

Solving the annuitisation problem in the Polish pension reform

by

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The Polish pension reform has started in 1999. Despite the fact, that it was preceded by a 9 year discussion, the reform seems to have been introduced in a rush. The most glaring example is the lack of information technology to serve the individual contribution accounts, which results in an enormous delay in the transfer of the contributions from the Social Security Institution (ZUS) to the open pension funds (OPFs).

There is also another aspect of the incompleteness of the reform. In 1999 only the first part of the system, called the second pillar, has been introduced. OPFs are solely companies collecting and investing the contributions on behalf of the individual members. They do not offer any pensions nor promise any benefit formula. Their final task is to transfer an individual pension asset to life annuity company (LAC), chosen by the member at the moment of retirement.

The problem is, however, that till now there is no Life Annuity Act, determining the constitution of the LAC and the benefits to be offered to the pensioners in exchange of the transferred assets. This means, that around 9 millions of Poles enthusiastically (and most of them voluntarily) joined a pension system, which is undefined concerning not only details, but also basic issues.

In our paper we concentrate on two principal problems of the nonexistent part of the pension system. The first one is the financial system of the LAC. We focus on the question, how the LAC, a private for-profit company should preserve a long-term solvency providing annuities on the competitive market. The problem of regulation is an important aspect to be discussed in the context of the financial system. The second question is the issue with a heavy political bias: should the second pillar pension distinguish gender of the beneficiary? There is a strong pressure to extend the solution of the first pillar (the ZUS system) and not to distinguish the sex. However, the question arises how the competitive annuity market can function if we repress the risk factor, which is not only very important but also very apparent. In addition to gender we tackle two main options considered to be offered at the moment of retirement: single or joint life annuity, and the option of guaranteed payment period.

1. A brief outline of the Pension Reform 1999

In Poland the core pension system, containing all non-agriculture activity, is administered by the Social Security Institution ZUS. The ZUS system covers ca. 12 million contributors and 8 million pensioners.

Prior to 1999 the ZUS system consisted of few separate subsystems, but from the viewpoint of the individual member it was a one-pillar system with one exclusive pension benefit. The pure PAYG system promised participants a bundle of benefits for the total contribution of 36.73%¹. The contribution has been not split into specific benefits (old-age and invalidity pensions, sickness leaves, maternity benefits, etc.) . An old-age pension, the main benefit in this bundle, was determined by the formula:

$$Pension(t) = \max \left\{ \begin{array}{l} 0.2232 + \{0.013 \cdot CY + 0.007 \cdot \max[NCY; 0.3 \cdot (CY + NCY)]\} \cdot \min[IWF; 2.5] \\ 0.39 \cdot NAE \end{array} \right\} \cdot NAE(t)$$

where: NAE(*t*) national average wage in the year *t*,
 CY number of contributions years
 NCY number of non-contribution years
 IWF individual wage factor, averaging best 10 years of the last 20 years before retirement, wages related to their current NAE.

The pension formula had a constant term and the benefit was positively affected by the seniority and the wages in the last period. The IWF factor is kept constant through the retirement, but the consecutive updates of NAE provided the indexation of pensions. There was an upper limit for benefits but no limit for contributions. The replacement ratio was relatively high - ca. 75% for a person with 40 contribution years and permanent wage at the level of NAE in the last phase of career.

The 1999 reform introduced, as a final solution, the three-pillar system:

- first pillar: mandatory, PAYG, administered by state (ZUS),
- second pillar: mandatory, fully funded, private administration,
- third pillar: voluntary, fully funded, private administration (tax preferences for private life insurance and company pension plans).

Till now there is no tax relief for the third pillar. However contributions to company pension plans up to 7% of wage are exempt from ZUS contributions.

Following eligibility rules for the participation in the second pillar have been set up:

- those who were born before 1949: mandatory first pillar with the old benefit formula: no entrance to the second pillar,
- those who were born between 1949 and 1969: mandatory first pillar with the new benefit formula: voluntary entrance to the second pillar,
- those who were born after 1969: mandatory first pillar with the new benefit formula: mandatory entrance to the second pillar.

Nominally the total rate of the social insurance contribution didn't change, but practically the contribution burden for high-earners dropped, after the upper limit for contributions (at the

¹ Contribution rate was nominally 45%, paid by the employer from the pre-tax salaries. This is an equivalent of 36,73% in the current system, in which an employer and employee share contribution in two equal parts and the contribution is related to pre-tax salary + employee's contribution.

level of 250% of NAE) had been imposed. The contribution has been split into specific programs as follows:

Social insurance programs	prior to 1999	1999 reform		
		total	employer	employee
All social insurance programs	36.73%*	35.37%- 43.09%	16.66%- 24.38%	18.71%
Maternity and sickness leaves		2.45%		2.45%
Work accident insurance		0.4%- 8.12%	0.4%- 8.12%	
Disability pensions		13%	6.5%	6.5%
Old age pensions		19.52%	9.76%	9.76%
there of**:				
first pillar (ZUS)		12.22%		
second pillar (OPFs)		7.3%		

*)equivalent rate, see footnote on the previous page.

