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OPTIMAL INDIVIDUAL CHOICE OF CONTRIBUTION TO SECOND PILLAR PENSION SYSTEM IN LITHUANIA

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Optimal Individual Choice of Contribution to Second Pillar Pension System in Lithuania

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Abstract

The 2013 pension reform in Lithuania forced workers to choose their level of participation to the second pillar system. Three options were given: a lower contribution rate, a higher contribution rate with governmental subsidy, and to exit from the second pillar system. The aim of this article is to evaluate the best rational choice for individuals of different gender and age, depending on the expected financial returns of their second pillar accounts. Results reveal that the participation in the second pillar system is always more convenient than the abandonment, even under the conservative hypothesis of zero real rate of return. Because of the governmental subsidy, the higher contribution rate can be the best choice for young and middle-aged workers, and its convenience increases with higher expected returns.

Keywords: Lithuanian pension system, second pillar, private pension funds, rational choice.
Jel Classification: C02, H55, H75, J11

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1. Introduction

Ageing population and low fertility rates started to disassemble pay-as-you-go (hereinafter – PAYG) systems. Moreover, global financial crisis negatively affected economic performance and it has increased the pressure for reforming such systems. Social security budgets, based on PAYG principle, became unbalanced, as premiums amounts paid by current working generation are not sufficient for fulfilling obligations for current old age pensioners. Further projections of population structure are even more threatening: in 2050 the population of 65 years and older would amount to more than 44% of the population over 15 years old in Europe (United Nations[2]). Governments are taking decisions to promote the conditions for establishment of fully funded second and third pension pillars and are encouraging citizens to save capital for the future retirement, which would allow to accumulate additional pension and would compensate smaller pension from first pillar. The success of these corrective actions would improve the balance of the social security budget, because the first pillar system is usually administrated by the state (government).

Lithuania is not excluded by the need of managing challenges related to the old-age pension. The fully-funded second pillar of Lithuanian pension system was introduced since the 1st January 2004. Before this date Lithuanian pensions were based solely on the public PAYG first pillar. The reasons to introduce a fully-funded pension system were the deterioration of demographic situation, sustainability of the pension system and the surplus of the state social security budget (Bitinas and Fiori Maccioni[3]). The aims, implementation and some results of the reform were analysed by different authors (Lazutka[4]; Medaiskis et al[5,6,7]; Gudaitis et al[8,9,10]).

The approach to the second pillar pension reform in Lithuania was similar to that in many

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[2] United Nations, Department of Economic and Social Affairs, Population Division (2013). World Population Prospects: The 2012 Revision, DVD Edition.

[3] Bitinas, A., Fiori Maccioni, A. (2014). Lithuanian Pension System's Reforms Transformations and Forecasts. Universal Journal of Industrial and Business Management 2.1, 13-23.

[4] Lazutka, R. (2008). Lietuvos socialinio draudimo pensiju dalinio privatizavimo tikslai ir rezultatai. Ekonomika, 82, 104-126.

[5] Medaiskis, T., Jankauskiené, D. (2010-2012). Pensions, Health and Long-term Care. ASISP annual reports.

[6] Medaiskis, T. (2011). Pensions at the Time of Recession. The Case of Lithuania. Zeitschrift fur Socialreform, 57, 251-266.

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[8] Gudaitis, T. (2013). Privaciu antros pakopos pensiju fondu investicinés veiklos rezultatu vertinimas. Proceedings of International Scientific Conference Practice and Research in Private and Sector – 2013, 203-215.

[9] Gudaitis, T. (2009). Lietuvos pensiju sistemos reformos vertinimas: nuo koncepcijos iki pirmuju anuitetu. Organizaciju vadyba: sisteminiai tyrimai. 2009, 49, 37-56.

[10] Gudaitis, T., Medaiskis, T. (2013). Was the Participation in Second Pillar Successful in Lithuania? Athens: ATINER'S Conference Paper Series, No: ECO2013-0605.

