening effects of being eligible are small or nearly absent. Parental leave in Portugal covers only six months. In Liechtenstein, as described above, the redistributive mechanisms of the first-pillar pension scheme imply that working part-time for six years for any reason whatsoever does not have any impact on the later first pillar pension. On the other hand, there is no provision for childcare in the second pillar. Differences in pension income are therefore entirely due to differences in second-pillar pension income.
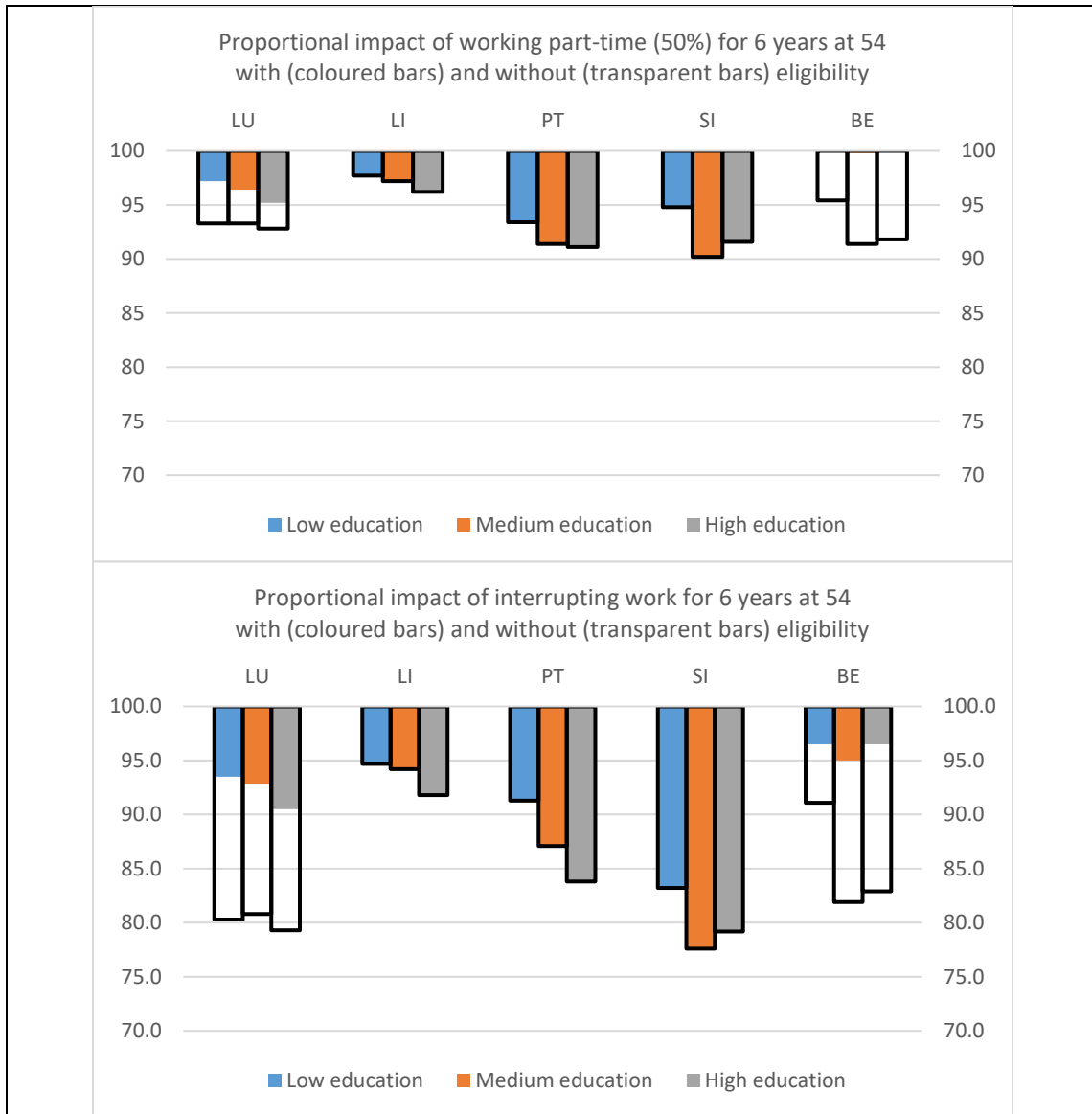
The bottom graph in Figure 3 shows that interrupting the career for six years at the age of 30, which entails a wage penalty, results in larger pension losses, compared to changing to part-time work. For the woman with low education and in the case of no eligibility to care-related pension credits, the loss varies between only 2% in Portugal to 21% in Luxembourg. In all countries, the losses are greater for a woman with higher education and no eligibility, suggesting the impact of the wage penalty is large for this category of women (see the discussion of Figure 2). For this case, the loss in pensions is very high in Luxembourg (29%) and Slovenia (30%). In both countries, the pension accrual rate increases when one works longer at an older age and after a long career. This additional accrual is missed if the career is interrupted without eligibility for pension credits.

In Liechtenstein and Portugal, the dampening impact of obtaining pension credits related to care compensation schemes remains absent or very small, for the same reasons as for the part-time scenario. In Belgium, Luxembourg and Slovenia, however, although these impacts are considerable, they are proportionally smaller than in the case of working part-time. This suggests that the losses are partly driven by the wage penalty that the woman suffers after her return to the labour market, which is not compensated by pension credits.

Care-for-an-older-relative scenario

Now we turn to the scenarios involving a care task for an older relative, at the age of 54 (Figure 4).

