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The best indexation of public pensions: the point system

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The best indexation of public pensions: the point system

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Abstract

We reconsider the problem of indexation of public pensions, emphasizing that similar contribution paths should imply similar benefit paths. This robustness criterion is only satisfied by full wage indexing, which in turn requires the politically unpopular reduction of the accrual rates. To minimize the redistribution from low-earning short-lived citizens to high-earning long-lived ones, progressive benefits should be introduced.

Keywords: public pensions, indexation, fairness

JEL-codes: D10, H55

A legjobb nyugdíjindexálás a pontrendszer

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Összefoglaló

Újra megvizsgáljuk a társadalombiztosítási nyugdíjak indexálását, hangsúlyozva azt a követelményt, hogy hasonló járulékpályáknak hasonló járadékpályát kell adniuk. Ezt a robusztussági ismérvet csak a már megállapított nyugdíjak teljes bérindexálása elégíti ki, amely azonban a járadékszorzók politikailag népszerűtlen csökkentését igényli. Sőt, ez a módszer maximalizálja a jövedelem-újraelosztást a kiskeresetű rövid életűektől a nagykeresetű hosszú életűekhez. Ezért a teljes bérindexálás degresszív nyugdíjakat kíván.

Tárgyszavak: tb-nyugdíj, valorizálás, indexálás, pontrendszer, jövedelem-újraelosztás

JEL: D10, H55

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The best indexation of public pensions: the point system

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Abstract

We reconsider the problem of indexation of public pensions, emphasizing that similar contribution paths should imply similar benefit paths. This robustness criterion is only satisfied by full wage indexing, which in turn requires the politically unpopular reduction of the accrual rates; moreover, maximizes the redistribution from low-earning short-lived citizens to high-earning long-lived ones. Therefore the application of full wage-indexing calls for progressive benefits.

Keywords: public pensions, indexation, fairness

JEL-codes: D10, H55

1. Introduction

In modern economies, *initial public pensions* are indexed (valorized) by wages and *pensions in progress* are indexed by various combination of prices and wages. In my opinion, in the pension literature, the indexation of public pensions have not received the attention which it deserves. In this paper, I call attention to a number of conflicting aims and suggest that the point system is the best method.

In the short run, in a normal country, the issue of indexation of pensions on progress is almost irrelevant. The consumer price index is equal to about 102, the nominal wage index is 104. Who cares if the nominal pensions are increased by 2 or 4%, or their arithmetic average, 3%? A typical pensioner spends about 20 years in retirement, therefore, the annual 1–2% differences become 20–40% differences at the end and 10–20% deviations during the whole period. The latter difference manifests itself both at the macro and the micro levels.

In a less normal country, where real wages increase or decrease by 5–10% a year, with a relative freedom from the GDP's index, indexation matters even in the short-run. Just in Hungary, from 2016 to 2018, real net average wage grew by an astonishing 28% while the GDP only grew only by 10%, pensions even less than the GDP. Those, who retire in 2017–2019 receive pensions higher by 10–20–30% than those, who—with similar wage paths—retired in 2016. The whole story is described in Table 1.

The only method to avoid this anomaly is to raise pensions in progress by the nationwide wage growth rate, shortly: *wage indexation.* At the same time, this type of indexation makes the necessary reductions in the marginal accrual rate (transforming wages into initial benefits per contributive year) more visible and prefers those living longer (females and higher earners) and weakens the incentives to retire later. Finally, in a country, where the pension system is DC, some form of flat component is inevitable. At this point I must admit that between 2010 and 2017 I also accepted the prevailing wisdom in Hungary: only pure price indexation is feasible.

Here we give a short review of the relevant literature. The best starting point is Barr and Diamond (2008, Subsection 5.1.4) which begins with the indexation of covered wages in calculating the initial benefits (valorization) and indexation of benefits in payment (or in progress). Concentrating on the latter, they analyze the advantages and disadvantages of price and wage indexation: the price indexing defends the workers against drop in real benefit; for a given starting value, it is less costly to the government than wage indexing but for growing real wages, it results in a relative decrease of pensions to wages: the earlier one retired, the more so. Price indexation is better for short lived pensioners than for others.

