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*Towards an equitable and sustainable points system. A proposal for pension reform in Belgium**

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Abstract

We describe the points system as proposed by the Belgian Commission for Pension Reform 2020–2040. Intragenerational equity can be realised through the allocation of points within a cohort. The intergenerational distribution is determined by fixing the value of a point for the newly retired and a sustainability parameter for the actual retirees. The value of the point links pensions to the average living standard of the employed population. We propose an automatic adjustment mechanism, in which a key role is played by the career length. This mechanism induces a balanced distribution of the burden of demographic and economic shocks over the different cohorts.

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Keywords: Pension reform, points system, automatic adjustment, Musgrave rule.

1 Introduction

In 2013, the Belgian government set up a so-called 'Commission for Pension Reform 2020–2040', which consisted of 12 experts with different ideological and disciplinary backgrounds (lawyers, economists, sociologists, actuaries). The mission of the

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Commission was to think about the broad design of the pension system and to investigate in full freedom and autonomy the specific reforms that could improve its social and economic sustainability in the medium and long-term. The Commission judged that it was necessary to go beyond the parametric reforms that had characterised Belgian pension policy until 2013. The final result was a proposal to introduce a points system in the first (pay-as-you-go) pension pillar with an automatic adjustment mechanism to keep the system economically sustainable (Commission Pension Reform, 2014). We will define our interpretation of 'economic' and 'social' sustainability in Section 2.

This paper presents the main principles of the reform proposal in a stylised model. Points systems have also been introduced in other countries with a traditional Bismarckian system. Like in Germany, the Belgian proposal is for a 'universal' points system covering all first-pillar pensions.[1] Also, like the German system, the Belgian proposal has a built-in automatic adjustment mechanism. Different forms of automatic adjustments to increases in life expectancy have been introduced in many OECD countries (see OECD, 2012, for an overview). These adjustments have often taken the form of a downward adjustment in pension benefits, in some cases leading to a problem of pension inadequacy. The Belgian proposal has some specific features which may be of interest for other countries. It integrates explicitly intragenerational and intergenerational equity effects. It considers both social and economic sustainability and introduces the (conditional) Musgrave rule as an operational criterion of risk sharing between different generations. It explicitly uses career length (and hence, implicitly the age of retirement) as an important component of the automatic adjustment mechanism. Most importantly, it is framed as a positive proposal for a new social contract between different generations, rather than as a cold attempt to cut pension expenditures. Its objective is to formulate credible promises to the younger generations. A credible pension promise must unavoidably be linked to future economic development and must necessarily be conditional on changes in retirement behaviour.

There are good reasons to introduce a pension system with a mix of funding and pay-as-you-go, because this portfolio diversification offers better protection against economic and political risks (see, e.g., Lindbeck and Persson, 2003; Devolder and Melis, 2015; De Menil *et al.*, 2016). Belgium has a funded second pillar with corporate and sectoral pension plans. In this paper, we only focus on the first pay-as-you-go pension pillar. Moreover, we limit ourselves to a description of the general structure of the proposed system.[2] It is obvious that many operational decisions will have to be made for its practical implementation. These operational decisions are dependent on the specific institutions of the country (Barr and Diamond, 2009). More details on the Belgian situation can be found in the Report of the Commission (Commission Pension Reform, 2014).

[1] In France, points are used only in the complementary pensions. There are proposals for a 'generalized' points system (Blanchet *et al.*, 2016), but these have not yet been implemented.

[2] In Belgium there are three separate systems or 'regimes' (private sector workers, civil servants and self-employed). The proposed points system would be applied separately but along similar principles for all three. For obvious reasons some elements in the practical implementation are different. We focus in this paper on the system for private sector workers.

We discuss the main objectives of the reform proposal in Section 2. The basic structure of the proposed points system is described in Section 3. We will show how this structure makes it possible to tackle intragenerational and intergenerational equity issues in a flexible and transparent way. The proposed automatic adjustment mechanism (including the Musgrave rule for the risk sharing between generations) is described in Section 4. In Section 5, we compare our proposal to the German points system and to Notional Defined Contribution (NDC) systems (on which the reforms in Sweden, Italy or Poland have been based). Section 6 contains our conclusion.

Our main objective is to present a coherent proposal of pension reform with some innovative features. Our aim was not to build a full model of welfare maximisation in the face of economic and demographic risks. We provide some links to the academic literature where this is useful to put our proposal in a broader perspective, but we do not work out all its theoretical aspects in detail.

2 Main objectives of the reform proposal

Like in other countries the main motivation of the Belgian government to set up the Commission for Pension Reform was the growing concern about the long-run financial sustainability of the pension system. The most fundamental notion of financial sustainability is that of an actuarial equilibrium, in which the discounted value of the future stream of pension benefits over a long time horizon is equal to the discounted value of the contributions over that same horizon.[3] The Commission did not start from this equilibrium definition but did rather focus on the so-called pay-as-you-go equilibrium that requires equality between contributions and pension benefits in each period. This concept is easier to understand and is closer to the time horizon of policy makers. Of course, financial sustainability defined in this way could be realised through a sharp increase in contribution rates with possibly negative economic effects in the longer run. This should be avoided, as it would threaten the capacity of the pension system to meet its promises in the future. We will integrate this longer-run perspective in the adjustment mechanism we propose. To reflect this broader perspective in our terminology, we prefer the expression '*economic' sustainability*.

There was consensus within the Commission that parametric reforms would not be sufficient and that safeguarding the Belgian pension system required a structural change to rebuild it on stronger foundations. Moreover, to keep the reform outside short-run political turmoil, it was deemed necessary to formulate explicit rules for keeping the system on a sustainable track from a longer run perspective. In fact, Belgium was lagging behind, considering that such automatic adjustment mechanisms (e.g. to take into account the effects of the increasing life expectancy) were already introduced in many OECD countries ('putting pensions on auto-pilot', OECD, 2012).

However, once one takes such a long-run perspective it is immediately clear that economic sustainability is not sufficient to also keep the system socially sustainable. This is illustrated by the experience in other countries, whereby some of the reforms

[3] Automatic balancing mechanisms to restore the actuarial balance of a pay-as-you-go system have recently been analysed by Godinez-Olivares *et al.* (2016).

led to a problem of inadequate pensions (OECD, 2012). In the short run this threatens the living standard of (often the poorest) pensioners. But it also creates a long-run problem, because the provision of inadequate pension benefits makes it less interesting for young generations to contribute to the pay-as-you-go system. For the latter system to be socially and politically sustainable, a *stable intergenerational social contract* is needed in which the young (contributing) generations can rely on credible promises about adequate pension benefits in the future. A long-run perspective on reform, therefore, requires a clear view on *fair risk sharing between generations* and on intergenerational equity. The challenge is to formulate the rules for future adjustments to the system in such a way that they reconcile economic sustainability with adequate pension benefits for younger generations. We define a pension system as 'socially sustainable' if it can pay out adequate pension benefits to actual pensioners and can credibly promise to younger generations that future pension benefits will remain adequate. As we will see, credible promises must be about the relative (and not the absolute) income position of pensioners and they must be conditional on the younger generations accepting behavioural changes, e.g., working longer.[4]

Furthermore, the pension system necessarily embodies a view on intragenerational equity. Pensions should be seen as an *insurance*. They should be sufficient to avoid a large drop in living standard at the moment of retirement. This means that they must be linked (to some extent) to previous earnings (and, hence, to previous contributions). Yet in a social insurance system *intragenerational solidarity* also remains essential.[5] A sufficiently generous minimum income protection is needed. Moreover, people have to be compensated for bad luck in their lives, for which they cannot be held responsible. Typical examples are health problems or involuntary unemployment. Part of the pension benefits will, therefore, be non-contributory, in that they are allocated independently of individual contributions. Since there is no consensus in society about how exactly to balance insurance and solidarity and since the majority opinion on these matters may change over time, the pension system should be sufficiently flexible to accommodate different views on solidarity. Moreover, it must be flexible in an additional sense. In a society with rapidly changing family structures and increasing job mobility, and where people want the opportunity to organise their own lives according to their own preferences, *freedom and flexibility* are important. Yet, freedom implies *responsibility*. From a welfare point of view, it is desirable to give people sufficient freedom of choice with respect to the organisation of their working life and their moment of retirement, but they should then be willing to accept the consequences of their choices in the form of lower (or higher) pensions. Intragenerational equity is indispensable for the perceived legitimacy of the system.

[4] In theory, there is no real assurance that a scheme operated by one generation will be acceptable by subsequent generations, unless it involves an amount of intragenerational redistribution. This is especially true when government debt is also taken up in the analysis (see, e.g., Tabellini, 1991). We do not go into public choice aspects in this paper.

[5] We do not go into the difficult debate on the relationship between 'solidarity' and 'intragenerational equity'. Equity is often used to refer to a notion of responsibility-sensitive egalitarianism. Solidarity (which is mainly a European idea) is sometimes defined as expressing the objective to integrate all citizens (also the weaker ones) into society. In so far as it involves reciprocity and equality of opportunity, it is of course closely linked to equity. We will use the two terms interchangeably.

Finally, credible long-run promises require that pensions are built up in a transparent way. This means that the automatic adjustment mechanism must be understandable for citizens. *Transparency* is also needed for the perceived legitimacy of solidarity. Transparency is essential if we want to hold people responsible for their own choices. They must be able to follow their own building-up of pension rights so that they can also take well-informed career decisions. Transparency is therefore important both for intergenerational and for intragenerational equity.

