Does Defined Contribution Pension System "Solve" the Problem of Population Ageing? – an Analysis the Distribution of Future Pensions Using Microsimulation Model of the Polish DC Pension System..

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…….2007

Draft version

Abstract

In many developed countries the population ageing imposes a general change of the old-age pension system from pay-as-you-go (PAYG) system to the system based on the defined contribution (DC). The DC system moves the responsibility for the level of future old-age pensions from the state to individuals and strengthen links between individual benefits and the amount of capital accumulated during the working life. Despite this change, the state have still to guarantee the minimum income to prevent the destitution during the old age. Costs of such support could be considered as a measure of the influence of population ageing on the public budget under the DC pension system. The aim of this paper is to estimate how high these costs would be under the DC system in Poland.

The adequate approach to that issue requires micro-level modelling of the life courses of individuals which accounts for the complex links between education, family career, employment and wages. At first, these relationships have been defined on the basis of models estimated on the data coming from the LFS in Poland. Next, these relationships have been used in the dynamic microsimulation model to calculate the distribution of future old-age pensions.

The results of the model show that pension benefits of women will be much lower than those of men due to lower retirement age, labour force participation and wages. The low-skilled people are also at a disadvantage because of the unstable employment and lower wages. These groups of future retirees will be main beneficiaries of social policy aimed at income compensation. The successful policy of increasing labour force participation and employment of these vulnerable groups can result in decreases of government expenditures when members of these groups retire.

1. Introduction

The ageing of the population in European will influence the sustainability of public finances in the next decades. The scope of increase of pension spending depends on the demographic structure of population and the type of pension system. The increase of expenditures connected with pension is to be observed in almost all countries with traditional PAYGO defined benefit system (DB), where the state guarantees the value of pension benefit. As the ageing process accelerates, the sustainability of public finance can force the governments to reduce the value of pension benefits, increase the pension age or to increase the taxes.

In these circumstances some countries anticipated demographic trends by switching the responsibility for the value of future pensions to the people. It was done by introduction of the systems with defined contribution (DC). This approach had the advantage of actuarial fairness and it is considered as a method which helps public budget to dodge the ageing bullet. It is however connected with the increase of uncertainty of the value of individual pensions which will be on average less generous than in the past.

There is one important difference between the two systems mentioned above. It is the ability to redistribution of income towards low-income pensioners and prevention from the destitution in the old age. The mechanism that in most DB systems is built in the system, in the DC systems requires additional funding. In Polish pension system it is the guaranteed by the state minimum pension financed not from the pension contributions but from the state budget.

Why it is worth to mention about it?

Most analysis of the future pension wealth, including the analysis made by OECD[1], use to take into consideration the distribution of wages and general assumptions about the undisturbed career of typical worker. This approach results in the straight conclusion that despite the fact that pension benefits in DC systems will be generally lower than today's, in terms of net replacement rates, the number of people who will need additional transfers from the state because of the pension below the minimum level is limited to those who have very low wages during the whole working life (see Figure 3).

[1] OECD(2005)

More careful analysis of the labour market performance of the low-wage employees show that the low wage is only one of the features characteristic for these persons. Low-wage workers are usually also less skilled and have lower level of education. These features are also correlated with the lower probability of employment and more frequent work in the shadow economy. The low-skilled persons have also much lower probability of finding a job in the older age. These observations lead to the conclusion that the wages and employment tenure during the whole life are not independent but positively correlated. If so, the defined contribution system could lead to the distribution of pensions that is more progressive that the distribution of earnings[2]. This means that, in comparison to pension projection with the independent wages and work tenure:

1) Future pensions of persons that for the significant part of life worked in low-paid jobs will be much lower
2) The public expenditure on financing the redistribute part of pension system could be higher. It appears that even in the pure DC system the public finances could be hit by the consequences of ageing process as the state is still responsible for the pensions for the minimum value of pensions.
3) The incentives to increase employment and labour market performance of the low-skilled persons aged over 50 become crucial not only because of the possible shortages of labor supply caused by ageing but also because of the reducing expenditures on minimum pension in the future.

