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ARTICLE

Pension reforms in Hungary: have they gone too far?

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Abstract

As a result of unfavorable demographic processes, the pension systems in the Central and Eastern European (CEE) EU countries face significant challenges, which has made the implementation of reforms inevitable in the last decade. Relying on economic theory, this paper analyses the effects of the Hungarian pension reforms in comparison with those of other CEE countries, and discusses the consequences from the point of view of social policy and the sustainability of the pension schemes. We explore the reasons why the reforms in Hungary ultimately did not improve sustainability but rather contributed to dismantling the social care system. Therefore, the Hungarian case provides useful lessons for other countries, and at the same time underlines the importance of automatic adjustment mechanisms. The study pays particular attention to the theoretical analysis of pension indexation because its accurate quantitative effects are far from being sufficiently clarified in the literature, although it is vital for a thoughtful evaluation of pension reforms.

Keywords: indexation mechanism; pension reforms; sustainability

JEL Classification: H55; J14; J18

1. Introduction

Like the majority of economically developed countries, Hungary is facing serious problems regarding the sustainability of the pay-as-you-go (PAYG) pension system. As a result of the low birth rate, the population is constantly decreasing, while the life expectancy of the elderly is increasing. The unfavorable demographic trends are putting the pension system under double pressure, and as a result, the old age dependency ratio has increased from 24 to 34% over the last two decades, which has presented significant challenges to the pension system and has made reforms inevitable.

However, governments are often reluctant to implement reforms to improve the sustainability of the pension system, as such reforms carry political risks and may entail political costs (Weaver and Willén, 2014; Gannon *et al.*, 2020). Unavoidable measures are postponed for a long time or introduced only when they are urgently needed. Therefore, it is not surprising that in the last decade, more and more countries have resorted to incorporating some form of automatic adjustment mechanism (AAM) into the pension system (Jedynak, 2018). In the case of the application of the AAM, decisions related to sustainability will take effect regardless of political will, which undoubtedly reduces the political risk (Bosworth and Weaver, 2011) and makes it easier for measures to be decided on a professional basis.

However, the case of Hungary is completely different. The political situation is extremely stable, as the party ruling the country since 2010 won the vote of confidence for the fourth time in a row with a two-thirds majority in 2022, which created an exceptional opportunity to take measures to ensure the long-term sustainability of the pension system. The reforms carried out over the past decade have affected all important elements of the pension system, including the retirement age, contribution rates, and the pension indexation system. In our study relying on the theory of pension policy, we examine the effect of all relevant measures in comparison with pension reforms taking place in Central and Eastern European (CEE) EU countries. We reveal the reasons why the Hungarian reforms ultimately did not lead to an improvement in the sustainability of the pension scheme, but rather to the dismantling of the social welfare system.

Furthermore, we pay special attention to the effects of indexation on pensions, basically for two reasons: partly because the indexation of pensions has undergone an important change in Hungary, which affects the balance of the pension system. It is even more important, however, that the analysis of pension indexation is quite scant in the literature, as Hohnerlein (2019) and Piggott and Sane (2009) remarked, and that the exact quantification of the effect of indexation is almost completely absent.

While the evaluation of the Hungarian pension reforms in comparison with other CEE countries is the focus of the study, we make three contributions to the theoretical literature of pension economics as well. First, we develop a general model that is suitable for clearly determining the impact of pension indexation on aggregate pension expenditures and the benefit ratio. Using the developed model, we identify the variables influencing the effects of changes in the indexation mechanism on the benefit ratio. Since the magnitude of these effects depends on several factors, we perform a sensitivity analysis to determine the most important ones. Our results show that under rational parameters the impact of a change in pension indexation is fundamentally determined by the wage growth and the replacement rate, while the role of the population growth rate and the years spent in retirement is marginal. This conclusion provides an important message for economic policy since it enables a precise assessment of the improvement in the balance of pension schemes triggered by switching to a less generous indexation method. Second, we prove that in the vicinity of a zero population growth rate characterizing most CEE countries, the dependency ratio can remain unchanged despite the increasing life expectancy if the ratio of the years spent in retirement to the active years does not change. Third, we show through the example of Hungary that governments with poor economic performance can use the pension system to break the connection between real wage growth and labor productivity growth, thereby preserving the illusion of a well-performing economy.

The remainder of the paper is organized as follows. In the first chapter, we briefly discuss the sustainability and the fundamentals of the PAYG pension scheme. In the second chapter, we present the basic equations of the model and examine the evolution of the dependency ratio in Hungary and other CEE countries. In the third chapter, we expand the model and analyze the relationship between the indexation of pensions, pension expenditures, and the benefit ratio. After discussing the theoretical background, we assess the impacts of changes in the indexation mechanism in CEE countries on the evolution of benefit ratios. In the fourth chapter, we explore the reasons that caused the contribution rate to decrease to such an extent in Hungary, which was almost unprecedented in economic history. Then, using the results of the previous chapters, we evaluate the reforms that have taken place in the Hungarian pension system in the last ten years from the point of view of sustainability. The study ends with a summary and conclusions.

2. Sustainability and the fundamentals of the pay-as-you-go pension scheme

Considering the sustainability of the pension system, several concepts and approaches can be found in the economic literature. The wide concept of sustainability includes financial stability (which undoubtedly is one of the main components of pension scheme sustainability), intergenerational fairness, and the lack of abrupt changes in the system's main parameters (Jedynak, 2018). The narrow concept of sustainability focuses only on the fiscal balance of the pension scheme in the long term. In this approach, sustainability is understood as the capacity of a pension system to meet its long-term financial and social commitments without the necessity of external financing (OECD, 2012).

A looser definition of long-term sustainability requires that the present value of contributions equals the present value of benefits over an infinite horizon (IMF, 2021). This approach, however, does not exclude external financing, in contrast to the narrow concept above, but only requires that the level of debt of the pension scheme stabilizes at some level in the long term. The problem with this approach is that it involves the possibility of violating the principle of intergenerational fairness. For generations who are pensioners when debt is piled up because of deficits in the pension scheme, the internal rate of return (IRR) of contributions exceeds that following from the Aaron–Samuelson theorem (Samuelson, 1958; Aaron, 1966).[1] By contrast, for generations who are pensioners when debt is paid down or interest is paid on the accumulated debt, the IRR falls short of that determined by the Aaron–Samuelson theorem since contributions must finance not only pension benefits but debt service as well. In what follows, we rely on the narrow definition of sustainability which excludes external financing and requires that the pension scheme be close to balance even in the short term, thereby ensuring intergenerational fairness.

