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FUNDED-CAPITALIZED PENSION DESIGNS AND THE DEMAND FOR MINIMUM PENSION GUARANTEE

Abstract

Using funded and unfunded pillars, the optimal pension structure is estimated using an over-lapping generation model, calibrated to the average OECD countries. While simulating different pillar sizes, a socio-economic characteristic was revealed in which low-earning groups are prone to unexpected market risks than high-earning cohorts and support a larger contribution than better-off individuals. This led to high contribution rates for funded pillars and low contributions rates for social security pillars. This suboptimal allocation leads to inefficient hedging capability for the pension portfolio. An alternative is a minimum pension guarantee as an efficient system stabilizer as it rebalances the economic cost among different earning cohorts. However, the guarantee might be expensive to implement if not capitalized early in the working phases in an era of aging populations, low birth rates, and deep financial crisis.

Keywords mix pension design, pension guarantee, social security, income cohorts, income inequality

JEL Classification B55, C02, D31, D63, G17, G28, H55

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INTRODUCTION

Since the 1990s, countries around the globe have introduced structural pension reforms, moving from the public pay-as-you-go (PAYG) defined benefit (DB) model to individual accounts (Ebbinghaus, 2015). The main reason is fiscal constriction due to low fertility rates and longer retirement periods. Governments, particularly in countries with an aging population, could not oblige anymore to the same PAYG DB benefit levels without raising taxes (Ayuso et al., 2016). This entailed diverting funds from the public pension system into individually funded accounts.

The privatization trend of pension systems met the financial crisis in 2008 (Ortiz et al., 2018), a wake-up call in that it highlights the uncertainty of retirement income derived from private-capitalized pension plans (Bohn, 2010). Negative accumulation in capitalized pension funds has been recorded in the current global markets due to the financial crisis caused by the COVID-19 pandemic (Chapman, 2020). The funding process is frequently commented on in the academic literature to propose optimal-mix designs (Fultz & Hirose, 2019).

While shifting to a funded multi-pillar scheme, a socio-economic anomaly is revealed in pension pillar sizes, favoring high-earning cohorts at the expense of low-earning cohorts' economic loss (Wolf & Caridad, 2021). In line with early papers such as Barr and Diamond (2009), it is found that even in an economy with a highly developed private pension market and a high average return rate, it is optimal

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that the pension system contains a sizeable unfunded pillar. This anomaly is realized in un-optimal market risk exposure to low earners. Here we contribute that this anomaly is most significant during financial crisis, such as in these days of the 2020 pandemic financial crisis (Natali, 2020). We mention two major distortions. The first is influence on benefit adequacy for long years after the crisis and the second is reduction in consumption in times of low income due to labor and income stress.

It is found that the minimum pension guarantee may rebalance the pension system. One shows that implementing a minimum pension guarantee, financed by an intra-generational method, may improve utility values for all earning cohorts while finding the path where different earning cohorts can benefit from the same mixed pension system. One mentions the minimum pension guarantee wave in many Continental Europe's countries (OECD, 2019; Ebbinghaus et al., 2019). These suggested risks sharing mechanisms may seem as analogue to the recent enormous governmental economic bailouts plans in response to the COVID-19 pandemic. Some of these plans focus on the adequacy of pension benefit to old age (Natali, 2020). Consequently, the necessity to impose public balance risk sharing mechanisms are more relevant than ever. Otherwise, we might be witness to another wave of pension re-reforms, like the one happened in Central East Europe and Latin America countries after the 2008 financial crisis.

In the next section, a short literature review is presented. In section 2, an overlapping generations (OLG) model is introduced, and the optimal pension pillar sizes are obtained using a simple utility function. Section 3 estimates the optimal contribution rates, using simulation procedures on the proposed model. Section 4 treats the consequences of the evolution to a pension design with larger funding and reveals an unwanted characteristic of the capitalized pension scheme. A minimum pension guarantee can be obtained using an intra-generational method for risk-sharing to achieve stability using the mixed system. The last section is devoted to some conclusions and future lines of development.

1. LITERATURE REVIEW

This paper can be included within the emerging trend of literature addressing optimal social security design in the stochastic framework using a portfolio choice approach, following the strand initiated by Merton (1983) who addressed the portfolio and diversification effects in pension systems. One wondered how low-earning cohorts could benefit from stable and adequate old-age benefits, while, in parallel, participants from high-earning cohorts can benefit from the same pension system from high exposure to the capital market.