This paper presents the attempt to analyze the problem of the pensions of the low-skilled persons using the simple microsimulation model. Microsimulation model allows preparing the projection of changes in education level, employment status and wages under the assumption that both employment and wages depend on individual characteristic of the people such as sex, age, education level and place of living. The projection of the individual paths of employment and wages of individuals from the representative survey is then used to calculate the pension benefit for each individual. The result of the model is the projection of the benefit of each individual in the simulated population. After aggregation the projection on the distribution of benefits on the macro level is received. In comparison to less detailed macro approaches used by OECD and Polish Financial Supervision Authority this approach allows the dynamic analysis of the impact of labour market performance of low-skilled workers on the pension system.

[2] According to the OECD (2005) Poland has one of the most progressive earnings distributions among OECD countries.

The next parts of the paper are organized as follows: the second chapter of that paper is devoted to closer description of the Polish pension system and the general classification of the pension systems. In the third chapter the microsimulation model is introduced. The description begins from the idea of microsimulation and ends with the construction of the model and assumption used in this analysis. The forth chapter presents the results of the simulation in comparison with the results of benchmark data. The main conclusions are described in the fifth chapter of the paper.

2. Defined Contribution Pension System and the pension reform in Poland

The variety of the existing pension systems could be generally classified with respect to the link between contributions and benefits.

The most popular in the OECD courtiers are different variants of DB systems. In the DB plans the amount that pensioner will receive is defined in the system but could defined using the measures of the individual earnings from work or years of contribution during working life. The mechanism of redistribution from high-income pensioners to low-income pension is usually included in the formulas of calculation of benefit.

The more close relation between contributions and benefits is in the "points systems". In such a system, contributions during the whole life are converted to points and future pension benefits depend on the number of points and the arbitrary value of point.

In the notional accounts and defined contribution plans the future benefits depend directly on the value of contributions during the whole life. The two mentioned systems differ in the approaches to saving method. In case of DC accounts the capital is collected and invested by the institutions that hold this accounts. In case of NDC during working life the contributions and the interest charged to them exist only on the books of the managing institution. These liabilities are converted into the stream of pension payments at the time of retirement.

Before the 1999, the pension system rules in Poland were close to those of traditional systems on the European continent. It was a pay-as-you-go system, operating on the basis of a defined benefit formula. According to the forecast prepared in 1998, the pension system deficit would have been increasing on average by 1% GDP (about 8 billion PLN) every 10 years to reach over 2% of GDP in 2030 and nearly 4% in 2050. The main factor responsible for the projected acceleration of growth of the budget deficit was the ageing process.

According to demographic projections the huge increase in the number of retired and dramatically decreased fertility will lead to increase of old-age dependency[3] ratio from 18,6% in 2004 to over 50% in the 2050.

From the point of view of the politicians the situation on the labour market was also important. In the material published by the Office for the Pension Funds Supervision in 2002 the strong decrease of the inflow of contributions due to sharp rise of unemployment was also mentioned as reason for pension reform. Beside that the new pensions system was created as a motivation for people to search for a legal job and avoiding the "free rider" problem in the pension system.

On the other hand at the previous century DC systems with capital pillars became more and more popular because of the successful experiences of some countries. The important reasons for their popularity were also the examples of high rates of return from investment on global capital markets and opportunity to develop local capital market using funds from the private pension funds.

The old system, which was based on the defined benefit rule, was transformed into a system based on a defined contribution. The mandatory part of the system was divided into two parts: non-financial and financial. The former is managed by a public institution – Social Insurance Institution (ZUS), the latter – by private institutions, i.e. general pension fund societies. For each insured person in this system two accounts are kept. The first account (non-financial) is kept by ZUS, the other is kept in an open pension fund. The retirement age applicable so far has been preserved: 60 years of age for women and 65 for men.

Old-age pension contribution amounts to 19.52 per cent of gross wage and are payable in equal parts by the employer and by the employee. In the event of a member of an open pension fund, part of the contribution in the amount of 7.3 per cent of the wage is transferred by ZUS to the fund of member's choice. The mandatory system should be supplemented with voluntary saving in the framework of Employee Pension Plans and Individual Retirement Accounts, although this form of saving is still not very popular probably because of the insufficient tax incentives.

The contributions registered on the individual account of the insured with ZUS are indexed. The indexation can be considered as a sort of rate of return on pension savings. Indexation factor is equal to consumer price index increased by the real growth of the contribution revenue, measured on contribution due. Indexation cannot be lower than the

[3] European Commision(2006) Anex

Consumer Price Index. The funds transferred to the Open Pension Funds (OPF) are converted into settlement units. Their value depends on investment performance.

