UNIVERSITY OF WARSAW

Faculty of Economic Sciences

WORKING PAPERS
No. 28/2022 (404)

THE LONG-TERM IMPACT OF QUASI-UNIVERSAL TRANSFERS TO OLDER HOUSEHOLDS

ALEKSANDRA KOLASA

WARSAW 2022

UNIVERSITY OF WARSAW
FACULTY OF ECONOMIC SCIENCES

WORKING PAPERS

The long-term impact of quasi-universal transfers to older households

Aleksandra Kolasa

Faculty of Economic Sciences, University of Warsaw

Corresponding author: aurbaniec@wne.uw.edu.pl

Abstract: One of the key challenges associated with current demographic trends is to provide adequate financial support to older households without jeopardizing fiscal sustainability or harming macroeconomic performance. Among possible policies, quasi-universal transfers have recently gained traction in several countries. One example of this approach is the 13th Pension, introduced in 2019 in Poland. In this paper, I study the long-term aggregate, redistributive, and welfare effects of this type of program, and compare its impact to that of more standard elderly-oriented policies with similar fiscal costs. I also investigate how simple modifications would affect its costs and effectiveness. My analysis is based on a general equilibrium overlapping generations model of an open economy that incorporates family types, individual risk associated with earnings, health and mortality, and stochastic out-of-pocket expenses. According to the model simulations, a quasi-universal transfer to retired households such as the Polish 13th Pension program significantly improves the financial situation of a median pensioner but generates an aggregate welfare loss (under the veil of ignorance) equivalent to a 0.7% reduction in average household lifetime consumption. It also has only a moderate impact on average measures of poverty and inequality.

Keywords: monetary poverty, catastrophic health expenditure, out-of-pocket medical expenses, recursive probit models

JEL codes: I32, I14, J14

1 Introduction

Population aging is leading to an increased number of the relatively poor elderly, who also face a high risk of deteriorating health and associated large out-of-pocket medical payments. Therefore, one of the key challenges in relation to current demographic trends is to provide adequate financial support to older population without jeopardizing fiscal sustainability or harming macroeconomic performance. In most countries, the two major state programs that provide the greatest support to older households are social security and public health insurance. In addition, governments implement smaller-scale programs aimed at the most vulnerable among the elderly. Income criteria are commonly used to determine eligibility. Means-testing aims to curb fiscal costs while reaching those most in financial need. However, such programs have several drawbacks. Critics point to stigmatization, administrative barriers, and a lack of broad political support (Stuber and Schlesinger, 2006; Currie, 2006). Means-tested programs can also distort incentives to work and save (Tran and Woodland, 2014; Bruckmeier and Wiemers, 2018; Bütler, Peijnenburg, and Staubli, 2017).

One alternative to means-testing is a quasi-universal benefit. It uses broad targeting, i.e. its recipients belong to a group that is widely recognized as having a higher risk of low income, but no individual income criteria are imposed. For example, such a benefit can cover the whole, or a large part, of the elderly population. Since the beginning of the Covid-19 pandemic, quasi-universal transfers have gained traction in several countries, providing temporary support to older households. In 2021, Canada introduced a one-time payment of $500 for older senior citizens. Similar benefits were provided in Israel. The advantages of quasi-universal transfers in achieving fiscal redistribution objectives are also recognized by international institutions like the International Monetary Fund (see e.g. Coady and Le, 2020).

A notable example of such a transfer is the *13th Pension*, introduced in 2019 in Poland. It gives an additional payment, equal to the minimum monthly pension, once a year to all pensioners. In 2020 this benefit was enshrined into Polish law by the Thirteenth Pension Act. In 2019 the total cost of the program amounted to around 0.5% of Polish GDP, and the payment received after taxes was 1/3 of a net median monthly salary. As the program has broad coverage, simplicity, and pays equal transfers to all pensioners, it can serve as a prototype version of broad quasi-universal transfers aimed at older households.

This paper aims to study the long-term aggregate, redistributive, and welfare effects of the *13th Pension,* and compare them to those of more standard elderly-oriented policies with similar fiscal costs. It also investigates how simple modifications to the *13th Pension* affect the cost and effectiveness of the program. To this end, I develop a general equilibrium overlapping generations model. In the spirit of the "Bewley-Huggett-Aiyagari" framework, I assume incomplete markets and individual earnings shocks. I allow for different types of families and introduce separate earnings and health shocks for all adults in the household. The model thus takes account not only of the key risks faced by households, such as uncertainty of future income, health, lifespan, and the size of medical expenses, but also makes these risks dependent on family composition. By doing so, the model incorporates a family insurance channel, takes into account major gender differences observed in the data, separate pension schemes for men and women, as well as survivors' pension benefits.

The model economy is calibrated to the Polish economy. In contrast to most previous studies that focus on the US, I adopt the perspective of a small open economy with features specific to most European countries. These include very low fertility, a moderate level of inequality, and free universal health care. None of these features are observed in the US. The model also reflects an aging economy, where older women are subject to great financial vulnerability, and the public health system is struggling with service delivery issues. Under such conditions, elderly-oriented policies are particularly relevant.

All these characteristics also apply to the Polish economy. Indeed, according to the *World Population Aging* (2020), Poland has one of the fastest aging populations in Europe. Polish women retire at 60, five years earlier than men, and much earlier than women in most developed countries. Thus, with the existing gender wage gap and contribution-based pension system, future pensions of currently working Polish women are expected to be very low (OECD *Pensions at a Glance,* 2019). Moreover, as the health system in Poland is predominantly focused on hospital care, outpatient medicines account for most of out-of-pocket spending (Polish *Country Health Profile 2019*). Poland also has one of the highest out-of-pocket pharmaceutical expenditures among European countries. To reflect all these features in the model, and in particular to properly allow for health-related risks of Polish households, I perform an additional empirical analysis using micro-level data from the Polish Household Budget Survey (HBS) and SHARE project (Börsch-Supan, 2020).

I find that the *13th Pension* significantly improves the financial situation of a median pensioner, thus reducing the gap between the median consumption of working and retired households. However, it causes a welfare loss (under the veil of ignorance) equivalent to a 0.7 percent reduction in average household lifetime consumption. One-third of this loss comes from the aggregate effect that is well known in the literature studying intergenerational transfers: the return that households receive from the *13th Pension* is lower than they could earn by saving individually. Moreover, by offering some insurance against old age-related shocks, the program reduces the incentive to save, which translates into a lower value of domestic assets and reduced aggregate output. Interestingly, I also find the distribution effect of the *13th Pension* to be ex-ante welfare-reducing, which means that the benefits of partial insurance gained from the shift in consumption towards older age does not compensate for increased vulnerability of the young to negative earnings shocks due to lower average income. Moreover, the model simulations suggest that only slightly more than 1% of households would ex-post benefit from being born in a country that has the *13th Pension.* These are households who end up living until very old age and have faced many negative income shocks. The program also only moderately decreases aggregate indicators of poverty and inequality, as well as the incidence of catastrophic health expenditure (CHE).

It is well-known that redistributive policies often face an equity-efficiency tradeoff. In the case of the *13th Pension*, better income redistribution can be achieved by increasing fiscal costs or using specific targeting. However, this comes at the expense of a deterioration in main economic aggregates, such as output and consumption, which often translates into lower overall welfare. For example, directing the transfers of the *13th Pension* to oldest-old (those aged 85 and over), while keeping its fiscal cost unchanged would strengthen the redistributive effects of the program, but generate a higher welfare loss. On the other hand, setting income limits that determine eligibility would help reduce the negative aggregate effect and significantly increase the number of the program's ex-post beneficiaries, but the average redistributive impact would be much lower. I also show that, compared to more standard policies that support individuals with low pensions or reduce the burden of out-of-pocket medical expenses, the *13th Pension* is less successful in reducing poverty and consumption inequality. On the other hand, it has a slightly lower negative effect on aggregate output and consumption.

Finally, I check the sensitivity of my findings by comparing them to alternative methods of financing the *13th Pension.* Taxing consumption instead of labor income does not notably change the program's overall performance. Using capital taxation generates aggregate distortions that outweigh any positive redistributive effects. Improvement in ex-ante welfare can be achieved by financing the *13th Pension* from the current pension fund, which lowers an average 'regular' pension but avoids increased taxation. However, in this case, the welfare improvement comes solely from the reduction in pension uncertainty and is very small.

Review of the literature

This paper is related to the literature on the macroeconomic and redistributive impact of non-exclusive programs aimed at older households. A number of papers discuss universal or non-contributory pensions, and stress the need to expand pension coverage in developing economies (see, among others, Willmore, 2007; Melguizo, Bosch, and Pages, 2017; Dethier, Pestieau, and Ali, 2010; Shen and Williamson, 2006). Another stream of the literature focuses on programs that address the health needs in old age, including long-term care (De Nardi, French, Jones, and McCauley, 2016; De Nardi, French, and Jones, 2016; Swartz, 2013; Villalobos Dintrans, 2018). My paper is also related to studies which use a general equilibrium framework with heterogeneous agents and idiosyncratic uncertainty to examine the welfare and redistributive effects of government policies for older households. The primary focus of this literature is on the US and its social security program. The general finding is that removing social security or parts of its redistributive policies improves welfare (see among others Conesa and Krueger, 1999; Huggett and Parra, 2010; Storesletten, Telmer, and Yaron, 1999; and İmrohoroglu, Imrohoroglu, and Joines, 1995 for certain specifications). However, some more recent studies show that incorporating transition costs or aggregate risks in the analysis can lead to the opposite conclusion (Nishiyama and Smetters, 2007; Harenberg and Ludwig, 2019). The impact of other elderly-oriented programs in the US, such as Medicare, Medicaid, and Supplemental Security Income, has also been explored in the literature. New research indicates that not only it would be costly to eliminate such programs, but some of them might even have improved ex-ante welfare (see among others Kaymak and Poschke, 2016; Braun, Kopecky, and Koreshkova, 2017; Conesa, Costa, Kamali, Kehoe, Nygard, Raveendranathan, and Saxena, 2018). My paper contributes to the literature which recognizes the importance of health and medical expenditure shocks faced by older households in shaping their economic decisions (De Nardi, French, and Jones, 2010; Yogo, 2016; Capatina, 2015). Similarly to De Nardi, French, Jones, and

McGee (2021), Nakajima and Telyukova (2020), and Braun, Kopecky, and Koreshkova (2017), my model departs from a more standard approach by introducing couples and singles separately, which allows key sources of risks to be modeled at the individual rather than household level, and major gender differences to be taken into account.

To my knowledge, this paper is the first to quantify the impact of quasi-universal transfers using a general equilibrium framework and a model with individual income, health and mortality risks, and stochastic out-of-pocket expenses. It is also one of the very few studies which assess the effects of income redistribution within this class of models from the perspective of a European economy. This includes careful calibration in line with the empirical evidence and with the support of additional mico-level analysis. Finally, the paper provides the first estimates of how the *13th Pension* is expected to affect the Polish economy in the long term.

The rest of the paper is structured as follows. In Section 2 I present the general equilibrium model developed for this paper. Section 3 discusses the calibration procedure and evaluates the model's ability to match non-targeted statistics. Section 4 presents the main results. It describes and compares the long-term impact of the *13th Pension*, selected modifications to the program, and its performance against the background of standard policies aimed at providing support to vulnerable older households. It also quantifies the effects of the *13th Pension* under different financing methods. The last Section containes concluding remarks.

2 The model

To assess the long-term impact of the *13th Pension*, I develop a general equilibrium overlapping generations model of a small open economy. The model is populated by heterogeneous individuals, who form households and are perfectly altruistic towards their spouses. Throughout the life-cycle, consumption-savings decisions are made at the household level.

There are several sources of uncertainty in the model. Similar to the "Bewley-Huggett-Aiyagari" framework (Aiyagari, 1994; Bewley, 1983; Huggett, 1993), individuals face idiosyncratic productivity shocks. These shocks are correlated between household members. Moreover, in the spirit of Braun, Kopecky, and Koreshkova (2017), individuals face the risk of health deterioration and health-dependent mortality as they age. Thus, a household composition might change due to the death of a household member. Similar to De Nardi, French, and Jones (2010), the model also features the risk of high medical expenses of older households. There is an obligatory pay-as-you-go pension system. Pension payments depend on individuals' average lifetime earnings. Under certain conditions, pension benefits can be inherited by the spouses.

Demographics The economy is inhabited by overlapping generations of households. The time is discrete and households can live at most for J periods. The number of households increases at a constant rate n. A new household is composed of two individuals who are the same age $j = j_{\text{born}}$ but different genders $i = \{f, m\}$. The age of a household equals j, that is the age of its members.

Mortality risk When individuals reach a certain age j_{surv}, they face a mortality risk with the conditional survival probability $s^i(j, h^i)$ that varies with gender, age, and health status h^i. Consequently, households older than j_{surv} might have different compositions d, where $d = 1$ refers to a couple, $d = 2$ indicates a widower, and $d = 3$ corresponds to a widow. The household conditional survival probabilities can be described as

$$S\left(d, j, H \equiv (h^m, h^f)\right) = \begin{cases} 1 - (1 - s^m(j, h^m))\left(1 - s^f(j, h^f)\right), & d = 1 \\ s^m(j, h^m), & d = 2 \\ s^f(j, h^f), & d = 3 \end{cases} \tag{1}$$

while, for surviving households, the transition matrix of household composition d is given by

$$\Upsilon = \begin{bmatrix} s^m(j, h^m)s^f(j, h^f) & s^m(j, h^m)\left(1 - s^f(j, h^f)\right) & s^f(j, h^f)\left(1 - s^m(j, h^m)\right) \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix} \tag{2}$$

$$\text{where} \quad \Upsilon(l, k) = \mathbf{P}(d'|d; j, H), \quad \text{for} \quad l, k = 1, 2, 3.$$

Note that, for widows and widowers ($d > 1$), the composition of their households cannot change.