3 The points system: intragenerational and intergenerational equity

3.1 Basic setup

People collect points *throughout their career*. Taking the year as a natural unit, define z_{it} as the number of points collected by a person i during the year t. The rules for allocating points will be further discussed in Section 3.2.1.

The total stock of points collected by a person i at the *moment of retirement* T[6] can then be written as

$$Z_{iT} = \sum_{t=T-N_i}^{T} z_{it} \tag{1}$$

where N_i is the length of the career of a person i. The rule to convert these points into a pension income P_{iT} is given by

$$P_{iT} = r_{iT} v_T Z_{iT}. \tag{2}$$

Individuals are held responsible for their (early) retirement decision through the individual-specific parameter r_{iT}. The working of that age-conversion rate will be discussed in Section 3.2.2. The value of a point (v_T) is the same for all members of the cohort retiring at the time T. We will explain how it is fixed in Section 3.3.

After retirement, pensions are, in principle, adjusted to changes in the real wages,[7] but deviations from this principle are possible if they are necessary to keep the pension system economically sustainable. The adjustment mechanism will be described in Section 4.3.2. The pension in the year after retirement can then be expressed as

$$P_{i(T+1)} = P_{iT}(1 + g_{T+1})\beta_{T+1} \tag{3}$$

where β_{T+1} is the sustainability coefficient and $g_{T+1} = (\overline{S}_{T+1} - \overline{S}_T)/\overline{S}_T$ is the growth rate of average gross labour earnings in the economy.

3.2 Intragenerational equity and the allocation of points

We first discuss how insurance and solidarity principles are implemented through the allocation of points during the working life. We then show how our proposal introduces freedom and responsibility with respect to the moment of retirement. Finally,

[6] Throughout the paper we will use the symbol T to indicate the moment of retirement.

[7] Note that our whole analysis is in real terms, so that there is no difference between real and nominal wage indexation. In the Belgian terminology, this adjustment to real wages is usually denoted as 'welfare adjustment'.

we illustrate the flexibility of the points system by focusing on three specific issues: partial retirement, the treatment of arduous and hazardous jobs and the treatment of varying family arrangements.

3.2.1 Allocation of points during the career

As mentioned in the previous section, the allocation of points throughout the career is driven by considerations of intragenerational equity and solidarity. On the one hand, we want to ensure that people do not experience a too-large drop in their living standard when they retire. There should, therefore, be a link between the level of their pension and their labour earnings, i.e., their productivity and their labour supply decisions. This is not only important from an equity point of view: strengthening the link between pensions and social contributions lowers labour market distortions due to the latter.[8] On the other hand, we want to protect the living standard of older people who have a very low market productivity, or who have been hit during their active life by negative shocks that were beyond their control, such as involuntary unemployment or disability. It may also be deemed equitable to allocate pension rights to persons who make a contribution to society which is not directly valued on the market. Care activities are the obvious example of this situation. All this means that points will be allocated not only on the basis of productive contributions but possibly in other situations as well. Of course, there is no social consensus about where to draw the boundary between responsibility and solidarity, or about the extent to which non-market contributions should lead to the building up of pension rights. The points system is sufficiently flexible to accommodate many different options.

Let us take as a starting point an individual who builds up pension rights only on the basis of labour earnings. In that case, the idea of holding people responsible for their labour effort, and for their productivity, can be implemented in a simple form by the following core expression

$$z_{it} = S_{it}/\overline{S}_t \tag{4}$$

where S_{it} denotes the gross labour earnings of a person i in year t and $\overline{S}_t$ denotes average gross labour earnings. This makes for an easy interpretation: someone with average gross labour earnings collects exactly one point. This is a natural reference for other situations.

Applying equation (4) without nuances would imply that people working less (more) in the period t with a lower (higher) productivity will always collect fewer (more) points. One may think that solidarity imposes deviations from this simple proportional rule, as it is arguably too harsh for people with a very low productivity and/or too generous for people with very large labour earnings that do not reflect differences in effort. To tackle the latter problem, one can introduce a cap on labour earnings S_t^* above which productivity increases are no longer rewarded by

[8] See, e.g., the analysis in Lindbeck and Persson (2003). Moreover, pension systems with a (too) weak link between contributions and benefits are often quite weak politically and may end up with poor benefits (De Donder and Hindriks, 1998).

adapting (4) as:

$$z_{it} = \min(S_{it}, \lambda_{it} S_t^*)/\overline{S}_t, \tag{5}$$

where λ_{it} is a correction if the individual is working part-time.[9,10] Low-income workers can be protected by introducing a minimum number of points. Moreover, certainly, when introducing an automatic adjustment mechanism in the pension system, there is also a need for a means-tested minimum income protection outside that system.[11]

Equation (5) is still a formula to allocate points on the basis of labour earnings. Solidarity considerations suggest the need to go beyond this and to also allocate points for periods of non-activity (such as sickness, disability, involuntary unemployment) or for periods of socially important activities that are not rewarded on the market. The kind of activities that create a claim on points and the number of points allocated (e.g., a simple lump sum amount, or an amount in relation to the previous labour earnings, or in relation to the average labour earnings in the economy), can be decided upon in a flexible way. The basic formula (4), through which someone working at the average gross wage collects exactly one point, is an interesting reference point to evaluate the number of points that should be allocated on a non-contributory basis. Of course, such non-contributory points are cumulatively added to the sum of points (1) during the career as a function of the changing circumstances of the working life.[12]

One of the advantages of the points system is its transparency. Individuals can be informed each year about the number of points they have collected (whether contributory or non-contributory) so that they can easily follow the building-up of their pension rights over time. In addition, equation (4) offers a useful anchor point for them: they know that when they have earned one point, this gives them the same pension rights as someone who has worked one year at the average wage.[13] It is equally

[9] Equation (4) implies that the hours worked by an individual during a specific year do not influence the number of points (s)he accumulates during that year, only the level of earnings counts. However, we consider it legitimate to introduce the number of hours worked in the (eventual) definition of a cap, or a minimum, to be applied to the points accumulated during one year. The approach of equation (5) with a yearly cap is disadvantageous for people with variable labour earnings that are one year far above and another year far below the cap, as compared with other people with the same life-cycle labour earnings that each year remain just below the cap. In principle, this problem could be solved by applying the transformation not to the yearly amounts, but to the total sum of points collected over the life cycle. However, such more complicated formulas decrease the transparency of the system.

[10] It is an open issue whether introducing a cap on the number of points also should imply that the pension contributions be capped. If not (the present situation in Sweden), the link between contributions and benefits becomes weaker and the system imposes more redistribution from high to low wage earners.

[11] In the proposal of the Belgian Commission for Pension Reform a minimum number of points is guaranteed for everybody. For someone who has worked full-time during a 'reference' or 'normal' career (see below, Section 3.2.2), this minimum number of points must be such that the corresponding pension is at least 110% of the (means-tested) minimum income protection for the elderly, which should in turn be equal to the official EU poverty threshold, i.e., 60% of median income.

[12] There are good reasons to finance the pension payments corresponding to these non-contributory points not from pension contributions, but from the general government budget – see Section 4.

[13] The proposal of the Commission for Pension Reform is to apply the points system separately in the three regimes (private sector workers, civil servants, self-employed). The basic principles underlying its implementation would be similar, but the values of some of the parameters might be different. Persons with so-called mixed careers can then build up pension claims in all the regimes in which they participate. This would remove the problems associated with job mobility in the present system (without points): the

important that the value of the point is set in a transparent way at the moment of retirement. We will return to that issue in Section 3.3.

3.2.2 The retirement decision

Freedom of choice is an important component of individual well-being. It is therefore desirable to introduce flexibility into the system with respect to the moment of retirement, while at the same time, holding people financially responsible for their retirement decision. Flexibility is not only necessary from the point of view of freedom, it may also increase the attractiveness of postponing the moment of retirement by switching to another less-physically demanding job or by starting to work part-time. These possibilities are discussed further in section 3.2.3.

Flexible retirement possibilities can be organised around a given age of retirement, or around a given career length. Working with a given age of retirement may be easier to communicate because it has been the common approach in the past. However, there are strong equity reasons to focus rather on career length. Prima facie, forcing people who start working earlier in their life to work longer before they can retire, seems unfair if we interpret the number of working years as an indicator of effort. More importantly, people that start working earlier in life are on average lower educated. This has two consequences. First, the lower educated in general have more arduous and hazardous jobs. As we will discuss later, focusing on career length rather than the age of retirement is then an easy way to take into account arduousness of the job in retirement decisions. Second, it is well known that there is a strong and robust correlation between years of education and life expectancy.[14] People that start working later will, therefore, have on average a longer life expectancy. Compensating persons in arduous jobs or with a lower life expectancy is an important aspect of intragenerational equity and, in fact, is a very sensitive issue in the societal discussions on pension reform. Structuring the system around the length of career implies a transparent stance on these ethical issues.[15] Note that giving career length a focal role in the process of retirement will automatically lead to a shift of the age of retirement over time, since in recent decades an increasing fraction of the population has been studying longer, and there is no reason to think that this trend will stop in the near future.

We define N_T^* as the 'normal' or 'reference' length of a career, as set by the regulator for the retirement period T.[16] The subscript T indicates that this 'normal' career length may change over time to keep the system economically sustainable (see Section 4). A person i starts working at age x_{i0} and has worked for N_i years. When retiring in the period T, his age at retirement x_{iT} and his 'normal' age of retirement x_{iT}^* are then, respectively,

$$x_{iT} = x_{i0} + N_i \tag{6}$$

claims are well-defined and are only transformed into a pension at the moment of retirement. Moreover, the building up of claims remains fully transparent at each moment in the career.