In 1999, people who were subject to insurance were divided into three groups:

1. those born before January 1, 1949, who retire according to the old pension system rules (defined benefit principle);
2. those born after December 31, 1948 and before January 1, 1969, who retire according to the new system rules (defined contribution principle), save that their pension rights acquired before the implementation of the new system were converted into initial capital, registered on the account with ZUS;
3. those born after December 31, 1968, who retire in accordance with the new rules and obligatorily have two accounts (full defined contribution principle).

The reform had impact on the general system's income due to the transfer of part of pension contributions to the OPF. Pensions financed from savings in OPF, will be paid out in the future, as people who are covered by the reform, will retire. The first old-age pensions in the new system will be paid out from 2009. Therefore, when assessing the new system, we can now rely only on the projections of the amounts of future benefits.

3. Microsimulation model

Difficulties in modelling the distribution of future pensions depend on the pension system. Knowing the rules of calculating the pensions it is relatively easy to calculate benefits for the individual under the assumption of certain input parameters[4]: wages, employment tenure etc. On the contrary the calculation of the distribution of benefits on the macro level is not easy and it requires assumptions and simplifications that allow the translation of rules created for the individuals on the level of total population. Such analysis usually requires using average values, analysis for the "average person", limiting the number of parameters, assuming the independence between variables etc.

The microsimulation model is different approach to that problem. In that kind of model the input parameters for the calculation of pensions could be simulated separately for each individual from the sample representative for the whole population. This type of modelling is efficient in complex problems with many interactions between variables and with continuous

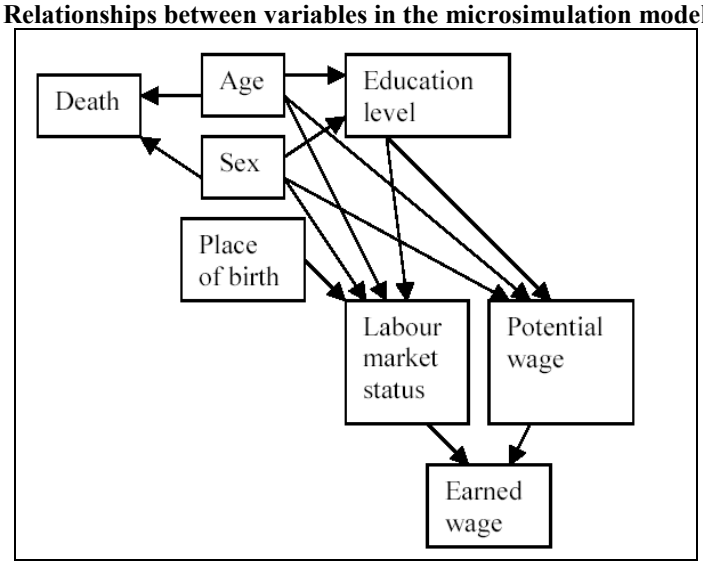
[4] In this part we don't touch the problem of the preparation of the assumptions for the simulation.

covariates[5]. Modelling of the pensions system is that type of problem. The microsimulation models are broadly used to such analysis[6]. However the complicated models require huge amount of data about the determinants of transitions that change the features of individuals.

The model used in this analysis could be classified as dynamic microsimulation model with discrete time (time unit is 1 year). It is a model with only some base features describing each individual. The minimalist approach used in this model is the result of the data limitations[7] but on the other hand it allows the model to avoid the "black box" problems and to be consistent with multistate projections that use the same input data[8].

The calculation of the pensions for each individual requires the information about employment and wages during the whole working life. In this model it is assumed that employment and wages depend on age, sex, education and place of birth. However the interactions between different variables are modelled as well (Figure 1).

Figure 1
Relationships between variables in the microsimulation model



Source: Own model

The unit of analysis is an individual that is characterized by:

[5] Imhoff (1998)
[6] There are many microsimulation models used in projections of the different aspects of pension systems, for example: MOSART (developed by Statistics Norway), PENSIM (US Department of Labour), SVERIGE (Sweden).
[7] The parameters of the model were estimated on the LFS database. The reliable estimation of the probabilities of events during the lifecycle requires the longitudinal data sources. LFS is only a quasi panel data that is why instead of the estimates of probabilities for the cohorts the so called "artificial cohort" approach was used. This approach leads to the assumption that there will be no cohort effects in the future.
[8] This approach to microsimulation is developed in the MicMac project in NIDI