**) those who are solely in the first pillar pay 19.52%

The new pension formula in the first pillar strengthens incentives to contribute to the system, allows for flexible retirement age with incentive for postponing the retirement and reduces the redistribution (eliminates the constant factor and keeps the minimum pension guarantee). For the life (x) getting retired in year t

$$Pension_x(t) = \max \left\{ \frac{CAF_x(t)}{e_x}; 0.29 \cdot NAE(t) \right\}$$

where $CAF_x(t) = c(t) \cdot \min[IW_x(t); 2.5 \cdot NAE(t)] + \frac{NAE(t)}{NAE(t-1)} \cdot CAF_{x-1}(t-1)$ is the

contribution accrual function, cumulating contributions through the whole career with the interest rate equal to the wage growth rate, $c(t)$ is the pension contribution rate in the first pillar and IW is the individual wage,

e_x expected future life time for a person at age x , e_x does not distinguish gender.

The new formula is obligatory for all contributors born after 1949, regardless on their membership to the second pillar. The initial amount of CAF is distributed to them as an equivalent of their pension entitlement in the old system.

The treatment of contributors is much more fair under the new formula, however the actuarially unfair treatment of males and females still remains. Pensions in the new ZUS system should be indexed by CPI.

To conclude, the main, long-term, objectives of the 1999 reform were:

- to reduce the scope of state pension scheme financed by PAYG method,
- to transfer a part of liabilities to the second, fully funded, pillar,
- to increase the actuarial fairness and to strengthen incentives in the pension system
- to motivate savings in the second and third pillar.

Apart from many technical problems the starting phase of the reform was very successful. Twenty Open Pension Funds (OPFs) emerged and attracted ca. 9 million members, almost all eligible to enter the second pillar. OPFs are investment funds providing the investment facilities for the pension system, but OPFs are not allowed to offer any pension benefits. At

the moment of retirement they have to transfer the asset to the separate institution of the second pillar, namely the Life Annuity Company (LAC).

2. The financial system of the Life Annuity Company (LAC)

The LAC's financial system is one of the major issues that need to be settled. A good solution is one that ensures the following:

- financial solvency, that is a high probability of the LAC being able to meet the liabilities fixed in the pension contract,
- profitability, which means, that the probability of the LAC achieving profits in the long run is acceptable for investors,
- flexibility, which makes it possible for the LAC to compete for pensioners and to take into consideration their own risk assessment.

There are different ways to put the above objectives in order according to their significance (i.e. the most important is financial solvency), but none of them should dominate too much. We are looking for a safe system, within which the freedom to enter into a pension agreement is restricted by an act, and the liability valuation, and as a consequence, also the financial result, are influenced by the Supervising Authority. But to bring LACs into existence, investors, who are expected to lay out enormous amounts of capital sufficient to cover the solvency margin, must be convinced of this investment's profitability. The profitability cannot depend only on the level of statutory control parameters (there is no guaranty, that their future level will be as favourable as it is now). There has to be a mechanism that makes it possible for LACs to adjust control parameters on their own risk. LACs have to be able to gain a bigger market share when their assessment of the situation is correct, or to loose (up to bankruptcy) if they turn out to be too optimistic or too pessimistic in their evaluations. The system's soundness means that there have to be high bankruptcy standards, so that taking over the bankrupt's liability portfolio is attractive for other market players.

Despite the lack of a Life Annuity Act some milestones have been already reached in the ongoing discussion on the pension reform. One of them is the strong conviction that the LAC should exclusively deal with the annuities for the second pillar of pensions and should not be engaged in any other activity on the insurance market. This strengthens, for sure, the financial transparency of the LAC, but on the other hand reduces the possibility to set off the demographical risk attached to pensions with other products, which gain from growing life duration. So we regard the problem as pre-decided and assume that the LAC confine itself exclusively to annuities for the second pillar of pension.

One of the difficulties connected with designing the LACs' financial system is the politicians' tendency to implement the same solutions that have been used for the OPFs. But this is possible only to a certain extent, because of the fundamental differences between products offered by LACs and OPFs.

The product offered by OPF is a saving product, for which there is no actuarial risk (associated with OPF members' mortality). OPF bears only a small share in the investment risk. Similar to investment funds, members of OPF incur a lion's share of all risk and OPF is left only with the risk of getting worse than average investment revenues and losing members, which could worsen the economy of scale.

On the other hand products offered by LACs are constructed in a way that LACs bear most of the long-term risk of technical interest rate and the risk resulting from the guarantee to index pensions by the inflation rate. LACs also incur the typical actuarial risk that occurs when the real mortality process of beneficiaries deviates from the expected mortality process which is taken as the base for calculating rates and reserves.

In the next part we describe further details of LAC's financial system. When analyzing the LAC finance we allow for some simplifications, that do not affect significantly the problem of financial system construction.

2.1. Sources of LAC income

There are three ways how LACs can generate the necessary sources for financing the costs and making profits:

- commissions from pensioners,
- share in the technical gains from investment of the pension reserves,
- revenues from investment of own assets.

The last source is the only one that is not controversial whatsoever. It is obvious, that investment of own assets cannot be the only source of a LAC's income. What is more, because of the LAC's nominal income taxation, it might even not be enough to regenerate the real value of own assets required to cover the solvency margin. We will return to this particular problem later on.