The violation of intergeneration fairness is not the only problem stemming from the external finance of the pension scheme. First, in countries with a vulnerable fiscal position or limited access to finance, pension system deficits could lead to unsustainable debt dynamics, and an increased sovereign risk premium (IMF, 2021). Second, a deficit in the pension system reduces the nationwide saving rate which brings about lower private investment through the classical crowding-out channel. As a result, the long-term growth rate of the economy declines, and the country converges to a lower steady-state income level compared to what it would have achieved with a balanced pension scheme. Thus, the presence of external financing is not without economic costs. Furthermore, these costs are country-specific and can vary on a large scale, emphasized by both the theoretical (Dedák and Dombi, 2018; Dombi and Dedák, 2019) and the empirical growth literature (Eberhardt and Presbitero, 2015). In countries with a high saving rate and with a low population growth rate – conditions typical for developed countries – the impact of public debt on steady-state output is modest. In contrast, the burden of public debt can be very serious under the conditions of less developed countries with low saving rates and high population growth rates.

The PAYG pension systems are defined by the linkage between generations in which contributions from the active population fund the pensioners' benefits. If the pension scheme is financially balanced then the contributions are equal to the pension payments, so the well-known basic equation of the PAYG system (Barr, 2000; Börsch-Supan *et al.*, 2016) can be written as:

$$\tau(t)W(t)N_W(t) = B(t)N_R(t) \tag{1}$$

where τ is the contribution rate, N_W is the number of people in the working-age population, N_R is the number of pensioners, W and B are the average wage and pension payment respectively, and t stands for time.

The left side of the equation shows the contributions the pension fund receives, which depend on the number of people in the working-age population, the contribution rate, and the wage a worker earns. The right side of the equation shows all the pension payments that are determined by the number of retirees and the average pension paid to them.

The impact of both demographic developments and government pension reform measures on the PAYG system can be seen even more clearly if we divide equation (1) by $W(t)N_W(t)$ and express the changes.

$$\frac{d\tau(t)/dt}{\tau(t)} = \frac{d\beta(t)/dt}{\beta(t)} + \frac{d\mu(t)/dt}{d\mu(t)} \tag{2}$$

where β is the benefit ratio defined as the ratio of average pension payment to the average wage ($\beta(t) = B(t)/W(t)$), and μ is the dependency ratio, which is the number of pensioners divided by the number of people in the working-age population ($\mu(t) = N_R(t)/N_W(t)$).

[1]The Samuelson–Aaron theorem states that the IRR of a financially balanced pay-as-you-go pension scheme is the sum of the growth rate of the population (n) and wages (g). That is, the present value of contributions an individual pays during the working years is equal to the present value of benefits the individual receives during retirement if contributions and benefits are discounted by $n + g$.

According to equation (2), there are three key variables of the PAYG pension scheme (the dependency ratio, the benefit ratio, and the contribution rate) and the evolution of these determines sustainability.

Because of the demographic developments and the impacts of global financial crises, Hungary, like many other developed countries, had to face significant challenges regarding the sustainability of the pension system. To meet these challenges, substantial reforms have been enacted over the past decade fundamentally affecting each of the main components of the PAYG system. In what follows, relying on economic theory, we will scrutinize the impact of Hungarian pension reforms on each of the key variables of PAYG and compare them with reforms in other CEE counties. Then we will assess the combined effects of the reforms on the sustainability of the Hungarian pension scheme.

3. Pension reforms and the dependency ratio

We work with continuous-time variables in our model and the fertility-driven population growth rate is denoted by n and it is constant in time $((dN/dt/N) = n)$. Concerning the demographic developments, like many other authors (Knell, 2012; Börsch-Supan *et al.*, 2016), we use the 'sudden death' model. We assume that all age groups live for $T(t)$ years and retire at the age of $R(t)$. Consequently, the number of years spent in retirement is $T(t) - R(t) = j$. The active population starts working at the age of A and spends $R(t) - A = z$ years at work. Let N_t be the size of the cohort retiring at time t. Then the size of the age group retiring in time $t + i$ is given by:

$$N_{t+i} = N_t e^{ni} \tag{3}$$

Before moving on, it is worth noting that, in terms of modeling mortality, one could also work with a survival function instead of the sudden death version (Blanchard, 1985; Dombi and Dedák, 2019). However, for the sake of simplicity and better handling of the model, we will use the sudden death version of the pension model and will neglect the use of the survival function. Furthermore, Dedák and Fiser (2023) have proved that using a survival function does not fundamentally change the conclusions compared to a model applying the sudden death assumption.

As we have seen in the previous chapter, one of the central elements of the PAYG pension system is the dependency ratio (μ), which is defined as the ratio of the age groups in retirement ($N_R[t]$) to the working-age population ($N_W[t]$). Considering the variables introduced above, the dependency ratio can be expressed as:

$$\mu = \frac{N_R(t)}{N_W(t)} = \frac{\int_{t-j}^{t} N_t e^{n(s-t)} ds}{\int_{t}^{t+z} N_t e^{n(s-t)} ds} = -\frac{e^{-nj} - 1}{e^{nz} - 1} \tag{4}$$

Based on equation (4), the dependency ratio in the long term is solely determined by three factors: the population growth rate, the number of years spent in work, and the number of years in retirement. Since $\partial\mu/\partial n < 0$, the lower population growth rate leads to an increase in the dependency ratio. However, this does not mean that the dependency ratio rises without limit; over time it stabilizes at the level determined by equation (4). Furthermore, with a given population growth rate and retirement age, an increase in life expectancy at 65 (i.e., an increase in j) also causes an increase in the dependency ratio. Equation (4) therefore simply reflects the double pressure (a low population growth rate and increasing life expectancy) that weighs on the sustainability of pension systems in developed countries.

The following figure, based on equation (4), illustrates the old-age dependency ratio (which is the ratio of the people aged 65 and above relative to those aged 20–64) as a function of the population growth rate and the expected age at 65 (Figure 1).

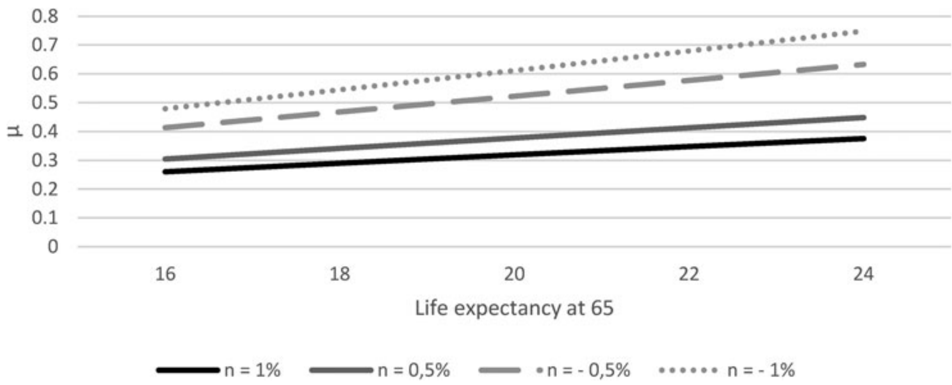

Figure 1. The old-age dependency ratio as a function of population growth rate and life expectancy at the age of 65 ($z = 45$).

