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**Article**

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# The distributional effects of the pension system reform in Poland

## Abstract

This paper quantifies the effect of Poland's 1999 pension reform on the inequality of future pension benefits. The reform increases inequality, both in the upper and lower parts of the distribution. The estimates, based on the 2012 Polish Household Budget Survey, show that the Gini coefficient reaches 0.27 once the full effect of the reform has materialized. Had the pre-reform system continued unchanged, the Gini coefficient would not be  $>0.19$ . The increased inequality of pension benefits is the result of the system gradually moving from a more redistributive defined benefit pension system to a system in which benefits are strongly linked to earnings. We show to what extent minimum pension benefits mitigate the increase in inequality under different scenarios.

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## 1 Introduction

As a result of the 1999 pension reform in Poland, the more generous and redistributive pension system was replaced with an earnings-related rule. The old pension system can be classified as a Beveridgean system since the benefit formula partially consisted of a flat rate, and the post-reform system as a Bismarckian system (Esping-Andersen, 1990). The Beveridgean system is highly redistributive and achieves a high degree of equalization of benefits, whereas under the Bismarckian system, little redistribution occurs (Cremer and Pestieau, 2003). The amount of redistribution in the pension system in turn affects the levels of inequality and poverty among elderly people. As pension reforms have become common in industrialized countries due to population aging (OECD, 2017), the distributional effects of these reforms for the elderly are a key question for economists and policymakers.

This paper quantifies the effect of Poland's 1999 pension reform on future pension benefits inequality.<sup>1</sup> We present simulations of first pension benefits for men born in the years 1969–1979 using the Polish Household Budget Survey (PHBS) of 2012. The cohort of 1969 is the first that will retire entirely under the new system and we extend the analysis to the subsequent 10 cohorts to analyze the gradual implementation of the reform.<sup>2</sup> The simulations are based on earnings predictions using a standard earnings equation.<sup>3</sup> Micro data allow us to study the effects of the reform in different parts of the pension benefits distribution. We compute two measures of within-cohort inequality – inequality in Gini coefficients of first pension benefits and replacement rates (RRs) – under the pre-reform and post-reform legislations. Thus, we can compare the inequality of pension benefits after the reform and in the absence of the reform.

Understanding inequality of pension benefits is important because of at least two reasons. First, rising inequality leads to growing demand on public finances, as the lowest pensions need to be topped up from general taxation if a country has a minimum pension or minimum income guarantee (Weller, 2004). Second, an increase in inequality in the lower part of pension distribution contributes to relative poverty. The elderly in Europe and worldwide are facing higher risks of poverty compared with the working-age population (Antczak and Zaidi, 2016). Although the risks of falling into poverty for elderly Polish citizens are currently lower than in many other European countries, this is likely to change in the future as more people covered by the new pension system will retire. Accordingly, as the standards of living of many elderly citizens are likely to decrease, policymakers need in-depth knowledge about the income distribution of current and future retirees, so that they can target their social policies toward the most vulnerable.

In the literature, two types of income redistribution are distinguished: intergenerational and intragenerational redistribution (Danzer et al., 2016). To measure intergenerational redistribution, researchers compare, over the life cycle, the receipt of benefits relative to taxes and contributions paid for successive date-of-birth cohorts. The intragenerational redistribution measures whether pension programs are more or less redistributive within a generation.

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1 Throughout this paper we use the terminology “pension reform” referring to the social security reform that replaced the existing pay-as-you-go scheme with a multi-tier system. While in the US and UK systems the term “social security” refers to government programs and “pension” refers to private programs, the Polish multi-tier system contains elements of both, and so we follow the previous literature (Chłoń-Domińczak, 2002; Lachowska and Myck, 2018) and refer to this as pension reform.

2 We focus on men because there are data restrictions for women. See the discussion in Section 3.

3 See, e.g., Heckman et al. (2003) and Lemieux (2006).

Gordon and Varian (1988) show that a social security pension system could be a device to facilitate intergenerational risk sharing in a case when, e.g., one generation is young in times of economic depression, which translates also into lower incomes in old age. Blake (2006), referring also to Blinder (1981), points to the fact that pension schemes allow also for intragenerational risk sharing via redistribution within a generation. Pension systems may transfer from those who are lifetime rich to those who are lifetime poor [or with lower life expectancy (LE)], whereas tax or subsidy systems transfer from those who are temporarily rich to the temporarily poor.

Studies on intragenerational redistribution show that various characteristics of pension systems have an impact on redistribution. Creedy et al. (1993) find that different mortality rates across industries and occupations negatively affect the progressivity of the UK pension formula. Aubert et al. (2013) show that an increase in the required insurance duration as a result of French pension reforms has a redistributive impact, but inequalities stemming from differential mortality seem to be less important. Part of the literature on intragenerational redistribution takes a longitudinal approach (e.g., Creedy et al., 1993; Karayel, 2006; Bonenkamp, 2009; Auerbach and Lee, 2011). It compares the balance between the total contributions paid and total benefits received, and confirms the regressive or progressive character of the pension system.<sup>4</sup> For instance, Bonenkamp (2009) finds a sizable redistribution from males to females and from less educated to higher educated workers in the Dutch system of occupational pensions.

Other studies use cross-sectional approach, i.e., they look at the way pension benefits affect the income distribution of the population of the elderly at a given period of time (e.g., Lefèbvre, 2007; Piirits and Vork, 2019). This approach stresses the extent to which public transfers reduce inequality and poverty at a given point in time. Lefèbvre (2007) finds a wide variation among the countries in the amount of intragenerational redistribution of public pension transfers. Piirits and Vork (2019) show that the introduction of a strong link between contributions and future benefits leads to a considerably higher inequality in pension incomes in Estonia.

To our knowledge, this paper is the first to analyze the intragenerational redistribution of pension incomes of elderly Polish citizens based on micro data. Studying the Polish case is interesting because Poland underwent a major pension reform that transformed the public pension system into a Bismarckian, defined contribution scheme, which will have a considerable impact on future incomes of those covered by the reform. As societies age across the industrialized world, many other countries have also implemented similar reforms or are due to implement them in the near future, and therefore the distributional effects of the Polish reform may be of more general interest. Most of the existing studies predict future pension benefits for a hypothetical worker (e.g., OECD, 2013; Määttänen et al., 2014; European Commission, 2018) or for year cohorts, with the latter focusing on intergenerational differences (see Leifels et al., 2010; Jabłonowski and Müller, 2013; Égert, 2013). These studies find large drops in projected RRs, especially for people with career breaks and short careers, as well as low earners. By contrast, Lachowska and Myck (2018) predict pension benefits for households based on the micro data, but they do not study the distributional effects of pension reforms. They focus instead on the crowd-out effects of public pensions on private savings. Finally, a paper by Tyrowicz et al. (2018) quantifies the effects of the pension system reform on consumption and wealth

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4 A system that pays the same amount of benefit to everyone is maximally progressive.

inequality of the Polish future retirees in a general equilibrium framework. Our paper is different from Tyrowicz et al. (2018) in that we use other methods and data, and we also adopt a partial equilibrium approach.