Aging in many modern societies introduces problems in the PAYG schemes, originating inefficiencies in the system's financial aspects. The growth rate in wages determines the implicit rate of return of the unfunded PAYG scheme; this level is lower than the real interest rate. The return on investment in funded systems would be higher than in unfunded systems (Aaron, 1966). This rate of return argument is stronger in countries with lower population growth and aging populations. One important ground of the literature on social security reforms lies in the fact that aging populations degrade the financial sustainability of PAYG-financed social security systems (Bouhakkou et al., 2020).

These assets can be considered welfare contributions; this situation is liked on relations between its yield and the mean return of the market (Markowitz, 2010). Some other authors, such as Dutta et al. (2000), show that using a mixture of funded and unfunded designs (considering portfolio criteria) permits risk diversification. Besides, this approach also allows for risk diversification, leading to using a mixture of funded and unfunded pillars. De Menil et al. (2006) analyze, for unfunded PAYG schemes, the optimization of both pillars. Also, Masten and Thorgesen (2004) use OLG models with two periods, as Knell (2010) who obtain an optimal portfolio mix, using the same type of modeling and taking into account if the beneficiaries compare their consumption to a representative community. Risk considerations introduce a new factor that would affect the relative preferences for funded and unfunded schemes. Increasing public funding will result in a loss of efficiency in the case of lack of insurance against unforecasted large losses in expected wages. Alonso-Garcia and Devolder

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(2016) use a similar approach, including defined contributions with unfunded schemes as a method for diversification. Again, the optimal relative sizes of both pillars are studied by Bouhakkou et al. (2020) for eight developed countries. Thus, different factors influence the potential gains when considering intergenerational risk-sharing and the environment and personal risk aversion, leading to a dual system with a large pay-as-you-go pillar.

It is worth mentioning the emergence strand of literature studying the process of pension reversals in funded pension schemes (Naczyk & Domonkos, 2016; Altiparmakov, 2018; Grech, 2018; Fultz & Hirose, 2019). We claim that the revealed socio-economic anomaly is accentuated especially in times of financial crisis and might explain some of the pension reversals during the last two decades. This anomaly, together with neglected feelings of a large portion of the public (Armeanu, 2018), may reveal the political pressure to reverse back from this design. In particular, the inherent anomaly in funded schemes may explain the global wave toward implementing minimum pension guarantee in countries side by side of individual savings accounts (Ortiz et al., 2018).

2. METHODS

In this approach, one considers different wage levels corresponding to different cohorts and determines the size of both pillars. We expand the model of Wolf and Caridad (2021) in analyzing the demand of minimum pension guarantee as alleviating the socio-economic anomaly and its global implementation.

A Monte-Carlo simulation of a simple over-lapping generation model is used to characterize optimal pension pillar sizes. In each period, a new generation is born, and three life periods are considered, in which individuals work during the first two parts of their life and are retired during the third part (Wolf & Caridad, 2021; Knell, 2010).

2.1. Individuals

The working population starts at the age of twenty-one, represented by $s = 0$, and the retirement age is $s = T_R$, and the death is at $s = T_D$. The wage earned at instant s is W_s, and contributes to social security and a private defined contribution pension fund, in a proportion τ of the earnings. After $s = T_R$, there is no income but the obtained from the social security pay-as-you-go system, P^U, plus the yields, P^F, of the private fund, to a total $P_s = P^U + P^F$, assumed to be constant during the retirement period; the remaining income is $C_s = W_s(1 - \tau)$, for $s \leq T_R$, that is, during the working period, and $C_s = P_s$, for $s \in (T_R, T_D)$. C_{ts} represents the disposable income of generation t in year s. The proportion of the funded pillar is $\gamma = P^F/P_s$. It is assumed that risk aversion and the corresponding utility function are constant for all population members, with a curvature α. The discount factor, δ, is also assumed constant, and the utility function for generation t is

$$U_t = \sum_{s=1}^{T_D} \frac{\delta^{s-1}}{1-\alpha} C_{t,t+s-1}^{1-\alpha}. \tag{1}$$

The objective is to obtain the optimum values (τ^*, γ^*) of τ and γ, that is, the optimal sizes of the contribution to the public pension part and to the privately funded pillar, which is achieved by maximizing the (common) utility function of each individual. If there is a social security guarantee for generation t, M_{ts}, then the utility to be optimized is

$$\begin{aligned} U_t^* &= \sum_{s=1}^{T_R} \frac{\delta^{s-1}}{1-\alpha} C_{t,t+s-1}^{1-\alpha} + \\ &+ \sum_{s=T_R+1}^{T_R} \frac{\delta^{s-1}}{1-\alpha} (C_{t,t+s-1} - M_{tT_R})^{1-\alpha}. \end{aligned} \tag{2}$$