Figure 4. Effect on retirement pension of working part-time (50%) or interrupting the career for 6 years due to care for an older relative, relative to the pension in the case of continuous full-time work. Women, by education level (% levels).

Proportional impact of working part-time (50%) for 6 years at 54 with (coloured bars) and without (transparent bars) eligibility

Proportional impact of interrupting work for 6 years at 54 with (coloured bars) and without (transparent bars) eligibility

Source: Typical-case simulations, see text. Note: See Figure 3 for an explanation.

If the person is not eligible for care-related credits, working half-time for six years at age 54 has only a small impact on the pension in Liechtenstein. The pension losses are larger in the other countries, ranging from 5% (a woman with low education in Belgium and Slovenia) to 10% (a woman with middle education in Slovenia). If the person is eligible, these losses are virtually eliminated in Belgium and much reduced in Luxembourg. The reasons are that the period of

eligibility covers the entire six-year period of interruption, and also that the fictitious wage taken into account for the pension calculation in Belgium is quite close to the wage of someone who would have continued working full-time, whereas it is equivalent to the minimum social wage in Luxembourg. By contrast, there are no compensating systems for taking up elderly care in Slovenia and Portugal. There exists such a system in Liechtenstein, but due to the redistributive impact of the first pillar (as described above), it has no impact on the pension in our scenarios.

The bottom graph in Figure 4 shows that fully interrupting the career for 6 years without eligibility for care-related pension credits has a substantial impact on the later pension. However, the comparison of the bottom graphs in Figures 3 and 4 indicates that the costs of interrupting the career are often lower when this interruption occurs at age 54 than at age 30. The reason for this is that the effects of the earnings penalty are smaller – mainly because the number of remaining career years during which one will suffer this penalty is lower, but also because the earnings curve is flatter at higher ages, thereby reducing the penalty per year.

In Belgium the dampening impact of taking up an eligible care task at age 54 is large, even stronger than at age 30. Apart from the smaller effect of the wage penalty, the reasons are the same as in case of half-time work, explained above. In Luxembourg, all periods devoted to care for an older person are compensated (though at a lower level of fictitious earnings) by the care-related pension credits, whereas only part of them are compensated when caring for a child at age 30.

6. **Discussion and Conclusions**

This article is about the impact of childcare and care for an older relative on the future gross pension in five European countries, given the pension legislation in force in the first half of 2020, using the typical-case method. Several main findings stand out. First, it is clear that the pension credits obtained by beneficiaries of care compensation schemes for childcare are important in mitigating the effects on the later pension of working part-time or interrupting the career in Belgium, Slovenia (especially in the case of working part-time) and Luxembourg. However, other features of the pension system (such as revaluation factors which uprate the care credits, like in Liechtenstein, or the consideration only of the years with the highest earnings, like in Portugal)

can also imply that interrupting or reducing work has a relatively small impact on the later pension, and are not necessarily less effective than pension credits. Conversely, other features (such as missing out of higher accrual rates for longer careers, as in Slovenia and Luxembourg) can aggravate this impact.

Secondly, increased accrual rates for those with longer careers, as used in Luxembourg and Slovenia, can strongly increase the loss in pension, for example when people interrupt their career to take up a care task. One solution to this problem is applied in Luxembourg, which is to include some of these years as career years.

Third, the dampening effect of pension credits in Belgium, Luxembourg and Slovenia for an interruption due to childcare depends on the way these credits are calculated. If they are derived from a minimum wage (like in Slovenia) instead of last actual earnings (as in Belgium and Luxembourg), then the mitigating effect is smaller. Imposing a restrictive ceiling on the last-earned income (Luxembourg) also leads to a more limited mitigating effect.

Fourth, in Belgium, Liechtenstein and Luxembourg (the only countries under scrutiny that have pension credits related to elderly care), the dampening impacts of these systems is stronger than in the case of childcare at the age of 30. This is partly due to the conditions of these systems. In Belgium and Luxembourg, the coverage period for elderly care extends over the entire 6-year period, whereas it is more limited in time for childcare. In Belgium the pension credits are based on the last earnings, while in Luxembourg the minimum wage is used for this purpose. Another reason that is independent of the regulations is the age at which in our scenario's the care-related pension credits are accessed. At age 54 the wage penalty after resuming work has much less impact than at age 30. Finally, in Liechtenstein it is the combination of the care-related pension credits and the highly redistributive first pillar of the pension system that mitigates care-related income losses in first pillar pension income.

There are several limitations to our results, apart from the usual qualifications that have to be made for any study using standard simulation on hypothetical cases. Note that the focus on women is not really a limitation. As pension legislation is formally gender-neutral in all countries (except for maternity and paternity leaves), the results apply also to men if they have the same

wage profiles. One limitation is that we have left out the important question of contemporary support for care activities, i.e. to what extent the state supports childcare and care for older people at the time of caring needs. To assess the overall support given to care activities, one would want to combine the results we have presented with a comparative analysis of the generosity of childcare benefits (e.g. Cascio et al., 2015) and benefits related to caring for older relatives (e.g. Riedel and Kraus, 2016). Another important limitation is that we simulate only first-pillar pensions (except for Liechtenstein). Adding the second- and third-pillar pension savings would exacerbate the impact of caring periods on the total pension outcomes, as usually no credits are given for periods of caring in these funded pension systems. Finally, the study covers only five countries, two of which are tiny and also are exceptionally rich. A follow-up study involving more countries and pension systems is therefore recommended.

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