We show that the pension reform increases the inequality of future pension benefits, both in the upper and lower parts of the distribution. Had the pre-reform system continued unchanged, the Gini coefficient would not be  $>0.187$ , but after the reform the Gini coefficient ranges from 0.219 for men who were born in 1969, to 0.267 for the 1979 cohort. The Gini coefficient increases for the younger cohorts because of the gradual implementation of the reform. After reform pension benefits are adjusted with the so called “initial capital,” which accounts for accrued pension rights in the pre-reform system and is calculated on a pre-reform formula, its average share in the total pension benefit steadily decreases in our sample, from 38% for the oldest 1969 cohort, to only 1.5% for the youngest 1979 cohort.

We further show to what extent the minimum pension guarantee mitigates the predicted increase in inequality, depending on the scenario. Under the current policy scenario, the minimum pension guarantee does not offset the increase in the Gini coefficient. However, under the high minimum pension scenario that follows the average level of minimum pension benefits in OECD countries, the minimum pension would more than offset the effect of the reform.

The structure of the remainder of the paper is as follows. In Section 2, we provide a brief description of the Polish pension system. In Section 3, we describe the data and empirical methods used to project pension benefits and RRs for individuals in selected cohorts. Section 4 describes the results, Section 5 analyzes the sensitivity of the results, and the last section concludes.

## 2 Overview of the Polish Pension System

In this section we briefly describe the pension system for employees and the self-employed, which is managed by the Social Insurance Institution (ZUS) and its 1999 reform. There are three separate old-age pension schemes in Poland, of which the ZUS pension system is considered the largest, since it covers the majority of the working population and retirees, amounting to around 5.5 million old-age pensioners (GUS, 2018). The other two are the pension scheme for farmers and the pension schemes for the armed forces, judges, and prosecutors.<sup>5</sup>

Old-age benefits from the pension system represent an important source of income in elderly households in Poland. According to our estimates, based on the PHBS, in 2012, old-age pensions amounted to 63% of current income in households of retirees from the 1st quartile and 56% of income in households from the 4th quartile of income distribution.

In the early 1990s, Poland had a relatively generous public pension system. However, common use of early retirement options, low fertility, and increased LE resulted in financial stress on the system (Lachowska and Myck, 2018). Early retirement was common because there were many incentives in the legislation to retire early and it was also an option for workers who were laid-off from their companies. Fertility rates dropped substantially, possibly in reaction to increased macroeconomic uncertainty and rising unemployment, especially for blue-collar workers and the less educated (Égert, 2013). The gradual modernization

<sup>5</sup> In 2017, there were 918,000 old-age pensioners in the farmers' scheme and 186,000 old-age pensioners in the armed forces scheme (GUS, 2018).

**Table 1** Main features of Poland's mandatory pension system before and after the 1999 reform

	Pre-reform	Post-reform
<i>Type of system</i>	Pay-as-you-go defined benefit	Pay-as-you-go, NDC plan (first pillar) + FDC plan (second pillar)*
<i>Benefit formula</i>	Flat rate plus a component based on earnings and tenure	Depends on contributions paid on lifetime earnings and LE at the retirement age
<i>Transition from old to new system</i>	Cohorts born before 1949 – covered by the old system Cohorts born between 1949 and 1968 could choose to participate only in NDC or in both NDC and FDC pillars Cohorts born after 1969 fully covered by the new system	

FDC, funded defined contribution; LE, life expectancy; NDC, notionally defined contribution.

\*In 2013, a part of the contributions paid into the second pillar was moved to the first pillar and indexed by an average GDP growth from 5 years before indexation. Furthermore, the reform of 2013 established that the first pillar, ZUS, will handle the pension funds retirement plans, with the accumulated funds transferred incrementally 10 years before the statutory retirement age. Since 2014, the NDC scheme is the default option; the insured can opt-out to allocate part of their contributions to the FDC scheme. If the insured decides to pay their entire contributions to the NDC scheme, they will be indexed as pension capital in ZUS.

*Note:* The information is according to the legal situation in December 2018.

*Source:* OECD (2017), ZUS (2017), and own elaboration of authors.

of healthcare systems increased LE, albeit from low levels. As noted by Chłoń-Domińczak (2002), incremental changes to the pension system in the 1990s were not sufficient to ensure long-term financial stability, and a major reform was needed. The first proposal of a more radical pension reform was accepted by the government in 1995, followed by several years of negotiations among different stakeholders, and the new pension system was finally enacted on January 1, 1999.

Table 1 summarizes the main differences between the old and the reformed pension systems for employees and the self-employed.

In addition to mandatory pillars, it is possible to save voluntarily for retirement in occupational and individual pension plans. However, their role in old-age income provision is still marginal, mainly due to weak tax incentives and penalties for early withdrawal of savings.

Pension benefits in the old pension system were calculated according to the following formula<sup>6</sup>:

$$\text{Pension benefit} = \text{Base amount} \times 0.24 + IB \times (0.013 \times CY + 0.007 \times NCY), \quad (1)$$

where

- *Base amount* is equal to the average economy-wide earnings net of social security contributions at the time of calculating the first pension;

<sup>6</sup> Own presentation based on Act of December 17, 1998 on *Old-Age and Disability Pensions from the Social Insurance Fund (with amendments)*.

- *IB (for individual base)* – stands for the ratio of earnings from the 10 best years of work out of the last 20 years before retirement to average earnings in the economy in the same years (additional restriction was  $IB \leq 250\%$ );
- *CY* – number of contributory years;
- *NCY* – number of non-contributory years, e.g., military service, studies, maternity leave (additional restriction  $NCY \leq 1/3 \times CY$ ).

In the old system, there was also a minimum pension guarantee. If an accrued pension benefit was below the minimum pension and the eligibility criteria were met, the pension was increased to the minimum pension level. Additionally, there was a cap on pension benefits – the pension could not be higher than 2.5 times the base amount. There were no deductions for early retirement or bonuses to make people postpone retirement. The old Polish pension system provided relatively higher RRs for low earners and lower rates for high earners.