Health risk All individuals are born in good health and remain so until the age of $j_{\text{health}} - 1$. Afterwards, they face uncertainty about their health status, which can be either good ($h^i = 1$) or poor ($h^i = 0$). The initial distribution of health status, i.e. distribution among households aged j_{health}, depends on their average lifetime earnings $\bar{e}^i$. Formally, for a ($j_{\text{health}} - 1$)-year-old, the probability of being in good health in the next period is defined by $\eta^i(\bar{e}^i) \in [0, 1]$. For individuals aged j_{health} or older, such probability no longer depends on their financial situation, but it can be expressed as a function of their current health condition, age, and gender. I denote this function as $\zeta^i(j, h^i) \in [0, 1]$. Let us define household health status $H \equiv (h^m, h^f)$ and make a technical assumption that $h^i \equiv 0$ for a former household member who is no longer alive. The above means that widowers (households with composition $d = 3$) have $h^f = 0$, and widows (households with composition $d = 2$) have $h^m = 0$. The formula below summarizes the probability of being in good health in the next period, given relevant characteristics:

$$\mathbf{P}\left(\left(h^i\right)' = 1 | h^i, j, \bar{e}^i, d'\right) = \begin{cases} 0, & d' \notin \tilde{D}^i \\ 1, & j < j_{\text{health}} - 1 \;\text{ and } d' \in \tilde{D}^i \\ \eta^i(\bar{e}^i), & j = j_{\text{health}} - 1 \;\text{ and } d' \in \tilde{D}^i \\ \zeta^i(j, h^i), & j \geq j_{\text{health}} \text{ and } d' \in \tilde{D}^i \end{cases} \tag{3}$$

$$\tilde{D}^f = \{1, 3\},\ \tilde{D}^m = \{1, 2\},$$

where d' indicates household composition in the next period.

Working life Individuals work until they reach a gender-specific retirement age j^i_{ret}. Over the working period, their productivity is a product of an age-dependent deterministic component $\bar{z}^i(j)$ and a stochastic component e^i. The latter is determined by a realization of a household earnings shock $E \equiv (e^m, e^f)$, which follows an age-invariant bivariate Markov process. Household gross labor income (excluding pensions) can be summarized by the following formula:

$$z_1(d, j, E, w) = I(j < j^m_{\text{ret}}) I(d < 3) \left(w \bar{z}^m(j) e^m\right) + I(j < j^f_{\text{ret}}) I(d \neq 2) \left(w \bar{z}^f(j) e^f\right), \tag{4}$$

where w stands for the wage rate per efficiency unit of labor and $I(j < j^m_{\text{ret}})$, $I(j < j^f_{\text{ret}})$, $I(d < 3)$, $I(d \neq 2)$ are binary indicator functions.[1] The formula above indicates that working men live only in households with composition $d < 3$ and age $j < j^m_{\text{ret}}$, contributing $w\bar{z}^m(j)e^m$ to household (gross) labor income. Similarly, working women are members of households with composition $d \neq 2$ and age $j < j^f_{\text{ret}}$, in which case the contribution to household labor income is $w\bar{z}^f(j)e^f$.

Pensions Individuals who are at the retirement age or older are no longer working but are entitled to pension benefits, which are calculated based on their average lifetime earnings $\bar{e}^i$ and a gender-specific replacement rate θ^i. The household gross pension benefits can be described as

$$\begin{aligned} z_2\left(d, j, \bar{E}, w\right) = I(j \geq j^m_{\text{ret}})I(d < 3)\left(w\theta^m\bar{e}^m\right) + I(j \geq j^f_{\text{ret}})I(d = 1)\left(w\theta^f\bar{e}^f\right) \\ + I(j \geq j^f_{\text{ret}})I(d = 3)\max\left(w\theta^f\bar{e}^f, \varrho w\theta^m\bar{e}^m\right), \end{aligned}$$

where $\bar{E} \equiv \left(\bar{e}^m, \bar{e}^f\right)$ is the average lifetime labor income of household members. Similar to Equation 4, retired men live only in households with composition $d < 3$ and age $j \geq j^m_{\text{ret}}$, and their earning gross pension benefits equal $w\theta^m\bar{e}^m$. In the case of a retired woman, there are two options. If she is a part of a two-person household ($d = 1$), her gross pension is simply $w\theta^f\bar{e}^f$. If she is a widow ($d = 3$), she can choose between her own pension and a part of pension benefits of her deceased spouse.[2]

Out-of-pocket medical expenses Starting at the age of j_{health}, households face out-of-pocket medical expenses, the value of which is a product of a deterministic component $\hbar$ and a stochastic shock ε. The former depends on household age, composition, health status, and the average wage in the economy, while the latter is defined as a transient *iid* shock:

$$\Theta \equiv I(j \geq j_{\text{health}})\hbar(j, d, H, w)\varepsilon.$$

Additional transfer income Retired households can receive additional income from government transfer programs, the value of which can vary with household character-

[1] An indicator function equals 1 if the expression inside its bracket is true and 0 otherwise.
[2] If a man dies before reaching the retirement age, his future pension cannot be inherited ($\theta^m\bar{e}^m \equiv 0$).

istics. In general, these additional payment can be expressed as

$$\Gamma \equiv \iota(j, d, \bar{E}, \Theta, w).$$

Preferences Individuals are perfectly altruistic towards other household members, and utility is derived at the household level. Following the recommendation of Chetty (2006), the utility function is logarithmic. It depends on household consumption without out-of-pocket medical expenses (c) adjusted for household size:

$$u\left(c/\chi(d)\right) = \log\left(c/\chi(d)\right), \tag{5}$$

where function $\chi(d)$ defines the equivalence scale.

Household decision problem A household of composition d, age j, with accumulated assets a, and average lifetime earnings $\bar{E}$, observes its current health status H, current productivity status E, and the realization of the out-of-pocket medical shock ε. Each period a household allocates its resources between consumption and next period assets. Thus, its budget constraint is the following:

$$(1-\tau_a)(1+r)a + (1-\tau_l)\left(z+\Gamma\right) + \flat = a' + c(1+\tau_c) + \Theta, \tag{6}$$

where $z \equiv z_1\left(d, j, E, w\right) + z_2\left(d, j, \bar{E}, w\right)$, τ_c, τ_a, τ_l stands for the tax rates, and r is the rate of return on assets. Accidental bequests, denoted by $\flat$, are equally distributed over all surviving households.

A household solves

$$\begin{aligned} V(j, d, a, \bar{E}, E, H, \varepsilon) = \max_{c>c_{\min}, a'>0} \{ & u\left(c/\chi(d)\right) + \\ & \beta S(d, j, H) \sum_{d'=1}^{3} \mathbf{P}(d'|d; j, H) \mathbf{E}\left[V(j+1, d', a', \bar{E}', E', H', \varepsilon') \mid \bar{E}, E, H, \varepsilon\right] \} \end{aligned}$$

subject to (1), (2), (3), (5), and (6). The expectations operator $\mathbf{E}$ is taken over $\bar{E}', E', H', \varepsilon'$.

Government The government collects taxes, pays retirement benefits, and redistributes income via transfer programs. Every period its budget is balanced with flat tax rates $\tau_c, \tau_a,$ and τ_l.

Firms Identical, perfectly competitive firms produce a final homogeneous good Y according to the Cobb-Douglas technology with constant returns to scale:

$$Y \equiv K^{\alpha}(GL)^{1-\alpha}.$$

Aggregate productivity G increases at a constant annual rate g. Firms rent domestic labor L and domestic and foreign capital K. Profit maximization implies that factor prices are equal to their marginal products:

$$\partial Y/\partial L = w \quad \text{and} \quad \partial Y/\partial K = r + \delta,$$

where δ stands for the capital depreciation rate.

Interest rate The model describes a small open economy, where the domestic real interest rate is a sum of the world interest rate r^* and a risk premium. Following Schmitt-Grohé and Uribe (2003), the risk premium reacts to changes in the country's net foreign debt according to the following formula:

$$r = r^* + \phi \left(\exp\left(\frac{K - A}{Y} \right) - 1 \right),$$

where A stands for aggregate domestic assets held by households and $(K - A)$ can be interpreted as the economy's net foreign liabilities.

Steady-state In the steady-state equilibrium of the model, households choose their optimal consumption level, firms make optimal production decisions, the government follows a given fiscal rule, and the domestic interest rate is tied to the world interest rate and the economy's net foreign assets position as described above. All variables are time-invariant, and all aggregate values, factor prices, and household distribution are consistent with optimization by individual agents. The formal definition of the steady-state equilibrium is presented in the Supplementary Appendix. The model is solved numerically by backward recursion from the final period. To ensure computational tractability, all continuous variables, i.e. earnings, pension benefits and the asset stock are discretized.

3 Calibration

I calibrate the model to Poland, a small open economy with a universal health care system and a moderate level of inequalities. Since I am interested in the long-term effects, my calibration strategy is to take a perspective of a young household, whose members are currently entering the labor market. To this end, I use recent data or projections on the Polish general economic conditions, the evolution of an individual income process, distribution of health status and out-of-pocket medical expenses, and the expected demographic structure. While calibrating the parameters, I use macroeconomic statistics and evidence established in the empirical literature. If these are not available, I perform additional analysis using micro-level data on Polish older population.

In the model, I assume an obligatory pay-as-you-go pension system, where a pension depends on individual contribution, and the retirement age is set according to the Polish statutory pension age. Widows have an option of choosing between their own pensions and a fraction of retirement benefits of their deceased husbands. Thus, the pension system in the model reflects the main characteristics of the current pension system in Poland.

As a result, my model economy exhibit the following key features:

- fast speed of population aging and low fertility,
- the large gap between the life expectancy of men and women,
- low statutory retirement age of women,
- low pension replacement rates, especially for women,
- relatively high burden of out-of-pocket medical expenses (high incidence of CHE) in comparison with other European countries.

For all calibration purposes, I use data from before the COVID-19 pandemic. This is because our current knowledge about the long-term (or even the medium-term) effects of the pandemic is very limited. Moreover, since this paper studies stationary equilibria, I need to assume stable economic conditions, and the most recent data were greatly influenced by the pandemic shock.

Given the available data, I can calculate two-year health-dependent survival probabilities and transitions between the health statuses. Thus, I set the model period to two years. In the baseline model, households do not receive any payments from the transfer program ($\Gamma \equiv 0$). Below, I discuss the calibration process in more detail. Additional information is provided in the Supplementary Appendix.

Demographics and health When a new household enters the model, it consists of two 20-year-old individuals. The mortality risk first occurs at age 45, and a person can live for a maximum of 80 years. Thus, the maximum household age is 100. The old-age dependency ratio in the model equals 40.2%, which matches the Eurostat projections for Poland for 2040. A household growth rate n is set according to this statistics.

I estimate health-dependent survival probabilities and transitions in and out of poor health using SHARE data. The SHARE project concentrates on the older part of the population (individuals aged 50 or older), and mostly on European citizens (Börsch-Supan, 2020). It collects longitudinal data on a wide range of socioeconomic indicators, including self-perceived health and the time of death (if one occurred). For more details about the project, please refer to (Börsch-Supan, Brandt, Hunkler, Kneip, Korbmacher, Malter, Schaan, Stuck, and Zuber, 2013).[3]

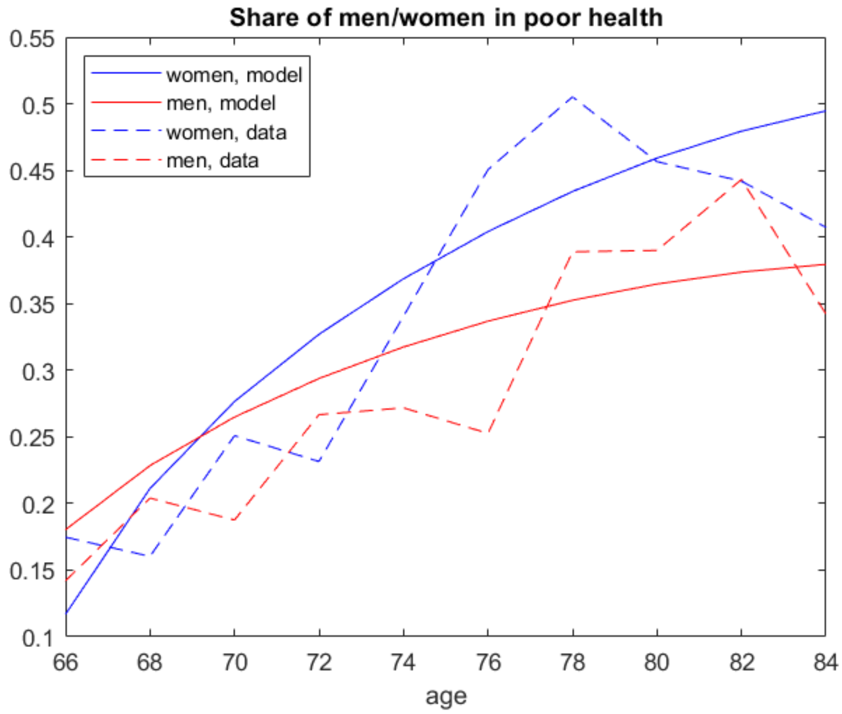
Survival probabilities To asses the effect of health status on survival probabilities, I perform logistic regressions using data on Polish individuals older than 55 from the

[3]The SHARE data collection has been funded by the European Commission, DG RTD through FP5 (QLK6-CT-2001-00360), FP6 (SHARE-I3: RII-CT-2006-062193, COMPARE: CIT5-CT-2005-028857, SHARELIFE: CIT4-CT-2006-028812), FP7 (SHARE-PREP: GA N°211909, SHARE-LEAP: GA N°227822, SHARE M4: GA N°261982, DASISH: GA N°283646) and Horizon 2020 (SHARE-DEV3: GA N°676536, SHARE-COHESION: GA N°870628, SERISS: GA N°654221, SSHOC: GA N°823782, SHARE-COVID19: GA N°101015924) and by DG Employment, Social Affairs & Inclusion through VS 2015/0195, VS 2016/0135, VS 2018/0285, VS 2019/0332, and VS 2020/0313. Additional funding from the German Ministry of Education and Research, the Max Planck Society for the Advancement of Science, the U.S. National Institute on Aging (U01_AG09740-13S2, P01_AG005842, P01_AG08291, P30_AG12815, R21_AG025169, Y1-AG-4553-01, IAG_BSR06-11, OGHA_04-064, HHSN271201300071C, RAG052527A) and from various national funding sources is gratefully acknowledged (see www.share-project.org).