[14] See, e.g., the recent study by the OECD (Murtin *et al.*, 2017).

[15] In Section 5.1 we compare our approach with the treatment of life expectancy in Notional Defined Contribution systems.

[16] Of course, people should know in advance how many years they will have to work and N_T^* should be communicated a few years before application.

$$x_{iT}^{*} = x_{i0} + N_T^{*} \tag{7}$$

Individuals are free to retire as soon as they have reached the age $x_{iT}^{min} = x_{iT}^{*} - \omega_T$, where ω_T is a predetermined window of a number of years. The 'discounting' parameter r_{iT} is equal to 1 if $x_{iT} = x_{iT}^{*}$. It is smaller than 1 for individuals retiring earlier than their normal retirement age and larger than 1 for individuals retiring later. Full actuarial neutrality would require that the formula be based on the discounted stream of pension benefits from the moment of retirement to the expected moment of death. It would therefore also take into account the uncertain development of the interest rate (see, e.g., Queisser and Whitehouse, 2006). In a pay-as-you-go system with pensions adjusted to real wages (as in equation (3)), it makes sense to disregard this time discounting effect and to determine the parameter r_{iT} only on the basis of the differences in life expectancy at different ages (see Appendix A).We, therefore, propose to set the age-conversion rate as follows:

$$r_{iT} = \frac{e_T(x_{iT}^{*})}{e_T(x_{iT})}, \tag{8}$$

where $e_T(x)$ denotes the remaining life expectancy at an age x in retirement period T, averaged over males and females.

Equations (6) and (7) hold for the standard case of an uninterrupted career. A more general approach that also covers the case of freely chosen career breaks, is presented in Appendix B. Such freely chosen career breaks are not included in the calculation of N_i, which is interpreted as the number of years actually worked or assimilated to working (e.g., because of disability or involuntary unemployment). Freely chosen career breaks also lead to an adjustment of the normal age of retirement x_{iT}^{*}. For people with large breaks in their career or who start working late, x_{iT}^{*} can become unrealistically large and applying the correction (8) would lead to an extremely small pension. In Appendix B we propose a system of corrections that is asymmetric for people whose individual normal retirement age is higher than the 'legal' age of retirement $\bar{x}_T^{*}$. This legal retirement age is the age at which everybody can retire, independently of the number of years worked before. In contrast to the normal retirement age (7) and the individual minimum retirement age that is derived from the latter, the legal retirement age is set at a uniform age, applicable to all individuals.

3.2.3 The flexibility of the points system illustrated

In addition to its transparency, another main advantage of the points system is its flexibility. We will show how easy it becomes to introduce the possibility of partial retirement, to take into account arduous and hazardous jobs and to handle varying family arrangements during working life. A points system is not per se needed to tackle these issues, but it is transparent for the individuals concerned and it considerably simplifies the burden of pension calculation for the administration. This is especially true because specific and possibly temporary circumstances during the working life do not require complicated (re)calculations of the pensions at the moment of retirement. Pension rights can be built up gradually during the career and the number

of points obtained is converted into a pension at the moment of retirement through the simple operation of multiplying them with the age conversion rate and the value of a point (see equation (2)). A system in which the number of points has to be recalculated at the end of the career on the basis of information that is only available at that moment would be much less transparent and more difficult to administrate.[17]

Partial retirement: The freedom to organise the last years of one's working life according to one's own preferences increases if there is an opportunity for partial retirement. The option of partial retirement may be attractive to prolong the working career of individuals who prefer not to work full-time when they grow older, e.g. because their health situation is deteriorating, or their employer is not willing to keep them full-time. The points system makes it easy to organise a system of partial retirement. People can simply convert part of their points (at the value of the period of conversion), and after that, they can keep working part-time. By working part-time they collect additional points, which can be added to the remaining fraction of points which have not yet been converted. All this can be organised in a flexible way, provided that there is some (pseudo-)actuarial correction for retiring earlier. In the system we propose, this is realised through the age-conversion rates (8). Without such correction, it would always be optimal for individuals to convert (part of) their points into a pension as soon as this is possible and to continue working afterwards.

Arduous and hazardous jobs: An important and hotly debated issue is the opportunity of earlier retirement for those having arduous and/or hazardous jobs. As mentioned before, giving a central role to the length of the career (rather than to the retirement age) is a partial answer to this question, since in general the most arduous jobs are taken by persons who start working earlier in their life. The points system allows for a further refinement, however, by allocating supplementary points for arduous jobs in the course of the career.

The traditional approach of allowing access to earlier retirement based on the job occupied has two main shortcomings. First, it is not equitable to let the moment of early retirement be decided on the basis of the last job in which people find themselves. Some individuals with a rather light job at the end of their career may have had a particularly arduous job in the past which has affected their health. Thus it is not only inequitable to focus solely on the last years of the career, but it is also ineffective if one of the objectives of pension policy is to postpone the moment of retirement. Some individuals who have had an arduous job during most of their career are only able to work longer if they can switch to a lighter job when they grow older. If their last job determines the possibility to retire earlier, this may create a strong disincentive to switch to such a lighter job. Second, the content of jobs is changing over time and will certainly change in the course of a long career. Technological and organisational changes in the economy may cause jobs that are arduous at some

[17] In our system the only insecurity before the moment of retirement is about the value of the point. Yet, as we will show in Section 3.3, we propose a transparent procedure to fix this value in order to make credible commitments to all generations.

moment in time to become much less arduous at a later moment (or the other way round). This implies that the definition of an arduous job cannot be fixed, but will have to change over time. This makes it difficult for individuals to plan their retirement in a well-informed way.

Allocating supplementary points for arduous jobs solves both problems. Individuals can collect additional points (i.e. build up additional pension rights) during the periods in which they have an arduous job, independent of where these periods are situated in the course of their career. Moreover, it is easy to adjust the definition of arduous jobs to changing circumstances. As noted before, in a points system, creating pension claims for well-defined periods in the past does not require complicated calculations at the moment of retirement. Of course, allocating additional points during the career does not directly change the conditions for early retirement. However, individuals that have been in arduous jobs will end up with a larger number of points. This gives them the possibility to retire earlier while still receiving the same pension as someone who did not have an arduous job. The pseudo-actuarial adjustment for retiring earlier is compensated to some extent by the larger number of points collected. In a nutshell, the arduous job compensation will offset the age correction.

Defining what an arduous job is, turns out to be very difficult. In those countries which have a list of arduous jobs, it is usually set up through a process of negotiation between the social partners and the government. Given that such a list is ultimately a normative choice, there is much to be said in favor of a negotiation procedure. To avoid budgetary problems it is possible to put a strict upper limit on the number of additional 'arduousness' points that can be allocated in any period. The way this fixed allotment of points is divided over different jobs can then be revised regularly. However, with a strict budget constraint it is only possible to add 'new' arduous jobs to the list if other jobs are removed or are treated less generously in terms of 'arduousness' points.

Changing family arrangements and inequality of labour within couples[18]: Until now we have described the points system as if it were purely individualised. It may be argued, however, that in some cases the household composition should play a role in the building up of pension rights. Consider the situation of a couple in which the two partners make all the economic and financial decisions together. Suppose they decide together that one partner will go into the labour market while the other remains at home. Suppose also that the activity at home does not give the right to pension points. In a purely individualised system, the first partner will have the right to a pension at the moment of retirement, the other not. This seems inequitable if their relationship breaks up (either before or after retirement), as both partners should bear together the consequences of their joint decisions. This problem may become more relevant in the future, because there will probably be a larger variation of forms of cohabitation (sometimes short-lived), and because individuals will go through a sequence of relationships in the course of their active life. One possible

[18] Of course there are also other questions related to changes in household composition. One is the treatment of the surviving partner in a couple after the death of the other partner. The Commission for Pension Reform (2014) made a series of specific proposals in this regard, but we do not discuss this issue here as it is not specifically linked to the introduction of a points system.

approach to solve this problem is to lump together the points collected by the partners during the period of their relationship and then redistribute the total number of points between the two partners (presumably with equal shares, but that is not necessary). All the partners in a relationship would then collect pension points. If the relationship ends, each of them has to take up again his/her own individual responsibility. This splitting is just one possible approach, but unless one goes for complete individualisation, alternative systems will have similar features. It is striking how easily this kind of solution can be implemented in a points system.

3.3 Intergenerational equity and the value of a point

We now consider the question of how to fix the value of a point for the cohort retiring in period T (v_T in equation (2)). Two (complementary) sets of considerations matter for the determination of that parameter. First, changing the value of v_T changes the intergenerational income distribution. This raises the issue of intergenerational equity. Second, any pay-as-you-go system can only survive if the younger generations accept to contribute in exchange for the promise of getting adequate ('equitable') pension when they themselves retire. This promise must be well-defined and it must remain credible in the face of economic and/or demographic shocks. Social sustainability, i.e., intergenerational trust and intergenerational equity, and economic sustainability, therefore, have to go hand-in-hand. They are all essential elements to build a stable social contract between the generations. This implies that the rules for setting the value of a point must be transparent, equitable and credible.