The post-reform pension benefits depend on contributions paid on lifetime earnings and LE at retirement age. They are calculated according to the following formula:

$$\text{Pension benefit} = \text{Pension assets accumulated in 1st and 2nd pillars} / \text{LE (retirement age)}, \quad (2)$$

where *LE (retirement age)* is the unisex LE at the actual retirement age.<sup>7</sup>

While the post-reform pension system is more sustainable in the long run, this has been achieved through reductions in future pension adequacy. From a policy perspective, pension adequacy can be measured in RRs (i.e., comparing pension benefits to an individual's last pre-retirement earnings) or in absolute amounts. A shift to the defined contribution formula results in smaller inequality in terms of RRs, given that the defined contribution formula is more linked to individual contributions, but a larger inequality in absolute pension amounts, because of a wider distribution of earnings as compared to pension benefits.

For people who worked before 1999, ZUS estimated the so-called “initial capital,” which was added to contributions recorded in the new system in order to account for accrued pension rights in the previous system.<sup>8</sup> The initial capital is a hypothetical old-age pension according to the pre-reform DB formula multiplied by the LE of a 62-year-old and by the adjustment factor, *AF*. The initial capital is computed as  $0.24 \times \text{Base amount} \times AF \times LE$  for a 62-year-old.

For men, the adjustment factor *AF* has the following form:

$$AF = \sqrt{\frac{\text{age on 31 Dec. 1998} - 18}{65 - 18} \times \frac{\text{tenure on 31 Dec. 1998}}{25}} \quad (3)$$

It is to be noted that the impact of the initial capital on future pension benefits would vary depending on how long a person has worked before the reform. For instance, for people with a long tenure before 1999, their initial capital is relatively more important for the level of future pensions than the contributions paid since 1999. In other words, for older cohorts, the initial capital has a larger impact on pension benefits than for younger cohorts. Due to the redistributive part of the initial capital, i.e., the base amount from the old formula, one would expect that pensions of older cohorts would be more equally distributed compared to those of younger

<sup>7</sup> Note that Poland implicitly uses a discount rate of zero because the calculation is based on life expectancy alone without any discounting. See Queisser and Whitehouse (2006) for a discussion of different discount rates in existing NDC schemes.

<sup>8</sup> For details, see Chłoń-Domińczak (2002).

cohorts. On the other hand, because of the stronger link between earnings and pension benefits in the reformed system, one would expect more inequality in RRs for older cohorts with relatively large initial capital and more equality in RRs for younger cohorts.

Apart from the initial capital, there is no straightforward distribution in the reformed pension system. The only elements of redistribution are: (1) contributions paid by the state from general taxation revenues for specific periods of the working career (e.g., maternity and childcare leave, unemployment) and (2) the minimum pension guarantee that tops up the individual pension benefit for individuals with at least 20 (women) or 25 (men) contributory years. Thus, after the reform, the distribution of pension benefits will follow the distribution of earnings more closely than in the old system.

To summarize, there are two major features of the Polish pension reform that would have an impact on the distribution of future pension benefits. First, pension benefits are calculated based on the more actuarially neutral defined contribution formula. Second, the post-reform formula contains a component – the initial capital – that is based on the pre-reform redistributive defined benefit formula, and its impact becomes smaller for younger cohorts. In addition to the initial capital, the redistribution in the new pension system is done through the minimum pension guarantee and contributions paid by the state from general taxation revenues for specific periods of the working career.

### 3 Data and Methods

In this section, we describe the data we use, details of the sample selection, computation of lifetime earnings, and the assumptions and steps made when calculating future pension benefits.

#### 3.1 Data

The data comes from the PHBS run by the Polish Central Statistical Office. The PHBS is an annual representative survey which covers >37,000 Polish households and >105,000 individuals. The available data are from 2012.

#### 3.2 Sample selection

We only include individuals who receive earnings from temporary and permanent employment. This is because we need the information on earnings from employment in order to compute lifetime earnings. Other individuals receive income from other sources, e.g., pension benefits, disability pensions, and family allowances.

We limit our sample to men because we can project their pension benefits with higher accuracy than women's pension benefits. Women usually experience more career breaks due to family or care duties, which is especially true for Polish women. As we do not have information on career breaks in PHBS, calculation of non-contributory periods becomes difficult.<sup>9</sup> On the other hand, men (at least, in Poland) rarely have periods of time out from employment because of family and care duties.

<sup>9</sup> Piirits and Vork (2019) also focus on men only due to data limitations.



We exclude individuals who work in agriculture and the armed forces. We do this because these occupations have special pension arrangements.

Finally, we trim individual earnings below the 1st percentile and above the 99th percentile in order to reduce the influence of outliers and avoid the impact from coding errors. The resulted sample for earnings profiles consists of 15,940 male individuals. For the pension benefits calculation, we select males aged 33–43 years in 2012, i.e., born between 1969 and 1979, consisting of 4,518 male individuals. Table 2 presents descriptive statistics for the estimation samples.

**Table 2** Sample descriptive statistics

Variable	Sample 1			Sample 2		
	Mean	Minimum	Maximum	Mean	Minimum	Maximum
<i>Dependent variable</i>						
Log monthly earnings	7.54	5.70	8.70	7.66	5.70	8.70
<i>Characteristics of individuals</i>						
Tenure	20.60	0	65	17.73	8	28
Educational attainment (%)						
Incomplete primary, primary and gymnasium	7.30			5.57		
Basic vocational	39.71			40.83		
Upper secondary general	7.24			5.90		
Upper secondary vocational	24.82			24.12		
Postsecondary non-tertiary	1.48			1.37		
Tertiary	19.44			22.22		
Occupation (%)						
Public servants and managers	4.22			5.18		
Scientists and researchers	10.73			12.78		
IT and technical personnel	8.34			9.29		
Administration	5.29			5.09		
Service workers	8.59			7.48		
Manual workers and workers in construction	31.73			31.32		
Other types of manual workers	21.29			22.23		
Elementary occupations	9.10			6.64		
Industry						
Mining	3.33			4.05		
Manufacturing	29.14			30.46		
Electric, gas and sanitary service	3.61			2.92		
Construction	18.19			17.16		
Trade	11.76			12.59		
Transportation, communications, information	13.41			13.32		
Finance, insurance, and real estate	2.37			2.39		
Services	6.22			4.14		
Public administration, education, and health	11.98			12.98		
Sample size, observations	15,940			4,518		

*Note:* Sample 1 is the estimation sample for earnings profiles; Sample 2 is the sample of working men born between 1969 and 1979 for pension benefits calculation.