Feldstein (1990) created a very abstract and extravagant model of the socially optimal age structure of the US Social Security benefits. Simonovits (2003, Section 14.4) modeled the intercohort impact of replacing wage indexation by price indexation. Legros (2006) analyzed the interaction of indexation and lifetime redistribution. Lovell (2009) gave a deep critique of the inconsistencies in US Social Security rules. Augusztinovics and Matits (2010); Borlói and Réti (2010) worked out the point system with and without basic pension for Hungary. Weinzierl (2014) analyzed the impact of various price indices on the US Social Security system. Knell (2018) gave a deep critique of various versions of cohort-specific NDC rules, and numerically illustrated their approximate characters.

Table 1. *Output, real wage and real pension dynamics: Hungary: 1993–2015*

Year	Real growth rate of GDP	net wage	pension	Replacement rate	Comment
t	$100(g_y-1)$	$100(g_w-1)$	$100(g_b-1)$	$\hat{\gamma}_t$	
wage indexation					
1993	–0.8	–3.9	–4.6	0.603	
1994	3.1	7.2	–4.7	0.594	E: change in PIT
1995	1.5	–12.2	–10.1	0.619	change in delay
1996	0.0	–5.0	–7.9	0.593	
1997	3.3	4.9	0.4	0.563	
1998	4.2	3.6	6.2	0.578	E
1999	3.1	2.5	2.1	0.592	
Swiss indexation (half wage+half price)					
2000	4.2	1.5	2.6	0.591	
2001	3.8	6.4	6.6	0.591	+ raise
2002	4.5	13.6	9.8	0.573	E++ raise
2003	3.8	9.2	8.5	0.568	+ 1 week pension
2004	4.9	–1.1	3.9	0.600	+ 2 weeks pension
2005	4.4	6.3	7.9	0.611	+ 3 weeks pension
2006	3.8	3.6	4.5	0.623	E + 4 weeks pension
2007	0.4	–4.6	–0.3	0.668	
2008	0.8	0.8	3.4	0.691	
2009	–6.6	–2.3	–5.7	0.672	no 13th month benefit
price indexation					
2010	0.7	1.8	–0.9	0.651	E
2011	1.8	2.4	1.2	0.647	
2012	–1.7	–3.4	0.1	0.670	
2013	1.9	3.1	4.5	0.678	overindexation
2014	3.7	3.2	3.2	0.675	E+ overindexation
2015	2.9	4.3	3.5	0.668	overindexation
2016	2.1	7.4	1.4	0.631	start of wage explosion
2017	4.1	10.2	3.0	0.583	wage explosion continued
2018*	4.0	8.0	2.0	0.550	wage explosion ends

Source: ONYF (2016, Table 1.3, p. 16), new data are added, * forecast, E = election.

It was probably Liebmann (2002) who first documented that the apparently progressive US Social Security system is hardly progressive on a lifetime basis, because life expectancy at retirement is an increasing function of the lifetime income. Recently there is a growing concern for this tendency which is strengthening. Among others, The National Academy ... (2015), Auerbach et al. (2017); Ayuso, Bravo and Holzmann (2017) reconsidered this problem on newer data. Simonovits (2018a, Section 14.4) returned to Legros's topic: the impact of weight of wage in indexation on the redistribution from the short-lived low-paid to the long-lived high-paid.

The structure of the present paper is as follows. Section 2 discusses the advantages and disadvantages of price indexation, while Sections 3 and 4 analyze the point system at macro and microlevels, respectively. Section 5 concludes. Appendix A contains the pension formulas for wage paths different from the average path, while Appendix B analyzes a model where the forced reduction of the employer's contribution rate temporary accelerates the real wage growth and strengthens inequalities between cohorts (Simonovits, 2018b).

2. Advantages and disadvantages of price indexation

In this paper, we calculate in real terms, i.e. we eliminate any inflationary effect. The only remaining problems stem from changes in the average real (total) wage.

In this Section, we create the core model. Let t be the index of year, v_t and b_t be the corresponding average net wage and benefit in real terms. Assuming a given *aggregate accrual rate* β (e.g. 0.8 for 40 years of contribution in Hungary), current initial benefit is proportional to past net wage:

$$b_{R,t} = \beta v_{t-1}. \tag{1}$$

(N.B. We have neglected the impact of the changing relative value of the cap operating.) General wage paths will be considered in Appendix A. Note that the valorization contains a one-year lag in a number of countries and this will create problem later on.

For price indexation, the benefit in progress retains its real value set at retirement:

$$b_{k,t} = b_{k-1,t-1} = \cdots = \beta v_{t-k+R}, \qquad k = R+1, \ldots, D-1, \tag{2}$$

where D is an integer denoting life expectancy.