Several additional considerations, such as the global minimum associated with the considered poverty level, and the GDP per capita will follow the same path as the aggregates wages, as in Knell (2010) and Bouhakkou et al. (2020). The return rates for the pay-as-you-go pillar are g_{s+1} with the same time path as wages and are stochastic represented by a Brownian process.

2.2. Compensation and benefits

The working generations pay the actual unfunded pension. When generation t reaches the retirement age ($s = T_R$), it starts earning a yearly unfunded

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pension P^U, and it is supposed to be financed by the two previous generations this year (as one has considered that the number of working years are twice the mean retirement period). Then

$$P_t^U N_t = \varphi\tau\left(\bar{W}_{t+1}N_{t+1} + \bar{W}_{t+2}N_{t+2}\right), \qquad (3)$$

that is, the unfunded pensions for generation t, a_t retirement time is supposed to be paid by the previous two generations still working, as the assumed working period is twice the mean retirement period, for the T_R and T_D values assumed. However, generation t will be getting pensions from the years $s = T_R$ to $T_D - 1$, and during these years, there will be $T_R = 46$ generations working, different as time goes by; for example, say, generation $t = 1950$ ($s = 0$), they have retired in 2017 ($s = T_R$) and will be getting P^U till 2040 ($s = T_D$). They will be paid P^U from 2017 to 2040. At any moment $t^* = 2020$ (for example), there will be $T_D - T_R = 23$ generations (those retired from 2020 – 22 to 2020) getting their unfunded pensions, and this is all paid by the $T_R = 46$ working generations in 2020 (those starting working in 2020 – 66 and still working in 2020).

To isolate what is paid to generation t, it would be necessary to consider the dynamics N_t of each generation working and retired, and the evolution of P^U for the retired generations. As a simplification, one can assume that the total yearly amount received by generation t, that is $P^U N_t$, will be paid by two previous working generations (as it has been assumed 46 workings years and 23 retired). As

$$\varphi = P^U / (\tau\bar{W}_t) \qquad (4)$$

is the constant ratio of unfunded pension payments to the total contributions, part of it, $1 - \varphi$, is devoted to other financial commitments such as the minimum pension guarantee or others unfunded expenses of the social security system for disabled people, support for poverty or medical care, or additional unfunded pensions. Of course, in the PAYG system, the T_R working generations are paying the whole unfunded pensions of the $T_D - T_R$ retired individuals; thus, depending on the real working years and the mean period of retirement, the last expression should be modified. The population dynamics and the evolution of the unfunded pension would originate an aggregation of unfunded pension payments financed by the T_R working generations. If this contribution is invested and produces interest, the yield in $s + 1$ is

$$g_{s+1} = W_{s+1,\,t} / W_{st} - 1. \qquad (5)$$

This type in year s is assumed to be equal to the growth rate of the GNP and of the wages, and assuming the economic principle of Aaron (1966), in the steady state, the yield for generation t is represented by g_t, the same as the population growth N_t. The individual unfunded pension in the steady state, P_t^U for an individual of generation t is calculated as

$$P_t^U = 2\varphi(1-\gamma)\tau\bar{W}_{t+2}. \qquad (6)$$

The funded-capitalized pillar is a private collective defined-contribution (DC) system with a fixed contribution rate. Individuals start with zero initial asset holdings. The individual adds the fraction of γW_t to his accumulations during the working phase, which is invested in a constant portfolio mix of financial assets (equities, bonds, etc.). This accumulation earns an average annual rate of return of: r_t that also follows a Brownian motion.