### 3.3 Earnings profiles

We define total earnings for each person as the sum of earnings from permanent and temporary employment in the private and public sectors.<sup>10</sup>

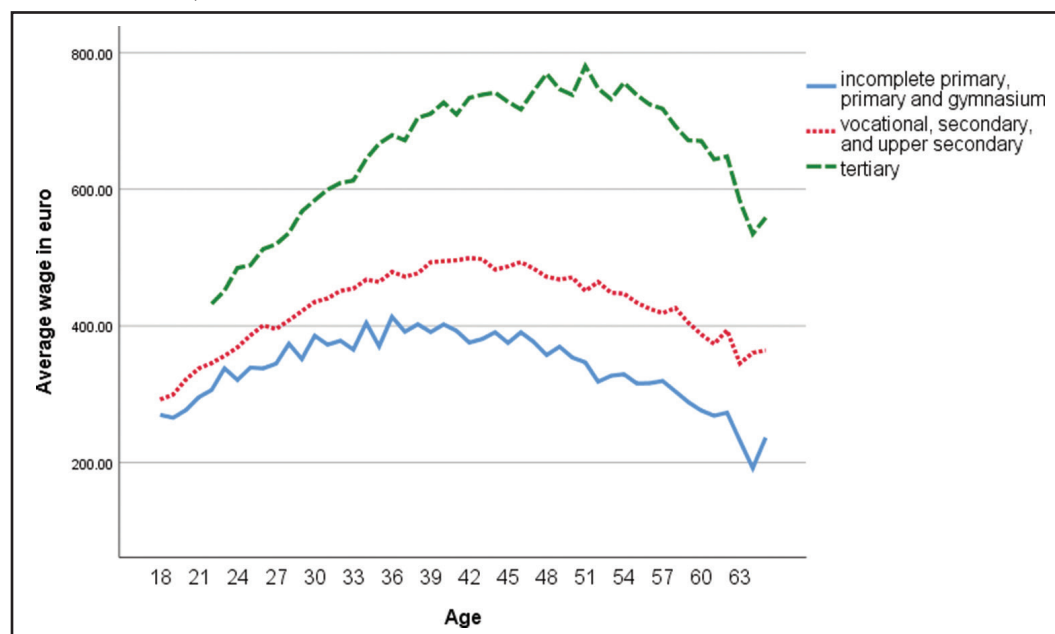
Following a benchmark Mincer earnings equation (e.g., Heckman et al., 2003; Lemieux, 2006), we calculate the earnings profiles. We estimate an OLS regression of log monthly earnings on tenure, tenure squared, education level, occupation dummies, industry dummies, and regional dummies (i.e., voivodships). Tenure is defined as age minus estimated years of schooling, minus seven.

The predicted age-earnings profiles are presented in Figure 1.

Theoretical literature generally predicts that earnings increase in the early stages of a career until they reach a plateau, after which they start to diminish due to decreasing productivity (Mincer, 1974). We also find evidence of concave age-earnings profiles (see Figure 1). The age of maximum earnings by education level in our estimation is consistent with previous papers (e.g., Walewski, 2008).

We use the predicted earnings profiles to forecast earnings for male employees, given their characteristics, from the age they were in 2012 until they retire at the age of 65 years. We assume that, except for age, all the current characteristics, i.e., education level and region of living, are fixed and the profile only changes with tenure. Mobility between industries and

**Figure 1** The predicted age-earnings profiles for men aged 18–64 years by education level, in euros.



*Notes:* Earnings are net monthly earnings in EUR 2012. Own calculations based on PHBS, 2012. Three groups of education levels include the following groups from Table 2: Group 1: Incomplete primary, primary, and gymnasium; Group 2: Basic vocational, upper secondary general, upper secondary vocational, and postsecondary non-tertiary; Group 3: Tertiary. PHBS, Polish Household Budget Survey.

<sup>10</sup> The corresponding variables in Polish are “Dochody z pracy najemnej stałej w kraju” and “Dochody z pracy najemnej dorywczej w kraju”.

occupations is not modeled.<sup>11</sup> We also assume that all individuals live and work until the statutory retirement age of 65 years. Thus, we do not account for various mortality or disability patterns among persons from the same cohort. Despite these limitations, there is a high degree of variation in individual age-earnings profiles among our sample.

We add residuals from the earnings regressions to the predicted earnings profiles. As expected, this increased their dispersion. Thanks to this, our statements about pension benefits inequality would be more realistic.

For earnings projections, we select males aged 33–43 years in 2012, i.e., born between 1969 and 1979, consisting of 4,518 working individuals. The cohort born in 1969 is the first cohort covered entirely by the new reformed pension system, i.e., without any transitory rules, allowing for early retirement on the DB formula. Thus, we could exclude individuals that may retire earlier. Another reason to limit our sample to individuals in mid-career is that earnings are more stable during these and later years, thus making our predictions more reliable. From the literature,<sup>12</sup> we know that there are large increases in earnings at the beginning of most peoples' careers, but after that they change much less. This is also confirmed by our data. In addition, by the time they have reached their 30s, most people have stopped their formal education, and so our assumption on the fixed education level is more plausible.

### 3.4 Pension benefits calculations

To calculate future pension benefits and RRs, we develop a simple micro-simulation model.<sup>13</sup>

First, we compute pension benefits and RRs using post-reform pension regulations. This is done for men aged 33–43 years in 2012 who will retire at age 65 years in years 2034–2044. We call it a *baseline scenario* throughout the paper. We present assumptions for the *baseline scenario* in Appendix. Second, we predict pension benefits under pre-reform regulations. In particular, we calculate pension benefits according to Eq. (1). We call it a *counterfactual scenario*.<sup>14</sup> Next, we show to what extent minimum pension benefits and other employment policies mitigate the increase in inequality under different scenarios.

We check the sensitivity of the results to the main assumptions (LE and rate of return) in Section 5. By comparing the corresponding RRs and Gini coefficients in both scenarios for each of the cohorts, we are able to study the effect of the Polish pension reform on inequality of pension incomes.

## 4 Results

In this section we first analyze the distribution of pension benefits and RRs after the 1999 pension reform and compare them to the counterfactual scenario, where pension benefits are calculated according to the pre-reform defined benefit formula. All pension benefits are in real

11 In reality, occupational and industry decisions might still be taken by our cohorts, leading to changes in labour productivity and consequently to changes in earnings within a cohort. Thus, we might not capture some changes in intra-cohort inequality.