other post-communist countries (e.g. Poland) where pension systems were reformed earlier. The second pillar was based on personal fully-funded accounts; participants were allowed to transfer a part of their obligatory pension insurance contribution into their personal second pillar pension accounts, instead of paying full contribution into state social insurance fund. The second pillar funds are managed by private pension accumulation companies who are proposing several pension funds with different investment strategies. The supplementary part of the (first pillar) state social insurance old-age pension is reduced in proportion to the size of the contribution rate to the second pillar. A specific feature of the Lithuanian case that worths mentioning, is that participation in second pillar was fully voluntary: residents fully insured under the state old-age pension system, were allowed to make individual choices for joining the second pension pillar. Other countries that reformed their pension systems, mostly introduced mandatory participation in the second pension pillar for certain age groups and/or had banned participation from certain age. In the mid of 2013 more than 1 million participants, or 96% of individuals insured under the full old-age pension system, are participating in the second pension pillar. The introduction of the funded second pension pillar in 2003 meant that the Lithuanian pension system turned into the Anglo-Saxon model: the state social security system became partly independent on the state budget and participants to the funded pension system have received less state guarantees from the first pension pillar (Bitinas and Fiori Maccioni[11]).

In the context of financial crisis some decisions on the balancing of the first pension pillar budget were taken. Firstly, in the beginning of 2009 contribution rates from first pillar to second pillar were reduced. It was expected that the decrease in contribution rates to second pillar pension funds would be only temporary, that rates would be early set back to their previous level and that the decrease could be even compensated later on by additional increase in new premia; however these plans were not implemented. Secondly, old-age pensions were temporarily decreased in 2010 (the amounts of old-age pension were restored in 2012). Moreover, since 2012 the retirement age is being coherently increased by two months per year for males and four months per year for females. Starting from 62.5 years for males and 60 years for females in 2012, the retirement age will reach 65 years for both genders in 2026. This decision was adopted with regard to the longer lifespan after the retirement age. According to the data from the Department of Statistics of Lithuania, in 2009 the average life expectancy after 65 years of age in Lithuania was 13.38 years for men and 18.25 years for women. According to the Eurostat projections, in future the life expectancy will grow (19 years for men and 22,6 years for women in 2050).

Once that individuals had taken the decision to join the fully-funded system, there were no way back to the full PAYG system. This principle was justified by arguments of financial stability of pension funds and of the PAYG system. Nevertheless, recently this principle was abolished because second pillar was reformed and new participation rules were established. The aim of these changes was to create opportunities for current and future retirees to decide how

[11] Bitinas, A., Fiori Maccioni, A. (2014). Lithuanian Pension System's Reforms Transformations and Forecasts. Universal Journal of Industrial and Business Management 2.1, 13-23.

they would like to accumulate their pension savings in future. According to the new regulations, from 2014 the financial sources of the second pension pillar can consist of three parts: the contributions transferred from state social insurance fund budget, the contributions paid from person's earnings and the subsidy from state budget. Participants to the second pillar in year 2013 had once more to decide if, from the following year, they want to increase their participation level or if they want to stop participating in the second pillar. From the 1st of April to the 30th of November 2013, workers had to choose their participation level by selecting one of the following options:

A) To stop further participation in the second pillar. It means that from 2014 no more premia would be transferred from first pillar to the participant's account in second pillar. Then, since 2014, the individual would contribute only to the old-age pension system and her pension would be primarily based on PAYG principle. Eventually, the amount already accumulated in the second pillar pension account between 2004-2013 would still stay there and be further invested according to selected investment strategy, giving rise at retirement to a (negligible) additional annuity.

B) To increase participation in the second pillar (compared to current levels). This option is known as "2+2+2" contribution rates. The contribution to the participant's second pillar account would consist of three parts: 2% withdrawn from her compulsory first pillar pension insurance contribution rate; plus 2% of person's wage as a voluntary contribution; plus 2% of country average wage subsidy that would be granted from the state budget and transferred by the Government to the participant's second pillar pension account. If participant selects this option, from 2014 till 2016 the contribution rates would be "2+1+1", that is, the additional voluntary contribution and the government subsidy would be 1%. From 2020, the contribution withdrawn from first pillar is planned to increase till 3.5%; the contribution to second pillar pension fund would therefore consists of "3.5+2+2" contribution rates.

C) To stay with current participation level: 2% withdrawn from compulsory first pillar pension insurance contribution rate, to be transferred to the private second pension pillar account. This rate is planned to be increased till 3.5% from 2020.

There are a lot of different discussions on which of the options are the most suitable for Lithuanian participants. The aim of our paper is to evaluate the criteria for rational choice among the three options for contribution rates described above. We intend to assess when it is convenient to continue participation in the second pillar pension system, when it is convenient to increase the level of contribution and when individuals should quit. Our findings identify which option would be the best rational choice for representative Lithuanian workers of different gender and age. In the following, we present the quantitative literature to which we refer (Section 2), the model of estimation (Section 3), the demographic and economic hypotheses (Section 4) and, finally, our results and conclusions (Section 5).