2.1.1. Commissions from pensioners

There are a few ways of charging commissions. We will single out three of them:

- single commission charged from the transfer sum in the moment of entering into the pension agreement,
- monthly commission charged from the pension benefit,
- periodical commission charged (monthly, annually) from the current pension reserve.

In spite of the different ways of charging, the aforementioned methods have one thing in common: the commission percentage rates are agreed upon before entering into the contract and remain unchanged. Since the commission rates are established at the same moment and based on the same assumptions about the future, the LAC can define its desired commission rate and then find out an actuarial equivalent rate for each commission type (we think of a prospective equivalence, because ex post it will turn out, that a given commission system would be less or more profitable).

The choice of a commission system is a rather technical, than content-related matter. From the beneficiary's point of view a single commission charged from the transfer sum is the most transparent way of payment. In this case the LAC has to create a reserve for future administrative costs, so that it is not possible for the company to consume all the collected commissions in the first year or years. The main disadvantage of this method is its insensitivity to investment efficiency. On the other hand it is desirable that the LAC's actuarial assumptions are conservative (including those applying to the interest rate), so that fulfilling them should be quite easy. The conservatism of assumptions means a high liability

assessment in the moment of issuing the pension policy and results in low pension rates for one unit of the transfer sum. This makes it necessary to give LACs incentives to take investment risk after the contract has been fixed and exceed low investment targets. The single commission can be used, if the LAC has a share in the profits generated by investing the pension fund's reserves.

The monthly commission charged from the pension benefit is very similar to the previous one – it is a single commission actuarially divided between the pension payments. This makes it also very simple and transparent for the beneficiaries, and there is no need to create an administrative costs reserve (the pension fund's reserve includes the “gross” benefit with commission). Since this kind of commission is derived from the current value of the benefit, it reflects the benefit valorization effects resulting from investment bonuses. This relationship is not strong enough for this source of LAC's income to eliminate the need of the LAC to have a share in the profits generated by investing the pension fund's reserves.

The periodical commission charged (monthly, annually) from the current pension reserve gives incentives for efficient investments (although incentives to increase the portfolio of pensioners are even stronger) and secures a continuous supply of sources necessary to cover the administrative costs. The main disadvantage of this method is the strong asymmetry of the sources inflow from a single contract: it reaches its maximum when the contract is signed and continues to decrease afterwards. On the contrary, the administrative costs connected with a pension contract are evenly divided between the contract duration. The LAC can go round this problem by making sure, it has a continuous inflow of new entrants, that ensures reserve stability. If new pensioners stop to flow in, the LAC is bound to have problems with financing its costs and its liability portfolio will become less transferable. In fact, even if new contract inflow is continuous, this kind of commission should be accompanied by an administrative cost reserve, which would protect against a fall in the profitability if the pension portfolio is getting matured or is aging up.

We have to keep in mind, that the commission methods used in an OPF, can work out worse if applied to a LAC, because of the different resource profile of a single contract (in a OPF resources are growing as long as the contract is valid and it can be instantly reduced to zero, if a member is not satisfied and decides to move his resources to another OPF).

The disadvantage of the periodical commission from the current pension reserve is not being transparent for beneficiaries – it could be very difficult for them to assess its costs. The equivalent of a 5% single commission from the transfer sum is a 5% commission from the pension benefits or a 0.6% annual commission from the current pension reserve. The last result of this equivalence is not very straightforward and that's why the effective cost of this type of commission is not very clear.

Keeping all this in mind, we can draw 2 main conclusions:

1. If for various reasons a commission should be the only, apart from revenues from own assets investments, income that the LAC has got, then the best commission system is a commission from the pension reserve combined with a commission from the pension benefit
2. If we allow LACs for taking a share in the technical profits from pension reserve investments, then the commission charged from pension payments should be chosen, because it is the most transparent.

In the next part we discuss the reasons for LACs having a share in the technical profits from pension reserve investments, thus we can opt for a fixed percentage commission charged from the pension benefits as being the best.

2.1.2. Share in the profits from pension reserve investments

It is possible to allow for the commission to be the only, apart from revenue from own assets, source of LAC's income if the cost of fulfilling the contract is deterministic. Because this assumption doesn't hold in reality, and what's more the main risks, that is demographic and financial risks are exogenous for the LAC, there has to be a mechanism of compensating technical losses with technical profits. It is not a sound situation if the LAC is only responsible for losses, but has no share in the profits. In this case LACs would pass the whole risk on the beneficiaries adopting extremely conservative actuarial assumptions.

In the projected system conservative actuarial assumptions are desired and should be represented by the Supervising Authority (SA). Conservative parameters should ensure a sound valuation of 1 zloty pension promised by the LAC. LACs ought to have the possibility to adjust SA's assumptions both in plus and in minus, that is to offer in their contracts less or more zlotys for each 1000 zlotys of the transfer sum. This sort of adjustment should result immediately in losses in the case of optimism (offering a higher pension for each 1000 zlotys transfer sum). If the optimism turns out to be realistic, the losses will be compensated by future technical profits. The SA controls the coverage of the solvency margin and will not allow for a situation, when the LAC's optimism could endanger the benefits.