12 See, e.g., Lemieux (2006).

13 We use Visual Basic to do micro-simulations.

14 We name it “counterfactual” as demographic trends and financial instability of the Polish pension system in the 1990s required a major reform. So, it was not possible not to implement changes.

terms with year 2012 as a base year. We discuss changes in decile ratios and Gini coefficients as measures of inequality. Second, we investigate how minimum pension benefit guarantee affects inequality in pension benefits. And finally, we discuss how other employment policies influence distribution of benefits and RRs.

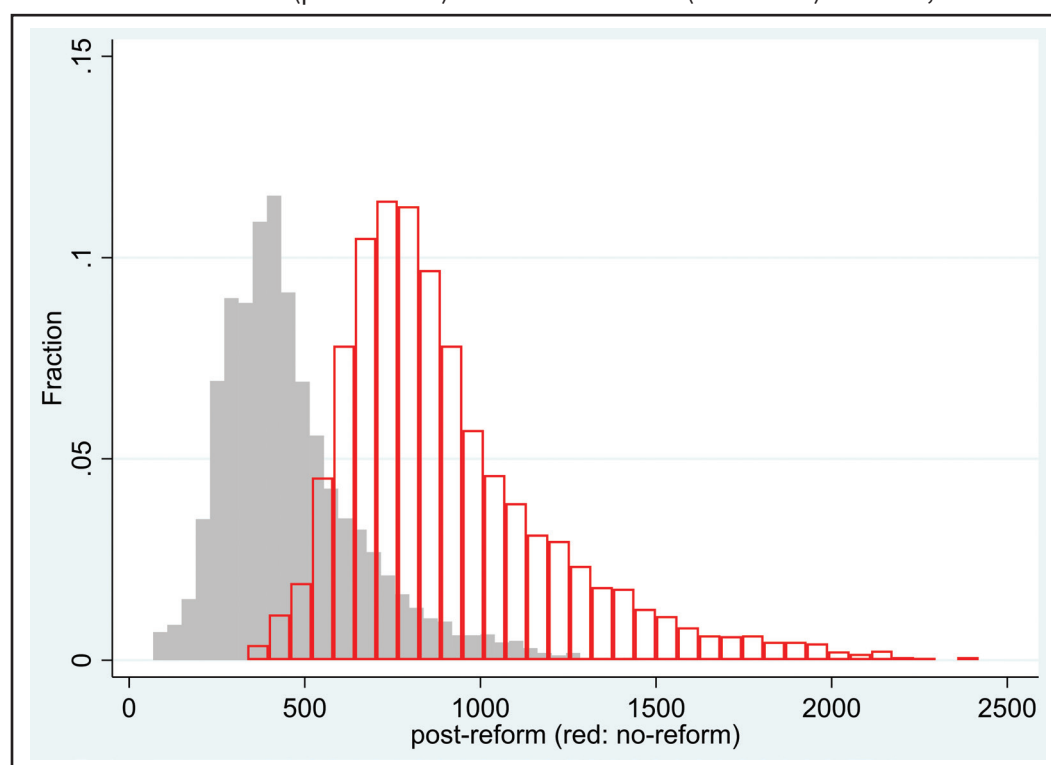
Figure 2 presents the distributions of predicted monthly pension benefits at the age of 65 years for the whole sample in both scenarios. Table 3 shows decile ratios and Gini coefficients for predicted first pension benefits in the baseline and counterfactual scenarios at the retirement age of 65 years by cohorts, starting from the oldest cohort in our sample (born in 1969) up to the youngest one (born in 1979).

Transition from the Beveridgean to the Bismarckian pension system in Poland has decreased generosity and increased inequality in the old-age pension benefits. The Gini coefficient for pensions ranges from 0.219 to 0.267 in the new reformed system, depending on the cohort, and it would be in the range of 0.178–0.187 without the reform. The result is consistent with the findings of Tyrowicz et al. (2018), who also find that the Polish pension reform results in higher consumption inequality.

The predicted median first RR in the new system is 44% in comparison to 80% in the old system. As expected, the Bismarckian pension system results in the distribution of pensions that are more closely linked to the distribution of earnings than in the Beveridgean system. In the baseline scenario, the Gini coefficient of predicted earnings at age 64 years (i.e., just before the retirement) equals 0.26–0.27, which is close to the Gini coefficient of pension benefits.

As Table 3 and Figure 3 show, the inequality within cohorts would be lower in the old pension system, and it does not depend on the year of birth. On the contrary, in the post-reform

**Figure 2** Distributions of predicted monthly pension benefits at the age of 65 years, baseline scenario (post-reform) and counterfactual (no-reform) scenario, in euro.

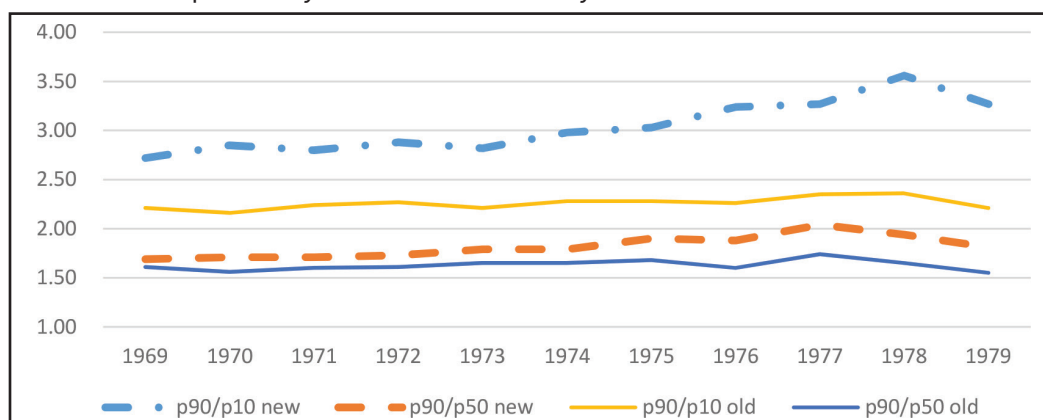


Note: Exchange rate 2012: 1 EURO = 4.185 PLN.

