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AKADÉMIAI KIADÓ

Statistical overstatement of average wages and its impact on pensions: The case of Hungary

GÁBOR OBLATH[1] and ANDRÁS SIMONOVITS[2*]

[1] Kopint-Tárki Institute for Economic Research, Budapest, Hungary

[2] Budapest University of Technology and Economics (BME), Műegyetem rkp. 3, H-1111 Budapest, Hungary

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ABSTRACT

In Hungary, initial pensions are indexed to average net wages, reported by official earnings statistics (ES). However, there is an alternative statistical source on labour income, the national accounts (NA). The latter indicate a markedly lower rate of growth in wages than the ES for the period between 2010 and 2020. We claim that the ES overstated the actual increase in wages at the national level during the 2010s, and make our own calculations regarding the path of net wages and implied (hypothetical) initial pensions. The main implications are as follows: (i) the actual increase in initial benefits was excessive; (ii) the ratio of average benefits to the revised average net wages fell much less; (iii) the accumulation of major tensions between cohorts retiring in subsequent years might have been reduced by relying on the more plausible wage statistics reported by the NA.

KEYWORDS

alternative measures of average wages, pensions, indexation of initial pensions, Hungary

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* Corresponding author. E-mail: simonov@math.bme.hu

This article is a shortened and streamlined version of Oblath – Simonovits (2023) and a modified version of Oblath – Simonovits (2024).

1. INTRODUCTION

In Hungary, the average initial pension has risen much faster than the average pension over the past decade. Between 2013 and 2021, on average, the former annually increased by about 9.5% in nominal terms (our estimate), while the latter increased by 4.1%, so the initial pension/average pension ratio rose from 87% to 130%, or by approximately 50%. This significant divergence in dynamics is essentially explained by the fact that while pensions in payment follow inflation, initial pensions are indexed to the official statistical indicator of net wages.[1] Between 2013 and 2021, according to the official earnings statistics (ES) of the Hungarian Central Statistical Office (CSO), nominal wages increased far above inflation, therefore, the gap between the initial pensions and pensions in payment broadly increased in line with the growth in net *real* wages. This in itself is a source of tension (Simonovits 2020), but it is compounded by the fact that the official net wage index – which covers about two-thirds of total employees – overstates economy-wide actual wage developments for the period 2013–2020.[2]

To support this assertion, we draw on the alternative statistical source on labour income, namely the national accounts (NA), which are meant to cover the total economy. The latter source indicates a markedly lower rate of growth in wages than the ES for the period between 2010 and 2020. Relying on feasibility tests, we show that the rapid increase reported by the ES cannot, while the milder growth shown by the NA can be reconciled with relevant macroeconomic developments, e.g., changes in productivity and household consumption. We, therefore, make our own estimates on the path of net wages and that of implied (hypothetical) initial pensions.

We draw the following inferences from our estimates: (i) the actual increase in initial benefits was excessive; (ii) the ratio of average benefits to average net wages did not fall by the extent shown by official statistics; (iii) relying on more plausible wage statistics, and taking into account the impact of the dramatically reduced social contribution rate (paid by employers) in calculating initial benefits, might have avoided the accumulation of major tensions between cohorts retiring in subsequent years (Simonovits 2023).

Our paper is structured as follows. Section 2 outlines the mode of determining initial benefits in Hungary and presents our estimate of the ratio of the average initial pension to average pensions. Section 3 explains the meaning of three different wage concepts used in our study and discusses the contents of alternative statistical sources on labour income. Section 4 presents macroeconomic feasibility tests regarding the indications of the two kinds of statistics. In Section 5 we present our own estimates of national net wages and the corresponding initial benefits. Section 6 summarises our results and points to further lines of research. The Appendices provide additional statistical information and conceptual clarification: Appendix A contains additional statistics and Appendix B outlines the correct indexation of initial benefits in addition to wage mismeasurement.

[1]For a detailed description and analysis of the Hungarian pension system, see e.g. Freudenberg et al. (2016).

[2]The claim that the ES overstates the nation-wide wage-growth has already been formulated in previous studies, see e.g., Köllő et al. (2022); Oblath (2022); Dedák (2022); Filep-Mosberger – Reiff (2022).

2. INDEXATION OF INITIAL PENSIONS AND THE RATIO OF INITIAL TO AVERAGE PENSIONS

By "indexation of initial pensions" we mean the process that raises a new retiree's annual historical earnings to the current level for calculating the initial benefit. In Hungary, as in almost all other countries, indexation in this special sense means the multiplication of individual nominal earnings of previous years by the average wage index, rather than by the price index. It is a specific Hungarian feature that instead of gross, net wages are considered. Since the average initial pension is roughly proportional to the past average of the earnings that have been indexed since 1988, the level of initial pensions is highly sensitive to the evolution of the official net earnings index, reported by the CSO (on the technical relationships see the box below).