The LAC's share in the profits from pension reserve investments is a precondition for the company's flexibility. First, LACs can compete with each other by transparent criterions (monthly pension rates for each 1000 zlotys of the transfer sum) and they don't have to resort to determinism (risk reduction through extremely conservative actuarial assumptions), which could weaken incentives for pension reserve investments. Second, this solution prevents politicians from having a too rigorous attitude towards commission rates (they could tend to put an upper limit on commission rates). In a system, where LACs have no share in the technical profits, it could happen that LACs wouldn't even come to existence, because of the differences in profitability assessment between the politicians and investors. In a system that allows LACs for sharing the profits, the policymaker's ideas about the optimal commission level, can be corrected by choosing the right conservatism level.

We conclude, that LAC's share in the technical profits from pension reserve investments is an essential component of the company's financial system and we opt for a constant statutory profit-participation rate. This problem needs separate calculation, but as for now we can assume that the beneficiaries get 75% and the LAC gets 25% of the technical profit.

It is noteworthy, that participation rate (i.e. 25% or 20%) is not a fundamental issue. The commission rate, participation rate, conservatism of actuarial parameters regulated by the SA and own conservatism are interrelated and they will compensate each other on a transparent, competitive market. A higher participation rate will induce the LAC to decrease commission rates or to become more optimistic in its assumptions.

In the next part we will examine the mechanism of pension fund's reserve investment profits participation and analyze its components.

2.2. Regulated actuarial parameters

Some of the actuarial parameters have to be settled by the Supervising Authority or by the State Actuary. This holds for the following:

- technical interest rate
- mortality tables in a cross section of risk factors allowed by the law to differentiate the pension tariffs (age, gender)

The technical interest rate respects the fact, that the pension contract guarantees a compensation for the inflation rate. This means, that the technical interest rate reflects the real discount rate in the reserve calculation.

The SA, who regulates the actuarial parameters, represents a conservative attitude, which means that the overestimation of reserves is much more probable than their underestimation. As a result the SA tends to underrate the interest rate and to assume a higher average life expectancy.

The SA has to update the regulated parameters as it gets new crucial information, but at least once a year. The SA shouldn't surprise LACs with enormous, cumulated over time changes. Therefore the SA should have access to the LAC's information about the observed mortality in a cross section of age and gender and also to the source data, that are used by National Statistical Office (NSO) to create the life expectancy tables. The SA must have the possibility to build its own tables, more adequate in this case than the tables published by NSO.

2.3. The pension fund reserve

The pension reserve is calculated for a given moment. It equals the actuarial present value of all pension liabilities resulting from all valid pension contracts and taking into consideration the current level of benefits. The reserve is calculated in a prospective way based on parameters regulated by the SA.

The pension reserve estimates the total liability of the LAC. The reserve is prospective, which means that the current valuation of the liability does not depend on its previous level, but solely on present information concerning current and future liabilities.

The LAC calculates the reserve for the whole portfolio each month. When a pension contract is signed after the day of the last reserve calculation, the individually calculated reserve for this contract is added to the portfolio's reserve. Therefore every new contract will immediately increase the LAC's liabilities. The new liability is independent of the transfer sum, but does depend on the pension rate offered to the entrant by the LAC, and on actuarial parameters settled by the SA. It may happen, that the initial liability exceeds the transfer sum: the LAC starts the new contract with a loss hoping for future technical profits.

We will illustrate the pension liabilities valuation mechanism by examining a simple example.

Example

Let's consider a pension contract, that specifies an individual annuity (without any guaranteed payment period) for a 65 year old man, who has a transfer sum of PLN 100 000. All companies charge a 5% commission of the benefit and have a 25% share in technical profit.

The SA sets the technical interest rate at 1%. It also publishes mortality tables, which show that the expected lifetime for this man is 14.4 years. We assume, that this demonstrates a conservative attitude of the state actuary since the NSO's mortality tables set this parameter at 13.4 years.

If a given LAC uses the SA's parameters to calculate the pension rates, it should offer this man a monthly gross pension (before the commission is deducted) of PLN 6.55, that is PLN 6.22 net benefit (after the commission was deducted) for each PLN 1000 of the transfer sum. The man from our example can buy a monthly pension of PLN 622. This is the initial amount that will grow with inflation and might be increased by investment bonuses resulting from the 75% share in technical profits. When the contract is signed, the LAC will get a revenue of PLN 100 000 and will bear the cost of creating a PLN 100 000 pension reserve. In the following year the LAC will pay out from the reserve 12 monthly pensions to the beneficiary and 12 monthly commission rates of PLN 33 to itself. After this year the reserve will decrease by PLN 7860 and increase by the amount of revenues from asset investments. It is very probable that when this year is over, after the inflation indexation of the pension, the new calculated prospective pension fund reserve will be smaller, than the retrospective reserve (that is 92 140 plus investment revenues). Thus with a high probability the LAC will make a technical profit and increase its commission income by a further amount.