Neglecting the rises in life expectancy and in normal retirement age, and the variability of the total fertility rate we have a stationary population. We assume that every pensioner (male or female) spends $T = D - R$ years in retirement. Then the average benefit and the average *replacement ratio* are respectively equal to

$$\bar{b}_t = \frac{b_{R,t} + \cdots + b_{D-1,t}}{T} \quad \text{and} \quad \gamma_t = \frac{\bar{b}_t}{v_t}. \tag{3}$$

Inserting (1) and (2) into (3):

$$\gamma_t = \beta \frac{v_{t-1} + \cdots + v_{t-T}}{T v_t}. \tag{4}$$

Dropping superscript v from g_t^v, let $g_t = v_t/v_{t-1}$ be the real growth factor of average net wages. For the time being, assume that this growth factor is time-invariant, i.e.

$$v_t = v_0 g^t, \qquad g > 1. \tag{5}$$

Substituting (5) into (4) and using the formula for the sum of the geometric progression, we obtain

Theorem 1. *For a constant real wage growth factor g, the corresponding constant replacement ratio is given by*

$$\gamma = \beta \frac{g^{-1} + \cdots + g^{-T}}{T} = \beta \frac{1 - g^{-T}}{T(g-1)}, \qquad g > 1. \tag{6}$$

Table 2 helps understanding a well-known disadvantage of price indexation: the higher the real growth rate, the lower the average replacement ratio with respect to the aggregate accrual rate. The lag in valorization (1) causes a small part of the drop, and the lagging of pensions in progress behind the initial one in indexation (2) causes the large part of the drop. Quantitatively, with $T = 20$ year, Table 2 demonstrates how the replacement ratio drops from 0.8 through 0.6 to 0.5 as the growth rate rises from 0 through 3 to 5%.

Table 2. *Average replacement ratio and growth rate of real wage*

Growth rate of real wage $100(g-1)$ %	0	1	2	3	4	5
Average replacement ratio γ	0.800	0.722	0.654	0.595	0.544	0.498

Turning to the more realistic time-variant growth rates, a more complex picture emerges. We shall derive a recursion connecting the new replacement ratio with the past replacement ratio and other factors.

Representing every cohort by a single pensioners, the change in the pension expenditure is connected by the change in the stock of pensioners:

$$T\bar{b}_t = b_t + T\bar{b}_{t-1} - b_{t-T}. \tag{7}$$

Hence relying on (4), the average replacement ratio is given by

$$\gamma_t = \frac{\bar{b}_t}{v_t} = \frac{\bar{b}_{t-1}}{g_t v_{t-1}} + \beta \frac{v_{t-1} - v_{t-T-1}}{T v_t}. \tag{8}$$

We introduce the accumulated real wage growth factor between years $t - T$ and t: $G_t = v_t / v_{t-T}$ which is also equal to the ratio of the next year's youngest and oldest pensions: $G_t = b_{t+1} / b_{t-T+1}$. (8) implies

Theorem 2. *For time-variant growth rates, the dynamic of replacement ratio is given by*

$$\gamma_t = \frac{\gamma_{t-1}}{g_t} + \beta \frac{1 - G_{t-1}^{-1}}{g_t T}, \qquad t = 0, 1, 2, \ldots. \tag{9}$$

It is worth adding some explanation to formula (9). The second term is less than $\beta/T = 0.04$, which pushes up or down the slightly contracted past replacement ratio.

Having this formula, we model the impact of the extraordinary wage rises occurring in Hungary during 2016–2018 on the average replacement ratio. We assume that there are two values of the real wage growth factors $1 < g_{\mathrm{m}} < g_{\mathrm{M}}$, the greater is reached in year $t_0 - 1, t_0, t_0 + 1$:

$$g_t = \begin{cases} g_{\mathrm{m}} & \text{if } t < t_0 - 1 \text{ or } t > t_0 + 1; \\ g_{\mathrm{M}}, & \text{otherwise.} \end{cases}$$

Noting that $G_0 = g_{\mathrm{m}}^T$ and $\gamma_1 = \gamma(g_{\mathrm{m}})$ and working with $g_{\mathrm{m}} = 1.02$ and $g_{\mathrm{M}} = 1.08$, Table 3 depicts a stylized process. Starting from a steady state, the wage explosion reduces $\gamma_0 = 0.654$ to $\gamma_3 = 0.557$ and then γ_t slowly rises again.