At first sight, it may seem that the most adequate protection for the current active workers is to promise them a pension that is fixed in real terms. However, such a promise cannot be credible in the long run in which many unpredictable shocks may occur. More importantly, a fixed pension is not equitable either. In periods of high economic growth, it would be too low to participate in a meaningful way in the social life of the community. In periods of low (or negative) economic growth, it would put the pensioners in a privileged position that is unacceptable for the future working generations. An equitable and credible promise should relate future pensions to the future average living standard in society. This is the only way to obtain an equitable income distribution between the members of different cohorts living at the same time.

One easy and attractive approach is the following. Define a (hypothetical) reference person with exactly the reference career N_T^* (and therefore $r_{iT} = 1$), who has earned the average labour earnings in each year of that career and did not build up any non-contributory pension claims. It is reasonable to assume that in each period gross average labour earnings are above the minimum threshold and below the ceiling as defined in equation (5). We can, therefore, apply equation (4) and our reference person will have $Z_{iT} = N_T^*$. The proposed pension formula is then designed in such a way that this reference person receives a pension which is a proportion of the gross average labour earnings in the economy at his moment of retirement, i.e.,

$$P_{iT} = \delta_T^* \overline{S}_T, \tag{9}$$

with δ_T^* the reference gross replacement rate.

Combining equation (9) with the basic pension formula (2) and taking into account that for the reference person $r_{iT} = 1$ and $Z_{iT} = N_T^*$, we can immediately derive the value of a point as

$$v_T = \frac{\delta_T^* \overline{S}_T}{N_T^*} \tag{10}$$

Inserting this value into the general pension formula (2) and using equation (8) yields an expression for the pension awarded to any person i in the period T:

$$P_{iT} = \left(\frac{e_T(x_{iT}^*)}{e_T(x_{iT})}\right) Z_{iT} \left(\frac{\delta_T^* \overline{S}_T}{N_T^*}\right). \tag{11}$$

The last factor in this expression is the value of the point. This is a *cohort-specific* parameter related to the intergenerational distribution. The first two factors are *individual-specific* and relate to the intragenerational distribution: the first gives the correction for early (or late) retirement, and the second is the number of points obtained by person *i*. For persons who have worked throughout their career, this number of points will reflect their past earnings and their career length with due corrections for minima and maxima. Moreover, as described before, individuals may also have collected points during periods in which they were not active in the labour market. *Ceteris paribus*, i.e., without behavioural reactions, a change in the value of a point will not change the income inequality within cohort T, as measured by all the relative inequality measures, since it leads to an equiproportional change in the pensions of all those retiring at T. The pension formula (11) makes it therefore possible to separate intra- and intergenerational issues in an elegant way.

It is important to notice that we have added a subscript T to δ_T^* (as we did already before for β_T and for N_T^*). If all these parameters could be set freely in each period T, this would not give much of an assurance to the younger generations. On the other hand, fixing all these parameters does not result in a system that is economically sustainable in the long run. As an example, fixing $\delta_T^* = \delta^*$ in equation (9) would just mean that we introduce a traditional defined benefit system, which is not sustainable when confronted with demographic and employment shocks. In the next section, we will discuss how to guarantee the sustainability of the pension system. This will require defining strict rules and a process of automatic adjustment of the various parameters so that the system remains economically and socially sustainable. Long-run social sustainability refers in the first place to intergenerational equity (and trust). Therefore the procedure to change the different parameters in the future has to obey transparent and equitable rules. Given the separation present in equation (11) we can discuss this issue independently of the intragenerational distribution (which is taken care of by the allocation of points, not by the value of a point).

4 The points system: sustainability, intergenerational risk sharing and automatic adjustments

As described before, the automatic adjustment mechanism proposed by the Commission for Pension Reform focuses on the pay-as-you-go equilibrium. This

does not mean that we do not elaborate a long-term vision. On the contrary, as will become clear, a change in life expectancy (which is fundamentally a long-term prediction) will imply adjustments here and now. Moreover, in any realistic application, the requirement of a yearly equilibrium has to be weakened to take account of economic cycles. Financing from general means can then be used as a buffer, increasing in periods with a low level of contributions and decreasing in periods with a high level of contributions.

Denoting the size of the employed population in the period T by A_T and the number of pensioners by B_T[19], the condition for a pay-as-you-go equilibrium can be written as

$$\overline{P}_T B_T = \pi_T \overline{S}_T A_T, \tag{12}$$

where $\overline{P}_T$ is the average pension, paid out in the period T and the contribution rate for pensions is written as π_T. Defining the overall economic dependency rate for the economy as $D_T = (B_T/A_T)$, this budget constraint can also be written as

$$\overline{P}_T D_T = \pi_T \overline{S}_T. \tag{13}$$

Defining the benefit ratio $\overline{P}_T/\overline{S}_T$ in the economy as δ_T a third way of writing the budget constraint is

$$\delta_T D_T = \pi_T. \tag{14}$$

It is important to see that this benefit ratio δ_T does not coincide with the reference replacement rate δ_T^*, that was defined in Section 3.3. The exact relation between the two is determined by the retirement and labour supply behaviour of the working population, by the rules and the behaviour concerning the non-contributory pensions, by the development of the actual pensions and by the age structure of the retired population. In general though, δ_T and δ_T^* are positively correlated. Moreover, their exact relation can be calculated with available data. This is further discussed in Appendix C.

Equations (12)–(14) do not take up the possibility of alternative financing of the pensions, i.e., financing with other means than the pension contributions. We have already noted that such alternative financing makes a lot of sense as a buffer for the economic cycle and that there may also be room for the structural alternative financing of a part of the pension benefits, e.g., the part related to the non-contributory pensions. This possibility of alternative financing can be integrated into the formal model in a straightforward way, e.g., by assuming that only a fraction of the total expenditures $\overline{P}_T B_T$ has to be financed by pension contributions. If this fraction is constant, all the following expressions carry on. We will therefore not include the possibility of alternative financing in the formal model of this section.

Structural shocks in the system can be absorbed through (an infinite number of combinations of) changes in the parameters δ_T and π_T. Moreover, career adjustments will have a direct effect on D_T. However, not all of these combinations are socially

[19] Later we will split the latter into two groups: the 'new' pensioners retiring in year T, denoted by B_T^N, and the stock of surviving pensioners that retired in earlier periods B_T^O.

sustainable in the sense that they yield an equitable sharing of the risk and create a credible long-run promise for the active contributing population. We first propose one solution to the latter problem (the so-called Musgrave rule) and then show how that rule can be implemented through an automatic adjustment mechanism.

4.1 Intergenerational risk sharing and the Musgrave rule

4.1.1 Defined benefit and defined contribution as two polar cases

Let us assume that there is a change in the economic dependency rate D. This shock can reflect demographic changes like the ageing of the population[20] or changes in the employment rate affecting the size of the working population A. Equation (14) then immediately shows how changes in δ and π can restore the pay-as-you-go equilibrium:

$$\frac{\mathrm{d}D_T}{D_T} = \frac{\mathrm{d}\pi_T}{\pi_T} - \frac{\mathrm{d}\delta_T}{\delta_\mathrm{T}}. \tag{15}$$

Most traditional pay-as-you-go systems were of the 'defined benefit' (DB)-type, keeping δ_T constant. In that case, the pensioners are fully protected and the risk associated with changes in the dependency rate is borne only by the working population, i.e. $(\mathrm{d}\pi_T/\pi_T) = (\mathrm{d}D_T/D_T)$. Therefore, in recent years, many countries have cut down on their defined benefit system and have switched (sometimes partially) to 'defined contribution' (DC) arrangements with $d\pi_T = 0$ (see OECD, 2012, for an overview). This is a move to another polar case since now the risk is fully borne by the retirees, i.e. $(\mathrm{d}\delta_T/\delta_\mathrm{T}) = -(\mathrm{d}D_T/D_T)$. Neither the traditional DB nor the DC-system realises a balanced distribution of the risk between the different generations. The former leads to a sharp increase in social contributions (and labour costs), the latter threatens the living standard of (mainly poor) pensioners.

We look for a fair way of sharing the risk between the generations, i.e., we look for an attractive value of ρ_T in the following expressions:

$$\frac{\mathrm{d}\pi_T}{\pi_T} = (1-\rho_T)\frac{\mathrm{d}D_T}{D_T} \tag{16}$$

$$\frac{\mathrm{d}\delta_T}{\delta_\mathrm{T}} = -\rho_T\frac{\mathrm{d}D_T}{D_T}. \tag{17}$$

All values of ρ between zero and one give intermediate solutions in between DB and DC (see Devolder and de Valeriola, 2018). A specific choice of ρ_T with attractive features of intergenerational equity and intergenerational insurance was proposed by Musgrave (1986), and later also advocated by Myles (2002) and Schokkaert and Van Parijs (2003).[21]

[20] Calling the ageing of the population as the result of an increase in life expectancy a 'shock' is to some extent a misnomer. It could perhaps better be called a 'change' and we should then also use the term 'burden sharing', rather than 'risk sharing'. However, for convenience, we will call all changes 'shocks' and we also keep the term 'risk sharing'.

[21] The German points system does not refer to the Musgrave rule but has an adjustment mechanism with $\rho = 0.25$. As observed by the referee, this value closely mimics the Musgrave rule. More about the German system in Section 5.2.

4.1.2 The Musgrave rule

Musgrave (1986) proposed to stabilise the ratio of the pensions and the labour earnings, *net of pension contributions*, i.e., to fix

$$\frac{\overline{P}_T}{(1-\pi_T)\overline{S}_T} = \mu, \tag{18}$$

or, equivalently,

$$\frac{\delta_T}{(1-\pi_T)} = \mu. \tag{19}$$

We will call the ratio at the LHS of equations (18) and (19) the 'Musgrave ratio'. The 'Musgrave rule' then refers to the principle that the Musgrave ratio should be stabilised. This is captured by the introduction of the constant μ in equations (18) and (19). We will later explain when and how such a constant μ can be justified.