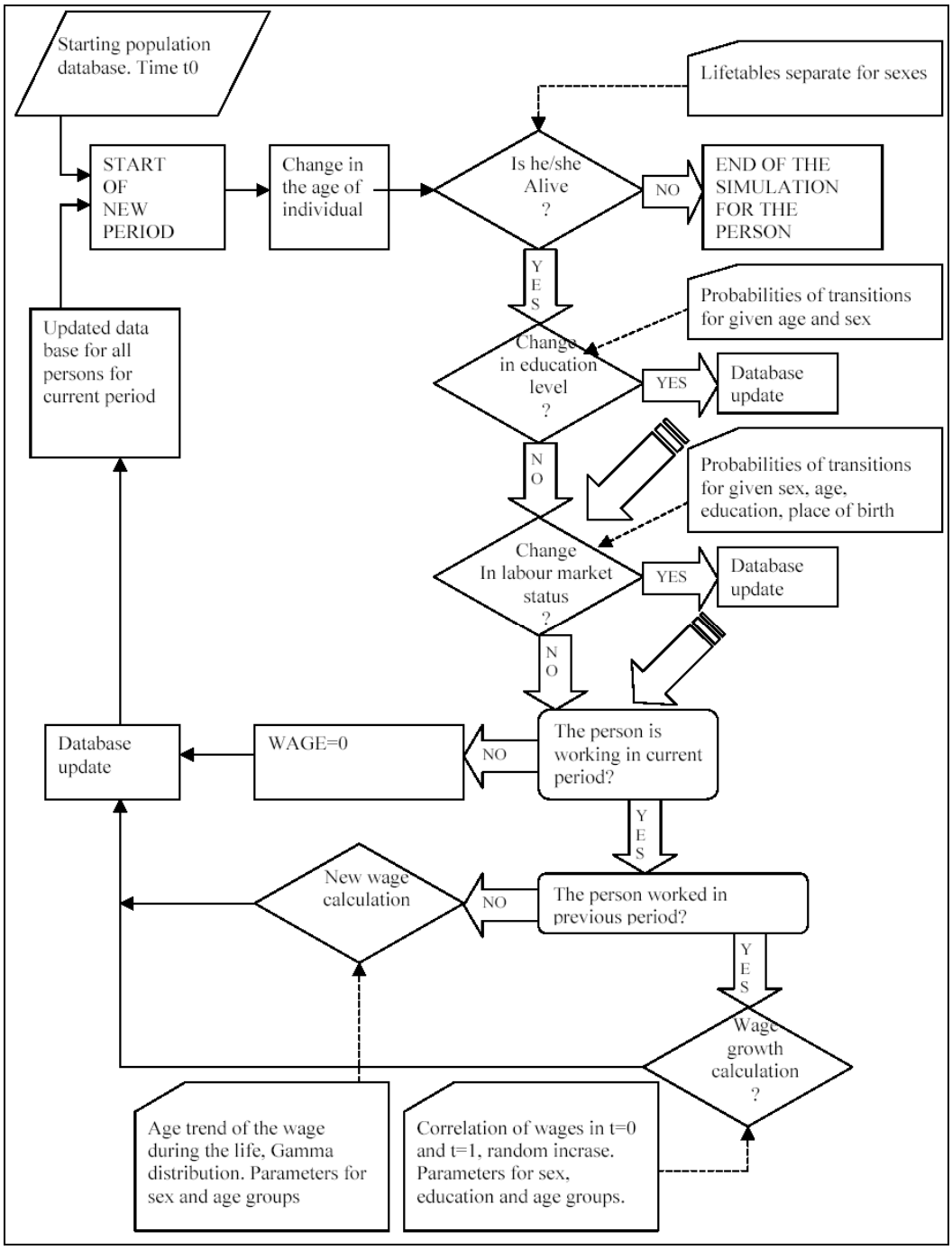
- Gender (male, female),
- age (in years),
- completed education level (primary, basic vocational, secondary, tertiary),
- place of living (urban, rural),
- labour market status (employed, unemployed, non-active),
- wages (if employed).

The features that could change during the time are: age, education level, labour market status and wage. The probabilities of transitions between the states are determined by multinomial logit models estimated in the sex and age groups with dependent variables of education level and place of birth. The wages in new jobs and the wage growth are derived from statistical distributions best fitted to the empirical distributions of those variables in groups defined by education and gender. The influence of age on the wage is modeled by the second order polynomial trend. The outline of the procedure of modeling is presented at the figure 2.