SHARE waves, which cover the years between 2006 and 2017. The dependent variable is binary and takes one if death occurred within two years of the last interview. The specification includes age, age squared, gender, health status, and health status interacted with age. As expected, the estimated probability of survival decreases with age and is higher for those in good health and for women. Models on different subsamples and a broader set of explanatory variables were also considered (more in the Supplementary Appendix). Based on the estimated parameters from the regression, I calculate four 2-years conditional survival probabilities, i.e. for men with poor health, men with good health, women with poor health, and women with good health. Since I want the average (health-independent) conditional survival probabilities in the model to match the official 2019 life tables of men and women, published by the Polish Central Statistical Office (CSO), the SHARE-based estimates are scaled accordingly.

Health transitions The risks of falling into and staying in poor health, expressed by the function ζ^i, are estimated separately for men and women on SHARE data for Poland. Current self-perceived health is a logistic function of a self-health assessment made two years earlier, a cubic in age, and age interacted with a previous self-health assessment (see the Supplementary Appendix for details). The initial shares of men and women in poor health are approximated by SHARE data from waves 6 and 7, while their relative distribution among income groups comes from the 2019 Eurostat data. In Figure 1, the empirical fractions of those in poor health are plotted against age and compared with the final fractions in the model. We can see that, on average, women have a greater risk of being in poor health than men, and this risk increases more sharply with age compared to that for men. Both of these features are reflected in the model.

Figure 1: Distribution of health status over age



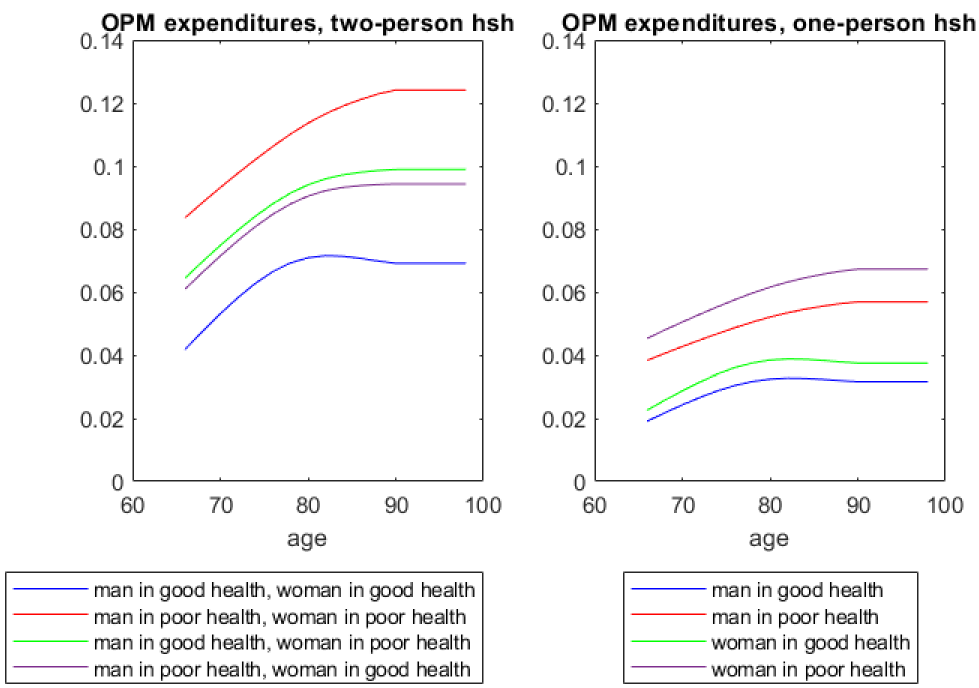
Notes: Author's estimates. Empirical shares are based on SHARE data for Poland from waves 6 and 7.

Health expenses Polish HBS has the best quality data on out-of-pocket medical expenditures in Poland. However, these data are at the household level and lack information on self-health assessments of household members. Thus, once again, I use SHARE data for Poland to calculate separate age profiles of average out-of-pocket health expenditures of individuals with different health statuses (more details in the Supplementary Appendix). These data are also used to account for the differences in average out-of-pocket medical expenditures between men and women. Then, I use the Polish HBS from 2016 to approximate the aggregate amount of out-of-pocket medical expenses and scale the SHARE-based profiles accordingly.

In the model, individuals begin to face the health risk at age 65. Figure 2 presents the final model assumptions and depicts how average out-of-pocket medical expenses of different household types vary with age. Intuitively, poor self-perceived health of a household member translates into higher out-of-pocket medical expenditures. Women have on average around 18% higher health-related spending than men. Empirical data indicate that the average out-of-pocket medical expenses of the Polish older adults increase with age. For individuals in poor health, this increase is observed up to age 90, while average out-of-pocket medical expenses of those in good health stabilize at age 80. There is not sufficient data on individuals older than 90 years, so in the model I assume that out-of-pocket medical expenditure are stable above this age.

I want the model to capture the extent of Polish older households suffering from high health-related spending. As an indicator, I use the share of households with CHE among all households older than 65. The variance of the transitory component of out-of-pocket medical expenses, i.e. var(ε), is calibrated to meet this target. To calculate CHE, I use the "budget share approach" and the most common threshold of 15%. The incidence of CHE occurs when household's out-of-pocket medical expenses are greater than 15% of its total consumption expenditures.

Figure 2: Out-of-pocket medical expenses over age, model assumptions



Earnings The shape of the earnings profiles is determined separately for men and women using the 2016 Polish HBS data. I regress the log of individual's monthly earnings on a cubic in age, and a set of dummy controls indicating the level of educational attainment, disability status, full-time job, working in private or public sector, voivodship, type of area, and month that the questionnaire was completed. The gender wage gap is set to 0.8, and reflects a ratio of the average wage of women to the average wage of men (data from the 2017 Polish HBS).

Following Storesletten, Telmer, and Yaron (2004), the logarithm of the individual earning process is a sum of permanent AR(1) and transitory shocks. Similar to Braun, Kopecky, and Koreshkova (2017) and Heathcote, Storesletten, and Violante (2010), these shocks are correlated between spouses, and the correlation of initial wages is approximated by the empirical correlation of education levels. This empirical correlation equals 0.54 and is calculated on the 2017 Polish HBS data, using binary variables indicating at least post-secondary education. The correlation of spouse earnings shocks targets the correlation of the annual wage growth rate of couples equal to 15% (Heathcote, Storesletten, and Violante, 2010). The autocorrelation coefficient and the variance of an individual permanent shock reproduce the parameters of a household income process estimated for Poland by Kolasa (2017). Finally, I calibrate the variance of a transitory component so that the Gini coefficient of earnings in the model matches that of wages in Poland (28.5% taken from 2016 Polish HBS).

Pension The retirement age for men and women are 65 and 60 years, respectively. The pension of a woman equals 27% of her average earnings, while a man's replacement rate is set to 35%. These numbers reflect the expected future pension benefits of a full-career average Polish earner who starts working in 2018 at age of 22 (OECD *Pensions at a Glance,* 2019). I assume that a widow can either receive her pension or 85% of a partner's retirement benefits if he had died after reaching the retirement age. The minimum pension is set at 12.1% of the average wage in the economy. Additional discussion of this assumption is provided in the Supplementary Appendix.

Table 1: Calibration targets

indicator	value	source
old-age dependency ratio 65+ vs. rest (%)	40.2	Eurostat predictions for 2040
consumption as % of output	74	household consumption in GDP excluding government expenditure, average from 2004-2019, Eurostat data
interest rate risk premium (%)	1.9	the difference between natural interest rates in Poland and in Euro area, 2010-2020 averages from Arena, Di Bella, Cuevas, Gracia, Nguyen, and Pienkowski (2020) estimates
net assets as % of output	-57	international investment position to GDP, average from 2004-2019, Eurostat and NBP data
Households with CHE (among those aged between 65 and 74, %)	13.8	author's estimates based on Polish HBS, 2018, budget share approach with 15% threshold
Gini of wages of Polish workers	28.5	author's estimates based on Polish HBS, 2016

Taxation In the baseline scenario, there is no tax imposed on assets or consumption. Pensions are financed by labor income tax with a flat rate τ_l.

Other parameters In the utility function and for relevant inequality statistics, I apply an Oxford equivalence scale. It gives a weight ratio of two-person households to a one-person household equal to 1.7. The capital depreciation rate δ takes an average value of the estimates used in recent overlapping generations models calibrated for Poland (Rubaszek, 2012; Makarski, Hagemejer, and Tyrowicz, 2017; Kolasa, 2021). The aggregate productivity growth rate g is approximated by average Polish TFP growth between 2004 and 2013 (Gradzewicz, Growiec, Kolasa, Postek, and Strzelecki, 2018). The global interest rate r^* reflects the average natural interest rate in the 2010s, estimated for the Euro area using the Holston, Laubach, and Williams (2017) model. The remaining three parameters, i.e. the capital share in output α, discount factor β, and debt elasticity of the domestic interest rate ϕ, are calibrated to reflect the following targets: consumption share in GDP, interest rate risk premium, and international investment position (see Table 1 for details).

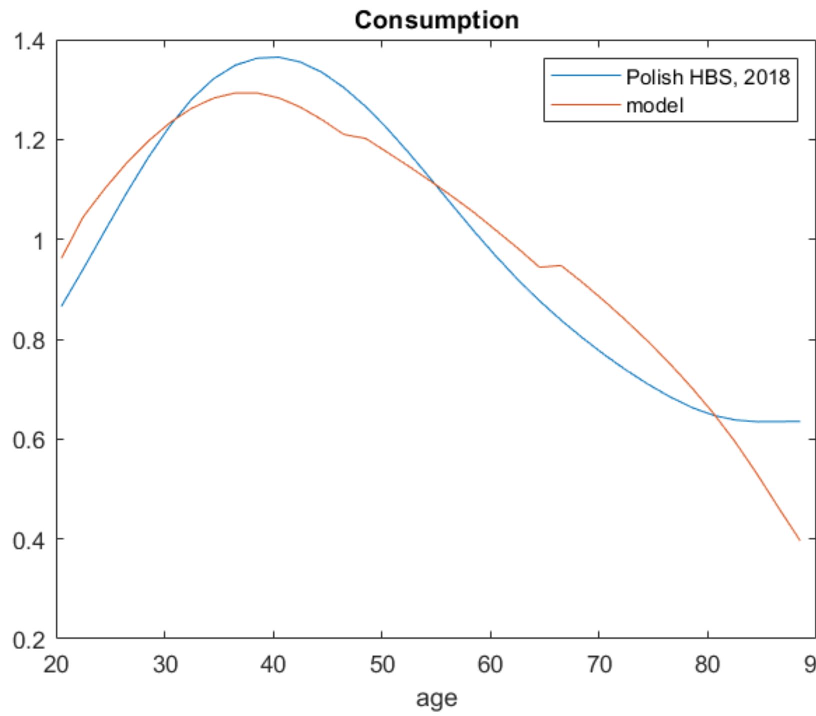
Calibration assessment Table 2 evaluates the model's performance in matching non-targeted statistics. The model does a good job of replicating the inequality in household labor income and household disposable income. It also generates a similar age profile of average consumption to the empirical one (see Figure 3). In the case of assets inequality, the Gini coefficient is slightly overestimated in the model, but the mean-to-median ratio fits the data exactly. Finally, for households aged between 65 and 74, the model captures the incidence of CHE and relative poverty quite well.

Table 2: Non-targeted statistics

	data	model
wages		
Mean to median wages, all	1.2*	1.1
Gini, households with two working adults (no scale)	23.5*	22.1
household disposable income		
Gini, workers (Oxford equivalence scale)	27.3**	26.3
Gini, pensioners (Oxford equivalence scale)	21.7**	20.4
household assets		
Gini, all (no scale)	56.8***	58.6
Mean to median assets, all	1.6***	1.6
households with CHE		
age 65-74, threshold = 10%	27.4**	29.0
age 65-74, threshold = 20%	6.7**	5.7
households in relative poverty		
age 65-74	12.7**	11.9

Notes: Author's estimates. * - Polish HBS, 2016, ** - Polish HBS, 2018, *** - Polish Wealth Survey of Households, 2016 (Bańbuła and Żółkiewski, 2016). Relative poverty is a consumption-based indicator calculated with the Oxford equivalence scale and a threshold set at 50% of the mean household equivalised consumption (excluding out-of-pocket medical expenses).

Figure 3: Average household consumption over age



Notes: Author's estimates. Profiles are scaled to their means. Out-of-pocket medical expenses are included in consumption.

4 Results

The calibration of the baseline model described above features a contribution-based pension system, but no additional social policy aimed at older households. I now introduce certain transfer programs to the model and, by looking at how they change the model's steady state, I quantify their long-term impact on the economy. All the programs analyzed in the following two Subsections are financed by a flat payroll tax. Following the main focus of this paper, I start with a program which resembles the actual Polish *13th Pension*. I will next describe some modification to it and compare the outcomes to more standard elderly-oriented programs. At the end of this Section, I check how the results change when different financing methods are chosen.