It follows from (19) that

$$\frac{d\delta_T}{\delta_T} = \frac{d(1-\pi_T)}{(1-\pi_T)} = -\frac{\pi_T}{(1-\pi_T)}\frac{d\pi_T}{\pi_T}. \tag{20}$$

Combining equations (16), (17) and (20) it is easily seen that the Musgrave rule implies that $\rho_T = \pi_T$. The larger the contribution rate, the smaller the share of the risk that has to be borne by the working population.

We can also express the consequences of applying the Musgrave rule in terms of the levels of the crucial parameters. Combining the budget constraint (13), the definitions of DB and DC, and the Musgrave rule as defined in equation (18), we arrive at the results summarised in Table 1.[22] This table shows that the risks associated with changes in the average labour earnings are shared between the generations in all three systems: changes in $\overline{S}$ affect proportionally the average pension and the average net earnings[23]. As a consequence $\overline{S}$ does not appear in the Musgrave ratio. However, in line with what was already found before, the risk associated with a change in the dependency rate is only borne by the retirees in a DC system and by the workers in a DB system. With the Musgrave rule that risk is shared between workers and retirees. Changes in D do not affect the Musgrave ratio if the Musgrave rule is respected. An increase in D lowers the Musgrave ratio in a DC system, whereas it increases the Musgrave ratio in a DB scheme.

Applying the Musgrave rule is attractive for two reasons. First, it implies that demographic or economic shocks lead to equiproportional changes in pensions and in labour earnings net of contributions, in so far as these changes are determined by pension policy. Therefore the intergenerational income inequality will remain unaffected in the face of these shocks. This may be considered desirable from an equity perspective.[24] Second, from the perspective of the allocation of the resources

[22] For notational convenience, we have dropped the time subscript in all the expressions in the Table.

[23] The terminology 'net earnings' is to some extent a misnomer, since the analysis only takes into account pension contributions and not taxes and other social contributions. We use it here solely for convenience.

[24] Knell (2010) analyses the consequences of different automatic adjustment mechanisms with the differences in the internal rates of return for the different cohorts as a measure of intergenerational

Table 1. *Risk sharing with different intergenerational distribution rules*

	Defined contribution	Defined benefit	Musgrave rule
Fixed	π	$\delta = (\overline{P}/\overline{S})$	$\mu = \delta/(1-\pi)$
Contribution rate π	π	δD	$\mu D/(1+\mu D)$
Average pension $\overline{P}$	$\pi\overline{S}/D$	$\delta\overline{S}$	$\mu\overline{S}/(1+\mu D)$
Average net earnings $(1-\pi)\overline{S}$	$(1-\pi)\overline{S}$	$(1-\delta D)\overline{S}$	$\overline{S}/(1+\mu D)$
Musgrave ratio $\dfrac{\overline{P}_T}{(1-\pi_T)\overline{S}_T}$	$\dfrac{1}{D}\dfrac{\pi}{(1-\pi)}$	$\dfrac{\delta}{1-\delta D}$	μ
Effect of ΔS	Shared	Shared	Shared
Effect of ΔD	Retirees	Workers	Shared

of one cohort over its own life-cycle, the Musgrave rule can be seen as a pragmatic interpretation of an optimal insurance policy. Indeed, under reasonable assumptions about the individual utility functions, optimal intergenerational risk sharing requires that shocks do not affect the ratio of the consumption levels of the old and the young.[25]

It is obvious that the Musgrave rule is an incomplete answer to the challenges of intergenerational equity and of intergenerational risk sharing. First, while it indicates how the risk of demographic *changes* has to be borne by different generations, it does not settle the problem of the correct *level* of the Musgrave ratio. An increase in the Musgrave ratio will increase the level of pensions compared with the level of net labour earnings. Fixing it at μ, therefore, implicitly represents a specific stance with respect to the allocation of income over the life cycle.

Second, the Musgrave rule remains silent about the age of retirement for which the Musgrave ratio should be stabilised. Yet, it is hardly acceptable to keep this age of retirement fixed, e.g., if the change in D follows from a change in life expectancy. Moreover, the actual age of retirement and the employment level in the economy (and therefore D) cannot be seen as exogenous. If there is an exogenous demographic shock, the economy will react by changing the allocation of labour and leisure over the life-time. This will immediately affect D. The Musgrave rule must, therefore, be complemented with a mechanism to determine the socially optimal age of retirement. Indeed, changes in the normal length of a career play an essential role in the adjustment mechanism that will be described in Section 4.3.

Third, the Musgrave rule only focuses on incomes and contributions that run through the pension system. Yet the consumption level of the working and the retired populations also depends on other taxes and transfers. It is arguable that the constant

distribution. The internal rate of return for a cohort is defined as the rate that equates the present value of benefits to the present value of contributions. Simulations with a multi-period OLG-model show that these internal rates of return are least sensitive to demographic shocks (in his model changes in cohort sizes) for a parameter ρ in between zero and one. In fact, the optimal value of ρ is close to the one implied by the Musgrave rule.

[25] As an example, Ball and Mankiw (2007) derive this result as the predicted outcome in a hypothetical situation with complete insurance markets and argue that social security should mimic this outcome. See also Spinnewyn (1989).

μ should be adapted if the intergenerational impact of these other taxes and transfers changes in a significant way, e.g. through specific forms of alternative financing.

The simplicity of the Musgrave rule is one of its main advantages. It is an intermediate solution in-between the DB and DC rules, which are known to everybody. Moreover, focusing on the relation between the (net) income levels of retirees and workers fits very well into an approach that aims at defining credible promises for future generations in terms of the relative income of retirees. The further refinements that are needed to implement the automatic adjustment mechanism then define the conditional nature of that promise. We will explain how this works in the following sections.

4.2 Risk sharing: wage growth

As the expressions in Section 4.1 and in Table 1 show, changes in labour earnings over time are automatically shared between the generations for all the rules that have been analysed, and hence also for the Musgrave rule. This is one of the risk sharing advantages of a pay-as-you-go system. Note that for this result to hold between new and old retirees, the adjustment of existing pensions to real wages is essential (see equation (3)).

4.3 Risk sharing: demographic shocks

We first analyse how to cope with changes in life expectancy, a structural demographic change that is likely to continue in the following decades. We will argue that it is natural to adapt the pension system to such a shift by adjusting the reference career N_T^*. We then discuss other demographic and economic shocks for which an adjustment of the reference career is less defensible. Finally, we bring the two types of adjustment together. The described adjustment mechanism has two features that are both rare in an international comparative perspective and desirable according to OECD (2012): it creates an explicit link between changes in life expectancy and the normal length of a career, and it leads to a balanced distribution of the burden of adjustment over different generations.

4.3.1 Changes in life expectancy

Using the notation introduced before and defining the 'standard' minimum age of retirement as $x_T^{min} = \bar{x}_T^* - \omega_T$ (with $\bar{x}_T^*$ the 'legal' age of retirement and ω_T the early retirement window), a change in life expectancy can be formalised as a change $e_T(x_T^{min}) - e_{T-1}(x_{T-1}^{min})$. This change does not affect the retirees that have already retired before period T. It seems therefore acceptable to assume that their pension should not be affected. Moreover, a change in life expectancy should change the allocation of labour and leisure time over the life cycle for those affected by it. If there was no publicly financed pension system, surely individuals would prolong their working life when their life expectancy increases. The public pension system can mimic this necessary reallocation through a change in the reference career length N_T^*. We propose

the following adjustment mechanism:

$$N_T^* = N_{T-1}^* \left[1 + \alpha_T \left(\frac{e_T(x_T^{min})}{e_{T-1}(x_{T-1}^{min})} - 1 \right) \right]. \tag{21}$$

Equation (21) can most easily be interpreted by starting from the specific case $\alpha_T = 1$. In that case, it implies that

$$\frac{e_T(x_T^{min})}{e_T(x_T^{min}) + N_T^*} = \frac{e_{T-1}(x_{T-1}^{min})}{e_{T-1}(x_{T-1}^{min}) + N_{T-1}^*}. \tag{22}$$

This means that the expected period of retirement (starting at the minimum age of retirement) is a fixed share of adult life. The number of life years gained is divided over the working and the retirement periods in a proportional way. This scenario has a strong intuitive appeal. It is called the 'constant time in retirement'-scenario in the simulations of Schwan and Sail (2013) for different European countries. It is also advocated by Börsch-Supan (2015) as one of the key elements in what he considers to be a rational pension policy. In fact, as shown in Appendix D, *if* the actual retirement decisions follow the changes in the normal age of retirement, this adjustment (21) with $\alpha_T = 1$ is just sufficient to stabilise the dependency rate D in a simplified model of the economy with a uniform distribution of life expectancy. This is an illustration of the idea that D cannot be treated as fully exogenous: changes in life expectancy can be compensated by changes in retirement behaviour (and in employment) such that D remains constant.