Let's assume, that another LAC considers the SA's parameters to be too conservative and thinks that a 2% technical rate is still safe enough. This company will offer a monthly gross pension of 7.15 that is 6.79 after the commission was deducted for each PLN 1000 of the transfer sum. When the contract is signed, the LAC will get a 100 000 transfer sum and will bear the cost of creating a PLN 109 160 pension reserve. It will incur an instant loss that will decrease its own capital and the solvency margin coverage level. Further reasoning is analogous. The LAC will pay out slightly higher pensions and take slightly higher commissions, but its chances to make a technical profit are the same as the other LAC's if it invests in the same way and has to face the same population of beneficiaries. A PLN 100 000 reserve related to a benefit of 622 is as safe as a PLN 109 160 reserve related to a benefit of 679 zł. The additional risk of the second LAC is capitalized immediately in the moment of entering into the agreement and from this time all contracts are valued on standard conditions.

The difference between the two LACs is not a difference in the reserve soundness, but in the risk, that the incurred expenditures won't pay out. The second LAC starts off from a worse position, because its initial expenditures are by PLN 9 124 higher. For this investment to pay out, the second LAC needs to invest more efficiently, have a "better" population of beneficiaries or reach returns to scale on the operational costs.

The pension fund reserve, like all other insurance reserves, has to be invested in qualified assets. Because pension insurance is obligatory, the investment restrictions shouldn't be weaker than those provided in the act for insurance companies.

LACs should have the possibility to use financial reinsurance, to protect themselves from the consequences of a reserve increase brought about by a change in the controlled actuarial parameters. This helps to limit the negative effects of the state actuary mistakes. Reinsurance is also of great importance to the SA: an attentive observation of the reinsurance contracts valuation shows, how the domestic and international insurance markets assess the SA's conservatism. Thanks to reinsurance the mechanism of instant risk valuation becomes complete. If the LAC is more optimistic than the SA, it has to bear immediately the costs of a higher pension reserve. All contracts on the market are valued in relation to the state actuary's attitude. If it turns out to be too optimistic, LAC can be not sufficiently prepared for such a mistake. In fact this readiness to absorb the SA's mistakes is constrained by the solvency margin level. Imposing a too high level of the solvency margin, could discourage investors from joining LACs. A much cheaper and not less effective solution is to reinsure the risk of a change in parameters regulated by the SA.

2.4. Technical profit from pension reserve investment

The technical profit from pension reserve investment is calculated once a year, on the last day. The technical profit equals the sum of the following components:

- + the prospective reserve at the beginning of the year
- + prospective reserves for all new contracts signed during the year, calculated in the moment of signing
- + revenues from asset investments calculated for the given year, in accordance with the daily level of assets,
- benefits paid out during the year,
- commissions due to the LAC according to the commission rates provided for in the contract
- the prospective reserve at the end of the year taking into consideration this year's inflation indexation of benefits

If the calculated amount is positive, a technical profit has been achieved. A negative value means a technical loss. The technical profit is divided between beneficiaries and the LAC according to the statutory profit share rate. The technical loss is not divided and the whole amount is charged from the LAC's current revenue account.

2.4.1. The division of the technical profit from pension reserve investment

The LACs share in the technical profit is added to the LAC's current revenue account. The pensioners' share is divided between them proportionately to their individual reserves at the end of the year. If a contract was signed during this year, the length of the period it was valid is also taken into consideration.

The investment bonus calculated for a given beneficiary, can be used in two different ways:

- as a single payment, possibly divided into twelve monthly payments,
- as an increase in benefit valid through the whole contract duration.

The first solution seems to be simpler. The investment bonus does not increase the reserve calculated at the end of the year (taking into consideration the inflation indexation), but is paid to the beneficiaries (in a single or twelve monthly payments). The main disadvantage of this method is the strong asymmetry of bonuses paid during the contract validity period: initial payments are high, then they become lower. In the aforementioned example a three-percentage-point investment bonus would result in a payment equal to 40% of an annual benefit in the second contract year. This bonus would fall to a few percent of an annual benefit in the next years.

The second solution divides each year's bonus evenly between the (statically expected) rest of the beneficiary's life. The bonus increases the pension fund reserve (after correction for the inflation rate), and the growth rate of an individual reserve determines the growth rate of the individual benefit. Therefore at the turn of the year the benefit increases because of inflation and in the next moment (a moment necessary to calculate and divide the technical profit) it increases again due to the technical profit. The new benefit level is valid until the next benefit in plus correction happens, and cannot become reduced in the future.

It may seem, that a permanent benefit increase is a less safe way of using one's share in technical profits, because it affects the future. But in fact there is no difference between changing the investment bonus into a permanent benefit in the t -th year and changing the transfer sum into benefits in the new contracts signed in the t -th year. In both cases the risk is similar, because the same parameters (regulated by a conservative SA) are used.

For the above reasons we opt for converting the technical profit into a permanent benefit increase.

2.4.2. Technical losses compensation reserve

It is not easy to reconcile the system's efficiency and soundness. A balanced compromise can be reached when a game between the conservative SA and the more risk-loving (or forced to taking risk by the competition) LAC ensues. The crucial feature of the described financial system is the fact, that the LAC can have a lower risk aversion than the conservative SA, but the company has to capitalize instantly this additional risk with respect to the relatively high risk valuation given by the SA. Therefore if a LAC wants to offer a benefit above the SA's norms it has to incur an initial loss expecting its future compensation.