2. Quantitative literature on the topic

The evaluations in the present study are made through the traditional actuarial approach widely adopted in literature. An introduction to survival models and longevity risk with a

comprehensive literary review is proposed by Pitacco[12]. Rigorous analyses of mortality projections have been conducted by Lee and Carter[13], Benjamin and Pollard[14], Benjamin and Soliman[15], Haberman and Renshaw[16], Lee[17], Olivieri[18], Thatcher et al.[19] and Olivieri and Pitacco[20]. Joint analyses of both financial and longevity risks have been proposed by Olivieri and Pitacco[21] and by Coppola et al.[22]. The securitisation of mortality risk has been analysed by Lin and Cox[23] and by Cairns et al.[24]. Analyses of the Lithuanian case are proposed by Klyvien[25] and Bitinas and Fiori Maccioni[26], which focus on the actuarial valuation of the national pension system through the forecasting of national population and the related fertility, migration and mortality trends. Sophisticated pension models have been proposed by Janssen and Manca[27], by

[12] Pitacco, E. (2004). Survival models in a dynamic context: a survey. Insurance: Mathematics and Economics, 35, 2, 279-298.

[13] Lee, R., Carter, L. (1992). Modelling and forecasting U.S. mortality. Journal of the Statistical Association, 87, 419.

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Bitinas, A., Fiori Maccioni, A. (2013). Lithuanian pension system's reforms following demographic and social transitions. CRENoS Working Papers 2013/15, 1-36.

[27] Janssen, J, Manca, R. (1997). A realistic non-homogeneous stochastic pension fund model on scenario basis. Scandinavian Actuarial Journal, 2, 113-137.

Colombo and Haberman[28] and by Cairns and Parker[29]. Abio et al.[30] analyse the age structure of future national population in PAYG public pension systems. Fiori Maccioni[31] proposes a discrete-time stochastic model for the estimation of new entrants in pension schemes of a professional category. Devolder et al.[32] analyse the financing of public pension in a stochastic environment, with a mix of funded and unfunded schemes. Angrisani et al.[33] propose a demographic model for studying the impact on PAYG pension systems of future developments of the population. Bianchi et al.[34] conduce joint demographic and behavioural analyses via dynamic microsimulation to test the economic effects of pension reforms.

3. Methodology

In this section we present the formulae that we use for the estimation of the internal rate of return for representative individuals who participate in the Lithuanian pension system, depending on demographic, financial and regulatory variables. We start, therefore, with a discrete, age-structured model of population that estimates the life dynamics of the representative workers of different gender and age. Our next step is to estimate, for the life-cycle of each individual, the time series of the expected cash flows to and from the pension system; these are the individual's cash outflows due to contributions paid during working years to public/private pension schemes and the cash inflows due to benefits received from the same schemes during retirement years.

The sequence of cash flows for individuals, from a common initial year until their expiration, is estimated as follows. For each representative worker, we estimate the nominal annual cash outflows that should be paid according to the three options of contribution rates set by the 2013 pension reform; we multiply such values by the relevant survival rates, so to obtain the expected cash outflows. Contributions should be paid to the PAYG public pension system and, eventually, to private pension funds, which provide individuals with their fully-funded defined contribution accounts.

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[28] Colombo, L., Haberman, S. (2005). Optimal contributions in a defined benefit pension scheme with stochastic new entrants. Insurance: Mathematics and Economics, Elsevier, 37, 2, 335-354.

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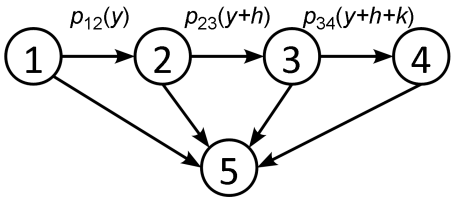
[34] Bianchi, C., Romanelli, M., Vagliasindi, P. (2003). Microsimulating the Evolution of the Italian Pension Benefit. Labour, 17, 139-173.