The crucial question remains, of course, as to whether actual retirement decisions will indeed follow the changes in the normal age of retirement and what happens if they do not. The implications of an increase in N_T^*, i.e., a decrease in the value of a point, for the pension calculation of person i are immediately clear from equation (11): his/her pension will decrease unless $(e_T(x_{iT}^*)/e_T(x_{iT}))(Z_{iT}/N_T^*)$ remains the same. By working longer, individuals can increase Z_{it} and r_{iT} so that their pension does not change. Under that condition, and since the contribution rate does not change either, the Musgrave condition (18) is satisfied. This makes clear that the promise made to the young generations is a *conditional* promise: their pension, as a proportion of the labour earnings of the active population, is guaranteed under the condition that they adjust their retirement behaviour when life expectancy increases. If they do not adjust their retirement behaviour, their pension goes down and so does the Musgrave ratio. One could, therefore argue that the adjustment rule (21) is a change in the generosity of the pension system, rather than a change in the eligibility conditions to get a pension. This is too simple, however. Changing N_T^* will immediately shift the 'normal' and the minimum retirement age (see equation (7)).[26] In addition, one should not underestimate the importance of the fact that the communication about the necessary adjustment would be in terms of the expected length of the career: people are told that the level of pensions can be maintained if they work longer. However, increasing N_T^* as an adjustment mechanism is only

[26] In principle, the regulator could change the eligibility conditions even more drastically by adapting the window ω_T.

meaningful if there are opportunities for the people to work longer. An active labour market policy is needed to make this employment increase possible.

As mentioned before, under a set of simplifying assumptions, the adjustment as defined in equation (21) with $\alpha_T = 1$, is just sufficient to stabilise the dependency rate D. Under these assumptions, therefore, the budget constraint (13) is satisfied. This will no longer be necessarily true if these simplifying assumptions do not hold. Moreover, if the regulator judges that the adjustment to life expectancy changes should not be borne fully by the newly retired, he/she may decide to choose $\alpha_T < 1$. If the adjustment of N_T^* does not suffice to restore budget equilibrium after the change in life expectancy, other measures will be needed, affecting the contribution rate π_T, the reference replacement rate δ_T^* and the sustainability coefficient β_T. How this can be done will be further explained in Section 4.3.3.

4.3.2 Other demographic changes

Changes in the dependency rate D can be caused by factors which do not call for changes in N_T^*. A possible example is the baby-boom, i.e. the increase in the dependency rate caused by variation in fertility rates in the past.[27] Another example is an economic shock, leading to an increase in the structural unemployment rate. In this section, we will focus on these cases in which the change in D is completely absorbed through changes in the pensions and the contribution rates with N_T^* kept constant. The Musgrave rule (18) then applies without any adaptation, and the expressions in Section 4.1 immediately show the consequences for the average pensions and for the contribution rate. There is one important new issue, however. The Musgrave rule determines how the average pension should be adapted, but this average pension is a mixture of the new pensions and the pensions of those that have retired earlier. In the situations considered here, there is no reason to put the risk fully on the newly retired and on the working population. The actual retirees should share part of the burden. The sustainability coefficient β_T then enters the picture.

Equation (20) and Table 1 show how the benefit ratio, and hence the average pension should be adapted. The new average 'equilibrium' pension $\overline{P}_T^*$ (satisfying both the Musgrave rule and the budget constraint) can be determined as

$$\overline{P}_T^* = \frac{\mu \overline{S}_T}{1 + \mu D_T}. \tag{23}$$

Equation (23) fixes the average pension in the period T. By introducing explicitly the distinction between new and old pensioners and assuming for simplicity that there are only two periods, we can then write (see equation (A.8) in Appendix C):

$$s_T^N (\overline{rZ})_T \frac{\delta_T^*}{N_T^*} \overline{S}_T + s_T^O (\overline{rZ})_{T-1} \frac{\delta_{T-1}^*}{N_{T-1}^*} \overline{S}_T \beta_T = \frac{\mu \overline{S}_T}{1 + \mu D_T}, \tag{24}$$

where s_T^N and s_T^O are the shares of new and old pensioners in the total number of

[27] This is just an example, and it can be discussed. It assumes that past generations are not held responsible for the reduction in fertility rates and for the lack of prefinancing of the resulting pension cost. See, e.g., the discussion in Howse (2007).

retired, and $(\overline{rZ})_T$ is the average value of $r_{iT}\,Z_{iT}$ in period T (averaged over all members of the cohort retiring at T). It is clear that the regulator now has an additional degree of freedom: there is an infinite number of combinations of δ^*_T and β_T satisfying equation (24). Decreasing β_T will make it possible to increase δ^*_T and vice versa. Fixing their relative values requires a decision of how to divide the burden of the adjustment over new and old retirees.

A natural solution to this problem is to define

$$\beta_T = \frac{\delta^*_T / N^*_T}{\delta^*_{T-1} / N^*_{T-1}}, \tag{25}$$

basically stating that the correction factor applied to the wage indexation of pensions is equal to the rate of change of the reference replacement rate per year of activity, or (if $\overline{S}_t$ does not change) to the rate of change of the value of a point. Combining (24) and (25), it is possible to solve for δ^*_T and β_T. Of course, if $N^*_T = N^*_{T-1}$, as assumed in this section, β_T is just proportional to the change in δ^*_T. If $(\delta^*_T / N^*_T) = (\delta^*_{T-1} / N^*_{T-1})$, actual pensions remain fully indexed to the development of earnings ($\beta_T = 1$).

In the face of negative demographic or economic shocks, the automatic adjustment mechanism sketched in this section may lead to a decrease in the pensions that threatens to push the lowest income retirees into poverty. To avoid this, it is important to introduce an adequate mechanism of minimum income protection. This can be realised through the introduction of minima in the pension system itself (see Section 3.2.1). However, if one wants to keep a link between contributions and benefits within the pension system, preventing poverty in old age requires a means-tested minimum income provision for the elderly outside the pension system proper.

4.3.3 Mixed changes

Let us now bring together the insights from the two previous sections. Suppose there is a demographic or economic shock that, according to the regulator, calls for an adjustment of the normal career length from N^*_{T-1} to N^*_T. As explained in Section 4.3.1, in that situation, people who do not adjust the length of their working life, will (and should) experience a fall in their pension relative to average earnings. A simple application of the Musgrave rule (18) then seems to suggest that this decrease in pensions should be partly 'compensated' by an increase in the contribution rate. Yet, this cannot be correct because we assume that this decrease in pensions, relative to average earnings, is legitimate. The promise made to future generations is conditional: their pension will be in proportion to the average living standard in society *if* they are willing to work N^*_T years. If they are not willing to adjust the length of their career, the constant μ in equations (18) and (19) has to be adjusted downwards. Remember that this parameter reflects the stance of society towards the allocation of income (and labour time) over the life cycle and that the Musgrave rule in itself is not sufficient to fix the correct value of μ.

We can describe the same mechanism by focusing on the sources of shocks in the dependency rate. Suppose we can split this shock into two parts, a first part that is caused by differences in life expectancy and a second part that is caused by other

demographic changes (e.g., a structural decrease in the unemployment rate):

$$\frac{\mathrm{d}D_T}{D_T} = \frac{(\mathrm{d}D_T)^{LE}}{D_T} + \frac{(\mathrm{d}D_T)^{OT}}{D_T} \tag{26}$$

The first part should in principle be absorbed through changes in the average career length without changes in average pensions or contributions. The second part calls for a distribution of the burden of adjustment over retirees and workers on the basis of the Musgrave rule. Only that second part justifies an adjustment of the contribution rate. Applying equations (16) and (20) yields:

$$\frac{\mathrm{d}\pi_T}{\pi_T} = (1-\pi_T)\frac{(\mathrm{d}D_T)^{OT}}{D_T}. \tag{27}$$

If the length of the career is adjusted sufficiently so that the first shock in equation (26) is fully absorbed, the change in the benefit ratio can be written as

$$\frac{\mathrm{d}\delta_T}{\delta_T} = -\pi_T\frac{(\mathrm{d}D_T)^{OT}}{D_T}, \tag{28}$$

and this change can further be divided over the new and old retirees according to the mechanism described in the previous section. However, if the length of the career is not adjusted sufficiently, the change in δ_T as described in equation (28) will not be sufficient to restore the pay-as-you-go equilibrium. The average pension (and therefore the Musgrave ratio) has to decrease further through a decrease in the pensions of the new retirees (who did not prolong sufficiently the length of their career) without affecting the pensions of the actual retirees who do not benefit from the increase in life expectancy.

4.4 Policy levers and monitoring

In the previous sections, we described a general structure to think about how to realise economic and social sustainability at the same time. We described how to satisfy the pay-as-you-go budget constraint while respecting the (conditional) Musgrave rule as a criterion of intergenerational justice. Of course, the model that has been sketched remains highly stylised. In reality, things are more complicated. This is immediately clear when we introduce the expression at the left-hand side of equation (24) into the Musgrave rule (18):

$$\frac{s_T^N(\overline{rZ})_T(\delta_T^*/N_T^*) + s_T^O(\overline{rZ})_{T-1}(\delta_{T-1}^*/N_{T-1}^*)\beta_T}{(1-\pi_T)} = \mu \tag{29}$$

As argued in Appendix C, the averages $(\overline{rZ})_T$ and $(\overline{rZ})_{T-1}$ reflect behavioural reactions and are not directly controlled by the policy maker. It is obvious therefore that the Musgrave rule is not a law that should be chiseled in stone. It is a kind of compass that can help to steer the direction of the adjustment mechanism in a rational and transparent way.