Since the population growth rate is close to zero in most developed countries, the case of $n = 0$ deserves special attention. From the point of view of the sustainability of the pension system equation (4) can be written in an extremely useful form in the case of $n = 0$. Applying the l'Hôpital's rule yields:

$$\lim_{n \to 0} - \frac{e^{-nj} - 1}{e^{nz} - 1} = \frac{j}{z} = \mu \qquad (5)$$

According to equation (5), the dependency ratio is simply determined by the number of years spent in retirement and the number of working years. In other words, equation (5) claims that the dependency ratio is stable if a constant share of adult life is spent in retirement.[2] Consequently, the dependency ratio can remain unchanged despite the increasing life expectancy if the ratio of the years spent in retirement to the active years does not change, which means that $dj = \mu dz$ must hold. For example, if the dependency ratio $\mu = 1/2$ and the life expectancy at 65 increases by one year, then the retirement age must increase by eight months ($dz = 2/3$ and $dj = 1/3$) to keep the dependency ratio at the same level despite the higher life expectancy.

In general, the effect of changing life expectancy and retirement age can be summarized as follows: if $(dj/dz) = \mu$ then $d\mu = 0$, if $(dj/dz) < \mu$, then $d\mu < 0$, while $(dj/dz) > \mu$, then $d\mu > 0$.

Although the dependency ratio defined in equation (5) is based on the assumption of zero population growth, the deviation from the values conveyed by equation (5) is not too large in the vicinity of $-0.003 \leq n \leq 0.003$. (For example, if $n = 0.003$ and $j = 20$, the difference between the results of equations (4) and (5) is only four percentage points.) Therefore, equation (5) serves as a suitable theoretical benchmark for the evaluation of the impact of the increasing life expectancy and retirement age on the evolution of the long-term dependency ratios in CEE countries.

Based on equation (5), the following table shows the impact of pension reforms and increasing life expectancy on retirement years and the long-term dependency ratios (μ_{2010} and μ_{2022}) in CEE countries (Table 1).

As can be seen from the table, because of the reforms, the legal retirement age increased in all CEE countries, except for Poland, where it remained unchanged. The largest increase in the statutory

[2]It is worth noting that equation (5) serves as a theoretical basis for why the automatic stabilizers (AAM) linking the retirement age to life expectancy can stabilize the dependency ratio and thereby the fiscal balance of the pension scheme. This relationship is recognized and emphasized by OECD (2021). '*A two-thirds link roughly keeps the share of adult life that people can expect to spend in retirement constant across cohorts.… if fertility rates are close to the population replacement rate of about 2.1, a two-thirds link in a PAYG system basically ensures a stable pension replacement rate across generations financed by a stable contribution rate in a sustainable way*' (OECD, 2021, p. 93).

Table 1. The evolution of long-term dependency ratio in CEE countries

Country	Average statutory retirement age in 2022 (2010)[a]	Life expectancy (LE) at 65 in 2019 (2010)[b]	Change in retirement years[c] ($dj = dLE - dz$)	dj/dz	Long-term dependency ratio[d]	
					μ_{2022}	μ_{2010}
Bulgaria	63.1 (61.5)	16.3 (15.6)	−0.9	−0.57	0.42	0.46
Czech Republic	63.1 (60.5)	18.4 (17.4)	−1.6	−0.61	0.47	0.54
Estonia	64.3 (62.0)	19.0 (17.4)	−0.7	−0.29	0.45	0.49
Croatia	64.0 (62.5)	17.9 (16.7)	−0.3	−0.20	0.43	0.45
Hungary	65.0 (62.0)	16.9 (16.5)	−2.6	−0.87	0.38	0.46
Latvia	64.3 (62.0)	17.4 (16.1)	−1.0	−0.43	0.41	0.45
Lithuania	64.1 (61.3)	17.9 (16.7)	−1.6	−0.57	0.43	0.49
Poland	62.5 (62.5)	18.5 (17.6)	0.9	–	0.49	0.47
Romania	63.6 (61.5)	16.9 (16.1)	−1.3	−0.62	0.42	0.47
Slovakia	62.4 (59.9)	17.9 (16.3)	−1.9	−0.36	0.48	0.54
Slovenia	65.0 (62.0)	20.1 (19.2)	−2.1	−0.7	0.45	0.53

Source: Eurostat, European Commission's Ageing Report 2021, Finnish Center for Pensions.
[a]The effective retirement age somewhat differs from the statutory retirement age because of the allowances countries apply. However, these retirement allowances keep narrowing because of pension reforms, so the gap between the effective and statutory retirement age is getting smaller.
[b]The pandemic caused a break in the time series for life expectancy at 65. Therefore, we used the data for 2019 as a proxy for life expectancy in 2022.
[c]*dLE* is calculated as the change in life expectancy while *dz* is calculated as the change in the statutory retirement age. The change in retirement years (*dj*) is the difference between *dLE* and *dz*.
[d]In the calculations of the long-term dependency ratios the number of working years (*z*) was determined as average statutory retirement age minus 20 years, while *j* is the difference between the statutory retirement age and life expectancy at 65.

retirement age occurred in Lithuania, Hungary, and Slovenia. Between 2013 and 2021, the retirement age gradually increased to 65 years in Hungary for both women and men from the previous 62 years. However, the evolution of the long-term dependency ratio is influenced not only by the change in the retirement age but also by the change in the number of years spent in retirement. In other words, when calculating dj, in addition to the change in the retirement age, the change in expected age at 65 must also be considered as shown in the fourth column of the table.

As the Hungarian life expectancy is very low, the largest fall in the retirement years (2.6 years) among the CEE countries over the past 12 years has occurred in Hungary. Given this, it is not surprising that in terms of the statutory retirement age, Hungarian pensioners can count on the fewest years of retirement among the CEE countries both in terms of the absolute number of years and in proportion to the years worked. Moreover, the expected retirement years for a new pensioner in 2022 in Hungary are less than 20 years ago.