Table 3: Aggregate effects of the *13th Pension*

	ΔY (%)	ΔC (%)	ΔA (%)
The partial equilibrium effect of the *13th Pension* (fixed factor prices)	0.00	-0.35	-4.34
Total effect of the *13th Pension*	-0.37	-0.22	-1.98

4.1 The long-term effects of the *13th Pension*

The *13th Pension* program gives an additional once-a-year payment to all pensioners. All women who have reached 60 and men aged 65 or more receive the same transfer in the amount of one-third of the median monthly salary. The model assumes that 44% of all households have at least one member eligible for the program. In the model, the *13th Pension* amounts to 0.7% of total output and its financing requires an increase of about 0.8 pp. in the income tax rate.

Macroeconomic aggregates The long-term impact of the *13th Pension* on the main economic aggregates is presented in Table 3. It is constructive to first look at the partial equilibrium effect of the program, i.e. how the *13th Pension* payments affect an economy in which factor prices remain fixed. First, as introducing the program requires an increase in income taxation, households receive lower net wages and pension payments. Second, the expected additional transfers incentivise households to reduce their savings for old age. In consequence, total domestic assets in the economy are more than 4.3% lower, and less capital income is earned by households. Lower household disposable income translates into a decline of 0.35% in total consumption. Since labor is assumed to be inelastic, aggregate output remains unchanged in this scenario.

Now, let us relax the assumption of fixed factor prices and consider a small open economy. In such a setting, the domestic interest rate responds to changes in domestic assets. Thus, the decline in domestic assets described above raises the domestic interest rate. This means higher costs of capital, translating into lower output and lower wage per efficiency unit of labor. Due to general equilibrium adjustments, the *13th Pension* program leads to an increase of 0.16 pp. in the domestic interest rate. In this scenario, household assets are expected to decline by almost 2%, while aggregate output and consumption drop by 0.4% and 0.2%, respectively.

Table 4: Redistribution due to the *13th Pension*, changes in pp.

Gini consumption*	-0.36
Theil (consumption) within	-0.16
Theil (consumption) between	-0.14
Q25 consumption, household age <65	-0.19
Q50 consumption, household age <65	-0.60
Q75 consumption, household age <65	-0.83
Q25 consumption, household age >=65	2.50
Q50 consumption, household age >=65	1.66
Q75 consumption, household age >=65	1.04
Gini assets	0.24

Note: * - Household equivalised consumption (excluding out-of-pocket medical expenses) with the Oxford equivalence scale; Gini and Theil indices on the scale 0-100

Redistribution The *13th Pension* has significant long-term redistributive effects. The median consumption of a retired household increases by almost 1.7%, while that of a working household drops by 0.6% (Table 4). As the *13th Pension* is a universal transfer, all recipients receive the same payouts. However, for poorer pensioners, the *13th Pension* payment is a more significant source of additional income, and, thus, the highest increase in consumption is observed for this group. Among households aged 65 or more, those at the 25th percentile of consumption distribution increase their spending on goods and services by 2.5%, while consumption of the family in the upper quartile of consumption distribution is only 1% higher.

As a household's available resources decrease in old age, so does its consumption. Thus, the highest rise in consumption associated with the introduction of the *13th Pension* is found for the oldest-old age group (Table 5). In the long term, a median household aged 85 or more has a 3.3% increase in consumption. Moreover, the increase in median consumption is more significant for retired couples and widows compared to retired widowers.

The *13th Pension* leads to a moderate reduction in total consumption inequality. Changes in inequality among retired and working households are responsible for around half of the overall decline in inequality. The other half is caused by lower consumption inequality between these groups (see the Theil decomposition in Table 4). As a result, the *13th Pension* reduces the Gini coefficient for consumption by around 0.36 pp. in the long term.

Table 5: Changes in median consumption, relative poverty and CHE due to the *13th Pension*

		household age					
	65+	65-74	75-84	85+	couples	widowers	widows
median cons.* (%)	1.66	1.04	1.77	3.28	1.76	1.00	1.86
CHE** (pp.)	-0.55	-0.55	-0.65	-0.34	-0.70	-0.32	-0.49
relative poverty*** (pp.)	-1.27	-0.88	-1.54	-1.58	-1.75	-0.52	-1.11

Note: * - household equivalised consumption (excluding out-of-pocket medical expenses) with the Oxford equivalence scale; ** - catastrophic health expenditure, budget share approach, threshold=15%; *** - consumption-based indicator calculated with the Oxford equivalence scale and a threshold set at 50% of the mean household equivalised consumption (excluding out-of-pocket medical expenses)

The program also affects the distribution of assets. As the expected transfers negatively impact savings of all groups of households, the highest drop in assets is found for the oldest-old and those in the lowest quartile of consumption distribution. Eventually, inequality in assets increases and the Gini coefficient for assets rises by 0.24 pp.

The *13th Pension* is moderately successful in reducing poverty among older households (Table 5). In the long term, it generates a 1.3 pp. decrease in relative poverty within the group aged 65 or more. The highest poverty reduction is found among the oldest-old and couples. Similarly, the *13th Pension*'s ability to mitigate the financial burden caused by out-of-pocket medical expenses is limited. In the long term, the program decreases the share of those with CHE by less than 0.6 pp. and is most effective for the middle-old (those aged from 75 to 84) and couples.

Welfare loss Let us now take a look at the welfare implications of the *13th Pension*. To this end, we will use welfare loss, expressed as the minimum required increase in household consumption at all ages for which it would be indifferent for the members of a household if they were born in an economy with or without the program. This is calculated under the veil of ignorance, meaning that a household does not know a priori anything about its future life trajectory. Welfare loss can be broken down into two components: the change in aggregate consumption in the new steady state (the level effect) and the compensation for changes in consumption distribution (the distribution effect).

Once again, let us first consider the partial effect of the *13th Pension* in an economy with a fixed domestic interest rate. In this scenario, the program gives a long-term

Table 6: Welfare loss due to the *13th Pension* under the veil of ignorance, in pp.

	Level effect	Distribution effect	Total loss
The partial equilibrium effect of the *13th Pension* (fixed factor prices)	0.35	0.18	0.53
The total effect of the *13th Pension*	0.22	0.46	0.68

welfare loss equal to 0.5% of household consumption (Table 6). Within a rational agent framework, welfare loss is not a surprising result for a program that redistributes income towards from working to retired households. As it is known from the previous literature, social security decreases welfare in this class of models. It partially comes from the fact that, with such programs in place, households do not receive the return on capital which they would earn if they saved independently. This loss of income translates into lower aggregate consumption. Indeed, around two-thirds of the estimated welfare loss from the *13th Pension* comes from the negative level effect. The rest is caused by the shift in income towards older ages, which is also found to be welfare-reducing. The burden of higher taxes faced by young workers, who are particularly vulnerable to earnings shocks, outweighs the positive effect of financial support provided by the program to older households.

Allowing for interest rate adjustments, the total welfare loss due the *13th Pension* rises to 0.68%. The level effect is smaller than in partial equilibrium because, in this case, an increase in the interest rate mitigates the drop in aggregate savings. As individuals, under the veil of ignorance, suffer from lower wages, the welfare loss from the distribution effect is now more than twice as large as that for fixed factor prices.

Beneficiaries and losers As I showed above, a perfectly rational household with no knowledge about its future life experience would prefer to be born in the economy without the *13th Pension*. However, whether a household ends up being better off with or without a selected transfer policy depends on the actual realization of its income shocks, as well as on how long, and in what health, its members actually get to live. More precisely, one can specify households who ex-post benefit from the *13th Pension* by comparing their discounted utility calculated on the basis of the observed consumption trajectories from the two alternative scenarios: being born in economies with and

Table 7: Beneficiaries of the *13th Pension*

	Average loss (%)	Average gain (%)	Share of those who gained (%)
The partial equilibrium effect of the *13th Pension* (fixed factor prices)	0.55	0.23	1.46
The general equilibrium effect of the *13th Pension*	0.69	0.28	1.29

Note: Simulation results.

without the *13th Pension*.

The simulations show that, in an economy with fixed factor prices, the *13th Pension* turns out to be ex post beneficial for roughly 1.5% of households. As the *13th Pension* leads to lower wages, the number of the program's ex-post beneficiaries is reduced to 1.3% when general equilibrium adjustments are taken into account (Table 7). The average loss among those who lose due to the program is more than twice as big as the average gain among beneficiaries.

It is instructive to look at the individual features and histories that make it more likely for someone to emerge as an ex post beneficiary of the program. Net beneficiaries of the *13th Pension* typically live to an old age and face mainly negative income shocks over their working life. As a result, they reach their retirement age with limited assets (Table 8). Indeed, more than 95% of the *13th Pension*'s ex-post beneficiaries are those who at the age of 65 had savings lower than 50% of the average for this age group. Becoming a widow under the age of 65 is another noticeable specificity, and such young widows account for around 75% of all those who are net beneficiaries of the *13th Pension*. Due to the gender wage gap and low pension age, women's accumulated pension contributions are low compared to those of men. Moreover, women have significantly longer life expectancy than men, so on average they spend a relatively long period of their life in retirement. If they do not have claims to their husbands' retirement benefits, as it is the case for young widows, they are likely to end up with a low pension and limited financial resources in old age. Thus, ex-post they can find *13th Pension* payments improve their overall welfare.

Table 8: Distribution of beneficiaries of the *13th Pension* (%)

Characteristics of households	Benefi-ciaries	Total population
savings at the age of 65 lower than 50% of the average for this age group	95.6	16.9
husband's pension at the lowest level (if he reaches 65 years old)	98.9	42.8
widow at the age of 65 or earlier	75.1	23.2
at least one household member lives up to 94	37.1	16.6
at least one household member lives up to 84	79.6	64.3

Note: Simulation results.

4.2 The *13th Pension* and other elderly-oriented policies

I next look at the effects of selected modifications to the *13th Pension* by narrowing the group of recipients and/or reducing the scale of the program. In doing so, I want to keep the spirit of the *13th Pension*, so I allow only universal transfer payments (the same for all recipients) and impose simple eligibility criteria. I also compare the Polish *13th Pension* with a program that has been a part of the pension systems of several European countries, such as Austria, Portugal or Italy, and which gives each pensioner an additional (13th) payment once a year equal to his/her monthly pension amount (I will refer to it subsequently as the *Additional Pension Payment*). Next, I consider standard policies aimed at supporting the most vulnerable older households. I investigate the impact of an increase in the minimum pension, and extended medical coverage for the elderly. Additionally, I quantify the effects of survivor's pensions for women. The costs of the first two programs are equal to those of the *13th Pension*, which means that they all require the same increase in income taxation. Table 9 presents a summary of all the considered policies. Finally, at the end of this Section, I look at whether different methods of financing the *13th Pension* can change the program's outcomes.

4.2.1 Modifications to the *13th Pension*

Increase in eligibility age Of all pensioners, the oldest-old are those particularly in need of financial support. Indeed, they may have already spent most of their savings,

Table 9: Government polices aimed at older households, introduced in the model

name	description	tax increase (in percentage points)	share of households that receive payments from the program
***13th Pension* program and its modifications**			
13th Pension	Each year every pensioner receives an extra payment that equals 30% of the median monthly salary.	0.79	44.42
Standard 13th Pension, 84+	Each year every person aged 84 or more receives an extra payment that equals 30% of the median monthly salary.	0.14	9.32
Enlarged 13th Pension 84+	Each year every person aged 84 or more receives an extra payment that equals 1.7 times the median monthly salary.	0.79	9.32
13th Pension Poor10	Pensioners in the lowest income decile receive an extra payment that equals 30% of the median monthly salary.	0.08	5.88
13th Pension Poorer Half	Pensioners with pension below mean receive an extra payment that equals 30% of the median monthly salary.	0.33	22.07
Additional Pension Payment	Each year every pensioner receives 13 instead of 12 installments of his/her monthly pension.	0.95	44.42
standard polices aimed at older households			
Minimum Pension Increase	There is an increase of the minimum pension from 12.1% to 23.2% of the average wage.	0.79	22.07
Extended Medical Coverage	Households aged 65 and older receive a reimbursement of 41.5% of their out-of-pocket medical expenses.	0.79	35.76
Survivor's Pensions for Women	Under conditions described in Section 3, survivors' pension is available for women.	0.58	5.99

face the highest out-of-pocket medical expenses, and are likely to live in single-person households. Thus, the first considered modification to the *13th Pension* is to limit the recipients to those aged at least 84. The individual payment is kept at 30% of the median monthly salary. Such an adjustment (which I refer to as the *Standard 13th Pension 84+*) costs substantially less than the original *13th Pension* program. While it has significantly smaller long-term negative impacts on aggregate output, consumption and assets, it is also far less effective in reducing inequality, poverty and the incidence of CHE (see Tables 10 and 11).

The limited effectiveness of the *Standard 13th Pension 84+* does not necessary mean that the program is poorly targeted. The aggregate payment may simply be too small to make a significant difference to an average household. Thus, another idea is to keep the same age restriction (84 plus), but increase the program's total expenses to those of the original *13th Pension*. With such an approach, the annual transfer received by the recipients is more than 5.7 times higher than in the case of the original program. Let us refer to these modifications of the *13th Pension* as the *Enlarged 13th Pension 84+*. It is worth pointing out that, even if the median elderly household is younger than 84, i.e. it is not eligible for the program, the *Enlarged 13th Pension 84+* can significantly increase its long-term consumption. Indeed, as the program can be viewed as partial insurance against longevity risk, it allows all households to reduce their savings for old age and increase current consumption. According to the model estimates, consumption of the median elderly household is 2.5% higher due to the *Enlarged 13th Pension 84+*, compared to 1.7% in the case of the original *13th Pension* (Table 11). The *Enlarged 13th Pension 84+* also leads to a twofold reduction in relative poverty and consumption inequality (measured by the Gini coefficient) compared the original *13th Pension* program. This, however, comes at the price of a larger drop in the main aggregates (i.e. output, consumption, and household assets, Table 10).