Accumulated capital of the funded pillar at year $s = T_R$ for an individual of generation t, is the capital accumulated, C_t^F, at retirement time, and from this is deduced the funded pension, P_{st}^F. This value is associated with generation t and then can vary during the retirement years. Let us consider that this individual makes contributions (at the end of every working year) of a part β of his salary W_{st} during all s working years; his contributions to the funded pillar will be the capitalized flow of contributions (minus taxes). If there is a direct tax of the proportion T^f on the contributions, then these are reduced to $(1 - T^f)\cdot\beta W_{st}$, for $s = 0, 1, \ldots, T_R - 1$; thus, the capital accumulated at the time of retirement ($s = T_R$) would be, for an individual of generation t

$$C_t^F = (1 - T^f)\beta\sum_{s=1}^{T_R} r_s^{T_R - s} W_{st}, \qquad (7)$$

and from this capital, the funded pension pillar obtained every year can be obtained. The additional problem is that this capital accumulated at $s = T_R$, has to be distributed during the years $s = T_R + 1, \ldots, T_D - 1$, and in this time, it would produce financial benefits at the random rate r_s,

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so the funded part of the pension would be variable. At retirement age, it could be calculated as a constant annuity for the retirement period, using the rate r_{TR} at instant T_R, and every year the annuity has to be recalculated using the current r_s. Adopting Knell's (2010) method, to simplify the process, only three periods are used, avoiding annuitization, as the third period is considered 'one-year' benefits.

2.3. Minimum pension guarantee

The minimum pension guarantee is considered an integrated part of the pension system. Financing the guarantee is a risk-sharing question, as there are several alternatives with different risk-sharing approaches (Grande & Visco, 2011; Pennachi, 1999). The guaranteed cost for the individual from generation t at retirement is the difference of the fixed level defining poverty minus the total pension if it is below.

Naturally, one can suggest financing the guarantee by the residual of contributions to social security $2(1-\varphi)(1-\gamma)\tau\overline{W}_{t+2}$. The minimum pension guarantee can be thus considered as a substitute for social means-testing and other social plans for old age. However, this residual finance for other social utilizations such as unemployment compensation, maternity benefits, disability compensation, etc., is according to the state social policy. Hence, it might not be adequate to finance the pension guarantee. Regardless, the solutions for financing the guarantee vary from intergenerational risk-sharing, such as increasing social security contributions, intra-generational redistribution, or any mix between these poles.

2.4. Calibration procedures

Using the pension system data in Israel, which is a typical platform for small open-funded pension systems, Israel has undergone a transition from a dominant PAYG defined benefit (DB) scheme to an almost purely capital-funded scheme with little government intervention. Most of the countries that had undertaken pension reforms wave over the 1990s scaled them back over the last decade (Ortiz et al., 2018). However, the pension system in Israel is stable with the same consistent capitalization trend (Giorno & Adda, 2016).

The aggregate wage income and the PAYG asset return are approximately set by the GDP per capita growth rate. The geometric average of GDP per capita in Israel from 1994 to 2019 is $\overline{g}$ = 1.6%, with σ_g = 2%; these values also correspond to the average OECD countries (OECD, 2019). We assume a ratio of 60% between contribution and return for the first pillar. For the second pillar, the gross annual rate of return in private pension funds is 4.24%, before deducing the assets administrative fee around 0.5%. The funded tax rate is 20%. Comparing it to a portfolio with 30% equities and 40% debt, common in the developed countries, the characteristics are quite near. The relationship between these portfolio's returns and the country growth rate influences the expected returns of the funds; the World Bank (2019) using data from developed countries in the last century a negative correlation of –0.32 is observed between the time series of return on equity and the evolution of income per capita. This influence barely affects the structure of the contribution preferences.

The poverty line is determined as 60% of the median income in the World Bank definition. As in Svirsky et al. (2020), a lag of 0.6% between GDP per capita and the poverty line index is allowed. Israel is one of the unequal economies in the Western world (OECD, 2019); hence, the median income and the poverty line are relatively low. Based on the statistical bureau report, the poverty line considered is a yearly income of USD 19,307.

Another parameter to be defined is the curvature of the utility function. It is set at α = 3, similar to values used in the academic literature, such as Masten and Thogensen (2004), Knell (2010), and Chen et al. (2014). Also, in Wolf and Caridad (2021), there is hardly a change in contribution rate as risk aversion changes. Based on the last two decades in Israel, the time preference coefficient is set to δ = 0.63, which corresponds to an annual discount rate of 2% (CBS, 2020; OECD, 2019).

The effect of the guarantee on replacement rates, utility change, and calculating the guarantee cost was calibrated in the simulations with different earning deciles according to the Israeli market in 2020 (CBS, 2020).