The relationship between net wages and initial benefits

Here we demonstrate that average initial benefits are proportional to average net wages lagged by one year. Consider a citizen who retired at the end of year t, earned net wages $V_Q,\ldots,V_{t-1}$ in years $Q,\ldots,t-1$ (where $Q = 1988$), while the corresponding nationwide average net wages were $v_Q,\ldots, v_{t-1}$, respectively. Apart from complicating factors to be explained in Appendix B, according to the Hungarian pension formula (Simonovits 2003), the citizen's initial benefit in year t is equal to

$$B_{R,t} = \sigma_S\left[\sum_{a=Q}^{t-1}(v_{t-1}/v_a)V_a\right]\Big/(t-Q) = \sigma_S v_{t-1}\left[\sum_{a=Q}^{t-1}(V_a/v_a)\right]\Big/(t-Q).$$

where S is the number of years of contributions, close to 40 years.

Neglecting the positive correlation between the individual number of years of contributions and individual earning paths, we take the expectation (denoted by **E**) at both sides and replace upper-case individual values by lower-case average values:

$$b_{R,t} = v_{t-1}\left[\sigma_S\sum_{a=Q}^{t-1}(V_a/v_a)\right]\Big/(t-Q).$$

Introducing notation $\beta_{R,t} = v_{t-1}\left[\sigma_S\sum_{a=Q}^{t-1}(V_a/v_a)\right]/(t-Q)$ yields $b_{R,t} = \beta_t\ v_{t-1}$.

This shows that the average initial pensions are indeed proportional to average past net wages.

As a closely related issue, it is important to clarify: how have average initial pensions developed in recent years and how have they evolved relative to the average of total pensions?

Skipping the details, it must be recorded that, since 2018, no official data has been available to answer these simple questions, as the current authority responsible for pensions, the Hungarian State Treasury, discontinued the publication of statistics on average initial benefits. However, thanks to the persistence of a journalist, some useful pieces of information were released (Tamásné Szabó 2022).[3] Drawing on this information, we made estimates of average initial pensions and their relation to total average benefits for the missing years (2018–2021). According to our calculations, average initial pensions in 2021 were by about 30% above the average pension level.[4] This represents a significant increase compared to 2013, when the average initial pension was 13% below the level of average pensions.

[3]The article presented data on initial average pensions within rather wide bands and the headcount corresponding to the bands.

[4]Ádám Reiff assisted us in these calculations, the results of which are also reported in Reiff – Simonovits (2023).

3. STATISTICAL CONCEPTS, SOURCES AND TENSIONS

As indicated, the official *net wage* index – based on earnings statistics (ES) – is applied to index (valorise) individual lifetime earnings, which is the basis for determining initial pensions.

To clarify the role of net wages, three concepts should be distinguished: that of *net, gross* and *super gross wages* (or total compensation). The *net wage* is what the worker takes home (it is net of all taxes on labour income), while the *super gross wage* – which corresponds to the term "compensation of employees" in the national accounts – includes all taxes on labour (paid by the worker and the employer), i.e., the total wage cost. The *gross wage* is somewhere in between: the net wage plus employee tax and contributions, or, alternatively, compensation of employees, less the social contribution paid by the employer.[5]

Though data on gross wages are often quoted in public discussions, the concept lacks a clear economic meaning, as it neither represents net labour income (relevant from the point of view of the employee), not total wage cost (important from the point of view of the employer). From *our point of view,* the relevance of gross wages stems from the fact that, as discussed below, it represents a conceptual bridge between two distinct statistical sources on labour income.

Two types of statistical sources are available on wage trends. One is the already mentioned ES, which provide monthly information on the evolution of net and gross wages. The other is the national accounts (NA, or GDP statistics), which, in principle, cover the whole economy (including its informal and non-legal part).[6] The latter source provides data on gross and super-gross wages at quarterly intervals and does not include information on net wages (the statistical concept which is important for determining initial pensions). Thus, the only directly comparable indicator between the two sets of statistics is gross wages.

The information on wages provided by the earnings statistics is based on full-time workers employed by enterprises with at least five employees.[7] This set covers roughly two-thirds of total employees (the latter is reported by the NA).

Comparing the two types of statistics, gross wages evolved similarly between 2000 and 2010, but something changed in the early 2010s. For the period 2010–2020, the ES show a much higher gross wage increase than the NA (GDP statistics). Between 2000 and 2010, average *real gross wages* rose by 2.9% per year according to the ES and by 2.5% according to the GDP statistics. The 0.4 percentage point difference between the two can be explained by the different coverage and methodology. In contrast, between 2010 and 2020, the average annual real gross wage growth indicated by the respective statistics were 4.9 and 1.9%. This means that, over the past decade, average gross real wages have cumulatively increased by almost 60% according to the ES and by about 20% according to the GDP statistics. This contrast cannot be ignored and cannot be attributed to technical differences. Also note that the ES indicates an acceleration, while the NA implies a deceleration in wage growth in the second decade (+2.0 vs. −0.6 percentage points).