The *Enlarged 13th Pension 84+* also leads to a larger decrease in welfare under the veil of ignorance than the *13th Pension*. By contrast, as the *Standard 13th pension 84+* has little negative impact on the economic aggregates, the welfare loss due to this program is also less severe. From all households, there are 4.6% and 4.2% ex-post program's beneficiaries based on the *Standard 13th Pension 84+* and the *Enlagred 13th Pension 84+,* respectively, which is more than three times as much as in the case of the original *13th Pension*.

Targeting low-income elderly Next, let us restrict the *13th Pension* recipients to those with pensions below a certain threshold. When keeping the annual payment from the program at 30% of the median monthly salary, such a restriction helps reduce the negative aggregate effect of the *13th Pension*. I consider two eligibility options: the poorest 10% of pensioners (*13th Pension Poor10*), and it is restricted to those with pension below the median (*13th Pension Poorer Half*).

As in the case of the previous modifications, the ones considered here face the same trade-off between lower welfare loss and a stronger redistributive impact (Tables 10 and 11). Their advantage is that they result in a significantly higher number of ex-post beneficiaries. Indeed, the *13th Pension Poorer Half* is ex-post beneficial for 18.8% of households, compared to 1.3% in the case of the original *13th Pension*. Being born in an economy with the *13th Pension Poor10* rather than in an economy with no social policy except for the regular pension system would be (ex-post) preferred by more than 17% of all households.

The *Additional Pension Payment* I turn now to the long-term effects of the *Additional Pension Payment*. The program is slightly more costly than the *13th Pension*, and its introduction requires an increase in income tax by 0.95%. Consequently, it also has more negative long-term aggregate effects and results in greater welfare loss (Table 10). Moreover, hardly any household would ex-post prefer to live in an economy with such a program compared to living in an economy without it. Intuitively, the *Additional Pension Payment* visibly increases consumption by the median elderly household, i.e. by more than 2%, compared to a rise in consumption of 1.7% attributable to the original *13th Pension* (Table 11), but it does not address inequality among pensioners, even though it can still narrow the gap between the consumption of working and retired households. Although it does so, it is not significantly more effective in reducing consumption inequality and poverty than the *13th Pension*.

4.2.2 Standard policies aimed at older households

As I have shown so far, simple modifications of the *13th Pension* can make the program have a more desirable effect on a selected indicator, but at the cost of worsening some other measures. But how do the *13th Pension* and its modifications compare to standard policies catering to older households? Can they bring a significant improvement where

Table 10: Aggregate and welfare effects of the selected programs

13th Pension modifications	ΔY (%)	ΔC (%)	ΔA (%)	Welfare loss (%)	Beneficiaries (%)
13th Pension	-0.37	-0.22	-1.98	0.68	1.29
Standard 13th Pension 84+	-0.10	-0.06	-0.53	0.17	4.54
Enlarged 13th Pension 84+	-0.46	-0.27	-2.42	0.90	4.16
13th Pension Poor10	-0.05	-0.03	-0.24	0.05	17.11
13th Pension Poorer Half	-0.17	-0.10	-0.90	0.23	18.84
Additional Pension Payment	-0.43	-0.24	-2.32	0.87	0.03
standard policies					
Minimum Pension Increase	-0.40	-0.24	-2.15	0.51	15.96
Extended Medical Coverage	-0.48	-0.28	-2.54	0.79	2.85
Survivor's Pensions for Women	-0.43	-0.23	-2.31	0.75	11.25

other programs are less successful? In this Subsection, I address these questions by assessing the long-term impact of three popular alternative elderly-oriented policies, using the same modeling framework.

Minimum Pension Increase One standard way to provide financial support to low-income elderly is to raise the minimum pension. Suppose that such a policy, which I refer to as the *Minimum Pension Increase*, is financed by the same amount of tax revenue as is raised for the *13th Pension*. With other model assumptions unchanged, the *Minimum Pension Increase* improves the disposable income of 22% of households (Table 9). However, it leads to a larger drop in household assets and higher asset inequality compared to the *13th Pension* (Table 10). This comes from the fact that the savings of those with low incomes fall more strongly in response to an imposed income redistribution from working to retired households when such a redistribution is financed by an increase in income taxation.

The *Minimum Pension Increase* has a stronger aggregate effect but a smaller redistributive effect than the *13th Pension*. Consequently, the total welfare loss under the veil of ignorance from the *Minimum Pension Increase* is significant but lower than that from the *13th Pension*. The program's impact on poverty and consumption inequality is stronger than that of the *13th Pension*, but significantly smaller compared to the *Enlarged 13th Pension 84+* (Table 11). Moreover, substantially more households (around 16%) ex-post benefit from the program than is the case with the *13th Pension* (Table

10). The number of ex-post beneficiaries of the *Minimum Pension Increase* is one of the highest among the programs analyzed so far, i.e. similar to that of the *13th Pension Poor10* and the *13th Pension Poorer Half*.

Extended Medical Coverage As out-of-pocket medical expenses increase with age, older households are particularly vulnerable to the burden of health-related payments. The next program - *Extended Medical Coverage* - is specifically designed to reduce out-of-pocket medical spending. Assuming that it is financed by the same increase in income tax as in the case of the *13th Pension*, it gives every older adult (aged 65 or more) a reimbursement of 41.5% of his/her out-of-pocket medical expenses. The *Extended Medical Coverage* program is effective in its objective and substantially reduces the incidence of CHE (by -14.1 pp.) - to an extent that no other policy considered in this paper has been able to achieve (Table 11). It is also slightly more successful in reducing consumption inequality and relative poverty and increasing the median consumption of retired households compared to the outcome of the *13th Pension*. As households do not need to engage in as much precautionary saving to protect themselves from medical shocks as in the economy without a program, their aggregate assets decline in the long term (Table 10). The side effects are a decrease in aggregate consumption and welfare loss, which are higher than in the case of the *13th Pension*. There are not many ex-post beneficiaries of *Extended Medical Coverage* either, and most households (around 97%) would ex-post prefer to self-insure themselves against medical shocks instead of being supported by the program.

Survivor's Pensions for Women Finally, I assess the long-term impact of pension inheritance rights (*Survivor's Pensions for Women*). This policy reflects the rules described in Section 3, according to which women are entitled to the pension benefits of their deceased husbands. Recall that, in the baseline model, a woman can choose between her own pension and 85% of her deceased husband's pension if he reached retirement age before his death. We now compare this economy to the one with no pension inheritance rights.

With the adopted demographic structure, the *Survivor's Pensions for Women* are less costly than the *13th Pension* as it requires a rise in income taxation by 0.58 pp. In each period, 6% of households use the inheritance option. The aggregate effects of the *Survivor's Pensions for Women* are close to those of the *Minimum Pension Increase*,

Table 11: Redistributive effects of the selected programs

13th Pension modifications	Gini assets (pp.)	Gini cons. (pp.)	hsh. aged 65+ median cons. (%)	hsh. aged 65+ CHE (pp.)	hsh. aged 65+ relative pov. (pp.)
13th Pension	0.24	-0.36	1.66	-0.55	-1.27
Standard 13th Pension 84+	0.22	-0.13	0.40	-0.12	-0.33
Enlarged 13th Pension 84+	0.91	-0.74	2.52	-0.54	-2.74
13th Pension Poor10	0.10	-0.06	0.08	-0.05	-0.13
13th Pension Poorer Half	0.25	-0.22	0.54	-0.20	-0.69
Additional Pension Payment	0.11	-0.33	2.03	-0.95	-1.27
standard policies					
Minimum Pension Increase	0.66	-0.55	1.26	-0.48	-1.66
Extended Medical Coverage	0.62	-0.38	1.76	-14.10	-1.39
Survivor's Pensions for Women	0.40	-0.30	1.71	-0.79	-1.13

Table 12: Aggregate and welfare effects of the *13th Pension* under different financing schemes

source of financing for the *13th Pension*	ΔY (%)	ΔC (%)	ΔA (%)	Welfare loss (%)	Beneficiaries (%)
labor income tax	-0.37	-0.22	-1.98	0.68	1.29
consumption tax	-0.30	-0.18	-1.61	0.59	1.79
asset tax	-1.02	-0.63	-5.47	0.71	0.59
pension fund	-0.03	-0.01	-0.06	-0.05	47.24

while the redistributive impact is similar to that of the *13th Pension*. Such a pension inheritence policy causes a higher welfare loss than the *13th Pension*, but has more ex-post beneficiaries. The simulations show that 11% of households would ex-post prefer favor prefer to be born in an economy with pension inheritance rights.

4.3 Financing the *13th Pension*

So far I have assumed that the *13th Pension* is financed by a flat labor income tax. Now I relax this assumption and allow for alternative financing methods.

Using a flat consumption tax instead of a payroll tax slightly improves the welfare statistics and mitigates the negative aggregate impact of the *13th Pension*, while generating

Table 13: Redistributive effects of the *13th Pension* under different financing schemes

			hsh. aged 65+		
source of financing for the *13th Pension*	Gini assets (pp.)	Gini cons. (pp.)	median cons. (%)	CHE (pp.)	relative pov. (pp.)
labor income tax	0.24	-0.36	1.66	-0.55	-1.27
consumption tax	0.32	-0.35	1.83	-0.69	-1.24
asset tax	0.71	-0.15	-0.65	-0.08	-0.30
pension fund	0.16	-0.09	0.04	-0.03	-0.15

a similar scale of inequality reduction (see Tables 12 and 13).It is well understood that taxing capital can significantly distort intertemporal decisions (see for example Chari, Nicolini, and Teles, 2020; Krusell, Quadrini, and Rios-Rull, 1996). Thus, when a flat tax on assets is used to finance the *13th Pension*, households respond to the lower effective return on capital with a significant reduction in their savings. We observe the largest drop in aggregate output (around 1%), consumption (more than 0.6%), and assets (around 5.5%) associated with the program compared to other financing methods (Tables 12 and 13). The program no longer carries out its redistributive role, and instead of increasing, it decreases the median consumption of retired households.

The last row in Tables 12 and 13 shows the effects of the *13th Pension* when the program is financed from the current pension fund. It means that all taxes are the same as in an economy without the transfer program, and the basic pension benefits are reduced to accommodate the additional payments made on the basis of the *13th Pension*. In this scenario, the aggregate and redistributive impact of the program is very limited. As there is no income transfer from working to retired households, the financial situation of older households barely improves. However, it is the only one of the financing schemes considered in the paper that results in higher ex-ante welfare due to the *13th Pension*, with the number of ex-post beneficiaries reaching almost 50%. These come from a decline in pension variability, which reduces uncertainty about one's future pension.

5 Summary and conclusions

This paper develops a general equilibrium overlapping generations model of a small open economy to investigate the long-term impact of quasi-universal transfers targeted at older households, using the Polish *13th Pension* as an example. The main advantages of the program are broad coverage, equality, and simplicity. It also significantly increases the consumption of a median pensioner. However, within the rational agent framework, the *13th Pension* is found to be welfare-reducing for the majority of households. While its impact on inequality is moderate, it has negative effects on aggregate output, consumption, and assets.

Like other programs aimed at income redistribution from working to retired households, there is a trade-off between a larger redistributive impact and lower negative aggregate effects. Thus, this study does not point to one "optimal" solution, as different policies might serve different objectives. From the welfare point of view, setting income criteria to determine eligibility for the *13th Pension* is recommended. However, that would lower the program's effectiveness in reducing consumption inequality and poverty. On the other hand, to strengthen the redistributive impact of the *13th Pension*, one possible solution is to increase the payments (within the program's budget) by raising the minimum age requirement. However, such a modification would deepen the decline in aggregate output and consumption caused by the program.

As shown in this paper, the aggregate and redistributive effects of the *13th Pension* do not differ substantially from those of more targeted programs, such as an increase in the minimum pension, reimbursement of some out-of-pocket medical expenses, or survivor's pensions for women. However, the *13th Pension* turns out to have a relatively small number of ex-post beneficiaries.

All but one of the analyzed variants of the *13th Pension* generate a welfare loss. The only exception is when the program does not require additional taxation but is instead financed with the current pension fund. In such a case, the welfare gain is associated with a reduction in future pension uncertainty. This result brings us to the broader debate on pension inequality. Finding the most welfare-optimizing level of variability in pension benefits is an interesting topic for future research.

References

AIYAGARI, S. R. (1994): "Uninsured idiosyncratic risk and aggregate saving," *The Quarterly Journal of Economics*, 109(3), 659–684.

ARENA, M., G. DI BELLA, M. A. CUEVAS, M. B. GRACIA, V. NGUYEN, AND

A. Pienkowski (2020): *It is only natural: Europe's low interest rates.* International Monetary Fund.

Bańbuła, P., and Z. Żółkiewski (2016): *Zasobność gospodarstw domowych w Polsce: Raport z badania 2016 r.* Departament Analiz Ekonomicznych i Departament Stabilnosci Finansowej NBP.

Bewley, T. (1983): "A difficulty with the optimum quantity of money," *Econometrica: Journal of the Econometric Society*, 51(5), 1485–1504.

Börsch-Supan, A. (2020): "Survey of health, ageing and retirement in Europe (SHARE) waves 2,3,4,6, and 7," Release version: 7.1.0 and 7.1.1. SHARE-ERIC. Data set.