Moreover, it is necessary to make a distinction between policy parameters that can be set by the government and endogenous variables. The parameters that can be

manipulated by the government (leaving aside the intragenerational allocation of points) are the reference career length N_T^* (including the choice of α_T), the gross replacement rate for the reference person δ_T^*, the contribution rate π_T, the sustainability coefficient β_T and the early retirement window ω_T. Careful modeling is needed to understand the relationship between these policy levers and the endogenous variables of interest (see Appendices C and D for some stylised results). The latter includes, e.g., the average pension ($\overline{P}_T$) and the dependency rate (D_T), that both will be influenced by labour supply, and, more specifically, by retirement behaviour. Closely related is the development of r_{iT} and Z_{it} for different groups of the population (and hence of the average $(\overline{rZ})_T$ for cohort T). While we have treated $\overline{S}_t$ as exogenous, in a broader view of the economy it is also endogenous. Of course, with $\overline{P}_T$ and $\overline{S}_t$ being endogenous, the same is true for the benefit ratio δ_T. While all these variables are endogenous, they are all observable and calculable. Information on them should be collected on a regular basis so that permanent monitoring of the pension system becomes possible.

5 A brief comparison with other systems

While our pension proposal was formulated for the specific case of Belgium, there is of course, nothing specifically 'Belgian' about it. In fact, it shares important features with the reforms that have been implemented in other countries. In this section, we briefly comment on the similarities and differences between our proposal and, first, principles of the NDC systems, which inspired reforms in Sweden, Italy or Poland, and, second, the points system in Germany.

5.1 NDC systems

NDC systems have been widely used in various European countries as a powerful tool to reform old and deeply entrenched DB schemes and to bring long-run financial sustainability. NDC systems present a lot of similarities with our proposed points system. Both mechanisms generate a clear 'contributive principle', either through a link between the contributions paid before retirement and the benefits received after retirement, or through a link between gross earnings and the benefits received. They contain automatic adjustment techniques to take into account future demographic and economic trends; they allow for individual flexibility while guaranteeing actuarial neutrality; they try to combine the solidarity induced by the PAYG technique with an individual logic of accumulation in a personal account. But there are also major differences in the approach and in the consequences in terms of risk sharing between generations. We mention three main reasons why we prefer our proposed points system to existing NDC systems.

First, NDC establishes by definition a DC system, meaning that the contribution rate remains constant over time. As a consequence, the whole adjustment of the system required by ageing will only affect the level of present and future benefits. This does not mean that there is no risk sharing between active people and retirees. Indeed, the adjustment mechanism can affect the notional rate applied to the notional accounts of active people as well as the adaptation of the current pensions. But the impact is only on the

benefit side, leading to a risk of a progressive social erosion of the whole system. Of course, financial stability is crucial for social security but, as emphasised before, the aim of a first pension pillar is also to offer social sustainability. The points system we propose seems to offer a better compromise between these two goals; there is not only sharing between generations but also a balanced allocation of the burden of ageing between the increase of the contributions and decrease of the benefits.

Second, NDC looks really like individual saving accounts or life annuity contracts with very few collective aspects. The communication is mainly focused on a yearly rate of return on contributions, be it a notional rate instead of a pure investment return in a funded scheme. This prominent similarity with the logic of pure individual saving can generate confusion and undesirable incentives; for instance, people can mistake the NDC notional rate for a measure of financial market returns. The extreme individualization also leads to a lack of more collective responses, which are the essence of a social security system. In our approach, there is less possible confusion with financial instruments, and the individual mechanism of points allocation does not preclude collective messages. For instance, the adjustment mechanism (21) of the reference career length is a strong and clear message towards the citizens, much easier and more transparent to communicate than changes in annuity prices as in NDC.

Third, in NDC the benefits are defined in a direct relation to the contributions paid. Implicitly, this assumes a funding only based on contributions on wages. In our system, we prefer to link the benefits to gross earnings. By doing so, we still establish a strong link between the contributing effort of the worker and his future pension but we also allow more freedom in the general financing of the system. In our approach, it is possible to apply a ceiling of the gross earnings for the allocation of points but still to use the total earnings as a contribution basis. Even if something similar has been done in the Swedish NDC system (ceiling of the contribution to calculate the pension but no ceiling of the employer contribution), the result is that two different notions of 'contribution' are used; this is confusing, notably in the NDC context. More importantly, in our system, other forms of funding than contributions can be naturally implemented, i.e. 'alternative financing' is part of the available policy instruments. Thus, the points system offers more degrees of freedom than pure NDC.

5.2 The points system in Germany

The German points system is also in many respects congenial to the points system proposed in this paper.[28] For each affiliate, the pension is the product of the points earned over the career, the value of the point at the time of retirement and an individual correction factor related to the individual's age of retirement (in short, the 'age conversion'): this is completely analogous to our equation (2). As in our equation (4), the points are based on the ratio of gross earnings to average gross earnings. There are also non-contributory points for unemployment, child care, sickness and invalidity, education, caring for your parents, and military services. The value of the points is indexed (with a one-year lag for data availability) to the gross wage

[28] See, e.g., Börsch-Supan *et al.* (2007).

change adjusted for the total contribution rate change (including contributions to both public and private 'Riester' pensions) and for the economic dependency change (the sustainability factor). The presence of the 'Riester' pension contribution (fixed at a theoretical level of 4%) in the determination of the value of the point is intended to operate a partial crowding out of the public (pay-as-you-go) system by the private Riester pension. In the German system, the value of the point is therefore used to pursue different objectives at the same time. In our proposal, it is only linked to the intergenerational distribution.

The German sustainability commission has set the sustainability coefficient in 2003 at 0.25 of the change in the economic dependency ratio so as to achieve the contribution rate targets of a maximum of 20% by 2020 and 22% by 2030 and to maintain a pension level of 67% of net earnings, as legally fixed in the Riester reform. The sustainability commission also proposed to raise the legal retirement age gradually from 65 to 67 by 2035, which corresponds to two-thirds of the expected change in life expectancy. The early retirement age is adjusted accordingly. The age conversion is based on this uniform retirement age with a malus of 3.6% by year of anticipation. The 2007 reform introduced an exception for workers with a career of 45 years who can retire 2 years earlier without actuarial adjustment.

Therefore, the German pension formula is like our formula indexed to the entire working life earnings, with a built-in mechanism (sustainability factor) to adjust to the demographic and economic changes, and with pension benefit linked to the change in the average wage net of contributions. Interestingly, as mentioned before, the sustainability coefficient in the German system replicates the Musgrave rule when the contribution rate to the pension system is close to 25% (which is the value set for the sustainability coefficient). Of course, our explicit introduction of the Musgrave rule makes the intergenerational equity implications more transparent, and we have also explained under which conditions the Musgrave ratio can be allowed to change.

However, a central difference between the German pension system and our proposal is the fact that we introduce the notion of a reference career. As described before, this implies a fundamental shift from a uniform retirement age to a uniform career requirement. The value of the point is indexed to a reference career and the age conversion is based on the individual-specific normal retirement age (i.e., without actuarial adjustment). Moreover, the reference career rather than the retirement age is indexed to longevity. As a result, increasing life expectancy reduces *ceteris paribus* the value of the point, leading workers to work longer to preserve their pension benefit. The reasons for our introduction of a reference career have been explained in Section 3.2.2. Since those starting earlier are in general less educated and earn less, our proposed system introduces a social correction in favor of the low-skill and low-income group. This makes the indexation of the career requirement to longevity politically more acceptable. It is worth noting that the 2004 reform raising the retirement age was one of the most unpopular reforms in Germany; it was strongly opposed by the trade unions and therefore delayed until 2007. Many loopholes and exceptions were introduced, diminishing its effect on the effective retirement age. As for the actuarial adjustments, they were mostly opposed by the employers' union because they

increase the severance costs. Hence, political economy arguments further underscore the need for a reform proposal which can be justified – in terms of fairness – by a focus on the career length rather than the age of retirement per se.

6 Conclusion

The points system that has been proposed by the Belgian Commission for Pension Reform 2020–2040 has some interesting features. It makes it possible to separate to a large extent issues of intra- and intergenerational equity. Intragenerational equity can be realised in a flexible and transparent way through the allocation of points within a cohort. Transparency is important to increase the perceived legitimacy of the system and to allow people to make their economic decisions with a good idea about the consequences for their future pension. Flexibility is important because it makes it possible to accommodate within the system different views about the boundaries of individual responsibility and about the content of solidarity. The intergenerational distribution is determined by fixing the value of a point for the newly retired and the sustainability parameter for the actual retirees.

A pay-as-you-go system is socially sustainable only if credible promises can be made to the younger contributing generations. The value of the point links future pensions to the future average living standard of the population in employment. Pensions will increase in real terms if earnings increase and they will decrease if earnings decrease.[29] Moreover, credible promises also require that the system is economically sustainable. We proposed an automatic adjustment mechanism with some specific features that distinguish it from the mechanisms that have been set up in other countries (OECD, 2012). A key role is played by the reference career length. The proposed adjustment mechanism implements the Musgrave rule by stating that the ratio of pensions over labour earnings net of pension contributions should remain constant (a promise in a conditional sense, as explained above). The conditional Musgrave rule induces a balanced distribution of the burden of demographic and economic shocks over the different cohorts and can also be seen as a transparent mechanism of intergenerational risk sharing.

The process of automatic adjustment should certainly not be seen as a mechanical device. However, the principles described in this paper clearly define the criteria of intergenerational justice and economic and social sustainability that should be monitored. They give a compass to guide the adjustment process in the right direction. In that sense, they also constrain the freedom of future governments to introduce unbalanced changes in the intergenerational distribution.