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2.5. The simulation methodology

In the first part of the simulation, the optimal shares of the contribution rate, τ, and the funded share from contribution, γ, are obtained, optimizing the individual's utility function for a wide variety of wage levels. Ex-ante risk sharing (Hassler & Lindbeck, 1997) was assumed in which the initial wage is fixed, and all other returns are uncertain while calculating the expected utility. The model includes two variables of uncertainty: the private pension fund's return rate and GDP per capita growth rate. The joint distribution of outcomes between the returns of the two pillars is modeled (see Appendix for a detailed calculation). To assess the relative attractiveness of funded and unfunded pension pillars, the measure *is* $V_t = U_t / W_t^{1-\alpha}$ across the simulations (a method similar to Knell's (2010)). This normalized measure is independent of the initial wage level of generation *t*.

For each simulation run, three random data points are drawn for each pension pillar and each period along the individual life cycle. For a given set of simulated data points, one evaluated the lifetime utility (or, more precisely, U_t) for various values of τ and γ. The optimal values of τ^* and γ^* set the utility function to a maximum level. The reported results are based on 2,100 Monte-Carlo simulations. For τ^* and γ^*, one sought values between 0 and 1 with a step length of 1/100.

After calculating the various values of optimal pension pillar sizes for different wage levels, in the second part of the simulation, the optimal values of the pension's pillar sizes were fixed for the median individual income. One then simulated the OLG model with a minimum pension guarantee while calibrating wage levels according to current Israeli earning deciles (CBS, 2020). The simulation enabled us to evaluate the guarantee's influence on both the financing deciles and benefiting deciles regarding the change in utility levels and average replacement rates.

3. RESULTS

According to figure 1, as the income level increases, the individual's contribution preference converges with a concave path to a ceiling. The intuition behind this result is straightforward. Risk-averse individuals dislike situations with uncertain payoffs since the disutility of a bad state outweighs the additional utility of an equally sized favorable outcome. The disposable income's influence during the working phase results in low earners' preference for low contributions rates. However, the high-earning cohorts prefer large savings because they have enough resources for present consumption and prefer to enjoy the second pillar's rates of return. The results confirm Bauhakkou et al. (2020), Knell (2010), De Menil et al. (2006), where a larger PAYG pillar is preferred in case of higher risk aversion. Naturally, high-earning cohorts

Source: Wolf and Caridad (2021).

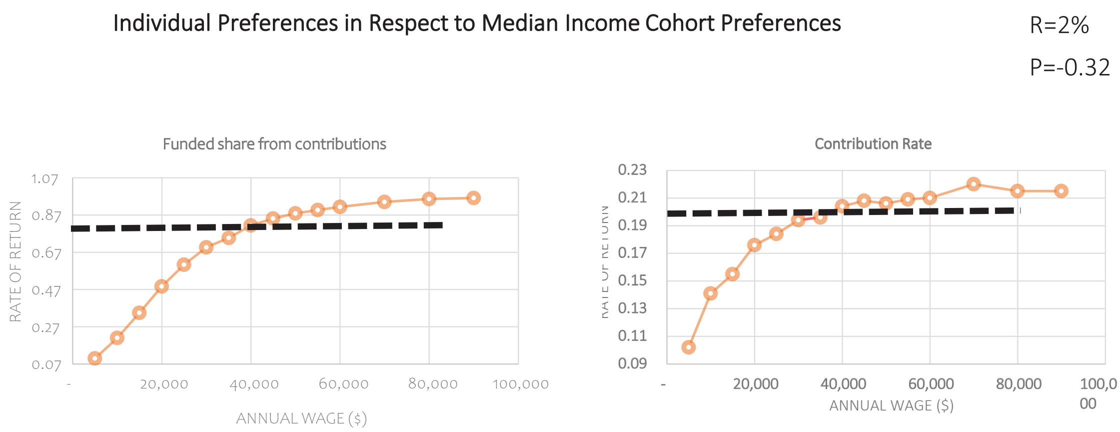

Figure 1. Individual preferences concerning median income cohort preferences

have enough financial resources for consumption during working phases and, in parallel, would prefer to save more for retirement and benefit from high returns. The unfunded pillar has less volatile returns and higher insurance values when the participant's income is lower.

When designing a pension system, the central planner determines a single value of contribution rate and a single value of funded share from contribution. When choosing the median income as a reference point, the optimal values[1] are 0.2 for τ^* and 0.77 for γ^* (marked in black line in Figure 1). These values for both the contribution rate and the funded share are closer to the higher-earning cohorts' optimal values than for the lower-earning cohorts' optimal values. In other words, by participating in a funded pension system, low-earning cohorts pay higher economic cost than high-earning cohorts do. Choosing the average income as a reference point leads to a larger gap in relation to low earners' optimal values ($\tau^* = 0.2$, $\gamma^* = 0.81$).