Börsch-Supan, A., M. Brandt, C. Hunkler, T. Kneip, J. Korbmacher, F. Malter, B. Schaan, S. Stuck, and S. Zuber (2013): "Data resource profile: the survey of health, ageing and retirement in Europe (SHARE)," *International Journal of Epidemiology*, 42(4), 992–1001.

Braun, R. A., K. A. Kopecky, and T. Koreshkova (2017): "Old, sick, alone, and poor: A welfare analysis of old-age social insurance programmes," *The Review of Economic Studies*, 84(2), 580–612.

Bruckmeier, K., and J. Wiemers (2018): "Benefit take-up and labor supply incentives of interdependent means-tested benefit programs for low-income households," *Comparative Economic Studies*, 60(4), 583–604.

Bütler, M., K. Peijnenburg, and S. Staubli (2017): "How much do means-tested benefits reduce the demand for annuities?," *Journal of Pension Economics & Finance*, 16(4), 419–449.

Capatina, E. (2015): "Life-cycle effects of health risk," *Journal of Monetary Economics*, 74, 67–88.

Chari, V. V., J. P. Nicolini, and P. Teles (2020): "Optimal capital taxation revisited," *Journal of Monetary Economics*, 116, 147–165.

Chetty, R. (2006): "A new method of estimating risk aversion," *American Economic Review*, 96(5), 1821–1834.

COADY, M. D., AND N.-P. LE (2020): *Designing Fiscal Redistribution: The Role of Universal and Targeted Transfers*. International Monetary Fund.

CONESA, J. C., D. COSTA, P. KAMALI, T. J. KEHOE, V. M. NYGARD, G. RAVEENDRANATHAN, AND A. SAXENA (2018): "Macroeconomic effects of Medicare," *The Journal of the Economics of Ageing*, 11, 27–40.

CONESA, J. C., AND D. KRUEGER (1999): "Social security reform with heterogeneous agents," *Review of Economic Dynamics*, 2(4), 757–795.

CURRIE, J. (2006): *Public policy and the distribution of income*chap. The take-up of social benefits, pp. 80–148. Russell Sage Foundation.

DE NARDI, M., E. FRENCH, AND J. B. JONES (2010): "Why do the elderly save? The role of medical expenses," *Journal of Political Economy*, 118(1), 39–75.

DE NARDI, M., E. FRENCH, AND J. B. JONES (2016): "Medicaid insurance in old age," *American Economic Review*, 106(11), 3480–3520.

DE NARDI, M., E. FRENCH, J. B. JONES, AND J. MCCAULEY (2016): "Medical spending of the US elderly," *Fiscal Studies*, 37(3-4), 717–747.

DE NARDI, M., E. FRENCH, J. B. JONES, AND R. MCGEE (2021): "Why do couples and singles save during retirement?," Discussion paper, National Bureau of Economic Research.

DETHIER, J.-J., P. PESTIEAU, AND R. ALI (2010): "Universal minimum old age pensions: Impact on poverty and fiscal cost in 18 Latin American countries," *World Bank Policy Research Working Paper*, (5292).

GRADZEWICZ, M., J. GROWIEC, M. KOLASA, L. POSTEK, AND P. STRZELECKI (2018): "Poland's uninterrupted growth performance: New growth accounting evidence," *Post-Communist Economies*, 30(2), 238–272.

HARENBERG, D., AND A. LUDWIG (2019): "Idiosyncratic risk, aggregate risk, and the welfare effects of social security," *International Economic Review*, 60(2), 661–692.

HEATHCOTE, J., K. STORESLETTEN, AND G. L. VIOLANTE (2010): "The macroeconomic implications of rising wage inequality in the United States," *Journal of Political Economy*, 118(4), 681–722.

Holston, K., T. Laubach, and J. C. Williams (2017): "Measuring the natural rate of interest: International trends and determinants," *Journal of International Economics*, 108, S59–S75.

Hosmer Jr, D. W., S. Lemeshow, and R. X. Sturdivant (2013): *Applied logistic regression*. John Wiley & Sons.

Huggett, M. (1993): "The risk-free rate in heterogeneous-agent incomplete-insurance economies," *Journal of economic Dynamics and Control*, 17(5-6), 953–969.

Huggett, M., and J. C. Parra (2010): "How well does the US social insurance system provide social insurance?," *Journal of Political Economy*, 118(1), 76–112.

İmrohoroglu, A., S. Imrohoroglu, and D. H. Joines (1995): "A life cycle analysis of social security," *Economic Theory*, 6(1), 83–114.

Karczewicz, E. (2021): *Struktura wysokości świadczeń wypłacanych przez ZUS po waloryzacji w marcu 2021 roku*. Departament Statystyki i Prognoz Aktuarialnych, Zakład Ubezpieczeń Społecznych.

Kaymak, B., and M. Poschke (2016): "The evolution of wealth inequality over half a century: The role of taxes, transfers and technology," *Journal of Monetary Economics*, 77, 1–25.

Kolasa, A. (2017): "Life Cycle Income and Consumption Patterns in Poland," *Central European Journal of Economic Modelling and Econometrics*, 9(2), 137–172.

——— (2021): "Macroeconomic consequences of the demographic and educational changes in poland after 1990," *Macroeconomic Dynamics*, 25(8), 1993–2036.

Krusell, P., V. Quadrini, and J.-V. Rios-Rull (1996): "Are consumption taxes really better than income taxes?," *Journal of monetary Economics*, 37(3), 475–503.

Makarski, K., J. Hagemejer, and J. Tyrowicz (2017): "Analyzing the efficiency of pension reform: The role of the welfare effects of fiscal closures," *Macroeconomic Dynamics*, 21(5), 1205–1234.

Melguizo, A., M. Bosch, and C. Pages (2017): "Better pensions, better jobs: Status and alternatives toward universal pension coverage in Latin America and the Caribbean," *Journal of Pension Economics & Finance*, 16(2), 121–143.

Nakajima, M., and I. A. Telyukova (2020): "Home equity in retirement," *International Economic Review*, 61(2), 573–616.

Nishiyama, S., and K. Smetters (2007): "Does social security privatization produce efficiency gains?," *The Quarterly Journal of Economics*, 122(4), 1677–1719.

OECD (2019): *Pensions at a glance 2019: OECD and G20 indicators*. OECD Publishing, Paris.

OECD/European Observatory on Health Systems and Policies (2019): *Poland: Country Health Profile 2019, State of Health in the EU*. OECD Publishing, Paris/European Observatory on Health Systems and Policies, Brussels.

Rubaszek, M. (2012): "Mortgage down-payment and welfare in a life-cycle model," *Bank i Kredyt*, 43(4), 5–28.

Schmitt-Grohé, S., and M. Uribe (2003): "Closing small open economy models," *Journal of International Economics*, 61(1), 163–185.

Shen, C., and J. B. Williamson (2006): "Does a universal non-contributory pension scheme make sense for rural China?," *Journal of Comparative Social Welfare*, 22(2), 143–153.

Storesletten, K., C. I. Telmer, and A. Yaron (1999): "The risk-sharing implications of alternative social security arrangements," in *Carnegie-Rochester Conference Series on Public Policy*, vol. 50, pp. 213–259. Elsevier.

Storesletten, K., C. I. Telmer, and A. Yaron (2004): "Consumption and risk sharing over the life cycle," *Journal of Monetary Economics*, 51(3), 609–633.

Stuber, J., and M. Schlesinger (2006): "Sources of stigma for means-tested government programs," *Social Science & Medicine*, 63(4), 933–945.

Swartz, K. (2013): "Searching for a balance of responsibilities: OECD countries' changing elderly assistance policies," *Annual Review of Public Health*, 34, 397–412.

Theil, H. (1967): *Economics and information theory*. Amsterdam: North Holland.

Tran, C., and A. Woodland (2014): "Trade-offs in means tested pension design," *Journal of Economic Dynamics and Control*, 47, 72–93.

United Nations Department of Economic and Social Affairs (2020): *World Population Ageing 2019.* Department of Economic and Social Affairs, Population Division.

Villalobos Dintrans, P. (2018): "Long-term care systems as social security: The case of Chile," *Health Policy and Planning*, 33(9), 1018–1025.

Willmore, L. (2007): "Universal pensions for developing countries," *World Development*, 35(1), 24–51.

Yogo, M. (2016): "Portfolio choice in retirement: Health risk and the demand for annuities, housing, and risky assets," *Journal of Monetary Economics*, 80, 17–34.

Supplementary Appendix

5.1 Steady-state equilibrium

Let suppress a household state into $x = (d, j, E, \bar{E}, H, \varepsilon, a)$, and define a state space $X \subset \{1,2,3\} \times \{1,2,\dots,J\} \times [0,\infty) \times [0,\infty) \times \{(0,0),(1,1),(1,0),(0,1)\} \times [0,\infty) \times [0,\infty)$, and the borel σ-algebra on X as $\Xi(X)$. Denote by $\mu(X)$ a probability measure of households with state $x \in X$.

Since the model incorporates population and aggregate productivity growth, some variables need to be transformed to time-invariant counterparts. It is done in the following way:

$$\tilde{c}_t(x) = c_t(x) * (1+g)^{j_{\text{born}}-j},\ \tilde{a}'_t(x) = a'_t(x) * (1+g)^{j_{\text{born}}-j},\ \tilde{\flat} = \flat * (1+g)^{j_{\text{born}}-j},$$

$$\tilde{Y} = Y/\left(GN\right),\ \tilde{L} = L/N,\ \tilde{K} = K/\left(GN\right),\ \tilde{w} = w/G,$$

where N is the total number of households.

Definition. Given the government transfer program $\Gamma\left(d, j, E, \bar{E}, \Theta(j,d,H,\varepsilon), \tilde{w}\right)$, a **steady-state equilibrium** for the model economy consists of households policy functions $\tilde{c}(x)$ and $\tilde{a}'(x)$, factor prices $(\tilde{w},\ r)$, the tax rates $(\tau_c,\ \tau_a,\ \tau_l)$, the value of accidental bequests $\tilde{\flat}$, macroeconomic aggregates $(\tilde{K},\ \tilde{L})$, and the distribution function Q, such that:

1. Households' individual choices sum up to aggregate values:

$$\tilde{L} = \frac{1}{\tilde{w}} \int z_1(d, j, E, \bar{E}, \tilde{w}) d\mu,$$

$$\tilde{A} = (1+n)^{-1}(1+g)^{-1} \int \tilde{a}'(x) d\mu,$$

$$\tilde{C} = \int \tilde{c}(x) d\mu,$$

$$\tilde{\flat} = (1+n)^{-1}(1+g)^{-1} \int (1+r)\left(1 - S(j,h)\right) \tilde{a}'(x) d\mu.$$

2. The government's budget is balanced:

$$\tau_l\left(\tilde{w}\tilde{L}\right)+\tau_a\tilde{A}+\tau_c\tilde{C} = (1-\tau_l)\left(\int z_2(d,j,E,\bar{E},\tilde{w})d\mu + \int \Gamma\left(d,j,E,\bar{E},\Theta(j,d,H,\varepsilon,\tilde{w}),\tilde{w}\right)d\mu\right).$$

3. Factor prices equal their marginal products:

$$\partial\tilde{Y}/\partial\tilde{L} = \tilde{w} \text{ and } \partial\tilde{Y}/\partial\tilde{K} = r+\delta.$$

4. The interest rate formula $r = r^* + \phi * (\exp(\frac{\tilde{K}-\tilde{A}}{\tilde{Y}}) - 1)$ is satisfied.

5. Given $\tilde{w}$, r, $\tau_c, \tau_a, \tau_l, \tilde{\flat}$, policy functions $\tilde{c}(x)$ and $\tilde{a}'(x)$ are consistent with the value functions.

6. Aggregate resource constraint holds

$$\tilde{Y} + (r-(1+n)(1+g)+1)(\tilde{A}-\tilde{K}) = \tilde{C}+\tilde{I}+\tilde{M},$$

$$\tilde{M} = \int \Theta(j,d,H,\varepsilon,\tilde{w})d\mu,$$

$$\tilde{I} = \tilde{K} * (\delta + (1+n)(1+g) - 1).$$

7. The household distribution coincides with households choices:

$$\mu(x_0) = \int_{x_0}\left(\int_X Q(x,x')I(j'=j+1)d\mu\right)d\mu',\ \forall x_0 \in \Xi,$$

where Q is a conditional probability of transiting to the state x' in the next period for a household of a current state x. $I(j'=j+1)$ is a binary indicator function (it returns one if the expression inside a bracket is true and zero otherwise).