Since the (dj/dz) ratio took on a negative value in almost all the CEE countries, the long-term dependency ratios declined remarkably as shown by the data on μ_{2010} and μ_{2022}. The largest fall in the long-term dependency ratio occurred in Hungary, Slovenia, and the Czech Republic, at 19, 16, and 13%, respectively. From an economic point of view, the significant reduction of the long-term dependency ratios seems rational both in the Czech Republic and Slovenia because the dependency ratios were very high in these countries and far exceeded the CEE average (48.7%) in 2010. Thus, the strict pension reforms aiming at reducing long-term dependency ratios can be regarded as a significant step forward in the direction of the sustainability of the pension schemes in these countries.

The case for Hungary is completely different. The dependency ratio was below the average of the CEE countries even in 2010, so the low value of dj/dz (−0.87) over the past decade has led to the lowest long-term dependency ratio among CEE countries (38%) by 2022. Given this, the remarkable decrease in the long-term dependency ratio (19%) in Hungary seems to be extremely large even if we consider the fact that the actual fall in the long-term dependency ratio must be smaller than the one predicted by equation (5) since the reforms did not change the rule that women can retire regardless of age after 40 years of service without any adverse effect on their established pension.

4. The impact of pension reforms on the indexation mechanism and the benefit ratio

Pension indexation is an important feature of pension systems for a number of reasons. The indexation mechanism has a significant impact on the sustainability of the pension system since it is one of the factors determining pension expenditures but it is also important from a social point of view, as it basically affects the standard of living that the elderly can achieve compared to their active years (Broeders *et al.*, 2014). In the EU, 23 countries apply indexation rules, in which pension increases are tied to changes in prices, wages, or a combination of these. Among the CEE countries, ten apply some form of indexation mechanism and the only exception is Romania where the changes in pension payments are determined by discretionary measures (European Commission, 2021a).

Pension indexation serves several purposes. Indexation linked to changes in consumer prices prevents a decrease in the real value of pensions, and, depending on the size of the benefit ratio, enables a certain standard of living to be maintained (Barr and Diamand, 2009). If the indexation is based on a combination of prices and wages, even those already retired can benefit from the growing performance of the economy. Since real wages tend to increase because of economic growth driven by technological progress in the long run, the purchasing power of those who are already retired can also rise if the pension increase is to some extent linked to wages (Disney and Whitehouse, 1991).

Although the importance of pension indexation is widely agreed upon, there are still relatively few studies dealing with the topic, as Hohnerlein (2019) and Piggott and Sane (2009) rightly noted in the recent past. In addition, the impact of indexation on pensions is completely different depending on whether it is examined from the point of view of a single pensioner or at an aggregate level considering all pensioners. This distinction is extremely important in the analysis of the economic effects related to indexation, both from the perspective of the sustainability of the pension system and from a social point of view. For example, during the global financial crisis, many countries suspended or limited the indexation to reduce pension expenses and improve the balance of both the pension system and the central government budget. Limiting the indexation mechanism during crises is a fairly common practice (Whitehouse, 2009; Brimblecombe, 2013); therefore, the determination of the quantitative effects of indexation is essential for both the evolution of pension payments and for economic policy.

Before assessing pension reforms related to the change in the indexation, we develop a model that is suitable for calculating the effects the change of indexation rules exert on pension expenditures and that at the same time promotes a better understanding of the relationship between indexation and the sustainability of the pension system. Then, relying on the developed theoretical model, we examine the indexation mechanisms of pensions in the CEE countries and assess how the change in the indexation rules in Hungary affected the sustainability of the pension system.

We focus on real variables throughout, so W_t denotes the real wage at time t, and φ is the replacement rate. (The replacement rate measures the very first pension benefit against the last wage before retirement, and we take it as given.) The initial pension of the age group retiring at time t is $P_t = \varphi W_t$. α is the degree of indexation and $0 \le \alpha \le 1$. The case of $\alpha = 0$ corresponds to the price indexation, which means that the real value of pensions for a retired individual does not change during the retirement years. This indexation mechanism is in effect in Slovakia and Hungary. If $\alpha = 1$, the indexation of pensions is fully linked to wages and approximately this is the case in Latvia. The case for $\alpha = 0.5$ represents the Swiss indexation, which means that the increase in nominal pensions is determined half by inflation and half by nominal wage growth. In this case, the real value of the pension of a retired individual grows at a rate just equal to half of the growth rate of real wages. The Swiss indexation is very popular in CEE countries since it is applied by Bulgaria, Czech Republic, and Lithuania, as can be seen in Table 2.

Keeping track of the evolution of the benefit ratio is quite simple from the point of view of a single pensioner. Let g denote the growth rate of real wages, then the benefit ratio for an individual with s years after retirement ($b[s]$) can be expressed as follows:

$$b(s) = \frac{\varphi W_t e^{\alpha gs}}{W_t e^{gs}} = \varphi e^{-g(1-\alpha)s} \tag{6}$$

According to equation (6) the individual benefit ratio keeps falling during the retirement years if $\alpha < 1$. The higher the growth rate of real wages and the lower the degree of indexation the smaller the individual benefit ratio is at any moment in time. As an illustration, assume that $\alpha = 0.4$ that is, the degree of indexation is almost halfway between price and wage indexation which corresponds to the average of CEE countries. Let us assume that $g = 0.035$ and $s = 19$, and these parameters also represent the average of the CEE countries. Under these conditions, a retired individual's benefit ratio at the end of his/her life will be 33% lower than it was at the beginning of his/her retirement.

The behavior of the benefit ratio at the aggregate level is completely different and much more complicated, fundamentally for two reasons. First, since real wages tend to rise, the pensions of new entrants to the pension system are higher than those who leave the system due to death.[3] Therefore, at the aggregate level, the average pension increases even if $\alpha = 0$, that is, when the pension of those who entered the system earlier remains unchanged during the retirement years. On the other hand, since population growth is usually different from zero, the number of pensioners belonging to a certain pension level changes continuously over time.