One next explored the implementation of a rebalances mechanism among earning cohorts' interests in the form of a minimum pension guarantee. The contribution rate and the funded share are fixed at the optimal values for the median income participant. One imposes a minimum pension guarantee and recalculates the utility change and the replacement of different earning deciles.

There are several ways to finance a guarantee (Pennachi, 1999). The most obvious way to finance public guarantees is by increasing contributions to the public pillar or increasing intergenerational risk-sharing. However, this method entails further economic burden on low-earning deciles. Any contribution increase reduces consumption further during the working phase for low-earning cohorts.

If implementing an intra-generational risk-sharing mechanism, the guarantee cost can be distributed unequally on the three highest deciles so that the designated contribution in period 1 will be progressive by decile. These early contributions are reduced from the accumulation/entitlement for the public pension pillar so that high earners meet the guarantee cost by reduced old-age benefit from the first pillar at retirement. According to income dispersion or social policy, the central planner might choose different burden distributions (Feldstein & Ranguelva, 2001; Ayuso et al., 2016). Part of the guarantee's cost can be financed through the residual contributions for social utilization.

When implementing the above intra-generational risk sharing mechanism in financing the guarantee, we can study how significant the guarantee on low earning cohorts' benefits and how it is insignificant to high earners, relatively. The guarantee's effect of old-age benefits are more evident for the lower earning decile cohort, there the income dispersion from AW is 15%, and the guarantee value retirement increases 30% from the expected AW. For the second decile, this guarantee falls to 18%, when incomes dispersion is 34%. In the range of the third earning decile cohort, the guarantee is 10% corresponding to an income dispersion of 46%; and, in the fourth decile, the guarantee is just 4%. The cohorts from the fifth to the seventh deciles are not affected. Contributions for the finance of these guarantees are borne by high earning cohorts, from the eighth earning decile. There are guarantee costs of 2%, 6% and 12% for these groups of higher earners, with finance contributions starting a 1%, then 3% and finally at 4% of the tenth decile cohort.

What is interesting is that even across the financing deciles (highest 3 deciles), the utility record was improves as of the implementation of the minimum guarantee. In decile 8 – the rate of utility change is 18%, decile 9 – 10% and decile 10- 3%. This implies that the insurance effect is higher than the effect of total benefit reduction in old age for the high-earning deciles.

Another characteristic of the guarantee is its effectiveness in financial turmoil. According to the sensitivity analysis in Figure 2, when the volatility increases in the funded rate of returns, the significance of the guarantee increases even for high earning deciles, respectively. When the market is unstable the values of the guarantee jumps so dramatically for the individual with no further fiscal

1 These results are quite close to the actual rates in the Israeli pension system (27% contribution rate and 72% funded fund proportion).

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Source: Authors' calculations.