5.2 Calibration details

5.2.1 Calibration summary

Table 14: Calibration sources

household growth rate n	targets old-age dependency ratio in Poland in 2040 (Eurostat)
survival probabilities	logistic regression on SHARE data for Poland combined with 2019 life tables (Polish CSO)
health transitions	logistic regression on SHARE data for Poland
initial distribution of health status	SHARE data for Poland combined with 2019 Eurostat data
age profile of average out-of-pocket medical expenses	SHARE data for Poland combined with aggregate statistics from 2016 Polish HBS
variance of the transitory component of out-of-pocket medical expenses	set to calibration targets
deterministic component of life-cycle earnings	log earnings regressions on 2016 Polish HBS
gender wage gap	ratio of the average wage of women to the average wage of men, monthly data from 2017 Polish HBS
parameters of a permanent earning shock	correspond to Kolasa (2017) estimates of a household earning process
parameters of a transitory earning shock	set to reproduce the Gini coefficient of workers monthly wages, 2016 Polish HBS
correlation of initial wages of couples	correlation of education levels of couples, 2017 Polish HBS
correlation of earning shocks of couples	set to reproduce the correlation of the wage growth of couples (Heathcote, Storesletten, and Violante, 2010)

replacement rates for women θ^f and men θ^m	future net replacement rates of a worker that enters Polish labour market in 2018, *Pensions at a Glance* (OECD, 2019)
retirement age	Poland's statutory pension age
equivalence scale χ	Oxford scale
discount factor β	set to calibration targets
depreciation rate δ	average of the estimates taken in overlapping generations models calibrated for Poland
aggregate productivity growth rate g	TFP growth estimates from Gradzewicz, Growiec, Kolasa, Postek, and Strzelecki (2018), average for Poland, 2004-2013
capital share in output α	set to calibration targets
global interest rate r^*	Holston-Laubach-Williams (2017) model, average for Euro area, 2010-2020
debt elasticity ϕ	set to calibration targets

Table 15: Calibration assumptions

demographics	
household growth rate n (%)	-0.56
the age of a newborn j_{born}	20
the first age with mortality risk j_{surv}	45
max number of years lived by individuals J	100
health and out-of-pocket medical expenses	
the first age with health risk j_{health}	65
variance of the transitory component of out-of-pocket medical expenses	0.16
average out-of-pocket medical expenses women/men	1.18
earnings	
gender wage gap	0.8
autocorrelation coefficient of earnings	0.9
variance of the permanent component of earnings	0.013
variance of the transitory component of earnings	0.04
correlation between couples initial earnings	0.54
correlation of earning shocks of couples	0.145
retirement	
retirement age women	60
retirement age men	65
replacement rate women θ^f (%)	27
replacement rate men θ^m (%)	35
survivors pension rate (ϱ, % of the benefits of a deceased husband)	85
preferences	
discount factor β	0.96
Equivalence scale $\chi(2)$	1.7
production function	
capital share α (%)	32
depreciation rate δ (%)	8.00
aggregate productivity growth rate g (%)	0.75
interest rate rule	
world interest rate r^* (%)	0.6
debt elasticity ϕ	0.025

Notes: Annual estimates.

5.2.2 Survival probabilities

The life tables published by the Polish CSO give the most accurate approximation of the overall survival probabilities. They do not, however, allow the calculation of health-dependent estimates. Thus, I use the SHARE data for Poland to account for the differences between the survival probabilities of those in poor and good health.

First, I estimate logistic regressions using data on Polish men and women (5752 observations, including 465 deaths). The dependent variable is binary and takes one if a person died within two years from his/her last interview. I include the following explanatory variables: age, age squared, gender, health status, relationship status, age interacted with health status, age interacted with gender, and age interacted with relationship status. The health status is a binary variable that takes one if a person perceives his health as "poor" while the relationship status equals one for those with a partner.

Some variables turned out to be insignificant, so I consider several specifications with a reduced number of covariates (see Table 17). In particular, the regressions indicate that being in a relationship does not significantly affect an individual risk of dying in the next two years. A different pattern can be observed in the US data, where Braun, Kopecky, and Koreshkova (2017) found that being single lowers the chances of survival of older adults.

All considered models pass the likelihood-ratio test, the Hosmer-Lemeshow test, and the link test at a 5% significance level (Hosmer Jr, Lemeshow, and Sturdivant, 2013). According to the likelihood-ratio test, the nested models: *model 7* and *model 8* do not fit significantly worse than the larger *model 1*. However, the smallest *model 8* fails to reproduce the shape of conditional survival probabilities indicated by the 2019 Polish life tables. Thus, my preferred specification is *model 7*.

Using the health-dependent conditional survival probabilities based on *model 7* and the empirical shares of those in poor health from SHARE data, I calculate the health-independent average conditional survival probabilities of men and women, and compare them with those based on Polish 2019 life tables (see the bottom panel of Figure 4). In general, the CSO estimates indicate a lower risk of dying, especially for men. This comes as no surprise as the life tables use more recent data, and the average life expectancy in Poland is in an increasing trend (or at least it was before the COVID-19 pandemics).

Additionally, I also estimate separate regressions for men and women. They produce similar conditional survival probabilities of those in poor health, but they indicate slightly larger estimates for men in good health and slightly lower estimates for women in good health compared to the models based on the whole sample (see Figure 4). The comparison of the overall (not conditional on health status) survival probabilities of men and women indicates that these differences are not substantial (see the bottom panel of Figure 4). All in all, due to the limited number of observations with the occurrence of death (206 for women and 259 for men), I choose to use the whole sample and identical specification (*model 7*) for men and women.

Table 16: SHARE waves

wave	year
wave2	2006/07
wave3	2008/09
wave4	2011/2012
wave6	2015
wave7	2017

Table 17: Logit regressions, death occurs within two years

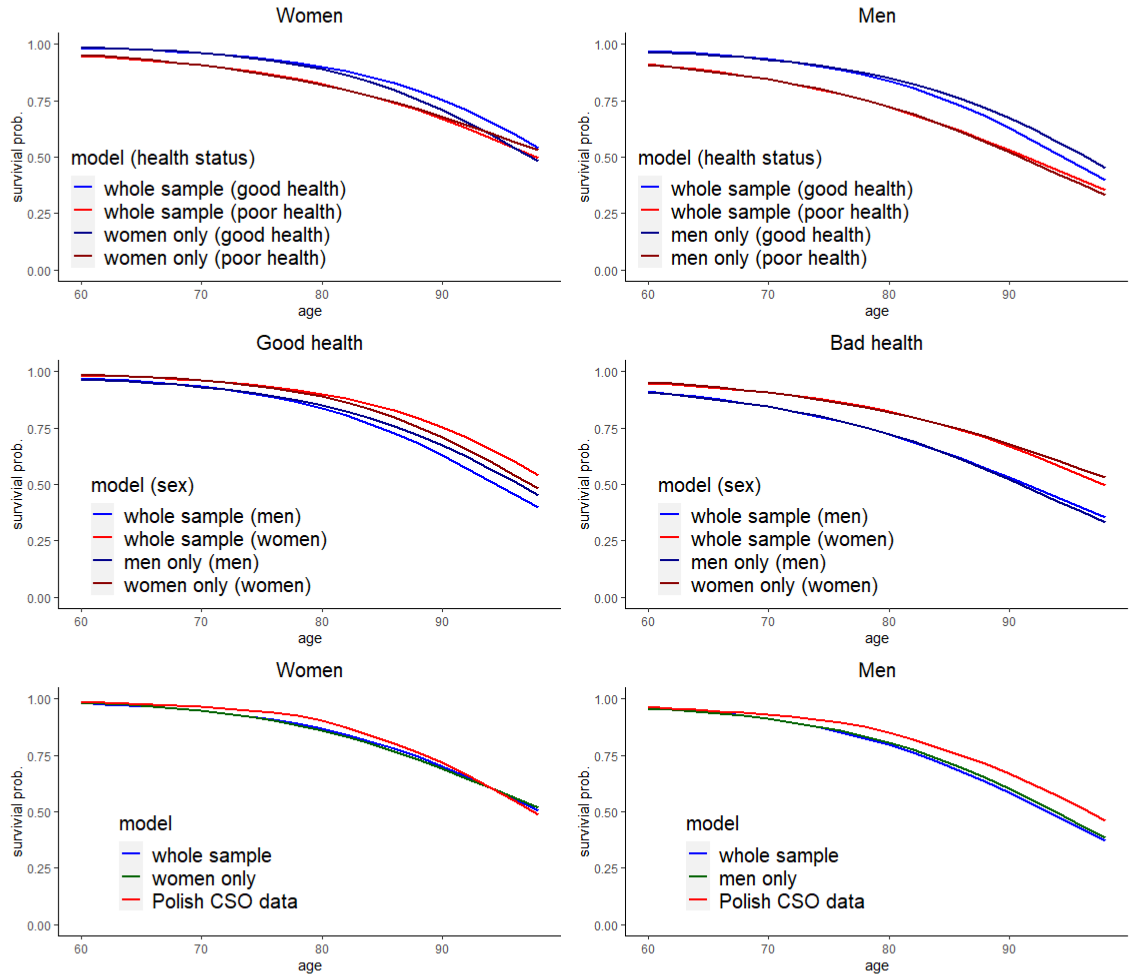
Full sample (total obs. 5752, deaths 465)								
	model 1	model 2	model 3	model 4	model 5	model 6	model 7	model 8
intercept	- 4.598	-6.538***	-5.531	-6.520*	-6.483*	-8.533***	-6.411*	-9.023***
age squared/100	0.035		0.026	0.038	0.038		0.048	
age	0.016	0.069**	0.035	0.040	0.039	0.096***	0.028	0.099***
has a partner	-0.642	-0.447	-0.179	-0.183	-0.204	-0.213		
gender	-1.932*	-1.967*	-1.800*	-0.655***	-0.654***	-0.652***	-0.588***	-0.581***
is in poor health	2.890***	2.862***	2.873***	2.786***	2.786***	2.750***	2.849***	2.807***
age x partner	0.006	0.004		0.000				
age x gender	0.017	0.018	0.015					
age x poor health	-0.028*	-0.027*	-0.027*	-0.026*	-0.026*	-0.026*	-0.027*	-0.027*
AIC	2821.734	2820.116	2819.947	2821.814	2819.814	2818.35	2820.661	2819.52

Women only (total obs. 3161, deaths 206)						
	model 1f	model 2f	model 3f	model 4f	model 5f	model 6f
intercept	-11.559*	-11.454***	-10.920**	-11.302***	-11.004**	11.516***
age squared/100	-0.002		0.007		0.009	
age	0.120	0.117***	0.105	0.115***	0.103	0.117***
has a partner	0.241	0.225	-0.095	-0.096		
in poor health	3.886**	3.888**	3.891**	3.882**	3.914**	3.903**
age x partner	-0.004	-0.004				
age x poor health	-0.041*	-0.041*	-0.041*	-0.041*	-0.042*	-0.042*
AIC	1310.896	1308.896	1308.943	1308.943	1307.268	1305.285

Men only (total obs. 2591, deaths 259)						
	model 1m	model 2m	model 3m	model 4m	model 5m	model 6m
intercept	-4.268	-7.625***	-5.286	-8.124***	-4.883	-8.573***
age squared/100	0.062		0.054		0.070	
age	-0.016	0.076***	0.003	0.082***	-0.017	0.085***
has a partner	-1.115	-0.981	-0.283	-0.298		
in poor health	1.913	1.889	1.847	1.836	2.003	2.000
age x partner	0.011	0.009				
age x poor health	-0.014	-0.014	-0.013	-0.013	-0.015	-0.015
AIC	1518.073	1516.66	1516.459	1514.916	1516.933	1515.707

Notes: Author's calculations based on SHARE data for Poland from waves 2,3,4,6,7. Significance: *** = p < 0.001; ** = p < 0.01; * = p < 0.05

Figure 4: Conditional survival probabilities for the next two years



Notes: Survival probabilities are based on the regression estimates presented in Table 17. The following models are used: *model 7* (whole sample), *model 5f* (women only), and *model 5m* (men only). In the bottom panel, survival probabilities are taken from the Polish CSO life tables and plotted together with the weighted sum of the health-dependent SHARE survival probabilities. The weights represent the shares of people in poor health. The shares are smoothed over age and based on SHARE data from waves 6 and 7 (from 2015 and 2017).

5.2.3 Health transitions

Here, my dependent variable is health status. Time intervals between the successive SHARE waves are not of equal length. Thus, to ensure consistency in variables, I only use panels based on the waves that are two years apart, i.e. waves 2 and 3, and waves 6 and 7. That gives the total number of observations 1,168 for Polish women and 921 for Polish men, including 387 women and 271 men declaring poor health conditions. Since the empirical distribution of health status exhibits different patterns for men and women (see Eurostat data), I choose to perform separate regressions for men and women.

First, I consider an extended set of control variables and include relationship status and its interaction with age in regressions. Having a partner turns out to be insignificant in determining individual health status. Thus, I do not include this variable in the final specifications (*model 5f* and *model 5m*). The goodness of fit is successfully tested with the likelihood-ratio test, the Hosmer-Lemeshow test, and the link test. The models' predictive abilities are also satisfactory (see Table 19). They correctly identify more than 60 percent of individuals in poor health and more than 85 percent of those in good health.

Based on the regression estimates, I calculate age-dependent probabilities of poor health status, conditional on the previous health assessment (Figure 5). Being in poor health two years earlier significantly increases the risk of current poor health status. For those who declared good health in the previous interview, the risk of entering poor health rises with age and is slightly higher for women. Staying in poor health has lower persistence in the case of elderly men compared to elderly women. Finally, as the share of individuals in poor health increases, the chances to escape poor health go up, and this effect is more profound for men.