Our description of the points system in this paper has deliberately been stylised. Our aim was to clearly illustrate the main variables that should be permanently monitored:

[29] In practice, it is highly improbable that pensions would decrease, even in the unlikely case of a temporary decrease in average earnings: to avoid sudden shocks, the linkages we propose should be implemented on the basis of moving averages, which have a smoothing impact. Moreover, in order to prevent downward nominal adjustment of pensions, it is conceivable to apply a floor when average wages decrease and to subsequently delay the coupling of pensions to later increases of wages until the impact of the floor has been neutralised.

the pay-as-you-go budget, the dependency rate, the average length of the career, and the Musgrave ratio. The development of these parameters indicates the direction in which the system should move. To move the system in the right direction, the government disposes of a number of policy levers: the reference length of career, the reference replacement rate, the window of early retirement, the sustainability ratio, and the contribution rate. Our stylised model shows when and how these various levers should be handled. Their exact values, however, depend on empirical relationships and on the predicted behaviour of economic agents. Therefore, constant monitoring of the important parameters has to be accompanied by careful calculations and simulations with macromodels and with microsimulation models. Moreover, in actual reality, drastic changes in the parameters need to be avoided: one will therefore, have to resort to the use of moving averages. Further, the pay-as-you-go equilibrium should be realised over the economic cycle: surpluses should be created in good periods to cover the deficits in bad periods. In this respect financing from general means can act as a buffer. More generally, alternative financing of pension expenditures can easily be integrated into the automatic adjustment mechanism as described. Yet, while formally easy, it raises difficult questions of equity and efficiency. More empirical work is needed to fine-tune our proposal.

We have left open the difficult question of the transition. We did not discuss the political conditions that must be fulfilled for this kind of structural reform to be accepted. The introduction of the points system was included in the program of the government in 2014 and in 2017 an important step has been taken when the pension administration expressed its interest in the system and its willingness to implement it. Yet, real progress will only be possible if the government succeeds in fostering enough support for a structural pension reform that anticipates on future, and, by definition uncertain, evolutions, whilst fixing a clear societal ambition. On this fundamental issue, the introduction of the points system in Belgium is still in a preparatory stage.

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Appendices

Appendix A – Pseudo-actuarial corrections

A traditional correction for actuarial neutrality (also applied in the common notional defined contribution-systems) would look as follows:

$$r_{iT} = \frac{a_T(x^*_{iT})}{a_T(x_{iT})}, \tag{A.1}$$

where

$$a_T(x) = \sum_{s=x}^{\infty} p_T(x, s) \frac{(1+g)^{s-x}}{(1+i)^{s-x}} \tag{A.2}$$

with i the discount rate (assumed constant), g the indexation rate of future pensions (assumed constant) and $p_T(x, s)$ the probability for somebody with age x at time T to be still alive at age s. If $i = g$ (which is a reasonable assumption in the long-run), equation (A.2) reduces to

$$a_T(x) = \sum_{s=x}^{\infty} p_T(s, x) = e_T(x),$$

and equation (A.1) simplifies to equation (8).

Appendix B – The retirement decision

Freedom of choice with respect to the moment of retirement can be structured with three concepts: the actual age of retirement x_{iT} (see equation (6)), the individual specific normal age of retirement x^*_{iT} (see equation (7)) and the legal age of retirement $\bar{x}^*_T$. The latter is introduced to solve the problem of unrealistically old 'normal' ages of retirement and is defined as

$$\bar{x}^*_T = x_0 + N^*_T, \tag{A.3}$$

where x_0 is the normal starting age of the career for educated workers. A natural choice would be $x_0 = 22$, but this can change over time. Changes in the reference length of the career will automatically affect this legal retirement age.

Assume that an individual has a career with a freely chosen gap of N_{iG} years, which are not assimilated to working. These freely chosen career breaks are not included in the calculation of the actual career length N_i. Moreover, his/her normal age of retirement will be adjusted to become

$$x^*_{iT} = x_{i0} + N_{iG} + N^*_T. \tag{A.4}$$

We introduce a window ω_T which defines the minimal age at which early retirement is possible. This minimal age is individual specific and is given by

$$x^{min}_{iT} = \min(x^*_{iT}, \bar{x}^*_T) - \omega_T. \tag{A.5}$$

For those retiring earlier than $\min(x^*_{iT}, \bar{x}^*_T)$, the pseudo-actuarial adjustment r_{iT}, as given in equation (8) is generalised to

$$r_{iT} = \frac{e_T\left[\min(x^*_{iT}, \bar{x}^*_T)\right]}{e_T(x_{iT})}. \tag{A.6}$$

No pseudo-actuarial adjustment is applied if $\min(x^*_{iT}, \bar{x}^*_T) < x_{iT} < x^*_{iT}$. If $x_{iT} > x^*_{iT}$ pseudo-actuarial bonuses are calculated with the original formula (8).

With this system individuals with $\min(x^*_{iT}, \bar{x}^*_T) < x_{iT} < x^*_{iT}$ would still have an incentive to work longer, because working longer is rewarded with additional pension

points. If this is seen as insufficient, one can introduce for all individuals a lump-sum pension points bonus for each year that they work beyond their age of (potential) early retirement. Such a lump sum would be relatively more important for low-income earners.

Appendix C – Replacement and benefit rates

Denoting the number of new and old pensioners by B_T^N and B_T^O respectively, the average pension can be written as

$$\overline{P}_T = \frac{B_T^N}{B_T}\overline{P}_T^N + \frac{B_T^O}{B_T}\overline{P}_T^O, \tag{A.7}$$

with $\overline{P}_T^N$ and $\overline{P}_T^O$ the average 'new' and 'old' pensions. Assuming for simplicity (and without loss of generality) that there are only two periods, i.e., that all actual cohorts of retirees did retire in the period $T-1$, we can use equations (11) and (3) to rewrite equation (A.7) as

$$\overline{P}_T = s_T^N(\overline{rZ})_T \frac{\delta_T^*}{N_T^*}\overline{S}_T + s_T^O(\overline{rZ})_{T-1}\frac{\delta_{T-1}^*}{N_{T-1}^*}\overline{S}_T\beta_T, \tag{A.8}$$

where s_T^N and s_T^O denote the share of new and old pensioners in the total number of retired and $(\overline{rZ})_T$ is the average value of $r_{iT}\,Z_{iT}$ in period T (averaged over all members of the cohort retiring at T).

Dividing through by $\overline{S}_t$ we obtain the following expression for the benefit ratio:

$$\delta_T = s_T^N(\overline{rZ})_T \frac{\delta_T^*}{N_T^*} + s_T^O(\overline{rZ})_{T-1}\frac{\delta_{T-1}^*}{N_{T-1}^*}\beta_T. \tag{A.9}$$

If the pensions of the actual retirees do not change if δ_T^* changes, i.e., if β_T does not depend on δ_T^*, the relation between the benefit ratio and the reference replacement rate is fully captured by the first term in equation (A.9). Additional insights are gained (and no insights are lost) by considering the approach, advocated in Section 4.3.2, in which β_T is set in such a way that the revalorisation of the pensions follows the changes in the value of the point (see equation (25)):

$$\beta_T = \frac{\delta_T^*/N_T^*}{\delta_{T-1}^*/N_{T-1}^*}.$$

Equation (A.9) then reduces to

$$\delta_T = \left[s_T^N(\overline{rZ})_T + s_T^O(\overline{rZ})_{T-1}\right]\frac{\delta_T^*}{N_T^*} \tag{A.10}$$

This expression immediately shows that the relation between the benefit ratio δ_T and the reference replacement rate δ_T^* depends on the age composition of the group of retirees (s_T^N and s_T^O), on the reference career length N_T^* and on the average values of $r_{iT}\,Z_{iT}$ in the different periods. These average values depend on behavioural reactions (labour supply during the active career and the choice of the moment of retirement) and on the rules that are used to allocate the points. If these rules are

(reasonably) assumed not to depend on δ_T^*, and if the behavioural reactions are neglected, the relation between δ_T and δ_T^* is unambiguously positive. The behavioural reactions on $(\overline{rZ})_T$ can go either way, since changes in δ_T^* will have both substitution and income effects on labour supply. However, the second (positive) term between brackets depends on past decisions and is fixed in period T. It is therefore highly unlikely that the overall effect of an increase in δ_T^* on the benefit ratio would be negative.

Note that equation (A.10) only contains variables that are in principle empirically observable. It can, therefore, be estimated reasonably well with the available data.

Appendix D – Changes in life expectancy

Assume that all individuals have the same life expectancy ℓ and that they are uniformly distributed over all possible ages. Denoting the number of pension years by b, the number of working years by a and the number of years not worked (e.g. because of schooling, unemployment, disability) by u. We will then have that in a steady state

$$\ell = a + b + u,$$

and therefore the dependency rate is given by

$$D = \frac{B}{A} = \frac{b}{a} = \frac{b}{\ell - b - u}.$$

Now assume that life expectancy changes, such that $\Delta\ell = \ell_1 - \ell$. Assuming that u remains constant, the change in b that will keep the dependency rate D constant can be derived from

$$\frac{b}{\ell - b - u} = \frac{b_1}{\ell_1 - b_1 - u}$$

to get

$$\frac{b}{\ell - u} = \frac{b_1}{\ell_1 - u},$$

or

$$\frac{b}{b + a} = \frac{b_1}{b_1 + a_1}. \tag{A.11}$$

Equation (A.11) is equivalent to equation (22) in the main text.