Furthermore, we estimate the nominal annual cash inflows received by retired workers from the PAYG public pension system and from the private pension funds, from their retirement until expiration. Such pensions are calculated separately for each regime of contribution mentioned above; also, we estimate the amount paid by the private pension scheme under the alternative hypotheses of 3% and 2% nominal rates of return on second pillar pension investments (*i.e.* 1% and 0% real rates of return). Again, we obtain the expected cash flows through multiplication of their nominal values by the relevant survival rates of the representative individuals.

3.1. Life cycle representation

We estimate the uncertain life evolution of an individual through a multistate Markov chain (see Figure 1). Each state represents a univocally identified working condition, which varies according to age: in education, unemployed; employed; retired; deceased. The stochastic variable is the time spent on each state. Also, the permanence in the states 'employed' and 'retired' will be associated to cash flows related, respectively, to contributions paid or to pension received. For the purposes of this paper, we assume that representative workers are all employed contributors (*i.e.* in state 3), which can only become pensioners or expire (*i.e.* they can move only to states 4 or 5).

Figure 1. Markov chain representing the life cycle of a member of the pension scheme



Description of states:
1: In education
2: Unemployed
3: Employed (contributor)
4: Retired (pensioner)
5: Deceased

The $p_{ij}(y)$ in the Markov chain represents the probability of transition from state i to state j at year y. An individual can move to a greater state exclusively after fixed time periods (0, h or k time units) depending on the state itself. The parameter h represents the expected years of unemployment in the life of an individual, which for simplicity are assumed to take place in life as a once-and-for-all unemployment period between the end of the education and the beginning of working life. The parameter k represents the years of work before retirement (i.e. the years of contribution to the public pension system). At any given time, an individual can only be in one state. Moving to a greater state can happen exclusively after fixed time periods (1, h or k time units) depending on the state itself. State 5 can be reached from any other previous state and represents the end of life. We remember that, in 2012, the initial year of our estimation, all the representative individuals in the study are considered to be already employed contributors (*i.e.* in state 3) and can only become pensioners (*i.e.* move to state 4) and expire (*i.e.* move to state 5).

3.2. The demographic and financial model

We calculate the demographic evolution of individuals divided by gender, age and working seniority, with the following formulae. Let $l_{s\,xa}(y)$ represent the population of members of the pension system alive at year *y*, of gender *s*={*F, M*}, age $x \geq 16$, and working seniority $a \geq 1$. We assume that $l_{s\,xa}(2012) = 1$. Then, for any year $y > 2012$, we estimate the evolution of such representative individuals as:

$$l_{s\,x\,a}(y) = l_{s\,x-1\,a-1}(y-1) \cdot \left[1 - \frac{q_{s\,x-1}(y-1)+q_{s\,x}(y-1)}{2}\right],$$

where $q_{s\,x}(y)$ represents the annual mortality rate at year *y* of individuals with gender *s* and age *x*. Because of its initial value in 2012, the preceding definition implies that $l_{s\,x\,a}(y)$ is equivalent to the survival rate from year 2013 inwards of a representative individual of gender *s*, age *x* and working seniority *a*, alive in 2012.

Let $c_{dsxa}(y)$ be the nominal contribution of type *d* paid at year *y* by an existing worker of gender *s*, age *x* and working seniority *a*, determined as:

$$c_{dsxa}(y) = \gamma_{dxay} \cdot R_{dsxa}(y)$$

where γ_{dxay} and $R_{dsxa}(y)$ represent respectively the contribution rate and the expected financial amount (*e.g.* gross income) for the determination of the contribution of type *d* due at year *y* by an individual of gender *s*, age *x* and seniority *a*.

The expected annual cash outflows at year *y*, paid in contributions by a representative worker of gender *s*, age *x* and working seniority *a*, is equal to:

$$C_{dsxa}(y) = \sum_d c_{dsxa}(y) \cdot l_{sxa}(y), \qquad \forall(x,a) - \{x > \hat{x}_{dsy} \wedge a \geq \hat{a}_{dsy}\},$$

where $\hat{x}_{dsy}$ and $\hat{a}_{dsy}$ represent respectively the retirement requirements of age and seniority, in force at year *y*, for individuals of gender *s* to be entitled to the benefit of type *b*; thus, the $l_{s\,x\,a}(y)$ considered in the previous equation represents the (survived) active workers who are not yet entitled to retire. The term $c_{dsxa}(y)$ is the nominal contribution of type *d* paid at year *y* by an existing individual of gender *s*, age *x* and working seniority *a*. The term $d = \{I\ Pillar, II\ Pillar\}$ represents here a generic contribution of the two types that we consider in the study: to the PAYG public pension system (*i.e.* the first pillar) or to the fully-funded private pension system (*i.e.* the second pillar).