[5]For technical details regarding the relationship between the three concepts, as well as related statistical information, see Appendix A, especially Table A2.

[6]Bak and Szabó (2016) give a detailed overview of alternative statistical sources on wages and explain their differences.

[7]To be precise, this is the set, which is comparable over time. Beginning 2019, earnings statistics are based on data provided by the tax authority and cover a wider part of the economy. However, statistics corresponding to the former coverage and definition are still being published. We rely on this source, as our interest is in comparing the trends.

Before discussing whether the indications of the ES or those of the NA are more plausible from a macroeconomic point of view, a brief digression is in order (Figure 1). Note that both statistics report a significant acceleration in the growth of gross wages after 2016 (Figures 2 and 4). One of the factors responsible for this surge is central to our thinking on developments regarding initial pensions in Hungary.

Figure 3 shows the evolution of compensation of employees (i.e., the super gross wage bill), the gross wage bill, and the difference between the two (social contributions paid by employers) in relation to GDP, as reported by the NA.

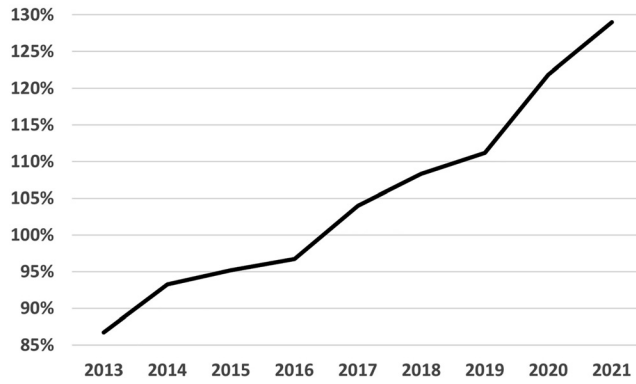

Fig. 1. The ratio of initial to average pension (2013–2021)
Sources: CSO and own calculation.

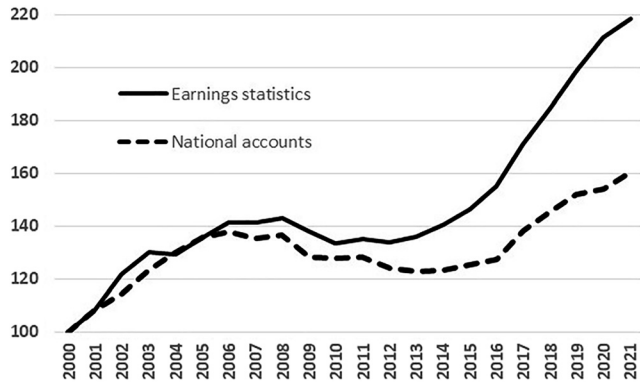

Fig. 2. Gross real wage increase according to the earnings statistics and the national accounts (2000 = 100)
Note: Gross nominal wage (ES) and gross wages and salaries (NA) per employee deflated by the consumer price index (CPI).
Source: CSO and own calculation.

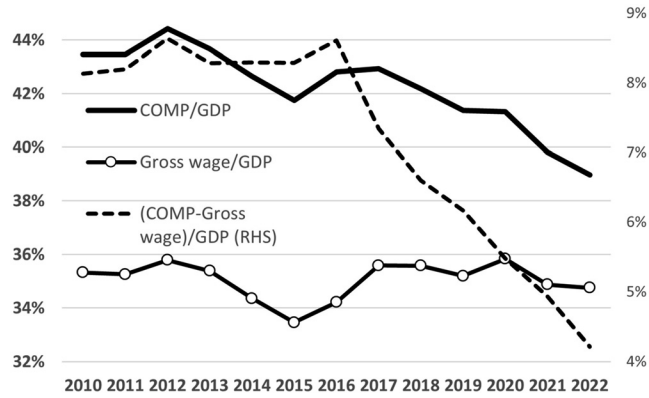

Fig. 3. The share of compensation of employees and gross wages in GDP (LHS) and the difference between the two (RHS) between 2010 and 2022
Note: COMP: Compensation of employees (super gross wage).
Source: Eurostat and own calculations.