To determine how the average pension changes at the aggregate level, consider the following: if the pension of the cohort retiring at time t is $P_t = \varphi W_t$, then the pension of the age group retiring i years earlier is as follows: $P_{t-i} = \varphi W_t e^{-gi} e^{\alpha gi}$. The term e^{-gi} represents the effect of wages on the starting value of pensions and reflects that the older a pensioner is, the smaller the initial value ($\varphi W_t e^{-gi}$) of his pension was. The term $e^{\alpha gi}$ represents the effect of indexation during the retirement years, and the larger α, the smaller the gap between the pensions of those who retire earlier and those who retire later. With this end in view, the average pension ($B[t]$) can be expressed as follows:

$$B(t) = \frac{\int_{t-j}^{t} N_t e^{n(s-t)} \varphi W_t e^{(g-\alpha g)(s-t)} ds}{\int_{t-j}^{t} N_t e^{n(s-t)} ds} \tag{7}$$

The numerator of equation (7) shows the total of all pensions paid, while the denominator shows the number of pensioners. To determine the change in the average pension, one must take the derivative of equation (7) with respect to time:

$$dB(t)/dt = \frac{d}{dt} \left| \frac{\int_{t-j}^{t} N_t e^{n(s-t)} \varphi W_t e^{(g-\alpha g)(s-t)} ds}{\int_{t-j}^{t} N_t e^{n(s-t)} ds} \right| \tag{8}$$

After derivation and integration, dividing equation (8) by equation (7) yields the dynamic behavior of average pension:[4]

$$\frac{dB(t)/dt}{B(t)} = g \tag{9}$$

The central message of equation (9) is that the change of the average pension is solely determined by the growth rate of wages. The degree of indexation does not affect the dynamics of the average pension,

[3]Except for the special situation when $\alpha = 1$, since in this case, the pension of those newly entering the system and those leaving it due to death is the same.

[4]Some intermediate steps for getting equation (9) are provided in Appendix B.

that is, the behavior of pensions at the aggregate level is completely different from the behavior one can see at the individual level, as reflected by equation (6). Furthermore, not only the degree of indexation but also the other variables (replacement rate, population growth rate, number of years spent in pension) have no effect on the dynamics of pensions at the aggregate level. The only variable determining the change of the average pension is the growth rate of real wages. Moreover, since the benefit ratio (β) at the aggregate level is the ratio of the average pension to the average wage $\beta = (B(t)/W(t))$, and $B(t)$ and $W(t)$ increase at the same rate, by g, the benefit ratio is constant, regardless of the indexation mechanism.

Although the degree of indexation does not affect the dynamics of the average pension and the aggregate benefit ratio, it does affect their level. In other words, indexation has a level effect on the benefit ratio, not a growth effect, which can be seen immediately after expressing the benefit ratio:

$$\beta = \frac{B(t)}{W(t)} = \frac{\int_{t-j}^{t} N_t e^{n(s-t)} \varphi W_t e^{(g-\alpha g)(s-t)} ds / \int_{t-j}^{t} N_t e^{n(s-t)} ds}{W_t} \tag{10}$$

After the integration, equation (10) takes the following form:

$$\beta = \frac{\varphi n}{1 - e^{-nj}} \frac{1 - e^{-(n+g-\alpha g)j}}{n + g - \alpha g} \tag{11}$$

Since $\partial\beta/\partial\alpha > 0$, the greater the weight of wage growth in the indexation mechanism, the higher the benefit ratio will be. So, comparing two countries that only differ in the degree of indexation, the average pension will be higher in the country with a higher α, but the growth rate of average pensions will be the same because it is solely determined by the rate of wage growth. Based on equation (11), the following figure illustrates the benefit ratio with parameters characterizing the CEE countries' average.

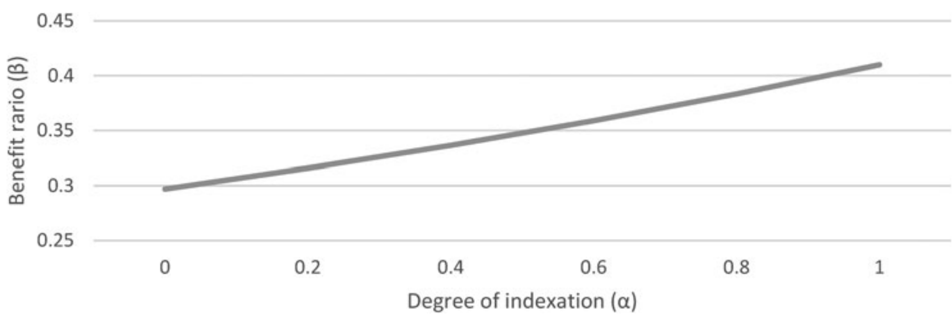

Figure 2. The benefit ratio as a function of indexation ($j = 19$, $n = -0.008$, $g = 0.035$, $\varphi = 0.41$).

The figure shows that an increase in the degree of indexation raises the level of the benefit ratio. For example, Swiss indexation ($\alpha = 0.5$) increases the benefit ratio by approximately 17% compared to just the price indexation ($\alpha = 0$). The aggregate benefit ratio reaches its peak when $\alpha = 1$. In this case, $\beta = \varphi$, that is, the benefit ratio is the same as the replacement rate, as follows from equation (11). This is also logical from an intuitive point of view, since in the case of wage indexation the individual's pension does not change at all compared to wages during the retirement years, so it is the same as the replacement rate, while the pension of new entrants is the same as the pension of retirees who leave the system due to death.

The degree of indexation is not the only variable that affects the level of the benefit ratio. According to equation (11), the number of years spent in retirement, the rate of population growth, the rate of wage growth, and the replacement rate also affect the benefit ratio. Among these parameters, the effect of the replacement rate can be seen immediately from equation (11) since it proportionally affects the benefit ratio. A 10% decrease in the replacement rate reduces the benefit ratio by 10%. However, regarding the effect of the other three factors, the situation is no longer so obvious. In Appendix A we present a sensitivity analysis which reveals that the evolution of the benefit ratio has almost no association with the number of years spent in retirement and the population growth rate but responds very sensitively to changes in real wage growth.

The following table shows the benefit ratio, the replacement rate, and the indexation mechanisms in CEE countries.

Table 2. The benefit ratio, the replacement rate and the degree of indexation in CEE countries in 2019

Country	Benefit ratio (β)	Replacement rate (ϕ)	Indexation to prices (%) and wages (%) and the implied value of α		Complementary remarks
Bulgaria	29.5	36.2	50/50	$\alpha = 0.5$	
Czech Republic	38.7	45.1	50/50	$\alpha \approx 0.5$	Applies to average pension and the indexation favors lower pensions
Estonia	31.3	39.8	20/80	$\alpha \approx 0.8$	The 80% stands for pension contribution revenues
Croatia	30.9	32.5	70/30	$\alpha = 0.3$	
Hungary	37.8	44.8	100/0	$\alpha = 0$	
Latvia	25.7	31.7	0/100	$\alpha \approx 1$	Total wage bill instead of average wages. Large pensions are indexed only partially
Lithuania	28.8	54.8	50/50	$\alpha \approx 0.5$	The ratio for old age pensions depends on contribution years; small pensions are indexed in full, large pensions are indexed only partially
Poland	40.2	54.1	80/20	$\alpha \approx 0.2$	Prices + at least 20% of real wages
Romania	32.8	27.1	Ad hoc	–	Change in pension payments depends on ad hoc decisions
Slovakia	37.8	33.2	100/0	$\alpha \approx 0$	A minimum fixed amount adjustment guaranteed
Slovenia	32.8	41.6	40/60	$\alpha = 0.6$	

Source: European Commission (2021a, 2021b, 2022), OECD (2021).