Table 3. *Dynamics of replacement ratio with price indexation*

Year t	Replacement ratio γ_t	Year t	Replacement ratio γ_t
–1	0.654	9	0.592
0	0.654	10	0.597
1	*0.618*	21	0.602
2	*0.585*	12	0.607
3	*0.557*	13	0.612
4	0.563	14	0.617
5	0.569	15	0.622
6	0.575	16	0.627
7	0.580	17	0.632
8	0.586	18	0.636

It is natural that the temporary drop of the average replacement ratio makes room for a similar temporary reduction of the contribution rate. But as the replacement ratio returns to its formal state, so does the contribution rate.

Finally, we present two simple though artificial examples showing the pitfalls of pure price indexation and fixed accrual rate.

Example 1. Start from the life path of citizen X, who worked 40 years before retired on the last day of year t, at the normal retirement age R. She will receive $b_{R,t}^X = \beta v_{t-1}$. Her twin brother Y, retired one day later, with the same wage path with benefit $b_{R,t}^Y = \beta v_t$. If $v_t > v_{t-1}$, then $b_{R,s}^Y = (v_t/v_{t-1})b_{R,s}^X > b_{R,s}^X$, for $s = t+1, \ldots, t+D-R$, just for an extra day of contribution.

The second example is much more robust than the first one.

Example 2. Let us assume that the real net wage is equal to v_m in even years, and to v_M in odd years, $v_m < v_M$. X starts to work in an even year; Y, who is one year younger, in an odd year. Both earn the annual average net wage during their careers. Since both work for 40 years, X retires in an even year, while Y does the same in an odd year and the previous anomaly is repeated: $b_t^X = \beta w_m$ and $b_t^Y = \beta w_M$. If wage indexation were in force, then the benefits would be $b_{2t}^X = 0.8 v_M$ and $b_{2t+1}^Y = 0.8 v_m$, but the last year's benefit of Y is again $b_{2t}^X = 0.8 v_M$, when X is already dead. The total benefits are the same.

3. Point system at macrolevel

We still consider the macroworld. We have already seen that with wildly oscillating real wages, the price indexation of pensions in progress is strongly unfair across cohorts. We add now: the partial wage indexation only dampens but does not eliminate unfairness. We have to answer the following question: why did the Hungarian government give up wage indexation in 2000, and the wage-price indexation in 2010? The answer is simple: for fast rising real wages, the fixed accrual rate have exploded the pension expenditures, especially when the fast aging population and slowily increasing average retirement age are also taken into account. Of course, the government could have reduced the accrual rate from 0.8 to 0.657 (consistent with $g = 1.02$) as suggested by Table 2 but it would have been difficult politically to do so. Furthermore, to dampen the impact of the more economical wage-price indexation, a 13th month pension was phased in between 2003–2006 (cf. Table 1 above).

Now we model the point system. To make room for the contribution and personal income tax rates, we rewrite the previous net wage equation for total rather than net wage (superscript w is also omitted):

$$w_t = g_t w_{t-1}. \tag{10}$$

Since we fix the pension contribution rate τ and the sum of the health contribution rate and the personal income tax rate, θ, the real value of the net income also grows in parallel:

$$v_t = (1 - \tau - \theta)w_t \quad \text{and} \quad v_t = g_t v_{t-1}.$$

We delay the formal definition of the point system to Appendix A, here we depict it as a simultaneous wage valorization and indexation. Anyway, we get rid of the lag in (1) as well as in (2).

Valorization of the initial pension with adjustable gross aggregate accrual rate:

$$b_{R,t} = \tilde{\beta}_t w_t. \tag{11}$$

Indexation of pensions in progress:

$$b_{R+k,t} = \tilde{\beta}_t w_t, \qquad k = 1, \ldots, T-1. \tag{12}$$

Denoting by P_t the number of pensioners, the pension expenditure is given by

$$B_t = P_t \tilde{\beta}_t w_t. \tag{13}$$

Denoting by M_t the number of workers, the pension revenue is also equal to

$$B_t = \tau M_t w_t. \tag{14}$$

Comparing (13) and (14) yields

$$\tau M_t = P_t \tilde{\beta}_t.$$

Introducing the old-age dependency ratio

$$\pi_t = \frac{P_t}{M_t},$$

simple calculation yields

Theorem 3. *For a point system, the adjustable gross and net accrual rates are respectively given by*

$$\tilde{\beta}_t = \frac{\tau}{\pi_t} \quad \text{and} \quad \beta_t = \frac{\tilde{\beta}_t}{1-\tau-\theta} = \frac{\tau}{(1-\tau-\theta)\pi_t}. \tag{15}$$

b) The benefit is independent of the year of retirement: $b_t = \beta_t v_t$.