Figure 3 clearly indicates that – because of continuous cuts in the social contribution rate (Table A2 in Appendix A) – a very significant and continuous decline in social contributions paid by employers was experienced after 2016 (dashed line), resulting in a fall of government revenues designed for financing pensions (and healthcare), in the order of 4.5 percentage points of GDP. It was exactly this decrease in employers' contribution (besides the acceleration in productivity, see below) that has mainly "financed" the surge in gross and net wages since 2016. We shall discuss the implications for initial pensions later on.

At this point, we return to the developments shown by Figure 2. Since net wages, which are of particular relevance to our topic, are linked to gross wages by the employee tax cum contribution rate, it is essential to clarify, which of the two statistical sources is more likely to reflect actual wage trends in the national economy.

4. PLAUSIBILITY TESTS AND A POSSIBLE EXPLANATION FOR THE DISCREPANCY

We have tried to check in several ways whether the gross wage growth shown by the earnings or GDP statistics is consistent with our knowledge of domestic macroeconomic developments during the 2010s. All tests confirmed that the earnings statistics significantly overstate gross wage growth in the national economy. Here we present the results of two types of tests.

(i) *Average real gross wages and productivity.* Given that the rise in real wages per worker (nominal wage deflated by the consumer price index) is sustained by the increase in output per worker, i.e., productivity growth, it is very difficult to believe that a 1% annual increase in productivity could be accompanied by a 4.6% annual increase in real gross wages over a decade, as suggested by the ES. The 2% annual increase in gross wages according to the NA (GDP statistics) is much more plausible, as its deviation from productivity growth can be

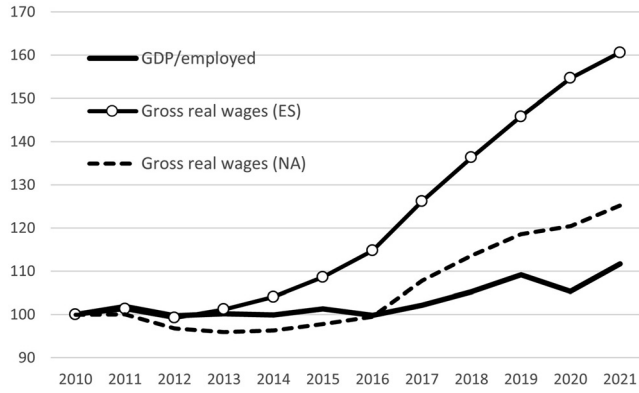

Fig. 4. The evolution of labour productivity and real gross wages according to earnings statistics (ES) and national accounts (NA) (2010 = 100)
Sources: CSO and own calculation.

explained by an important technical factor: the annual increase in the GDP deflator (the deflator of the increase in nominal GDP/employed) was by 1 percentage point higher than that of the consumer price index (the deflator of nominal wage growth) in the period in our focus. By contrast, there is no way to explain the remaining annual 2.6 percentage points of real gross wage growth above productivity, implied by the earnings statistics (Figure 4).

(ii) *Nominal wage bill and household consumption.* The growth in the macroeconomic wage bill and the increase in household consumption may diverge in the short-run, but over a decade it is highly unlikely that the gap between the two could widen to the extent implied by earnings statistics. As shown by Figure 5, between 2010 and 2020, the latter suggests a 90% increase at constant prices (dotted line), while household consumption grew by 40% in real terms (dashed line) – which is an extremely implausible combination. The 50% increase in

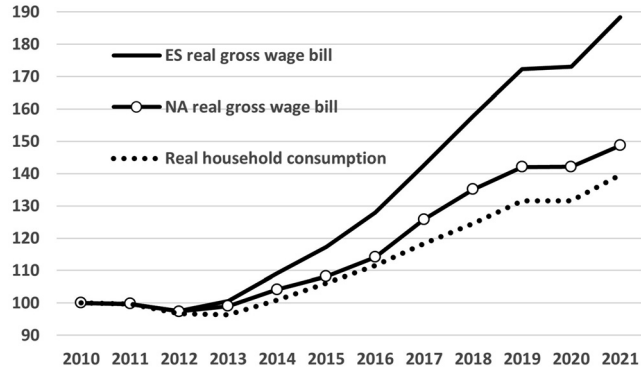

Fig. 5. The increase in the real wage bill according to two statistical sources and growth in real household consumption (2010 = 100)
Sources: CSO and own calculation.

the real gross wage bill indicated by the NA, in turn, does make sense and can easily be reconciled with the change in real consumption, considering the rise in household savings.

This, along with other tests,[8] leads us to the conclusion that, for the 2010s, the earnings statistics significantly overestimate, while the NA provide a relatively sound representation of gross wage developments at the economy-wide level. This conclusion is in line with those of two statisticians of the CSO (Janák – Szőkéné Boros 2022) who not only confirm our claim, but also offer a kind of explanation.