As Table 2 indicates, the generosity of the pension schemes represented by the benefit ratio varies on a large scale in the CEE countries, mainly due to the large variation in the indexation rules and the replacement rates. The most generous pension system is in Poland with a benefit ratio of 40.2% while the least generous scheme is in Latvia with a benefit ratio of 25.7%.

When it comes to Hungary, significant government measures have been taken over the past 15 years to reduce pension expenditures and the benefit ratio. First, as a response to the negative effects of the global financial crisis of 2008 the 13th-month pension was abolished. However, this does not affect the actual value of the benefit ratio, as it was reintroduced in 2022, mainly for political reasons related to the parliamentary elections. Another important step was the change in pension indexation. Before 2008, the amount of the pension increase was determined half by inflation and half by wage growth, that is, the Swiss indexation was in effect. In 2009, the Swiss indexation was suspended, then the new government completely abolished it in 2011 and instead set the goal of preserving the purchasing power of pensions by introducing a new indexation mechanism linked entirely to inflation. What happened in fact, was a significant reduction in the degree of indexation; the value of α decreased from 0.5 to 0. Since $\alpha = 0$ entails that the generation which is already retired is excluded from the gain of a thriving economy, it is not surprising that only one of the CEE countries (Slovakia) applies pure price indexation. By switching to price indexation from Swiss indexation, Hungary was the second CEE country to introduce the strictest indexation rule.

According to equation (11) a huge fall in α must lead to a significant drop in the benefit ratio in the CEE countries because they are on a catch-up path associated with high real wage growth. With a real wage growth of 3.5% characterizing the CEE countries over the past decade, a reduction of α from 0.5 to zero decreases the benefit ratio by 17% in the long run as shown in Figure 2. However, the real wage growth was very modest in Hungary (1.1%), less than one-third of the CEE countries' average, so the introduction of the price indexation decreases the benefit ratio only by 7.5%. As a result, the benefit ratio declined over the past decade but it still somewhat exceeds the CEE countries' average, mainly thanks to the relatively high replacement rate which was left untouched by the Hungarian pension reforms.

Since the abolition of Swiss indexation means that those who are already retired will not benefit from the better performance of the economy at all, the Hungarian government tried to compensate for this negative effect on pensioners by introducing the so-called pension premium. The essence of the measure is that if GDP growth exceeds 3.5%, pensioners are entitled to a pension premium. Each percentage point of GDP growth above 3.5% enables the payment of a pension premium equal to ¼ of the monthly pension. However, the impact of the introduction of the pension premium system on pension payments is rather small, mainly for two reasons. First, the upper limit of the amount of the pension premium is maximized at a rather low level. Secondly, we must consider one of the key results of the neoclassical growth theory literature (Mankiw, 1995; Islam, 2003) namely, the GDP growth in a country at an income level similar to that of Hungary cannot significantly exceed 3.5%.[5]

All in all, with the transition to price indexation, Hungary has switched to a much more stringent indexation mechanism, which is only applied by Slovakia in the CEE countries so far. However, the change in the indexation mechanism only modestly reduced the benefit ratio in Hungary because of the extremely low real wage growth. Nonetheless, if the wage growth accelerates in the near future and reaches at least the average of the CEE countries, a significant decrease in the benefit ratio can be taken for granted.

5. The impact of the measures of the Hungarian pension reform on the equilibrium of the pay-as-you-go pension system

In the previous chapters, we have seen that both the benefit ratio and the dependency ratio have undergone significant changes in Hungary over the past decade. The benefit ratio decreased by 7.5%, mainly due to the abolition of Swiss indexation, while the dependency ratio decreased by 16%, mainly because of the significant increase in the retirement age, so the combined long-term effect of the two factors was −23.5%.

In order to evaluate the pension system from a sustainability point of view, in addition to the dependency ratio and the benefit ratio, we must also take into account the change in the contribution rate. In Hungary, both employees and employers pay pension contributions based on wages. The employee pension contribution rate is 10% and has not changed at all in the last decade. A larger part of the contributions paid by employers finances pension payments while a smaller part funds health expenditures. In the last decade, the employer's contribution rate has been significantly reduced from 27 to 13%; moreover, a smaller proportion finances pension expenditures. Regarding the contributions of employees and employers together, this means that the average contribution rate has been drastically cut from 33 to 20%. This change corresponds to a 40% decline in the average contribution rate,[6] which is a huge drop hardly ever seen in economic history, especially at a time when demographic trends are challenging pension systems like never before.

The 40% reduction in the contribution rate far exceeds the improvement that took place in the benefit and the dependency ratio together. Given this, it is not surprising that the Hungarian pension system,

[5]Regarding the speed of convergence in the neoclassical growth theory, an economic growth rate of 3.5% in the initial years of the catch-up process means that the steady-state income is 2.5 times as high as the initial income. Since the income level of Hungary is around 70% of the EU average at present, a 3.5% growth rate would imply that the Hungarian economy should converge to an income level that is 175% of the EU average. This is far beyond the economic rationality and not supported by the performance of the Hungarian economy in the recent past.

[6]It is worth noting that the fall in contribution payments in percentage terms is somewhat smaller than that implied by the reduction of the employers' contribution rate. The reason for this is that the smaller contribution rate of employers enables firms to raise wages, which entails larger contribution payments as well.

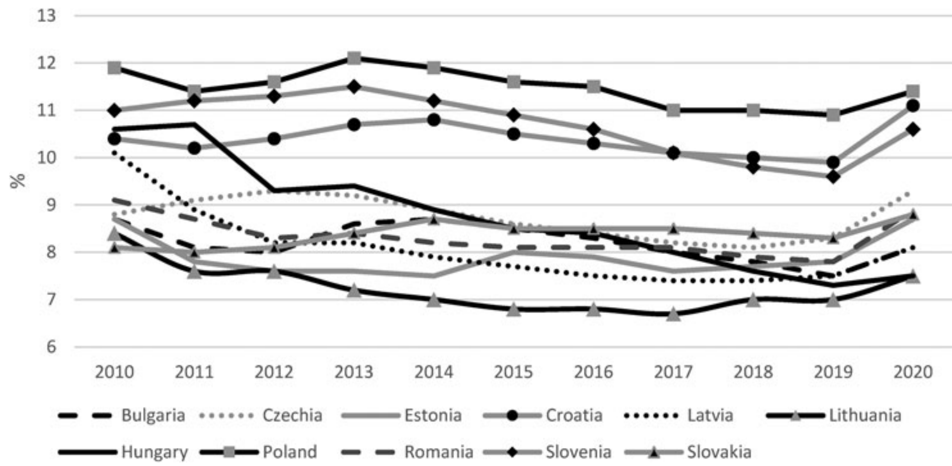

Figure 3. Pension expenditures as a percent of GDP in Central and Eastern European EU countries between 2010 and 2020.
Source: Eurostat.