The expected annual cash inflows at year *y*, received in pension benefits by a representative individual of gender *s*, age *x* and working seniority *a*, is equal to:

$$B_{dsxa}(y) = \sum_d b_{dsxa}(y) \cdot l_{sxa}(y), \qquad \forall(x,a): \{x > \hat{x}_{dsy} \wedge a \geq \hat{a}_{dsy}\},$$

where $\hat{x}_{dsy}$ and $\hat{a}_{dsy}$ represent the retirement requirements of age and seniority, in force at year *y*, for individuals of gender *s* to be entitled to a benefit of type *d*; thus, the $l_{s\,x\,a}(y)$ considered in the previous equation are retired members of the pension system who survived at year *y* of gender *s*, age *x* and seniority *a*. The term $b_{dsxa}(y)$ is the average benefit of type *d* received at year *y* by a pensioner of gender *s*, age *x* and working seniority *a*. The term $d = \{I\ Pillar,\ II\ Pillar\}$ represents here a generic benefit of the two types that we consider in the study: from the PAYG public pension system (*i.e.* the first pillar) or from the fully-funded private pension system (*i.e.* the second pillar).

Let IRR_{sxa} represent the internal rate of return of the expected cash flows that steam from participating in the pension system, for an individual of gender *s*, age *x* and working seniority *a* at the initial year 2012. Then, we define the internal rate of return as the value IRR_{sxa} that verifies the following equation:

$$\sum_{n=y-2012} \frac{B_{ds,x+n,a+n}(y+n) - C_{ds,x+n,a+n}(y+n)}{(1+IRR_{sxa})^n} = 0$$

where $B_{dsxa}(y)$ and $C_{dsxa}(y)$ represent respectively the amounts of pension benefits received and of contribution expenses paid by a representative worker of gender *s*, age *x* and working seniority *a*, at year *y*.

As usual, the internal rate of return is the annualised effective compounded rate that makes the net present value of (positive and negative) cash flows equal to zero; in our application, the IRR represents therefore the discount rate at which the net present value of contributions paid is equal to that of pension received. Its calculation permits to compare the convenience of the three options of contribution rates offered by the 2013 pension reform, from a risk-neutral perspective and with an objective indicator; the higher its IRR, the more desirable should be the pension regime.

4. Technical assumptions

We estimate the expected cash flows for representative Lithuanian workers divided by gender and age, due to their participation in the public and private pension systems, in the period starting from 2012 until their expiration. The cash flows are calculated with the demographic, economic and regulatory variables exposed in the following. We consider the current reform of second pillar system, exposed in introduction, which requires workers to choose among three different options of contribution rates. We adopt the forecasting model described in Section 3, under the following assumptions.

Demographic hypotheses:

• Working seniority of each representative individual is equal to the average working

seniority of Lithuanian workers divided by gender and age in 2012, estimated from data of the Lithuanian Official Statistics Portal.

• Mortality rates estimated as a function of official Lithuanian values in 2011 and their average rates of change in 1975-2011, by gender and age (data retrieved on 19-09-13 from the Human Mortality Database of the Max Planck Institute for Demographic Research and the University of California Berkeley, at www.mortality.org).

Financial hypotheses:

• Inflation rate equal until 2013 to Lithuanian historical values, and from 2014 inwards to European Central Bank long-term objective, thus equal to 2,00%.

• We do not consider any management costs (in other words, the rates of return of pension investments represent net financial returns).

• Nominal annual rate of return of pension funds is assumed from 2014 inwards equal: to its historical mean in 2004-13 in the reference scenario, thus is equal to 3,00% (source: Lithuanian Central Bank); to the expected inflation in the conservative scenario, thus is equal to 2,00%.

Contributions:

• Two types of contributions determined in accordance with Lithuanian regulations: to 1st pillar public pension system and to 2nd pillar pension system.

• Total contribution rate on gross income in period 2004-13 (which we need for the estimation of future pension) are equal to 26,3%, divided between 1st pillar and 2nd pillar systems according to Lithuanian regulations at the time.