In their opinion, the "whitening of wages" is the key to understanding the divergence between the two types of statistics. In this context, "whitening" means that unofficial earnings (not reported at all or only partially reported) progressively become visible not only to the tax authorities, but are also being increasingly accounted by the earnings statistics based on data reported by firms.[9] The "whitening" may have been induced by a number of government measures (including increases in minimum wages, linking cash registers to the tax office, increased controls, etc.).

This may cause a discrepancy between the measures of wage growth reported by the two sources because GDP statistics are intended to cover not only the legal but also the whole economy (including the hidden part of the economy from the illegal to the grey zone).

If data reported by the NA is a good estimate of total labour income at the national level – if it includes wages *actually paid* (in both the formal and in the informal parts of the economy in a "tax-efficient" way) – then the "whitening" is simply a redistribution between the tax-avoiding (informal) and the tax-paying parts of the economy. As the former shrinks, the latter widens, but this does not in itself imply a change in the macroeconomic wage bill. This entails that a part of the wage increase reported by the earnings statistics is fictitious, even if it is a reality in the sense that it contributes to tax revenues.[10]

Though "whitening" alone can hardly account for the gap between the growth rates indicated by the two types of wage statistics, we do not dwell on further possible explanations, but turn to issues related to the estimation of nation-wide net wages and the implied initial pensions.

5. ESTIMATES OF NATIONAL NET WAGES AND HYPOTHETICAL INITIAL PENSIONS

The facts that the earnings statistics significantly overestimate nationwide gross wages and the NA approximate them quite well over a decade, do not allow direct conclusions regarding initial pensions, as the NA does not include an indicator of net wages. Therefore, our estimates of

[8]Further tests include the relationship between inflation and unit labour costs, as well as the evolution of the wage share in total income, as measured by the two statistical sources (Oblath 2022). Both tests indicate the implausibility of the magnitude of increase reported by the ES. Kónya et al. (2020, 2021) provide analyses of the labour share in Europe and of the evolution of the labour share in Hungary in a European context.

[9]As already mentioned, since 2019, the ES is based on information provided by the tax authority, but comparable data are accessible.

[10]Filep-Mosberger and Reiff (2022) provide evidence on the existence of a "whitening" process during the 2010s, as a partial explanation for the diverging trends indicated by ES and NA statistics.

initial pensions consistent with nation-wide wage developments is carried out in two steps. First, we estimate the average net wages at the economy-wide level, and then, based on this, we approximate the average of *hypothetical* initial pensions.

5.1. First step: estimating national net wages

To estimate the national average net wage, we used two methods. The first departed from the employee tax rate (i.e., the ratio of average gross to net wages, as reported by the ES) and adjusted the gross wage reported by the NA to obtain a macroeconomic indicator of net wages. The second departed from the concept of super gross wages (compensation of employees, as reported by the NA), and deducted all taxes on labour (reported by "Taxation Trends in the European Union" EC 2022) to obtain an alternative indicator of national net wages.[11]

The results of the two approaches were rather different and, regarding levels, those of the first estimate were much more reasonable. According to this estimate, average nominal net wages in the national economy increased by around 55% between 2010 and 2020 (in contrast to the more than 100% rise indicated by the earnings statistics). As we have estimated the development of net wages from their levels, it is worth showing, how our estimates regarding the *benefit ratio* (the relation of average pensions to average net wages) evolved, as compared to the ratio implied by official statistics.

According to the official indicator, based on earnings statistics, the average old-age pension to net pay ratio fell from 77 to 56% (by 21 percentage points) between 2013 and 2020, which would be a dramatic decline in seven years by international standards.[12] Our estimates confirm the decline, but the magnitude of the fall is much smaller, at around half the rate indicated by the official indicator (Figure 6).

5.2. Second step: estimating hypothetical initial pensions

To quantify the average *hypothetical* initial pension, i.e., its level justified by (consistent with) our estimates on net wage developments discussed above, we also used several methods. (Recall Section 2, where we explained the approximate proportionality of initial benefits to average wages lagged by one year.)

We found that, between 2013 and 2021, depending on the method of estimation, the overstatement of average wage growth by the ES could have pushed up the increase in initial pensions by about 23–27%. Thus, according to our calculations, and considering the mean of our estimates, the change in national net wage growth may have justified about 70% of the actual increase in initial pensions, i.e., the effect of overstating net wage growth on the increase in initial pensions over this period could have reached about 30% (Figure 7).

[11]We also considered the estimation of net wages by departing from gross wages as reported in the NA and deducting employees' taxes and contributions as reported by EC (2022). The results differed somewhat, but not significantly, from our estimates based on super-gross wages.

[12]In Oblath and Simonovits (2023), we show that in this period the evolution of the benefit ratio was quite flat regarding the average of the EU (at around 60%), and there was a mild decline in the average of central and east-European member-states (less Hungary) from 56 to 52%. However, there is no precedent of the decline implied by official Hungarian data.