The LAC's share in the technical profit is designed to compensate initial losses. But the process of loss compensation is slow because of the asymmetry between technical losses and profits. If the LAC has a PLN 100 loss, the whole amount is charged from its income. On the other hand from a PLN 100 technical profit, the LAC gets only a gross income of PLN 25 (if we assume, like in the earlier example, that the LAC's share in profits is 25%) and equivalently a net income of PLN 17.5. This means, that a PLN 1 loss needs to be compensated by as much as PLN 5.71 technical profit (without taking into consideration the discount rate, that would reflect the fact, that the loss occurs earlier than the profit). The main reason behind this disproportion is the fully justified fact, that pensioners are privileged not to share technical losses. The different taxation status of losses and profits is also of some significance - it means, that LAC can reduce its taxable income by past losses only to a certain extent.

The initial loss occurs on the LACs own “request” and there is not much it can do to decrease the fiscal costs of loss compensation. Apart from this the LAC has to take into account the possibility of sporadic future losses, depending on the investment risk of the given LAC. In the case of future losses there is a way to reduce the fiscal asymmetry by creating a reserve for future loss compensation from current technical profit. Let’s assume, that the described reserve is supplied by a half of the LACs profit share, that is 12.5% of the technical profit, which will now become a cost reducing the taxable income. This reserve can grow up to 1.5% - 2 % of the pension reserve. After that all technical profits are added to the current revenue account. Revenues from this reserve’s investment are added to this reserve and after they exceed the upper limit, they are transferred to the current revenue account. If a technical loss occurs it is compensated by this reserve.

The loss compensation reserve increases the LAC’s security by becoming an additional solvency margin created from gross profits. It is advisable to be cautious with setting the payment rate and the upper limit for this reserve. The reserve is designed to improve the intertemporal loss and profit compensation and should encourage to taking on a moderate investment risk. But an excessively high reserve would raise the compensation cost and become an additional profit taxation itself.

2.5. The solvency margin

Assets invested in qualified instruments should always cover the gross pension reserve and the loss compensation reserve (up to its upper limit). So the qualified financial assets should cover between 101.5% and 102% of the pension fund reserve, depending on the established loss compensation reserve’s upper limit. An efficient check of this requirement’s fulfillment can be carried out once a month. Definitions of qualified assets can be adopted from the insurance act.

We suggest to set the solvency margin at the level of 5% of the pension fund reserve. Assets that can be used for the solvency margin coverage are own assets and assets accumulated on the loss compensation reserve with the exception of certain assets categories (the same as in the insurance act). Solvency margin calculation can be requested once a month, but examining its coverage (which involves valuation of less liquid assets, that are excluded from assets, which can make up reserve coverage, but are included in own assets investments, i.e. direct real estate investments, shares in non-public stock companies) can be done more rarely, for example quarterly. The lack of the solvency margin coverage (or reserve coverage) results in the SA’s request to present a plan, how the LAC intends to solve its financial problems. The LAC has also to present a list of measures needed for a timely plan realization. If the LAC fails to keep to this agreement or 80% of the solvency margin are not covered, the SA introduces much more severe measures, by suspending from the right to enter into new contracts or by appointing an official receiver. The next step is an enforced liquidation or bankruptcy of the LAC.

2.6. LACs mergers and takeovers, pension portfolio takeovers

When LACs merge, are taken over (as a consequence of a voluntary agreement or reinforced by an appointed by the court receiver or by the SA’s official receiver) the following rules are to be abided. The taking-over company has to increase the pension funds reserve by the gross reserve calculated from all valid contracts of the company being taken over, and the loss compensation reserve by the loss compensation reserve accumulated by the company being

taken over. The taking-over company is taking over all assets and liabilities and has to account for them according to the agreed rates in the form of writing off all the taken-over company's shares (and paying off all shareholders) or in the form of converting the taken-over LAC's shares into taking-over LAC's shares according to an agreed exchange rate. If not all assets and liabilities are taken over and only a pension contracts portfolio takeover takes place, then one has to take into account, that when the taking-over company creates the pension reserves it will ask for an assets transfer equivalent to the formed reserves. It can demand less hoping for its share in the future technical profits from the continued contracts or from returns to scale etc. On the other hand it can demand more because it will have to create a loss compensation reserve from its own assets. This reserve is a form of adjourned (and connected with a risk) profit. Allocating own assets to this reserve is a form of investment associated with a risk of losing them.

If the official receiver is not able to find another LAC that is willing to take over the LAC's portfolio on the described conditions, the portfolio is taken over by the Annuity Guarantee Fund AGF, which pays out all benefits corrected only for inflation, starting off from the latest benefit levels achieved by the LAC's beneficiaries. The technical profits worked out in the past became a part of the increased above inflation benefits and therefore the Guarantee Fund has to stick to this commitment.