• Contribution rates from 2014 determined according to the three alternative regimes exposed in Section 1, which we summarise:

A) contribution rate to 1st pillar equal to 24,3% in years 2014-19 and to 22,8% from 2020. Contribution rate to 2nd pillar equal to 2% in years 2014-19 and to 3.5% from 2020.
B) Contribution rate to 1st pillar equal to 24,3% in years 2014-19 and to 22,8% from 2020. Contribution rate to 2nd pillar equal to 3% in years 2014-15, to 4% in years 2016-19 and to 5.5% from 2020. Additional governmental subsidy to 2nd pillar individual accounts of 1% in years 2014-15 and of 2% from 2016 of average national salary.
C) Contribution rate to 1st pillar equal to 26,3% of gross income; no contribution to 2nd pillar system.

• We estimate the time series of contributions and benefits for each representative individual, in each of the preceding options A, B or C of 2nd pillar contributory regime.

• Annual gross incomes, for each representative individual are equal to average values by gender and age in 2010, published by the Lithuanian Official Statistical Portal, appreciated at historical Lithuanian nominal GDP growth rate in 2011-2012 and at 3,00% for the following years.

Old-age insurance public pensions:

• Representative individuals get after retirement an old-age insurance pension consisting of three components: a basic sum; a supplement based on working seniority; an earnings-related part, calculated with an accounting unit ("points") system and reduced proportionally to second pillar contributions.

• Pensions are estimated for each representative individual according to current Lithuanian regulations for different gender and age.

• All pensions are appreciated annually at inflation rate. Each representative individual retires immediately after fulfilling requirements. We do not consider benefit reversion to survivors.

Second pillar pensions:

• We assume that, at 1-1-2012, the representative workers can have already contributed to the 2nd pillar system: workers aged 29 or more have contributed since 2004; workers aged from 22 to 28 have contributed since their 21 years of age; all other representative workers (aged 16-21) start to contribute to the 2nd pillar system in 2012.

• Second pillar pension funds generate 3.00% nominal annual net returns in period 2004-13 (as their average internal rate of return in the same period, as published by the Lithuanian Central Bank); from 2014 inwards, we make two alternative hypotheses: 3% and 2% nominal rates.

• Annuities are calculated at retirement by applying to the accrued contributions the regulatory conversion rates, fixed by Lithuanian Central Bank in 2012.

5. Results and conclusions

We evaluated the internal rates of return (IRR) that would be obtained by the representative individuals from their participation in the Lithuanian pension system. We considered female and male workers, who are 16 to 50 years old in the starting year 2012; we estimated their life dynamics and their survival rates from the initial year 2012 until 2100, the year when the youngest worker (aged 16 in 2012) would have by hypothesis surely expired. For each individual, we calculated the nominal annual cash flows due to contributions and pensions, under the contibutive options A, B and C of the 2013 pension reform and under the hypotheses of 3% and 2% nominal financial returns on second pillar pension investments. Then, for each individual, we multiplied the time series of nominal cash flows by that of annual survival rates; we obtained therefore the time series of expected cash flows and we computed their internal rates of return.

The internal rates of return of the three alternative scenarios of contribution to the second pillar system (A, B and C described earlier in the paper) have been separately analysed and results are shown in Figures 2-5. Results suggest that the option B of higher contribution rates, could be the rational choice at individual level for the major part of Lithuanian working population of young and middle age, under risk-neutral evaluation. Because of the governmental subsidy, this conclusion holds even under the conservative hypothesis of zero real financial returns on pension fund investments. The convenience of option B of higher contribution to second pillar

is positively correlated with expected returns and negatively correlated with workers' age. Its convenience could be negatively affected by the risk aversion of individuals and by the economic costs of capital for the additional share of contribution that this option implies.

The internal rates of return of option A (*i.e.* lower contribution to second pillar) tend to outperform as workers' age increases. According to our assumptions, with 3% nominal annual financial returns on pension savings (*i.e.* 1% real investment returns), which is equal to the average returns of Lithuanian pension funds in 2004-2013, the option A would be the rational choice for female workers over age 52 and for male workers over age 55. With the conservative hypothesis of 2% nominal annual financial returns (*i.e.* 0% real investment returns), the option A would be rational choice for females over age 44 and for males over age 45.

Under our assumptions, the internal rates of return of abandoning the second pillar (option C) never outperforms those of the other available options. However, risk-averse individuals who are close to retirement may find convenient to contribute only to first pillar (option C) to avoid short-term volatility of investment returns. The option C might also be justifiable for individuals who do not trust the pension and financial systems.