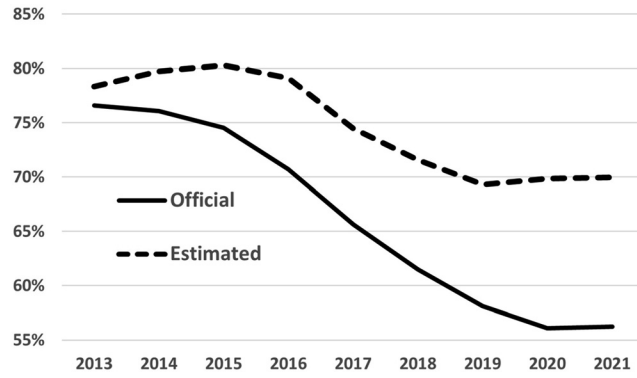

Fig. 6. The average old-age benefits in relation to the officially reported and to the estimated net average net wages (2013–2021)
Sources: CSO and own calculation.

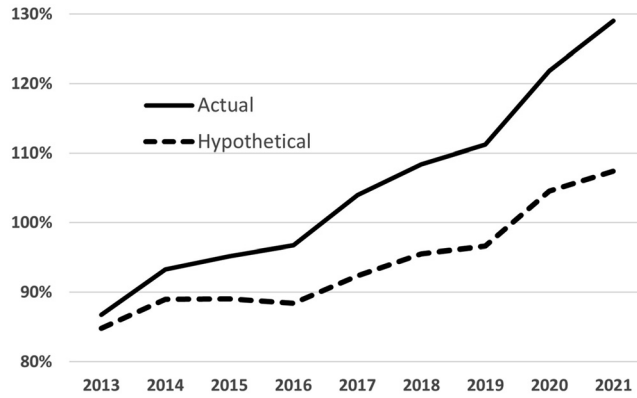

Fig. 7. The ratio of the actual vs. hypothetical initial average benefits to the average of total benefits (2013–2021)
Sources: CSO and own calculations.

5.3. Open questions

Our reasoning, estimates and calculations by no means suggest that the government should retrospectively reduce pensions granted after 2010. We have merely drawn attention to an anomaly that is important for the determination of initial pensions, namely that the official wage index reported by the ES of the CSO significantly overstated actual wage growth in the national economy during the 2010s. Due to the method of indexing initial pensions (based on official statistics on net wages), this resulted in unduly high initial pensions, especially since 2017.

From 2021 onwards, regarding gross wages, the divergence between the dynamics of earnings statistics and those shown by the NA seem to disappear. If the consistency of wage changes across the two sources is maintained, what happens is that the tension we were discussing does not increase further, "only" the overestimation of the 2010s is trapped in the determination of further initial pensions.

Apparently, the correction for this period is countered by the fact that employee contribution payments (consistent with the assumption of "whitening") are relatively closely correlated with the higher wage dynamics in the earnings statistics. However, if this argument were accepted, there would be reason to question why the sharp reduction in employer contributions between 2016 and 2021 does not matter for the determination of initial pensions (Figure 3). If the official net wage index is relevant for initial pensions because it is representative of employee contributions, can the significant loss in public revenue due to the reduction in the employer contribution rate be ignored when indexing initial pensions? Appendix B gives a negative answer.

6. SUMMARY

Our paper, drawing on Hungary's experiences, demonstrated the importance of the accuracy of wage statistics for indexing initial pensions – if the indexation is based on the historical path of wages. We showed that the two statistical sources on labour income display contrasting developments, therefore, depending on the source, significantly different measures of initial pensions are implied. Moreover, depending on whether social contributions paid by employers are taken into account, there is a relatively wide space for determining the "justified" initial level of pensions (Appendix Table B1).

Regarding Hungary, our study has shown that (i) the actual increase in initial benefits (linked to net wages, as reported by the earnings statistics) has been excessive; (ii) in our estimate, the ratio of average benefits to average net wages did not fall by the extent shown by official statistics (the former is linked to the increase in prices, rather than that of wages). Moreover, (iii) relying on more plausible wage statistics and considering the impact of the dramatically reduced social contribution rate (paid by employers) in calculating initial benefits might have dampened the accumulation of major tensions between cohorts retiring in subsequent years.

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Appendix A. Additional Hungarian statistics

Table A1 shows the slow rise or eventual decrease in male and female life expectancy at age 65 in Hungary, implying that the steep rise in normal retirement age put a significant burden on those retiring after 2013.