Introducing the point system, we maintained the balance of the system and avoided the intercohort unfairness of price indexation. Note that this rule does not prevent a drop in the benefit when the accrual ratio or the net wage drops. If we set up a trust fund, then the following feedback rule helps avoiding any drop:

$$b_t = \begin{cases} \beta_t v_t, & \text{if } \beta_t g_t \geq \beta_{t-1} \text{ and } b_{t-1} > b_{t-2}; \\ \beta_t v_t + \kappa F_{t-1} & \text{if } \beta_t g_t \geq \beta_{t-1} \text{ and } b_{t-1} = b_{t-2}; \\ b_{t-1}, & \text{otherwise,} \end{cases}$$

where $\kappa > 0$ is an appropriately chosen feedback coefficient. The trust fund's dynamics is as follows:

$$F_t = F_{t-1} + \tau M_t w_t - P_t b_t, \qquad F_0 = 0. \tag{16}$$

This rule has nothing to do with the overindexation rule which used the greater of 1 or the real wage growth factor and operated in the UK between 1975 and 1980 (Barr–Diamond, 2008, Box 5.8, p. 77).

To demonstrate the operation of our rule, we use the following parameter values as of Hungary, 2018. Pension contribution rate: $\tau = (0.1 + 0.145)/1.195 = 0.205$; health + unemployment+PIT rate: $\theta = (0.135 + 0.15)/1.195 = 0.238$; i.e. with a dependency ratio $\pi = 0.6$, the gross and net replacement ratios are respectively equal to $\tilde{\beta} = 0.342$ and $\beta = 0.342/(1 - 0.205 - 0.238) = 0.614$.

Table 4 displays the following dynamic when the growth factor is given as $g_t = 1.02 + (-1)^t 0.04$, i.e. it alternates between 0.98 and 1.06, their geometric average being close to 1.02. Note that without the trust fund, from year 2 to year 3, in terms of the initial gross wage, the benefit drops from 0.355 to 0.348. In the modified system, in odd years, the benefit remains the same as previously, but in even years, its value is diminished with respect to the simple rule, e.g. in year 4, $0.355 < 0.369$. The trust fund value oscillates with narrow bounds.

Table 4. *Point systems (PS) without or with trust fund*

Year t	Net wage v_t	Pure PS benefit b_t^P	Modified PS benefit b_t	Modified PS trust fund F_t
1	0.545	0.335	0.335	0
2	0.578	0.355	0.355	0
3	0.567	0.348	0.355	–0.142
4	0.601	0.369	0.355	0.142
5	0.588	0.361	0.361	0.142
6	0.624	0.383	0.383	0.142
7	0.611	0.375	0.383	–0.011
8	0.648	0.398	0.397	0.011
9	0.635	0.390	0.397	–0.125

4. Point system at microlevel

In Sections 2 and 3, we demonstrated that at the macro-level, the only consistent method is wage indexation with an adjusted accrual ratio. This requires, however, some political courage from the government. Moreover, at micro-level, wage indexation has a very unpleasant side effect: since the life expectancies of various income groups widely differ, namely higher earners live longer, then the faster the benefits increase, the stronger the income redistribution from the shorter lived to the longer lived. This can only be mitigated by pension progression or return to progressive personal income taxation.

Working out the necessary changes, for simplicity, we neglect now the time-variance of real wage growth factors but relax the assumptions of homogeneous wages and life expectancies. (For a more general description, see Appendix A.) Let i be the index of group i, $f_i > 0$ be their initial frequency: $\sum_{i=1}^n f_i = 1$ and $w_{i,t}$ be the corresponding wage:

$$w_{i,t} = w_{i,0}g^t, \quad \text{where} \quad \sum_{i=1}^{n} f_i w_{i,0} = 1. \tag{17}$$

By assumption, everybody retires at age R, type i lives until D_i: D_i is increasing, and $\sum_{i=1}^n f_i D_i = D$.

It would be a simple solution to have type-specific accrual rates β_i $(i = 1, 2, \ldots, n)$ but it would be politically untenable. Rather, we rely on progression or equalize part of the DC benefits. Denoting average total and net wages by w_t and v_t, respectively, the share of proportional benefits be α, $0 \le \alpha \le 1$.