Quantitative results should be considered with caution, because the model cannot capture the risk of abrupt demographic and economic changes. Improvements in accuracy can be obtained with wider statistical data. However, we expect that higher accuracy would not significantly affect the ranking between the options of contribution rates that we tested. It would be an interesting follow-up study to compare the rational choices according to our calculations, with the real choices of Lithuanian workers. The comparison between theoretical and empirical preferences may reveal information on the levels of risk aversion and trust in the pension system among Lithuanian workers. We aim to conduct this further research when the official data on individual choices following the 2013 pension reform will be released.

Figure 2. Internal rate of return on pension expenditures for females aged 16-50 in year 2012, estimated from year 2012 until their expiration, with 3% nominal yearly investment return (or 1% real yearly investment return).

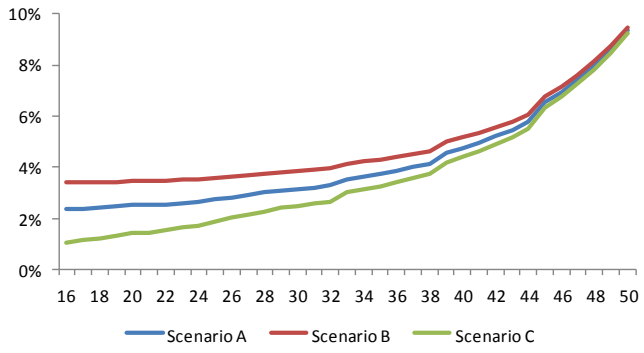


Figure 3. Internal rate of return on pension expenditures for females aged 16-50 in year 2012, estimated from year 2012 until their expiration, with 2% nominal yearly investment return (or 0% real yearly investment return).

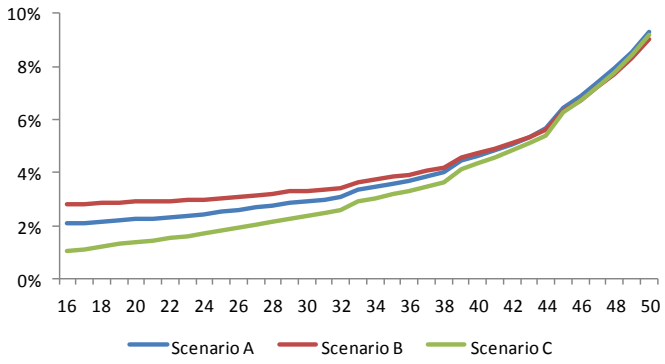


Figure 4. Internal rate of return on pension expenditures for males aged 16-50 in year 2012, estimated from year 2012 until their expiration, with 3% nominal yearly investment return (or 1% real yearly investment return).

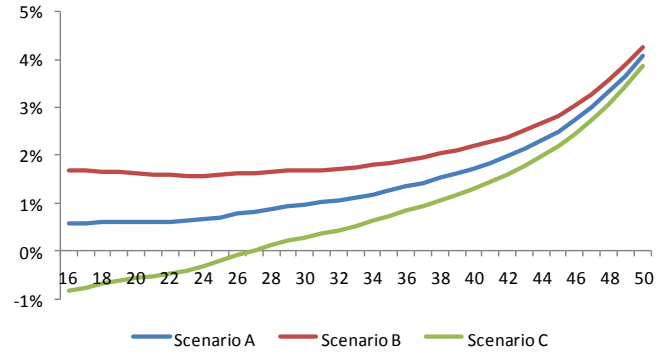
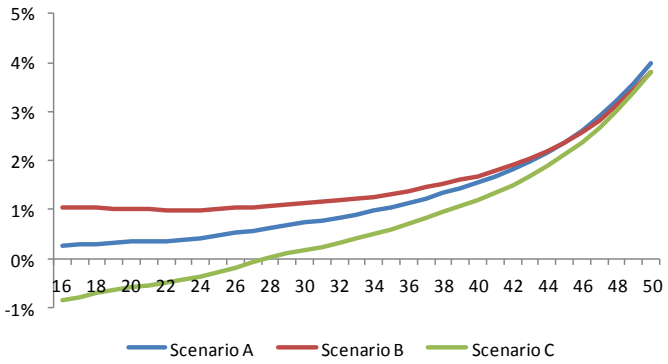


Figure 5. Internal rate of return on pension expenditures for males aged 16-50 in year 2012, estimated from year 2012 until their expiration, with 2% nominal yearly investment return (or 0% real yearly investment return).



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