The starting population is the cohort of persons borne in 1980 who were surveyed in the LFS in 2001. The starting time for the simulation is the year 2000. In the year 2000 they have 20 years so it could be assumed that their pensions will depend on the contributions from wages that they earn during the period of simulation. Because of the lack of the data concerning the wages and employment of the whole cohort the so called “artificial cohort” assumption is adopted. It means that the simulated cohort is assumed to follow the cross-section patterns estimated for the years 2000-2003. Simulation is also made under the assumption that all parameters are constant during the time of simulation. This assumption implies many assumptions that could not be altered by the changes on the labor market, for example it imply the assumption of unemployment rate and participation rate from the year 2003.

Figure 2

Outline of the procedure of simulation



Source: own model

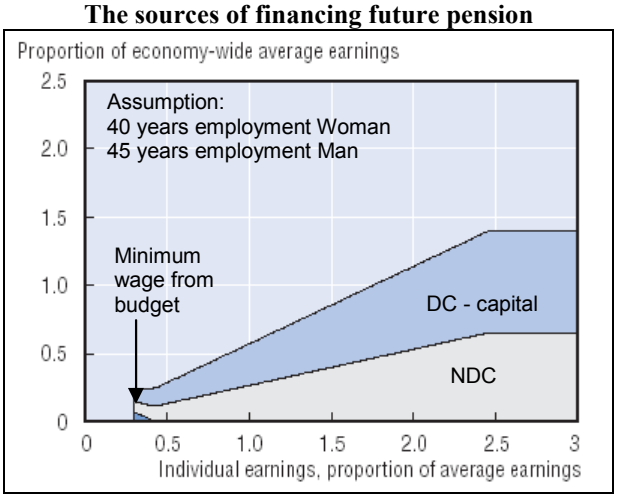
Beside the assumptions connected with the transition rules, the following assumptions concerning the endogenous variable are used: real wage growth – 2%, rate of return from the NDC and DC pension system 2%. These assumptions are close to the assumptions used in the OECD simulation. In the simulation the mortality changes during the period 2000-2050 were

included. The life table's adjustment followed the scenario proposed in EUROPOP2004 projection prepared by EUROSTAT.

4. Pensions of the low-skilled workers

The problem of the estimation of the future costs of the minimum pension in Poland is still open. According to the simulation made by OECD the share of the minimum pension benefits in the total pension payment should be. (Figure 3).

Figure 3
The relation between average earnings during the life period and the value of future pension. The sources of financing future pension

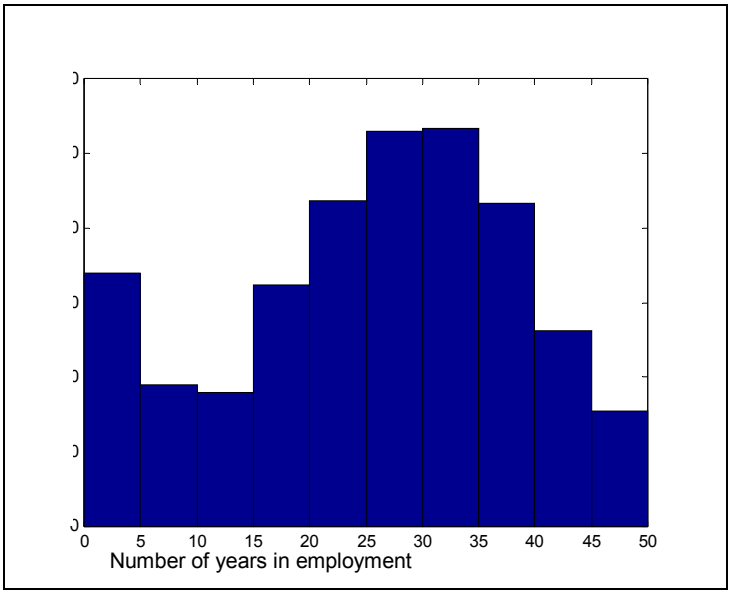


Source: OECD (2005)

However this calculation was made under the assumptions of uninterrupted period of work between the age 20 and the retirement age. It means that women will work for 40 years and men for 45 during the whole working life. This simplified assumption was made in the OECD report in order to achieve comparability of he results among all OECD countries. In the reality this assumption is not fulfilled because a part of the time of average life is connected with non-participation or unemployment. In the case of polish economy it is particularly unreliable due to very low participation and high unemployment rate. Although these indicators will probably change in the future it is hard to assume that each member of the whole population will work over 40 years without the increase of the retirement age. The results of the microsimulation model shows that under the assumptions of no change of the labour market indicators from the year 2002 the average period of employment for the 1980 cohort the number of years of work during the whole life can be close to 30 years for women

and 35 years for men. However individuals in the simulation differ in terms of the number of years in employment between the age of 20 and 70. (Figure 4).