**Table 3** Distribution of net monthly pension benefits at the age of 65 years in euro, 2034–2044

Year of birth	N	New pension system (baseline)				Old pension system (counterfactual)			
		p90/p10	p90/p50	p10/p50	Gini	p90/p10	p90/p50	p10/p50	Gini
1969	378	2.72	1.69	0.62	0.219	2.21	1.61	0.73	0.178
1970	360	2.85	1.71	0.60	0.220	2.16	1.56	0.72	0.172
1971	390	2.80	1.71	0.61	0.227	2.24	1.60	0.71	0.182
1972	388	2.88	1.73	0.60	0.228	2.27	1.61	0.71	0.180
1973	394	2.82	1.79	0.64	0.236	2.21	1.65	0.75	0.185
1974	406	2.98	1.79	0.60	0.239	2.28	1.65	0.73	0.182
1975	417	3.03	1.90	0.63	0.248	2.28	1.68	0.74	0.187
1976	445	3.24	1.88	0.58	0.250	2.26	1.60	0.71	0.185
1977	412	3.27	2.04	0.62	0.259	2.35	1.74	0.74	0.186
1978	456	3.56	1.94	0.54	0.264	2.36	1.65	0.70	0.188
1979	472	3.27	1.81	0.55	0.267	2.21	1.55	0.70	0.187

Note: Depending on the birth year, projections of pension benefits are for 2034 (birth year 1969) up to 2044 (birth year 1979).

**Figure 3** Projected changes in p90/p50 and p90/p10 percentile ratios in the old and the new pension systems for men born in years 1969–1979.

system, both the Gini coefficient and the decile ratio p90/p10 show that inequality within cohorts increases for younger generations. The Gini coefficient steadily increases from 0.219 for the 1969 cohort to 0.267 for the 1979 cohort. The observed increase in inequality in pension benefits for younger cohorts can be explained by a decrease in the share of initial capital. As explained in Section 2, the initial capital, calculated for all individuals insured before 1999, is based on the pre-reform DB pension formula that includes a constant redistributive part. For younger cohorts, the share of initial capital is lower than for older cohorts as they had shorter careers before the 1999 reform. In particular, the average share of the initial capital in the total pension capital accumulated until age 65 years decreases from 38% for men born in 1969, to 1.5% for the cohort born in 1979.

Focusing further on the decile ratios p10/p50 and p90/p50, it is interesting to note that they are nearly constant across cohorts in the counterfactual scenario, while in the baseline scenario (the new pension system) inequality increases for younger generations both in the

**Table 4** RRs for first pension benefits received at the age of 65 years

Year of birth	N	New pension system (baseline)				Old pension system (counterfactual)			
		p90/p10	p90/p50	p10/p50	Average (%)	p90/p10	p90/p50	p10/p50	Average (%)
1969	378	1.33	1.14	0.85	42	1.56	1.26	0.81	80
1970	360	1.33	1.13	0.85	42	1.62	1.33	0.82	82
1971	390	1.30	1.13	0.87	40	1.57	1.30	0.83	80
1972	388	1.30	1.13	0.87	39	1.57	1.31	0.83	78
1973	394	1.28	1.13	0.88	38	1.58	1.32	0.83	80
1974	406	1.27	1.12	0.88	38	1.60	1.32	0.82	81
1975	417	1.24	1.13	0.91	37	1.56	1.28	0.82	80
1976	445	1.21	1.12	0.93	36	1.58	1.32	0.84	80
1977	412	1.22	1.11	0.91	36	1.55	1.27	0.82	79
1978	456	1.15	1.08	0.94	35	1.57	1.30	0.83	78
1979	472	1.14	1.08	0.95	35	1.51	1.28	0.85	78

RR, replacement rate.

Notes: Depending on the birth year, projections of pension benefits are for 2034 (birth year 1969) up to 2044 (birth year 1979). RRs are calculated as a ratio of the first pension benefits to last earnings before retirement.

upper part of the distribution for most of the years and in the lower part of the distribution (see Table 3). From a policy perspective, an increase in inequality in the lower part of the distribution is worrying, as it contributes to relative poverty as more elderly people will be left under the poverty line.

Table 4 presents descriptive statistics of individual RRs in the same two scenarios. As expected,<sup>15</sup> inequality in RRs in the new system is lower than it would be in the old system, as the DC system pension benefits are closely linked to lifetime contributions. Also note that after the reform, inequality in RRs decreases over time, reflecting the fact that the pension benefits of younger cohorts are more strongly linked to earnings than the pension benefits of the older cohorts. Decile ratio p90/p10 is 1.33 for the cohort born in 1969 and is 1.14 for those born in 1979. That is due to both a slight decrease in the upper part and an increase in the lower part of the RRs distribution.

The predicted average RR at the age of 65 years for all cohorts amounts to 38%. This is consistent with Lachowska and Myck (2018), who estimate the RR for men who were born in 1960 to be <40%. This is also consistent with predictions of the European Commission (European Commission, 2018).<sup>16</sup>

Next, we study how the minimum pension guarantee affects inequality of pension benefits. We adjust the first pension benefit to the minimum pension benefit if the pension benefit is lower than this level. Following Chłoń-Domińczak and Strzelecki (2013), we consider two scenarios:

- The lower (L) minimum pension scenario follows the current policy. It assumes that the pension benefit available for men with at least 25 years of contributions equals 22% of

<sup>15</sup> See the discussion in Section 2.

<sup>16</sup> For an average male income earner with a 40-year career, the European Commission predicts that the RR would drop from 86% in 2016 to 45% in 2056 due to a shift from the defined benefit to the defined contribution pension system (European Commission, 2018), which is similar to our results.

the average wage (the actual value for Poland in 2018).<sup>17</sup> Then it is indexed annually by the inflation rate plus 20% of real wage growth (indexation currently stipulated by the law). Given the 20% share of average wage growth in the indexation, the relation of the minimum pension to average wage decreases over time.

- The higher (H) minimum pension scenario assumes that the minimum pension will be set for all years at the level of 24% of the average wage. The H minimum pension scenario follows the average level of minimum pension benefits in OECD countries (OECD, 2019). Indexation amounts to 100% of wage growth and is a hypothetical maximum indexation that is assumed in Chłoń-Domińczak and Strzelecki (2013).

These two scenarios are relevant because they represent two possible levels of the minimum guarantee: one with the low minimum pension benefit that follows current policy, and one that ensures a higher minimum pension benefit.

Under the L scenario, the minimum pension guarantee does not offset the increase in the Gini coefficient (see Table 5). However, under the H scenario, the minimum pension would more than offset the effect of the reform. The minimum pension benefit in the L scenario reduces the Gini coefficient of pensions by roughly 20%–30% of the original increase due to the pension system reform. This result is similar to findings of Tyrowicz et al. (2018), who studied

**Table 5** Impact of the minimum pension benefit on inequality of pension benefits and RRs

Scenario	Cohorts		
	1969	1974	1979
	<b>Gini index of pension benefits</b>		
Baseline – 65 years, new system	0.219	0.239	0.267
Counterfactual – 65 years, old system*	0.178	0.182	0.187
New 65 years + min pension H	0.167	0.158	0.179
New 65 years + min pension L	0.199	0.210	0.241
	<b>First pension benefits p90/p10 ratio</b>		
Baseline – 65 years, new system	2.72	3.03	3.27
Counterfactual – 65 years, old system	2.21	2.28	2.21
New 65 years + min pension H	1.99	1.89	1.97
New 65 years + min pension L	2.45	2.51	2.84
	<b>Average RRs (%)</b>		
Baseline – 65 years, new system	42	38	35
Counterfactual – 65 years, old system	80	81	78
New 65 years + min pension H	48	47	44
New 65 years + min pension L	45	41	38

RR, replacement rate.