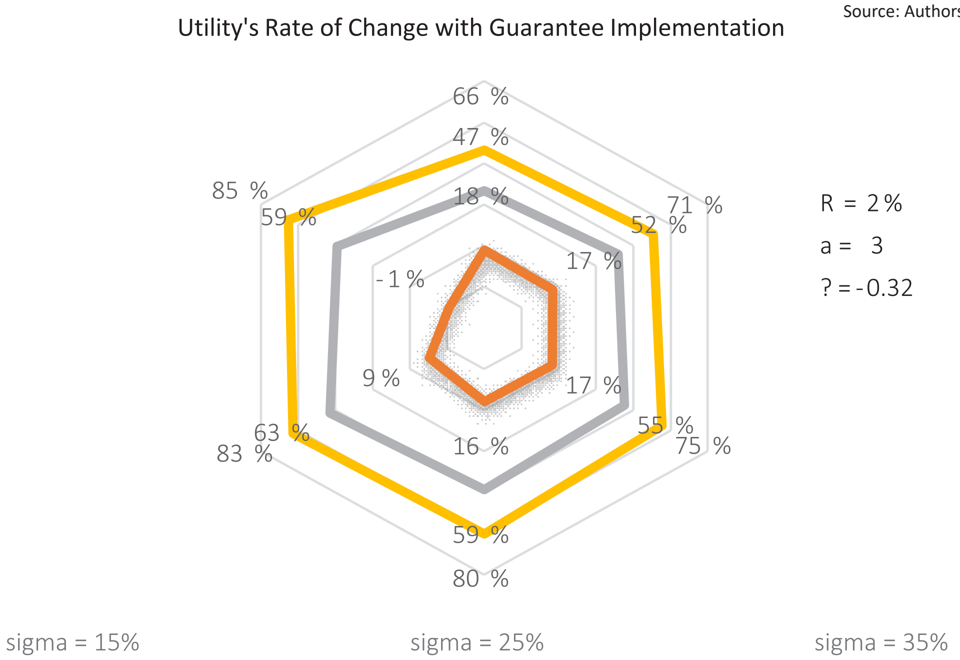

Figure 2. Guarantee implementation: the change in the normalized utility per earning decile

costs for the government. In these days of global financial crisis, which realized among other in fluctuations in the markets, governments might consider the value of certainty in benefit even on the expense of further social spending.

Figure 3 points to a convergence process of implementing minimum pension guarantee or target pension after pension reform reversals from a global perspective. Central and Eastern European countries that have been through pension reform during the 1990s and made reversals are marked

Figure 3. Implementation of minimum pension guarantee in Europe

in red color. These countries are compared to Western European countries, colored in yellow, which implement stable target pensions or minimum pension guarantee.

4. DISCUSSION

The simulation results confirm that the optimal pillars' shares depend on wage levels and sensitivity to capital markets (Boelaars & Mehlkopf, 2018; Beetsma et al., 2013). These results reveal an inherent social-economic anomaly in favor of high-earning cohorts at the expense of low-earning cohorts (Wolf & Caridad, 2021). The revealed financial burden on low earning cohorts is most relevant in these days of extreme global financial crisis, where these low earning cohorts were mostly offended. The participants' risk aversion values as function of income and the risk management capabilities are mostly relevant in periods of financial crisis, as in these days (Natali, 2020).

Nowadays, for the low earner's pension perspective the anomaly is realized in twofold dimensions. First capital falls harm the adequacy of pension benefits with no capability to hedge as of short financial resources. Second, unemployment periods not leave enough income to consume in the present days, hence optimal contribution rates is critical for these low earning cohorts.

One finds convergence of optimal funding portions and the contribution rates to a cap (see Figure 1) due to the participant's financial risk aversion in both unfunded and funded pillars. While considering different earning cohorts and not attributing the economy as a single actor, it revealed that the low earner has higher risk aversion. This risk aversion naturally includes the effects of ensuring adequate consumption during the working phase. However, the preference for low-funded portions is less trivial. One links this preference to the hedging nature of the first pillar or non-contribution transfers (see Figure 2). The concave shape of the optimal values makes the median or the average values consistent with high earners. Consequently, with higher income and inequality levels in the market, many participants find themselves with sub-optimal contribution rates and unwanted risk-bearing.

The anomaly presented is linked to Arrow's (1970) "externalities theory," as higher earners benefit from higher contribution rates to the funded pillar at the expense of low earners. These contribution rates harm low earners twice, resulting in low consumption during working phases and unwanted exposure to market risks during retirement. Hence, if one shows that the minimum pension guarantee may alleviate this anomaly, it must be financed through an intra-generational risk-sharing mechanism. In this way, high earners "compensate" lower earners an excessive level of risk. In analog to the exchange option benefit theory (Romaniuk, 2009), the guarantee is a "collar" (Grande & Visco, 2011; Feldstein & Rangueleva, 2001).

The results demonstrate the value of insurance in the participant's consideration. The surprising outcome is the utility improvements, by implementing the guarantee for the low-earning beneficiaries and those who finance the guarantee. Indeed, in the ongoing COVID-19 pandemic financial crisis, public saving nets are revealed to be highly significant for higher-earning deciles (Chapman, 2020).

According to this work's perspective, there is no use in implementing a return-minimum pension guarantee rate. The reason is that individuals coherently attribute to their total incomes at retirement. This perspective enables us to think of the first pillar as a financial source for the guarantee, which compensates for the lack of contribution to the first pillar in the first place.

To overcome the anomaly, there is a need to implement a minimum pension guarantee. Some governments have recognized this mechanism as a pre-condition to the sustainability of funded pension schemes (Grande & Visco, 2011; Grech, 2018). If implemented as intra-generational or intergenerational risk sharing, a minimum pension guarantee entails fiscal risk exposure, as it obligates the government to take an active part in the pension market as a mediator.