Before presenting our next table, we discuss some useful relations among various wage categories. We distinguish 3 wage categories, each for the average: net wage, gross wage and total wage compensation, denoted now by w^{n}, w^{n} and w^{s}, respectively. Symbol τ_1 stands for the employee's social insurance contribution rate, within it $\tau_{1,\mathrm{P}}$ and $\tau_{1,\mathrm{H}}$ stand for the pension and the health care components, respectively. Similarly, for the employer's rate: τ_2, $\tau_{2\mathrm{P}}$ and $\tau_{2\mathrm{H}}$. By definition, the following identities hold:

$$\tau_1 = \tau_{1,\mathrm{P}} + \tau_{1,\mathrm{H}} \text{ and } \tau_2 = \tau_{2,\mathrm{P}} + \tau_{2,\mathrm{H}};\ \tau_{\mathrm{P}} = \tau_{1,\mathrm{P}} + \tau_{2,\mathrm{P}} \text{ and } \tau_{\mathrm{H}} = \tau_{1,\mathrm{H}} + \tau_{2,\mathrm{H}}.$$

Introducing the personal income tax rate θ, we have three wage-identities:

Table A1. Life expectancy at age 65 (2010–2022), in years

Year	Average	Male	Female
2010	16.5	14.1	18.2
2011	16.6	14.3	18.3
2012	16.5	14.3	18.1
2013	16.8	14.5	18.4
2014	16.9	14.6	18.6
2015	16.0	14.5	18.2
2016	17.0	14.6	18.7
2017	16.7	14.5	18.4
2018	16.8	14.6	18.5
2019	16.9	14.8	18.6
2020	16.2	14.0	17.9
2021	15.5	13.2	17.3
2022	16.5	14.3	18.3

Net wage–gross wage:

$$w^{\mathrm{n}} = w^{\mathrm{b}}(1 - \tau_1 - \theta).$$

Total wage compensation-gross wage:

$$w^{s} = w^{\mathrm{b}}(1+\tau_2).$$

Net wage–total wage compensation:

$$w^{\mathrm{n}}/w^{s} = (1 - \tau_1 - \theta)\ /(1 + \tau_2).$$

To avoid the ambiguity caused by the arbitrary break-up of contribution to employee and employer's ones, we recalculate the gross-wage based contribution rates to total wage compensation base, denoted by primes. For $i = 1, 2$, where 1 stands for the employee and 2 stands for the employer:

$$\tau_i' = \tau_i/(1 + \tau_2), \tau_{i,\mathrm{P}}' = \tau_{i,\mathrm{P}}/(1 + \tau_2) \text{ and } \tau_{i,\mathrm{H}}' = \tau_{i,\mathrm{H}}/(1 + \tau_2).$$

Table A2 displays the drastically reduced social insurance contribution rates, recalculated from total wage compensation. It is noteworthy that the originally constant PIT rate in the new base was rising from 11.8 to 13.3% and the relevant net to total wage ratio rose from 52.4 to 58.8%!

Table A3 displays two processes: (i) Though the real value of any individual pension should be constant since 2010, but overindexation between 2013 and 2016 implied significant rises. The reintroduction of the 13th month benefits (in 2021/2022) increases the individual benefits. (ii) The dynamics of individual and average pensions are partly autonomous. For example, the average rise in pensions was higher than zero, because the newly granted pensions were typically much higher than those of the departing ones (2022 was an exception).

Table A2. Contribution rates (WRT) to total wage compensation (TWC) (2016–2022, %)

Year (t)	Employee			Employer			Corrected PIT (θ')	Net/TWC (w^{n}/w^{s})
	Total (τ_1')	Pension ($\tau'_{1,\mathrm{P}}$)	Health-care ($\tau'_{1,\mathrm{H}}$)	Total (τ_2')	Pension ($\tau'_{2,\mathrm{P}}$)	Health-care ($\tau'_{2,\mathrm{H}}$)		
2016	14.6	7.9	6.7	21.3	17.2	4.1	11.8	52.4
2017	15.2	8.2	7.0	18.0	13.0	5.1	12.3	54.5
2018	15.4	8.3	7.1	16.7	12.9	3.7	12.5	55.4
2019	15.6	8.4	7.2	15.6	11.0	4.6	12.7	56.1
2020	15.9	8.6	7.3	14.2	9.5	4.6	12.9	57.1
2021	16.0	8.7	7.4	13.4	9.0	4.4	13.0	57.6
2022	16.4	8.8	7.5	11.5	8.2	3.3	13.3	58.8

Table A3. Individual and average rise in pensions: real values (2010–2022, %)

Year	Individual rise in pensions	Average rise in pensions	Consumer price index
2011	−0.1	−3.1	3.9
2012	0.2	1.6	5.7
2013	3.6	4.5	1.7
2014	3.0	3.3	−0.2
2015	1.4	2.4	−0.1
2016	1.0	0.0	0.4
2017	0.1	0.8	2.4
2018	0.3	2.4	2.8
2019	−0.1	1.3	3.4
2020	0.2	1.8	3.3
2021	2.3	4.6	5.1
2022	5.0	0.6	14.5

Source: Hungarian Government (2023).
Note: For simplicity, we only display the consumer rather than the pensioners' price index. The difference between them is quite small.