which was close to equilibrium at the beginning of the last decade, gradually turned into a deficit, and it nearly reached 1.5% of GDP in 2022. Although equation (2) implies a slightly greater deterioration than 1.5%, the reason why this did not happen can be found in the change in the employment rate, which increased significantly in all groups of the working population. From the point of view of the balance of the pension system, the positive effects of the increase in the employment rate appear immediately in the form of higher contribution revenues, while the negative effects caused by the increasing pension expenditures – because of the increase in the number of persons entitled to pension benefits and the increasing pensions due to more contribution years – only appear in the distant future.

All in all, we can conclude that the Hungarian pension reforms not only weakened the sustainability of the pension system but also contributed to the destruction of the social care system by reducing pension expenditures in proportion to GDP as shown by Figure 3.

The figure shows that pension expenditures compared to GDP have dropped dramatically in Hungary over the past decade from 10.6 to 7.5%. While the pension expenditure to GDP ratio was the third highest in 2010 among the CEE countries, it was the lowest in 2020, along with Lithuania. Since the plunge in pension expenditures was basically triggered by a historic 40% reduction in the contribution rate, the important question is obviously what prompted the government to resort to this drastic measure.

The answer lies in the weak performance of the Hungarian economy. In the past ten years the growth rate of labor productivity, which fundamentally determines real wage growth, fell to one-third of the growth rate characterizing the decade before the global financial crisis. What is more, Hungary performed extremely poorly not only in comparison to its own former performance but compared to its regional competitors as well. This is illustrated in Figure 4.

As a result of low productivity growth, Hungary keeps sliding down in the income ranking among the EU-27 countries. While it was in 20th place in 2010 in terms of the income per person employed, it slipped back to 25th place in 2021.

Low wage growth resulting from poor labor productivity carries political risks (Alesina *et al*., 1996; Brückner and Gradstein, 2015). What can a government do to mitigate this risk? It can try to break the connection between real wage growth and labor productivity growth. The obvious way to do this is to reduce the contribution paid by employers since this decreases the costs of production. A reduction in the contribution rate allows firms to increase wages above productivity growth without causing additional inflationary pressure. The implication of this government measure is an immediate and higher real wage growth, which may entail political benefits.

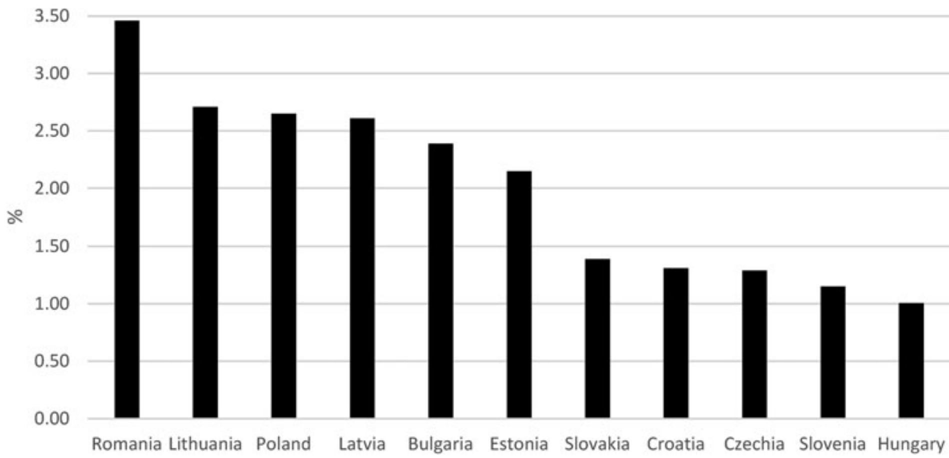

Figure 4. The average growth rate of GDP per person employed in Central and Eastern European EU countries between 2010 and 2021.
Source: Eurostat.

To see the accurate impact of the reduction of employers' social contribution rate on the real wage growth one must start from the definition of the labor share of income. The labor share (λ) is defined as the proportion of total labor cost to GDP, and can be written as:

$$\lambda(t) = \frac{Total\ labor\ cost}{GDP} = \frac{N_W(t)\bar{W}(t)(1+\tau_1(t))}{N_W(t)y(t)P(t)} \tag{12}$$

where $\bar{W}$ is the nominal wage, y is the real GDP per workers, τ_1 is the contribution rate paid by employers, P is the price level.

The dynamics of real wages ($\bar{W}/P$) can be obtained by taking logs and derivatives of equation (12) with respect to time.

$$\frac{d(\bar{W}/P)/dt}{\bar{W}/P} = \frac{dy/dt}{y} + \frac{d\lambda/dt}{\lambda} - \frac{d\tau_1/dt}{1+\tau_1} \tag{13}$$

According to equation (13) the growth rate of real wages is equal to the growth rate of labor productivity ($[dy/dt/]/y$) if the labor share and the employer's contribution rate are unchanged.

However, if the employers' social contribution rate declines, the real wage growth exceeds the labor productivity growth, as shown by the last term of equation (13). In other words, governments with poor economic performance can preserve the illusion of a well-performing economy by significantly reducing the employers' contribution rate.

This is exactly what happened in Hungary. The labor productivity was only 15% larger in 2022 than in 2010 while real wages grew by 28%. The difference can be mainly attributed to the significant decrease of the employers' contribution rate from 27 to 13%. This fall in the employers' contribution rate increased the real wages by 11% as follows from the last term of equation (13). In other words, with the lack of a reduction of the social contribution rate the real wages would have grown only by 17% instead of 28%. That is, a remarkable fraction (40%) of the real wage growth between 2010 and 2022 in Hungary can be explained by the unprecedented decline in the employers' social contribution rate.

However, such a government action also has its costs since a large reduction in the contribution rate weakens the sustainability of the pension system and makes it necessary to reduce the benefit ratio and raise the retirement age much more than demographic developments would justify. But these austerity measures can be explained to voters as unavoidable ones that had to be taken to respond to the problems caused by the global financial crisis and the aging society.[7] In addition, a special feature of the Hungarian case is that, while the unprecedented decrease in the contribution rate can be traced back to the poor performance of the economy, the growing deficit in the pension fund as a result of the reforms further weakens the economy's growth potential through the crowding-out channel.