Based on global experience in Central Eastern Europe and Latin American countries, the participant's expectation of compensation due to suboptimal contribution values are not just on

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the theoretical level. If a system is not seen as beneficial by the electoral majority, namely if it does not help them maintain their pre-retirement living standards, it could be voted out (Bradley et al., 2016; Grech, 2018).

CONCLUSION

Based on a simple OLG model, one maps a socio-economic anomaly during the pension transition to a more capitalized one in which risks are not distributed equally across earning cohorts during pension transition. It is found that the optimal values of the median income are closer to the high-earning cohorts than low-earning cohorts.

This anomaly is practically realized in the market by obligating low-earning cohorts to a sub-optimal contribution rate and riskier investments that they would rather avoid (Wolf & Caridad, 2021). One shows how implementing a minimum pension guarantee can rebalance the multi-pillar pension system via an intra-generational risk-sharing mechanism. By this method, those who benefit from high contributions compensate low earners who may heart from low consumption and insufficient hedging capability from the first pillar.

This paper deals with the participant's point of view. Here, one mentions that according to Barr and Diamond (2009), funded pension schemes have macro-economic consequences that may not satisfy government targets to save fiscal spending in the first place. When shifting to a funded pension scheme, the shifting of fiscal and longevity risks might become a double-sword for the government. When systemic risks affect both tax collecting and GDP growth in financial crises, the government might use PAYG taxes for short-term Keynesian injection. With this, the government can foster infrastructure investment to encourage market economic growth. By that aspect, the 2020 pandemic financial crisis has the same fiscal characteristics as the previous financial crisis in 2008. According to Altiparmakov (2018) and Grech (2018), that was one of the main motives to funded pension re-reform in Central Eastern countries during the last decade. The fiscal considerations and the socio-economic revealed are most relevant in times of financial crisis when the government meet high fiscal deficit and the low earner individual might prefer consumption on future savings. These two considerations can be easily realized to political pressure to reverse pension scheme as was experiences in the last financial crisis in CEE countries. Hence, now more than ever it is suggested to central planners to impose intra-generational risk sharing mechanisms to alleviate market and systemic risks of labor and capital fluctuations. This is most relevant for low earners who do not have the sufficient sources to hedge risks in their personal portfolios. Furthermore, implementation of these mechanisms signal to the public that there is no need to panic and to prefer current consumption on future savings.

Further research is needed to demonstrate the conclusions in this composition in an era of the deep financial crisis. The COVID-19 pandemic-induced financial crisis has demonstrated that the government's responsibility to its citizens' old-age benefits and welfare may vary without a direct link to the funded rate of pension schemes. That may result in questioning the motive for pension transition in the first place due to fiscal risk, as in the examples of CEE countries (Grech, 2018).

AUTHOR CONTRIBUTIONS

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APPENDIX

Calculation of multivariate lognormal distribution

For the simulation of return data, it is assumed that:

- $R \equiv 1 + r;$
- $G \equiv 1 + g.$

These are jointly lognormal distributed with the following:

- $E(R) = 1 + \overline{r}, \quad Var(R) = \sigma_r^2;$
- $E(G) = 1 + \overline{g}, \quad Var(G) = \sigma_g^2.$

Given this information, one knows the two variables.

The procedure for simulating data points that possess these stochastic properties is the following:

a) Random and normally distributed data points are defined for a funded fund rate of return (r_t) and GDP per capita (g_t): $r_t^{'} \sim N(0,1)$ and $g_t^{'} \sim N(0,1)$.

b) g_t is adjusted to correlation with r_t:

$$g_t^{'}(corr.adj.) = r_t^{'}\rho_{g.r}^2 + g_t^{'}\sqrt{1-\rho_{g.r}^2} \quad . \tag{1}$$

c) The bivariate lognormal distribution variables are specified as:

$$\tilde{R} = exp\left[\left(\overline{r} - \frac{\sigma_r^2}{2}\right)\cdot T + \sigma_r r_t^{'}\sqrt{T}\right]. \tag{2}$$

$$\tilde{G} = \exp\left[\left(\overline{g} - \frac{\sigma_g^2}{2}\right)\cdot T + \sigma_g \cdot g_t^{'(corr.adj.)} \cdot \sqrt{T}\right], \tag{3}$$

d) From these, one calculates the periodic stochastic rates of return:

$$r_t = \exp\left(\tilde{R}_t\right) - 1$$

$$g_t = \exp\left(\tilde{G}_t\right) - 1$$

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