\*Results for the counterfactual scenario with minimum pension are not reported. The impact of the minimum pension in the old system on inequality in pension benefits is almost negligible due to a generous redistributive formula. In addition, men in our sample have relatively long tenure. As a result, only <1% of pensioners under old rules would receive a minimum pension.

<sup>17</sup> Own calculations based on the level of minimum pension in 2018 and 2019 and average wage in the economy calculated by the Polish Statistical Office.

the impact of the minimum pension on the Gini coefficient of consumption. In the H minimum pension scenario, inequality measured by the Gini coefficient and the decile ratio p90/p10 would be even lower in the new system than under the old pension system regulation. In the L minimum pension scenario, 18% of new retirees receive the minimum pension benefit in our sample, whereas in the H minimum pension scenario, this share rises to 42%.

Finally, we analyze how other employment policies influence inequality of pension benefits. In particular, we study the impact of higher retirement age and of equalized employment rates among various groups of employees.

First, we consider the higher retirement age scenario (see Table 6). Working longer until the age of 67 years has almost no effect on the distribution of both pensions and decile ratios, but considerably increases average RRs for every cohort when compared to the baseline scenario.

Second, we assume that employment probabilities are the same across education levels (no difference in employment rate scenario).<sup>18</sup> The expected inequality in pension benefits decreases substantially for all cohorts (see Table 6). This is due to relatively longer contributory periods for less educated individuals than in the baseline scenario.

Is increasing employment rates feasible for policymakers? As noted by Lindner and Morawski (2012), as a result of the pension reforms undertaken in 1999, the link between social security contributions and benefits tightens and so the incentives to work should increase. However, they found no evidence for increased labor supply as a result of the 1999 pension reform (Lindner and Morawski, 2012). A more recent paper by French et al. (2022) finds some, but rather small, employment responses to the 1999 reform. Contributing to this is the fact that labor supply is less responsive for those in their 30s than for those at older ages, and so the improved labor

**Table 6** Impact of higher retirement age and no difference in employment rate on pension benefits and RRs

Scenario	Cohorts		
	1969	1974	1979
<b>Gini index of pension benefits</b>			
Baseline – 65 years, new system	0.219	0.239	0.267
Counterfactual – 65 years, old system	0.178	0.182	0.187
Higher retirement age (67 years)	0.221	0.241	0.268
No difference in employment rate	0.203	0.220	0.240
<b>First pension benefits p90/p10 ratio</b>			
Baseline – 65 years, new system	2.72	3.03	3.27
Counterfactual – 65 years, old system	2.21	2.28	2.21
Higher retirement age (67 years)	2.76	3.01	3.28
No difference in employment rate	2.58	2.84	2.95
<b>Average RRs (%)</b>			
Baseline – 65 years, new system	42	38	35
Counterfactual – 65 years, old system	80	81	78
Higher retirement age (67 years)	49	44	41
No difference in employment rate	47	43	40

RR, replacement rate.

<sup>18</sup> We set the employment probabilities as equal to 92.9%, which is the average employment rate during 2005–2014 for men with tertiary education. See the discussion in Appendix.



supply incentives at earlier ages due to the closer pension-contribution link yield less additional labor supply than that which is lost due to reduced work incentives later in the lifecycle.

With regard to average RRs, both scenarios contribute to higher RRs when compared to the baseline scenario. These scenarios show similar increases in RRs as in the scenario with the high minimum pension guarantee, which confirms the robustness of our findings (see Tables 5 and 6).

## 5 Sensitivity of Results

In this section, we check the sensitivity of our results to the underlying assumptions.<sup>19</sup> In particular, we compare the distribution of predicted pension benefits and RRs in the baseline (after-reform) and counterfactual (pre-reform) scenarios to scenarios with a higher rate of return and a longer LE.<sup>20</sup> All the sensitivity scenarios assume the after-reform DC pension benefits. The results are presented in Table 7.

First, we examine the higher LE scenario. In particular, we assume an increase in LE at the age of 65 years by 12 months from the baseline of 252 months for those retiring in the year 2034 (the cohort born in 1969), and 271 months for those retiring in 2044. Higher LE results in a decrease in absolute benefits and RRs in the new system, but has no impact on pension inequality (see Table 7). Lower RRs as compared to the baseline are due to the lower level of first benefits in the defined contribution system.

**Table 7** Gini index of pension benefits, first pension benefits p90/p10 ratio, and average RRs for selected cohorts

Scenario	Cohorts		
	1969	1974	1979
<b>Gini index of pension benefits</b>			
Baseline – 65 years, new system	0.219	0.239	0.267
Counterfactual – 65 years, old system	0.178	0.182	0.187
Higher LE	0.219	0.239	0.267
Higher rate of return	0.216	0.236	0.264
<b>First pension benefits p90/p10 ratio</b>			
Baseline – 65 years, new system	2.72	3.03	3.27
Counterfactual – 65 years, old system	2.21	2.28	2.21
Higher LE	2.72	3.03	3.27
Higher rate of return	2.70	2.94	3.27
<b>Average RRs (%)</b>			
Baseline – 65 years, new system	42	38	35
Counterfactual – 65 years, old system	80	81	78
Higher LE	40	36	33
Higher rate of return	48	44	42

LE, life expectancy; RR, replacement rate.

<sup>19</sup> In the long-run simulation models, assumptions can have a significant impact on the size of the effect studied (see, e.g., Bielecki et al., 2015).

<sup>20</sup> A detailed explanation of the assumptions used in the calculations below is presented in Table A1 in Appendix.

Next, we change the real rate of return in the funded defined contribution (FDC) and the real annual indexation of accumulated pension capital in the NDC from 2% to 3% (higher rate of return scenario). As we assume the same rate of return in the funded and unfunded parts of the Polish pension system throughout the paper (see Appendix for additional details), changes in the rate of return have an impact on the level of future pensions and RRs, but not on predicted inequality of pensions, as measured by the Gini index and the decile ratio  $p_{90}/p_{10}$  (see Table 7).