Figure 4
Distribution of the number of years in employment between the age 20 and 70
Result of one run of the microsimulation model

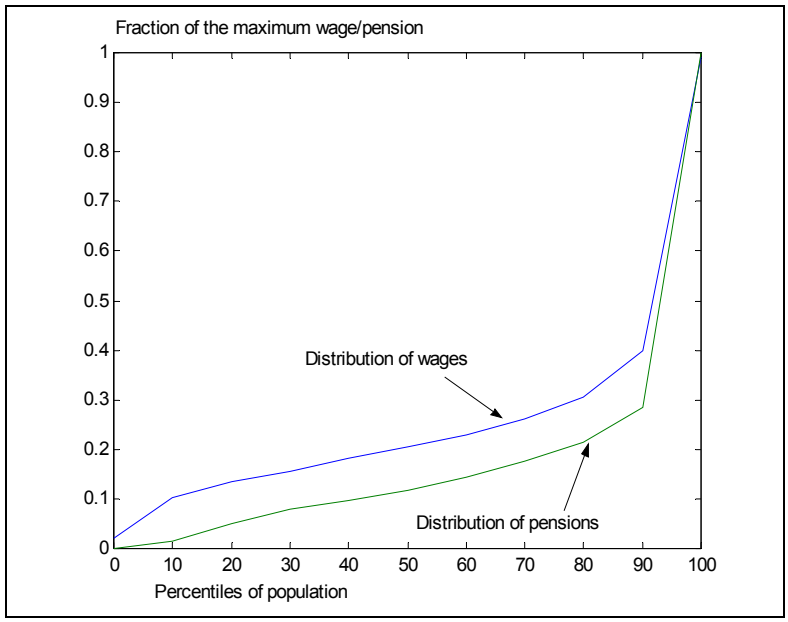


Source: own calculations

According to the simulation results about 23% of persons who were alive in the age of 20 were employed for the less than 15 years in the next 50 analyzed years. The percentage of employed under 15 years dropped to 19% only those persons who were still alive in the age of 70 were taken into consideration. The diversification of the duration of employment during the whole working life would influence significantly the value of the pension from the obligatory DC system. As a confirmation the simulation show that distribution of the pensions which is the mixture of the distributions of wages and employment duration will be more diversified than the distribution of wages in the age 50. (Figure 5).

This result is quite robust despite the fact that the annul sum of pension contribution to the public system is upwards limited (contribution ceiling) and this should decrease the diversification of pensions.

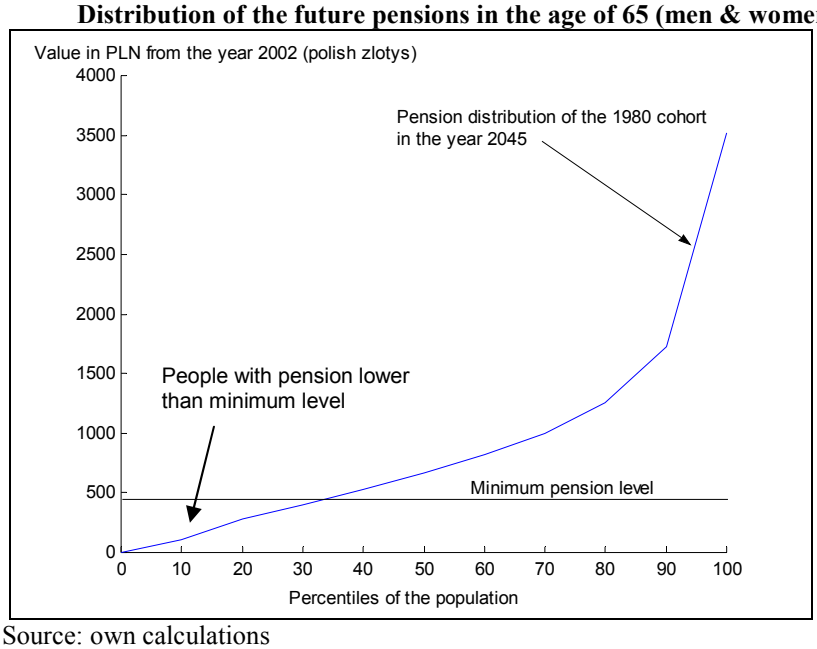
Figure 5
Comparison of the distribution of future pensions and wages in the age of 50 (men & women)
Result of one run of microsimulation model



Source: own calculations

Finally the distribution of pensions support the expectations that in most cases the capital accumulated during the whole working life divided by the life-expectancy[9] in months will be lower than the average wages during the life period (replacement rate).