Appendix B. Correct indexation of initial benefits

Appendix B discusses other dimensions of correct indexation neglected until now; namely, taking into account the reduction of the social insurance contribution rate paid by the employer, the rising retirement age, etc.

First, we shall analyse the role of the *social insurance contribution rate* using the simplest OLG model invented by Samuelson (1958). The original OLG model distinguished two types of agents by age: the young, who works and the old, who is retired. Here we calculate with the total wage compensation denoted by w_t and the half of total fertility rate, to be denoted by f_t. Then every pensioner is supported by f_t workers and the cross-sectional pension equation of period t is

$$f_t\ \tau_t\ w_t = b_t.$$

By definition, the following longitudinal equation for a worker of period t–1 gives the *internal factor* r_t of the social insurance system:

$$\tau_{t-1} w_{t-1}\ r_t = b_t.$$

We equate the left-hand sides of the two equations:

$$\tau_{t-1}\ w_{t-1}\ r_t = f_t\ \tau_t\ w_t$$

and solve the new equation for the internal factor:

$$r_t = f_t\ (\tau_t\ /\tau_{t-1})\ (w_t\ /w_{t-1}).$$

There are three factors on the right-hand side: the halved fertility rate, the ratio of current to past tax rate, and the growth factor of the total wage compensation. Unfortunately, the Hungarian practice only considers factor 3, and even there w_t/w_{t-1} is replaced by $\delta_t w_t/(\delta_{t-1} w_{t-1})$, where δ_t is the time-variant ratio of average net wages to average total wages.

Compare two periods (0 and 1) and two wage statistics E (official) and N (consistent). Assume that the wage levels were similar in period 0, denote it by 100, and their real values diverged by period 1 to w_E and w_N, $w_E > w_N$. By the logic of wage indexed initial benefits, the official average initial benefit in period 1 are approximately proportional to the new wages, i.e., $b_E = \beta w_E$ and $b_N = \beta w_N$, where $\beta > 0$ is a common proportionality factor. The overstatement of $w_E > w_N$ implies a proportionally excessive overstatement of the initial benefits in period 1: $b_E > b_N$. We shall show that in the first decade, there was only a slow divergence between price indexed average (all) benefits. Using approximation $B = B_0 + \varepsilon w$, where ε is a relatively small positive number, we have $B_E = B_0 + \varepsilon w_E$ and $B_N = B_0 + \varepsilon w_N$. Their ratios to the average wages, the so-called benefit ratio is understated: $B_0 + \varepsilon w_E/w_E < B_0 + \varepsilon w_N/w_N$, and superfluously understates the relative position of the pensioners to the wage earners. Our paper explained this dynamical situation in detail and filled these formulas with appropriate numbers.

Second, we analyse the difference between the lengths of work and retirement, also influenced by the rising retirement age, neglected in this simple model. A possible remedy is as follows. Let L, R and D denote the age at which the individual starts working, retires and dies, respectively: $L < R < D$. Neglecting the rise of real wages but taking into account the rising retirement age and the stagnating life expectancy, the actuarially fair initial benefit is given by

$$b_t = \tau_t\ w_t\ (R_t - L)/(D_t - R_t).$$

The conjunction of stagnating life expectancy D_t and the rising retirement age R_t could partially compensate for the declining τ_t and overestimated w_t.

Table B1 demonstrates the impact of counteracting tendencies. We choose two values, low and high for the contribution rate, the total wage compensation, the retirement age and life expectancy. The resulting 16 combinations yield 16 benefit values, ranging from 0.759 to 0.348.

Table B1. Impact of counteracting tendencies

Contribution rate τ	TWC w^s	Retirement age R	Life expectancy D	Pension b
0.25	1.2	65	82	0.759
0.25	1.2	65	85	0.645
0.25	1.0	65	82	0.632
0.20	1.2	65	82	0.607
0.25	1.2	62	82	0.600
0.25	1.0	65	85	0.538
0.25	1.2	62	85	0.522
0.20	1.2	65	85	0.516
0.20	1.0	65	82	0.506
0.25	1.0	62	82	0.500
0.20	1.2	62	82	0.480
0.25	1.0	62	85	0.435
0.20	1.0	65	85	0.430
0.20	1.2	62	85	0.417
0.20	1.0	62	82	0.400
0.20	1.0	62	85	0.348

Source: Own construction.