Then the point rule provides the mixed benefits:

$$b_{i,k,t} = \tilde{\beta}[\alpha w_{i,t} + (1-\alpha)w_t], \qquad k = R, \ldots, D-1. \tag{18}$$

Simplifying the calculations, we retain stationary population, and introduce the common *length of contribution* $S = R - Q$. The balance condition is now

$$\tau S w_t = \sum_{i=1}^{n} f_i T_i b_{i,t}.$$

Take the simply and doubly weighted average times spent in retirement respectively:

$$T = \sum_{i=1}^{n} f_i T_i \quad \text{and} \quad T_w = \sum_{i=1}^{n} f_i T_i w_{i,0}. \tag{19}$$

Obviously, $T_w > T$. Substituting (18) and (19) into the first balance condition, yields the second balance equation:

$$\tau S = \sum_{i=1}^{n} f_i T_i \tilde{\beta}[\alpha w_{i,t} + (1-\alpha) w_t].$$

Thus we have arrived to

Theorem 4. *(a) For heterogeneous wage profile* $(w_{i,0})$ *and times* (T_i) *spent in retirement, the balanced gross and net accrual rates are respectively equal to*

$$\tilde{\beta}_\alpha = \frac{\tau S}{\alpha T_w + (1-\alpha)T} \quad \text{and} \quad \beta_\alpha = \frac{\tilde{\beta}_\alpha}{1-\theta-\tau}. \tag{20}$$

Remark. As the proportional benefit's share α decreases, so rises the accrual rate. The proportion of the two extreme cases (0/1) is equal to T_w/T, and this also increases with heterogeneity.

We shall analyze the income redistribution due to heterogeneous earnings and life expectancies. Corresponding to the logic of the pay-as-you-go system, the *type-specific lifetime balance* in year 0 should be discounted by the real growth factor g, therefore it is defined by

$$z_i = \tau S w_{i,0} - \sum_{k=R}^{D_i} g^{-(k-R)} b_{i,k,k}.$$

Using (19), the balance is given by

$$z_i = \tau S w_{i,0} - \tilde{\beta}[\alpha T_i w_{i,0} + (1-\alpha)T_i]. \tag{21}$$

As an illustration , we consider the traditional homogeneous case, where $T_i \equiv T$, i.e. $T_w = T$, i.e. (20) is replaced by $\tilde{\beta} = S/T$, regardless α. The type-specific lifetime balance is equal to $z_i = \tau S(1-\alpha)(w_{i,0} - 1)$, i.e. those who earn below the average, gain ($z_i < 0$), the others lose ($z_i > 0$).

Table 5 presents a numerical example. There are three types: $w_{1,0} = 0.5$; $w_{2,0} = 1$ and $w_{3,0} = 1.5$; their frequencies are 1/3. Let the corresponding life expectancies be $D_1 = 75$, $D_2 = 80$, and $D_3 = 85$, Though their average is $D = 80$, the lower the proportional part, the higher the accrual rate. In addition, we display the life balances.

For a proportional system ($\alpha = 1$), the higher earners and longer lived are the gainers ($z_3 < 0$), the others are the losers; this changes with decreasing α.

Table 5. *Progression, accrual rates and balances*

Proportional share α	Net accrual rate β	Lifetime balance (life expectancy) short z_1	medium z_2	long z_3
1.00	0.680	1.262	0.631	–1.893
0.75	0.693	0.482	0.482	–0.965
0.50	0.707	–0.328	0.328	0.000
0.25	0.722	–1.172	0.167	1.004
0.00	0.737	–2.050	0.000	2.050

Note that we have left out the fragmentation of working careers (cf. Augusztinovics and Köllő, 2007) and here we make up this omission. We introduce the simple and double-weighted expected contribution lengths, respectively:

$$S = \sum_{i=1}^{n} f_i S_i \quad \text{and} \quad S_w = \sum_{i=1}^{n} f_i w_{i,0} S_i.$$

Now (20)–(21) modify into

$$\tilde{\beta}_\alpha = \frac{\tau S_w}{\alpha T_w + (1-\alpha)T}$$

and

$$z_i = \tau S_i w_{i,0} - \tilde{\beta}[\alpha T_i w_{i,0} + (1-\alpha)T_i].$$

We have also neglected early and late retirement, these problems have been analyzed in other papers (e.g. Czeglédi, Simonovits, Szabó and Tir, 2017 and Simonovits, 2018a).