Figure 6
Distribution of the future pensions in the age of 65 (men & women)



Source: own calculations

[9] In the recent draft simulation the life expectancies were taken from the separate tables for women and men. Life expectancy in the age 60 is now about 5 years longer for woman than for men, by the year 2050 this gap is expecting to decease to about 3 years. In the new polish system it is however assumed that the benefits should be calculated using so called uni-sex life tables but until now this type of life tables have been calculated only for some past years and there are no projections of the them into the future. This assumption in the simulation significantly influence the results additionally decreasing the pensions of women.

The results of the simulation of the pension's distribution (discounted for the year 2002) shows that the value of over 30% of pensions could be lower then the value of minimum pension from the year 2002 (Figure 6).

This result should be treated carefully as it is a product of strong assumptions. Calculating the pension under the assumption of the different life expectancies for women and men additionally worsen the situation of women, who in comparison to men have on average lower wages and shorter employment histories. However it shows that under the certain conditions the share of people who will require the help from the state could be significant.

Using the microsimulation model it is quite easy to identify the groups most expose on the risk of very low pension. The risk is strongly bound with the length of the employment during the working life and wages. What is more important the education level achieved before the 26 year of life use to strongly influence future labour market performance. Higher education is usually connected with high probability of employment and significantly higher wages. This results in very low probability of insufficient pension of men and relatively low of women with tertiary education. On the other hand the persons with less then secondary education (low-skilled) have a significantly higher probability of collecting too less capital for their retirement. It is especially the problem of low-skilled women for whom the wage could be often too low to attract them to participate on the labour market.

Table 1.
Results of the simulation of pensions by sex and education level (one run of the simulation)

Sex	Education level in the age of 25	Average years in employment between the age 20 and 65	Average wage (proportion of average earnings)	Average pension (proportion of average earnings in the economy)	Share of minimum pension (%)
Male					
	Tertiary	37.8	2.27	1.20	3%
	Secondary	30.6	1.34	0.84	8%
	Basic Vocational	27.5	1.18	0.73	23%
	Primary	27.4	0.61	- *	-*
Female					
	Tertiary	29.1	1.63	0.55	20.3%
	Secondary	23.5	0.87	0.38	39.0%
	Basic Vocational	20.5	0.70	0.29	55.8%
	Primary	16.2	0.52	-*	-*

*too small sample
Source: own calculations

5. Conclusion

The DC system introduces the clear partitioning of the two main aims of the pension system: assurance of the adequacy of benefits to the contributions and the redistribution due to prevent the destitution in old age. The analysis of the influence of the ageing process on the pension system expenditure prepared for Poland usually underlined the advantages of the moving responsibility for the future pensions to people and diminished the fact that the additional burden on the public finances will be caused by the necessary redistribution of wealth to poor pensioners. The size of the estimates of the additional expenditures from the state budget vary greatly on the assumptions. However it should be taken into considertion that future pension wealth and expenditure seem to be determined by far more complex processes than presented in analysis published so far. The future burden will depend mainly on the changes in the labour market: participation rates, employment rates, the wage differential, human capital, the share of shadow economy and the process of return of migrants and their pension entitlement in other countries. These changes are not independent and it is difficult to model them using standard macro-level models.

This paper is the attempt to use the microsimulation in dynamic modelling of the polish population. The results should be considered as a projection (conditional forecast), because of the data limitations and strong assumptions regarding the development of the economy. Draft results of the this projection shows that under the assumptions, which can be described as constant scenario of the economic indicators, the share of the beneficiaries of minimum pension among the all future pensioners could be significant. This result suggest that in the future further reforms could be needed to prevent the state expenditures from increasing as a result of ageing. The most efficient seems to be the increase of the retirement age with a guarantee of minimum pension and the labour market policies targeted to increase the participation of low-skilled people.

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