It is in the beneficiaries' best interest to continue getting benefits with an indexation higher than only reflecting inflation. If so, the question arises, if the official receiver shouldn't have the right (after proving, that there is no other LAC willing to take over the portfolio on standard conditions) to continue looking for a LAC, that would offer a takeover on substandard conditions, but more profitable for beneficiaries, than the conditions offered by the Guarantee Fund. It could mean, for example, that for a given period the taking-over company is not obliged to index benefits over inflation (this means, that with reference to the overtaken portfolio, for a given period, i.e. one or two years, the whole technical profit – instead of 25% - increases the loss compensation reserve up to its upper limit; when the reserve limit is exceeded, the technical profit is added to the companies net profit). It seems, that the act should contain at least some of the emergency solutions (not necessarily the same like the described above) that could be put into effect in the case of mergers and takeovers of LACs.

3. Life annuities offered by LAC's

The conception of a market for life annuities offered under the II pillar is founded on certain principles, which are also foundations of the reform of the whole pension system in Poland. Those principles, which are of major importance when considering details of benefits definitions, are:

- II pillar should be self-financing (in relation to state budget), and thus resistant to political risk
- Insolvency risk of Life Annuity Companies (LAC's) should be very low
- The system should offer possibly high rates of benefits (should not generate too high costs, and should not offer to LAC shareholders unduly high profits). Rates should be high enough to complement the insufficient longevity risk cover under the I pillar.

As it has been already mentioned, OPF's are in fact savings institutions, not exposed to mortality risk. It is due to the fact that the balance is inheritable in case of death of the participant. In case of death of one of the spouses in a married couple one half of the balance

is transferred to the survivor's OPF account, and the other half is subdivided between him/her and other successors according to the general rules of succession. So far it has not been decided what should happen to the first part of the balance if the survivor is already retired. Perhaps it is not a serious mistake, because such a problem will not occur earlier than in 2008. At present it is assumed, that the nominal retirement age is 60 for women and 65 for men, and the oldest people to join OPF's in 1999 were then 50 years old.

At least three important properties of the solution for OPF's are worth mentioning, when considering the benefits definitions proposed by the preliminary version of the act regulating LACs, worked out under the auspices of the Ministry of Labor and Social Policy (further on quoted as "project"):

1. the solution concerning OPF's has been relatively easy to implement (generally based on the existing legislation concerning open investment funds, with necessary differences due to regular and obligatory contributions and restrictions concerning withdrawal)
2. compared to pensions offered under the first pillar the solution results in providing substantial cover against premature death at the cost of reduced cover against longevity risk
3. the solution poses a problem of "transition shock" when the transfer of savings from OPF to the Life Annuity Company (LAC) takes place – the shock is due to the transition from a system where savings are inheritable to a life annuity system, which could be disastrous for the family of a pensioner who attains retirement age at death's door.

The first property has been surely the major advantage of the solution for politicians. The second and the third are those with which we should cope now.

The second property can result in unfavourable outcomes, when we compare the ratio of benefits to contributions in the II pillar to the same ratio in the I pillar. Typically such ratios are understandable to the general public, when they are calculated for the person who survived till retirement age. Of course such comparisons would favour the I pillar, and the better investment performance of OPF's would hardly overcome that. Of course, this will be a problem for politicians after 2008, perhaps not the same ones as in 1999.

Several details of the definitions of annuities, included in the project, are disputable. This part is devoted to presenting some doubts concerning the project and positive proposals for some alternative solutions.

Existing project assumes four basic types of life annuities:

- single life annuity
- annuity for a married couple
- single life annuity with a guaranteed benefit period of n years
- annuity for a married couple with a guaranteed benefit period of n years

In case of annuity for a couple the project assumes symmetric treatment of partners. The parameter of the contract is the "survivor factor" sf (not smaller than 60%) by which the basic benefit level is multiplied after the death of one of the spouses (no matter which one). In fact sf could also take the value of 0%, because (on condition that the partner has agreed) one can take out the individual life annuity. The project does not define the upper limit of the parameter (which seems to be just a simple mistake - it is unlikely that authors intended to make it possible to choose 200%). The choice of the couple variant is not allowed in case when the younger spouse is under 50.

In case of an annuity with a guaranteed benefit period of n years the beneficiary is a third party. The parameters of the contract are n and the beneficiary factor bf (no smaller than 50%) by which the basic benefit level is multiplied after the death of the annuitant (or the last survivor of the couple). The project does not define the upper limit of bf , but it seems to be reasonable to introduce it (in case of an annuity for a couple the reasonable limit is $bf \leq sf$).

According to the project, life annuities (their 4 basic versions) are to be offered by LACs, with tariffs expressed in terms of rates (amount of monthly payment per one thousand PLN of sum transferred from OPF). Rates are allowed to differ by:

- variant of the annuity (individual versus couple)
- age
- gender (this issue is regarded as difficult in terms of the parliamentary debate)
- guaranteed benefit period n and the parameter bf
- in the couple variant by parameter sf

In our opinion the range of possible choices for persons transferring their savings from OPF to a LAC is too wide, which can impose too much additional risk on LACs, which in turn could squeeze down the rates offered. The most serious problems in our opinion can arise as a result of too wide range of choice in respect of:

1. parameters n and bf of annuities with guaranteed benefit periods
2. the age at which the transfer from OPF to a LAC is made
3. single versus couple annuity in case of a married person

The special attention should be paid to point 3, which acquires special importance in the light of (possible) prohibition of differentiation of rates by gender.