All in all, Hungary's past decade provides an excellent example of how governments with poor economic performance can use the pension system to achieve short-term political goals instead of taking the long-term sustainability measures suggested by economic theory.

6. Conclusions

In our study, we evaluated the measures of the Hungarian pension reform in comparison with the reforms of CEE countries. The sustainability of PAYG pension systems in all CEE countries faces serious challenges because of demographic processes, so pension reforms become unavoidable. Our results indicate that, in terms of the strictness of the reforms, the Hungarian measures stand out by far among the examined countries.

As a result of the reforms, the dependency ratio has decreased remarkably in all CEE countries. However, due to the significant increase in the retirement age and the low life expectancy, the dependency ratio is by far the lowest in Hungary and pensioners can expect the fewest years of retirement. The abolition of Swiss indexation reduced the degree of indexation from 0.5 to zero, while the CEE countries' average fluctuates around 0.4. The switch to price indexation not only excludes pensioners from benefiting from the growing economic performance but also caused a 7.5% decrease in the benefit ratio. Moreover, if wage growth, which has been extremely low in Hungary, accelerates in the future, a further significant drop in the benefit ratio can be expected.

In sum, it seems that the measures of the Hungarian pension reform have gone too far, which is reflected, among other things, by the fact that pension expenditures compared to GDP decreased by 30% (from 10.6 to 7.4%) over the past decade. Hungary, along with Lithuania, has spent the least on pensions in proportion to GDP. The Hungarian pension reforms turned out to have been more stringent than those introduced by other CEE countries, and much stricter than what the country's demographic processes would justify.

Surprisingly, however, the sustainability of the pension system did not improve because the reduction in the contribution rate far exceeded the fall in the dependency and benefit ratio. The unprecedented reduction in the contribution rate can be traced back to the weak performance of the Hungarian economy. Eventually, the Hungarian pension reform led to the demolition of the social care system, while the long-term sustainability of the pension system was impaired. The Hungarian case provides an outstanding example of how politicians can use the pension system to cover up the poor performance of the economy. At the same time, it underlines the importance of AAMs in future pension policies since they serve the sustainability of the pension system by overriding the short-term interests of politicians.

Competing interests. The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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[7]Politicians can use a number of tricks to avoid the unpleasant political consequences of painful measures related to pension reforms, as Bosworth and Weaver (2011) have excellently demonstrated. For instance, 'They also frequently use "stealth" mechanisms that are difficult for voters to understand, such as changes in indexation mechanisms and increasing the number of years worked that are needed to qualify for a "full" pension benefit. Politicians may also employ other mechanisms to reduce blame by voters, such as reform processes that share responsibility across political parties' (Bosworth and Weaver, 2011, p. 10).

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Appendix A

The sensitivity analysis of the benefit ratio

The degree of indexation is not the only variable that affects the level of the benefit ratio. According to equation (11), the number of years spent in retirement, the rate of population growth, the rate of wage growth also affect the benefit ratio.

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To see how the benefit ratio responds to changes in n, j, and g we performed a sensitivity test. (The parameters of the baseline scenario represent the average of CEE countries.) The results are shown in the following table.As can be seen from the table, there is a positive relationship between the population growth rate and the benefit ratio; a higher population growth rate leads to an increase in the benefit ratio. However, the effect is so weak that the benefit ratio reacts to a negligible extent to changes in the population growth rate. The situation concerning the years spent in retirement is the opposite, since there is an inverse relationship between the benefit ratio and the years spent in retirement. Although the partial effect here is somewhat stronger than in the case of the population growth rate, it is nevertheless quite small. In addition, the data on the joint sensitivity indicate not only that the partial effect of the population growth rate and the number of years spent in retirement is small, but that their combined impacts are rather weak as well.

Finally, the relationship between the rate of wage growth and the benefit ratio is negative; higher wage growth leads to a fall of the benefit ratio. However, in contrast to the effects of n and j, the growth rate of wages significantly affects the benefit ratio. For given benchmark values for the other parameters, the data on partial sensitivity show that an increase in the rate of wage growth from 1 to 4% reduces the benefit ratio by 5.9 percentage points (from 38.7 to 32.8%).

Table 1A. The sensitivity of the benefit ratio to n, j, and g

Baseline scenario: $n = -0.005$, $j = 19$, $g = 0.035$, $\varphi = 0.41$, $\alpha = 0.4$, $\beta = 0.34$						
Partial sensitivity	n		j		g	
	−0.01	0.01	17	23	0.01	0.04
Benefit ratio (%)	33.6	34.0	34.4	32.4	38.7	32.8
Joint sensitivity	$j = 23$	$j = 17$	$n = -0.01$	$n = 0.01$	$n = -0.01$	$n = 0.01$
	$g = 0.04$	$g = 0.01$	$g = 0.04$	$g = 0.01$	$j = 23$	$j = 17$
Benefit ratio (%)	31.2	39.0	33.5	38.4	38.2	33.9

Notes: The results of the joint sensitivity analysis are colored gray if the underlying parameter combination is detrimental to the sustainability of the pension scheme in the sense that it increases the benefit ratio.

Appendix B

The connection between indexation and the growth rate of the average pension

In this appendix, we present some intermediate steps that lead to the result obtained in equation (9). First of all, the solution of equation (8) requires an application of the Leibniz formula. Namely:

$$F(t) = \int_{a(t)}^{b(t)} f(t, x)dx \tag{B1}$$

$$F'(t) = f(t, b(t))b'(t) - f(t, a(t))a'(t) + \int_{a(t)}^{b(t)} \frac{\partial f(t, x)}{\partial t} dx \tag{B2}$$

Using equations (B1) and (B2) and considering the fact that $(\partial N_t/\partial t) = nN_t$ and $(\partial W_t/\partial t) = gW_t$ equation (8) can be written as

$$\frac{dB}{dt} = \frac{\{N_t\varphi W_t(1 - e^{-(n+g-\alpha g)j}) + (N_t\alpha g\varphi W_t/n + g - \alpha g)[1 - e^{-(n+g-\alpha g)j}]\}(N_t/n)(1 - e^{-nj})}{[(N_t/n)(1 - e^{-nj}]^2} -$$

$$\frac{N_t(1 - e^{-nj})(N_t\varphi W_t/n + g - \alpha g)(1 - e^{-(n+g-\alpha g)j})}{[(N_t/n)(1 - e^{-nj}]^2} \tag{B3}$$

Dividing equation (B3) by equation (7), and after some simplification, one gets equation (9).

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