To sum up, our main results on changes in intragenerational inequality are robust to assumptions on retirement age and the rate of return in the pension system. Also, these scenarios show similar increases in RRs as in the scenario with the high minimum pension guarantee, which confirms the robustness of our findings (see Tables 5 and 7).

## 6 Conclusions

This paper has analyzed the intragenerational distributional effects of the 1999 Polish pension reform, based on micro data. We have studied the sample of men born between 1969 and 1979 (who will retire in the future according to the fully mature DC system) and predicted their pension benefits at the age of 65 years according to pre-reform and post-reform rules.

The main estimates in Table 3 suggest that the Gini coefficient of pension benefits steadily increases from 0.219 for the youngest cohort, to 0.267 for the oldest cohort in the reformed system. The increased inequality of pension benefits is driven by the change in the pension benefits formula, which is the result of the system gradually moving from a defined benefit to a defined contribution type. Our model shows that for younger generations, inequality increases both in the upper and lower parts of the distribution, which implies that relative poverty in Poland might increase as a result of the pension reform.

We further show that the minimum pension guarantee would be able to mitigate the predicted increase in inequality. The minimum pension benefit reduces pension inequality in the reformed pension system, and the size of this reduction depends on the relative level of the minimum pension to average wage. However, it is important that people contribute to the system long enough in order to have the right to a minimum pension (Sawulski et al., 2019).

Finally, our estimations show that an increase in retirement age in the Polish system would have similar effects on the adequacy of future benefits, measured by RRs, as the minimum pension guarantee. Increasing retirement age would be less costly for the public budget than providing a minimum pension benefit, but is arguably more politically challenging, as recent developments in reversing the reforms in Poland show.

When interpreting our results, one has to remember that we simulate pension benefits only for a part of the population, focusing on men. We omit women, who usually have more career breaks and lower earnings, as well as miners and members of the armed services, who retire with more generous pension formulas. Another omitted group is farmers covered by a separate, less generous pension system.<sup>21</sup> Adding these groups to the analysis would probably increase intra-generational inequality even more.

Future challenges for pension systems (e.g., Carone et al., 2016) include the need for boosting retirement incomes by extending working lives and providing additional sources of

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21 However, the share of employment in agriculture is decreasing in Poland.

retirement incomes from voluntary savings. Our research confirms that longer work in the Polish pension system contributes to higher RRs, if retirement age increases, but also to lower inequality of pensions, if employment rates are similar for all educational groups. Our results suggest that policymakers should try to identify potentially vulnerable groups (i.e., those with low expected future pensions) in every cohort and implement policies that would allow individuals to accumulate enough pension capital to have an adequate pension income in the future.

#### **Declarations**

##### **Availability of data and material**

The datasets supporting the conclusions of this article are included within its additional files.

##### **Competing interests**

The authors declare that they have no competing interests.

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##### **Authors' contributions**

Both authors contributed to the analysis of the data and discussion of the results. Both authors read and approved the final manuscript.

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# Appendix

## A.1. Pension benefit projections and assumptions for sensitivity analysis

### A.1.1. Pension benefit projections

Additional assumptions for the baseline scenario include the following:

- In the baseline scenario, we assume a 2% annual real average wage growth since 2018 (and higher in the section on sensitivity of results). This is in line with the productivity growth assumptions of the European Commission (see European Commission, 2018).
- The rate of return and indexation of funds in the accumulation phase and the benefit formula are the same as in the current Polish pension system. As we do not know how many people decided to stop paying contributions to open pension funds, we assume that the real annual indexation of accumulated pension capital in the NDC pillar and the rate of return in the FDC are the same, and in the baseline scenario equal to 2%. For the years 1999–2017, we take the actual indexation.<sup>22</sup>
- For the calculation of contributions, we need information on individual earnings before 2012. Some men in our sample paid their contributions >25 years. We assume that previous individual earnings change according to estimated age-earnings profiles.
- Earnings in the PHBS are reported net of taxes and social security contributions. We gross up net earnings, and so they include taxes and social security contributions. We assume that personal income tax rates and social security contributions rates in the future will be the same as in 2012.<sup>23</sup>
- To take into account unemployment and other breaks in a professional career, we assume that every person is employed and pays his old-age pension contributions with a probability equal to the average employment rate during 2005–2014 for men with the same education level. During this period, average employment rates varied from 53.1% for the shortest education (i.e., category 1: incomplete primary, primary, and lower secondary education), through 79.1% for secondary education, to 92.9% for tertiary education. Thus, we account for the average expected employment by education in a business cycle, but disregard persistence in unemployment. We assume that employment for men is a period when pension contributions are paid.
- We assume that every person in our sample starts working just after completing his formal education. For older cohorts that worked before 1999, we need to estimate the initial capital (see Section 2). We calculate the initial capital according to the formula discussed in Section 2.
- Future unisex LE is calculated based on EUROPOP2010 projections of life expectancies at 65 years or 67 years (see Eurostat database). That results in 0.73% growth in LE at 67 years every year starting from 201.1 months for 2014.
- For simplicity, we assume that people retire on January 1st of the year they turn 65 years or 67 years of age.

<sup>22</sup> See ZUS website <http://www.zus.pl/wskazniki-waloryzacji-rocznej>, date of access 16 March 2018.

<sup>23</sup> In Poland contributions are paid also on flat rate unemployment benefits, but <20% of the unemployed are entitled to such benefits. Other contributory periods are maternity leave and parental leave but those spells concern women.

**Table A1** Assumptions for sensitivity analysis – various scenarios

	<b>Baseline: new system</b>	<b>Counterfactual: old system</b>	<b>New system, with higher (H) minimum pension</b>	<b>New system, with lower (L) minimum pension</b>	<b>New system, higher retirement age</b>	<b>New system, higher LE</b>	<b>New system, higher rate of return</b>	<b>New system, same employment rates for all education groups</b>	<b>Earnings not falling</b>
Employment rates (%)	Higher education – 92.9, secondary education – 79.1, primary education and lower – 53.1 92.9 for all								
Retirement age (years)	65		67	65					
LE at retirement (in months) at the year of retirement	From 252 to 271	-	From 252 to 271	From 236 to 254	From 252 to 271	LE from the baseline scenario + 12 months (from 264 months to 283 months)	From 252 to 271		
Rate of return since 2018 (%)	2	-	2				3		
Wage profiles	Age-wage profiles rising until the age of maximum wage and then falling								Age-wage profiles constant since the age of maximum wage

LE, life expectancy.