5. Conclusions

At the end of the paper, we draw some conclusions. We have demonstrated that the apparently economical partial wage indexing or pure price indexation has a number of pitfalls. In addition to reducing the relative value of old benefits to current wages, it also creates unjustified differences between pension paths of close earning paths, especially for temporarily exploding real wages. This anomaly justifies a return to or the introduction of wage indexation, but the accrual rate of the initial benefits should be controlled. We have to realize the pitfall of the wage indexation that it maximizes the perverse redistribution from low-earning short lived citizen to high-earning long-lived ones. To mitigate this pitfall, we have to return to progressive pensions or progressive personal income taxation.

Unfortunately, introducing progression weakens the incentives to report wages. In addition, together with wage indexation, they weaken the incentives to work longer and strengthen those for early retirement. But the wage indexation is the smallest bad if supplemented with progression.

Appendix A. Valorization, indexation and point system

In the main text we avoided structurally changing time-variant real wage developments. Now we make up this omission.

Assume that a worker of type i, born in year t enters work at age Q and earns a net real wage $v_{i,a,t+a}$ at age a, $a = Q, \ldots, R-1$. Neglecting the implied net wage cap, her initial pension is given as

$$b_{i,R,t+R} = \delta_{t+R} \sum_{a=Q}^{R-1} G_{t+R-1,a} v_{i,a,t+a}, \tag{A.1}$$

where the *valorization multipliers* from age a to year $t+R$ in real terms are

$$G_{t+R-1,a} = \frac{v_{t+R-1}}{v_{t+a}}, \qquad a = Q, \ldots, R-1,$$

where v_{t+a} is the nationwide net real wage in year $t+a$ and δ_{t+R} denotes the marginal accrual rate.

Let ι be a real number between 0 and 1, which shows the weight of the wage growth on the benefit in progress, then

$$b_{i,a,t+a} = b_{i,a-1,t+a-1} g_t^{\iota}, \qquad a = R+1, \ldots, D-1. \tag{A.2}$$

It is obvious that $\iota = 1, 1/2, 0$ represent wage, wage-price and price indexation, respectively.

In year $t+a$, an i-type worker of age a earns points

$$p_{i,a,t+a} = \frac{v_{i,a,t+a}}{v_{t+a}}, \tag{A.3}$$

i.e. the ratio of her net wage to the nationwide average. Her *accumulated* points earned up to retirement is equal to the sum of these points:

$$\mathbf{p}_{i,R,t+R} = \sum_{a=Q}^{R-1} p_{i,a,t+a}. \tag{A.4}$$

The value of one point in year $t+a$, x_{t+a} is determined by the government through the balance condition, yielding a benefit path

$$b_{i,a,t+a} = \mathbf{p}_{i,R,t+R} x_{t+a}, \qquad a = R, \ldots, D-1. \tag{A.5}$$

Note that in the point system there is neither wage indexation nor price indexation nor their mixture; the benefit rise x_{t+a}/x_{t+a-1} is determined from two complex balance conditions.

Appendix B. Forced reduction of pension contribution rate

This Appendix discusses three scenarios for the forced reduction of pension contribution rate concerning current Hungarian developments. To do so we have to introduce the gross wage u, the total wage compensation w and break down the pension and health contribution rates between employee's (E) and employer's (firm F) rates: Let θ^E and θ^F be the exogenously given and constant health care contribution rates paid by the employee and the employer (the former also includes the personal income tax rate), respectively. Let τ^E and τ_t^F be the exogenously given pension contribution rates paid by the employee and the employer, respectively, their sum being the pension contribution rate $\tau_t = \tau^E + \tau_t^F$—the latter two being time-variant. By definition, for a given gross wage u_t, the total and the net wages in year t are respectively equal to

$$w_t = (1 + \theta^F + \tau_t^F)u_t \qquad (B.1)$$

and

$$v_t = (1 - \theta^E - \tau^E)u_t, \quad \text{ahol} \quad \theta^E + \tau^E < 1. \qquad (B.2)$$

Reflecting the logic of the current Hungarian pension system, the *initial representative benefit* in year t is proportional to the net representative wage in year $t-1$ and to time-varying length of contributions S_t:

$$b_t = \delta S_t v_{t-1}. \qquad (B.3)$$

(Appendix A explains why this does not apply to individual benefits.)