Table 19: Prediction statistics based on logit models of self-perceived health status

Index	women		men	
	model 1f	model 5f	model 1m	model 5m
Balanced Accuracy	0.762	0.746	0.758	0.755
Precision	0.676	0.637	0.738	0.689
Sensitivity	0.706	0.675	0.632	0.64
Specificity	0.819	0.816	0.885	0.87

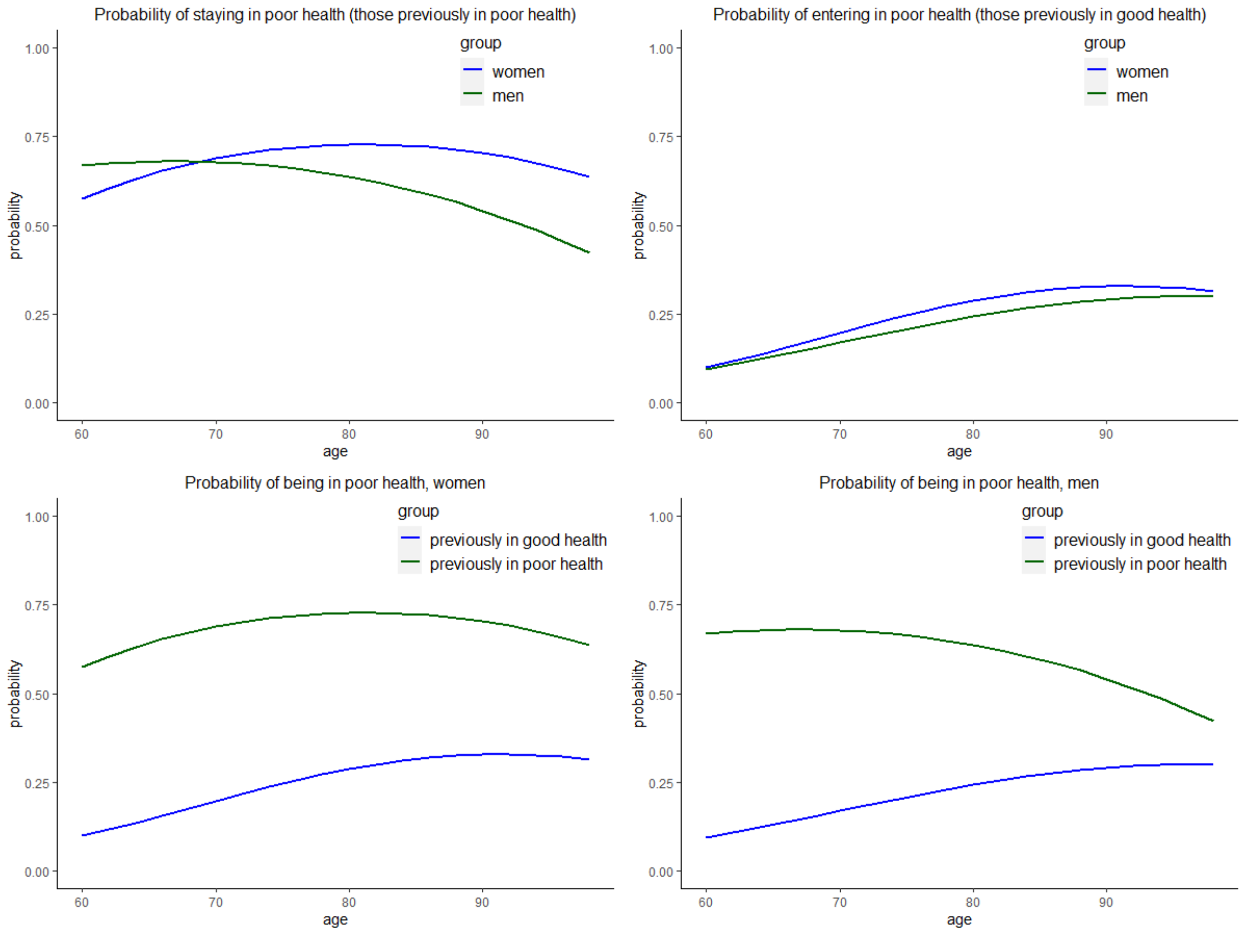
Notes: Author's calculations based on regression estimates presented in Table 18.

Table 18: Logit regressions, self-perceived health status

Women (total obs. 1168, currently in poor health 387)					
	model 1f	model 2f	model 3f	model 4f	model 5f
intercept	-8.738	-4.041***	-13.812**	-5.397***	-13.828**
age squared/100	-0.084		-0.158		-0.152
age	0.164	0.037*	0.288*	0.055***	0.282*
has a partner	-2.75	-3.224*	-0.154	-0.138	
in poor health two years earlier	4.545***	4.617***	4.386***	4.467***	4.421***
age x partner	0.036	0.043*			
age x in poor health two years earlier	-0.033	-0.034	-0.031	-0.032	-0.031
AIC	1165.461	1164.103	1166.467	1167.167	1165.423
Men (total obs. 921, currently in poor health 271)					
	model 1m	model 2m	model 3m	model 4m	model 5m
intercept	-9.409	-4.690**	-10.896	-5.672***	-11.248
age squared/100	-0.086		-0.098		-0.109
age	0.169	0.041	0.198	0.054***	0.213
has a partner	-0.889	-1.093	0.163	0.186	
in poor health two years earlier	7.075***	7.013***	7.031***	6.947***	6.926***
age x partner	0.015	0.018			
age x in poor health two years earlier	-0.066**	-0.065**	-0.066**	-0.064**	-0.064**
AIC	891.125	889.547	889.41	887.987	887.887

Notes: Author's calculations based on SHARE data for Poland from panels constructed with waves: 2 and 3; 6 and 7.
Significance: *** = p < 0.001; ** = p < 0.01; * = p < 0.05

Figure 5: The risk of poor health status



Notes: Probabilities are based on the regression estimates presented in Table 18. The following models are used: *model 5f* (women), *model 5m* (men). Previous self-health assessment was made two years earlier.

5.2.4 Out-of-pocket medical expenses

Only wave 6 of the SHARE database has adequate data on out-of-pocket medication spending of Polish individuals. I use them as a proxy of out-of-pocket health-related payments, since records on other types of out-of-pocket medical expenses do not have sufficient quality. According to the *Polish Health Profile* (OECD, 2019), pharmaceutics account for around 3/5 of all out-of-pocket medical payments in Poland. I calculate the age profiles of average out-of-pocket medical payments of individuals with different health assessments. As the data are very volatile and there are only 14 observations for individuals older than 90, for calibration purposes I chose to rely on smoothed profiles (Figure 6). Reassuringly, they closely match the health-independent age profile

Table 20: The average out-of-pocket medication spendings of women to the average spendings of men

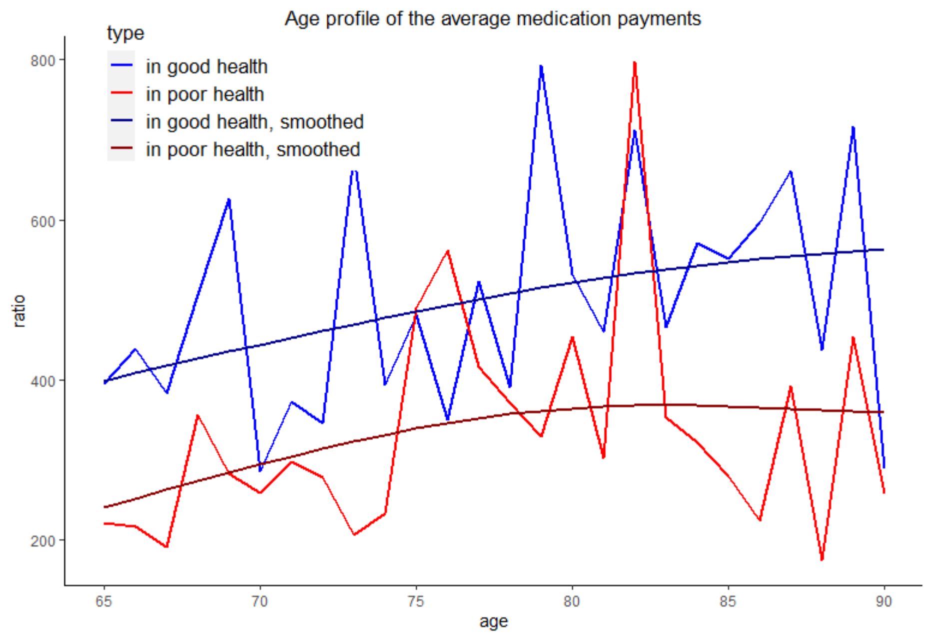
group	ratio (women/men)
in good health	1.19
in poor health	1.18

Notes: Author's estimates based on SHARE data for Poland from wave 6. Individuals older than 55.

of average out-of-pocket medication payments of a two-person household calculated on the Polish HBS data from 2016 (see Figure 7).

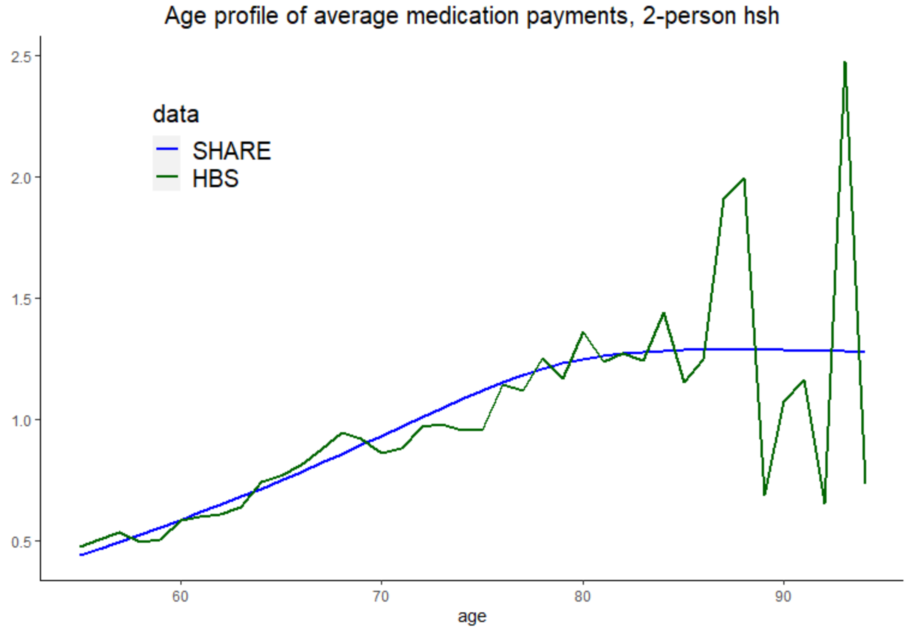
According to the SHARE data from wave 6, Polish women in good health spend on medications about 18% more than men with the same health status (Table 20). Similarly, Women in poor health have higher (by 19%) out-of-pocket medication payments than men in poor self-perceived health.

Figure 6: The average out-of-pocket medication spendings, broken by health status



Notes: Author's estimates based on SHARE data for Poland from wave 6.

Figure 7: Average medication payments of a two-person Polish household, comparison between SHARE and HBS data

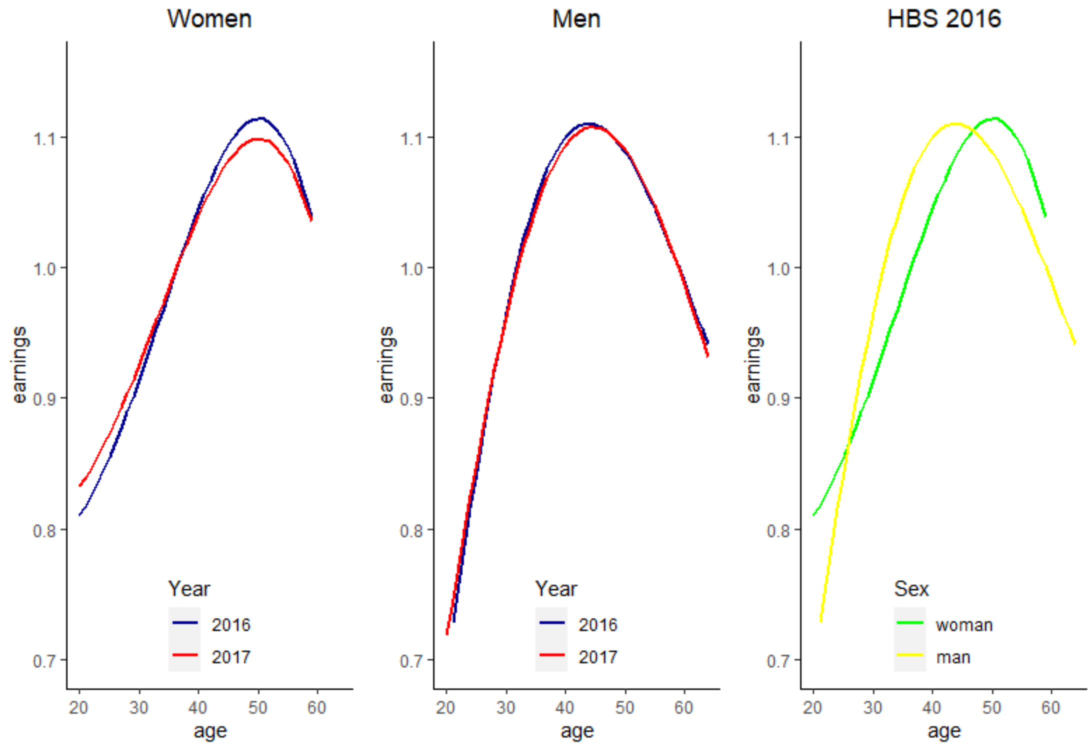


Notes: Author's estimates based on SHARE and 2016 Polish HBS data. The values are scaled to their means.

5.2.5 Earnings

Using data from 2017 instead of 2016 produces relatively similar results (Figure 8). All average life cycle profiles of earnings are inverted-U shaped. Men have a steeper slope of their profile than women. Their average earnings start to deteriorate faster, i.e. at the age of 45, while average earnings of women increase up to the age of 55.

Figure 8: Deterministic earnings profile



Notes: Author's estimates based on Polish HBS data from 2016 and 2017. Profiles are scaled to their means. Blue line - uses data from 2016, red line - uses data from 2017.

5.2.6 Minimum pension

The minimum pension in Poland was around 20% of the average wage in 2021. However, according to recent estimates, even more than 6% of pensioners received pension benefits lower than the minimum pension, and this share has increased dramatically over the recent years (Karczewicz, 2021). Rough estimates based on the ZUS report (2021) indicates that the average pension among those receiving the minimum pension or less is around 1/7 of the average wage. Moreover, more than 80% of those with pension benefits below or equal the minimum pension are women.

To solve the model, I need to use a limited number of levels of pension payments. To account for those with little pension benefits, the minimum pension in the model is assumed to be lower than the Polish statutory level.

University of Warsaw
Faculty of Economic Sciences
44/50 Długa St.
00-241 Warsaw
www.wne.uw.edu.pl