Due to the price indexation of *benefits in progress*, in year t (in real terms) the representative benefit set $k-1$ years earlier is still equal to

$$b_{t-k} = \delta S_t v_{t-k}, \qquad k = 2, \ldots, T. \qquad (B.4)$$

We assume that the length of the contribution period rises for a while:

$$S_t = 33 + 0.5(t - 2016) \quad \text{if} \quad t = 2016, 2017, 2018 \quad \text{and} \quad S_t = 35 \quad \text{later.} \qquad (B.5)$$

Furthermore, pension revenues are given as

$$R_t = \tau_t S_t u_t. \qquad (B.6)$$

Also, we diminish the entry of new pensioners by half until 2022, represented by multiplier a_t in (14) below, (an ad hoc assumption). To get rid of the complex problem of age distribution of benefits in 2016 granted $k = 1, 2, \ldots, T$ years earlier, we model the pension expenditures like

$$B_t = B_{t-1} + \delta(a_t S_t v_{t-1} - S_{2015} v_{2015}). \qquad (B.7)$$

The parameter values are as follows: $\tau^E = 0.10$, $\tau_{-1}^F = 0.22$, $\theta^E = 0.15 + 0.085 = 0.235$ and $\theta^F = 0.05$, with $T = 20$ years, the annual accrual rate $\delta = 0,023$. We choose $a_t = 0.7$ until 2022, later it rises to 1.

We compare three scenarios: Scenario 1 depicts the forced reduction of pension contribution rate as a feasible process due to high wage growth. Scenario 2 describes the process as infeasible due to slower wage growth. Scenario 3 stops the forced reduction to maintain the equilibrium. The numbers are given in percent. Revenues and expenditures are given in terms of the initial revenue.

Scenario 1. Persistently fast wage growth and fast reduction of pension contribution rate

The first scenario (displayed in Table B.1) is consistent with the government plan but it assumes very fast real total wage growth, namely 5% per year. We assume that τ_t^F drops from 0.22 ($t = -1$) to 0.085. Here are the numerical results.

Table B.1.
Persistently fast wage growth and fast reduction of pension contribution rate, %

Year t	Pension contribution rate $100\tau_t$	Real growth rate of total wage $100(g_t^w - 1)$	Pension revenues $100R_t/R_{2016}$	Pension expenditures $100B_t/R_{2016}$
2016	32.0	7.4	100.0	95.6
2017	27.0	5.9	94.4	94.5
2018	24.5	5.8	93.9	93.9
2019	22.5	5.2	93.6	93.6
2020	20.5	5.2	91.3	93.6
2021	18.5	5.1	88.1	93.9
2022	18.5	5.1	92.5	94.6
2023	18.5	5.0	97.2	97.8
2024	18.5	5.0	102.0	101.4
2025	18.5	5.0	107.1	105.3

Scenario 2. Decelerating wage growth and fast reduction of pension contribution rate

The second scenario (Table B.2) reduces the total wage growth rate to a feasible value namely 3% starting with 2019 but the government continues its reduction program. (The data of years 2016–2018 are the same as in Table B.1, therefore they are omitted.) Then the gap between the revenues and the expenditures widens and by 2022 reaches 8% of the initial revenues, amounting to 1% of the GDP.

Table B.2.

Decelerating wage growth and fast reduction of pension contribution rate, %

Year t	Pension contribution rate $100\tau_t$	Real growth rate of total wage $100(g_t^w - 1)$	Pension revenues $100R_t/R_{2016}$	Pension expenditures $100B_t/R_{2016}$
	...		...	
2019	22.5	3.2	91.9	93.6
2020	20.5	3.2	87.9	93.5
2021	18.5	3.2	83.3	93.7
2022	18.5	3.0	85.8	94.0
2023	18.5	3.0	88.3	96.7
2024	18.5	3.0	91.0	99.5
2025	18.5	3.0	93.7	102.6

Scenario 3. Decelerating wage growth and reduction of pension contribution rate

The third scenario (Table B.3) adjusts the pension contribution rate to the decelerating total real wage growth. Stopping at 20.5 rather than 18.5, the equilibrium is more or less preserved.

Table B.3.

Decelerating wage growth and pension contribution rate, %

Year t	Pension contribution rate $100\tau_t$	Real growth rate of total wage $100(g_t^w - 1)$	Pension revenues $100R_t/R_{2016}$	Pension expenditures $100B_t/R_{2016}$
	...		...	
2019	22.5	3.2	91.9	93.6
2020	20.5	3.2	87.9	93.5
2021	20.5	3.0	90.5	93.7
2022	20.5	3.0	93.2	93.9
2023	20.5	3.0	96.0	96.4
2024	20.5	3.0	98.9	99.2
2025	20.5	3.0	101.9	102.1

Even this scenario maintains a distorted pension profile where the benefits of those who retired in 2019 are cc. 28% higher than the benefits of those who retired in 2016.

Note that these runs are quite primitive and further examinations are needed to corroborate their robustness.

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