The next subsection contains an analysis of effects of allowing too much choice in respect of guaranteed periods. The whole section 4 is devoted to examine the effects of prohibiting rate differentiation by gender. The analysis in both cases is based on an economic way of thinking – rather than arguing that the proposed solutions are unacceptable – we set out to show, how much will they cost.

The choice of the age (according to the project the minimal age is 65 and 60) poses also a serious problem; however, there is much less room for alternative solutions here. Thus, a systematic analysis of this problem is omitted in the paper.

3.1. Annuities with guaranteed benefit period

The basic argument for introducing the guaranteed benefit period is the „transition shock”. The transition shock could be considered from the point of view of an individual, approaching the nominal retirement age in poor health. The loss in case of no guaranteed annuities is evident – OPF participants are notified about their balance, which is not the case in the I pillar (where the same type of shock takes place). Thus some cushion might be considered desirable. Particularly when we consider the situation of a single person wishing to leave its savings to his/her successor, the temptation to delay the decision to retire (in order to die before retirement and thus avoid loss of savings) may be strong. We could imagine a game in which the successor offers to the parent some benefits, in order to convince him/her to refuse retirement. Of course the successor game is fairly risky, except when the forthcoming death of the parent is inevitable. Surely the game could be undertaken more likely by affluent successors. The result for the system would be the antiselection of risks, which will reduce

annuity rates offered. Thus (as far as other circumstances allow for delaying the retirement) the „transition shock” will give undesirable effects.

The basic argument against introducing a guaranteed benefit period is that it will obviously reduce annuity rates.

Perhaps that is why optional guaranteed periods are proposed in the project. Unfortunately, the option itself causes problems, illustrated by the example below.

Example

Assume we consider the monthly rates of an individual annuity per 1000 PLN of transfer sum, for a person of a given age and gender, in four variants:

- GObl – rate of annuity with guaranteed period of n years, provided the guaranteed period is obligatory
- GOpt - rate of annuity with guaranteed period of n years, provided this choice is optional (some choose annuity with a guaranteed period of n years, others choose annuity with no guaranteed period)
- NoOpt – rate of annuity without a guaranteed period, provided this choice is optional
- NoObl – rate of annuity without a guaranteed period, provided this solution is obligatory.

Then the following inequalities hold:

$$\text{GObl} < \text{GOpt} < \text{NoOpt} < \text{NoObl}$$

The first and last inequalities hold because of antiselection of risks. LACs have to make allowance for the anticipated concentration of persons with high expected mortality in the group of those who choose guarantees.

The second inequality also holds, just because the guarantee always has a positive value even for those who expect to live longer than others and do not care too much about their successors. So no difference (as well as too small difference) will result in most clients choosing guaranteed annuities. This in turn will weaken the antiselection effect. That is because the knowledge of a client about his/her own expected mortality probably takes such a form that few know quite well that their expected mortality is evidently high, whereas the majority do not know too much – perhaps that „everything is OK” which means that their risk of death in the nearest few years is close to average.

Generally, not much more could be guessed besides that inequalities hold. There is no reason to expect that on the market for annuities with optional guarantees there is any type of equilibrium mechanism, which will stabilize the position of the GOpt and NoOpt rates within the range (GObl, NoObl).

The conclusion is that there is no easy way to achieve two goals at the same time: namely maximization of longevity risk cover (which is achieved when no guaranteed periods are offered, provided there is no room for delaying retirement), and cushioning the „transition shock”, (which is achieved when long term guaranteed periods are obligatory). The solution based on optional guaranteed periods is some kind of a compromise, but in the case when the interval (GObl, NoObl) is too wide, it could destabilize the market, imposing an additional source of risk on LACs, which in turn would increase the costs of the system via higher Value at Risk, and following higher capital requirements imposed by the SA.

In our opinion the best compromise is to allow for optional guaranteed periods by imposing relatively strict limits for parameters n and bf , which assures that the ratio:

$$\frac{NoObl - GObl}{NoObl}$$

will be no greater than 5% - 8%.

Assuming several simplifications, this goal could be achieved when:

- $bf \leq 75\%$
- $n \leq \max\{0, 38 - \frac{1}{2} \cdot age\}$,

where “age” represents the age of a client, and, for the couple variant, the age of the younger spouse.

4. Prohibition of differentiation of rates by gender

Prohibition of differentiation of rates by gender imposes a new source of risk on the market: the risk associated with the gender structure of LAC’s portfolio. We will present its consequences analysing three basic solutions designed to cope with it.

Solution 1.

The prohibition is not accompanied by any device on the whole market level. This means that all the gender structure risk is an individual LAC’s burden.

Solution 2.

The system of taxes and subventions is introduced. At the time of transfer of savings from OPF to LAC male’s transfer sums are taxed and females transfer sums are subsidized. The system requires the existence of a central institution – say a Clearing House, responsible for setting tax and subvention rates (differentiated by age and type of annuity) on the proper level, assuring that:

- in subsequent time periods tax returns cover subvention outlays
- for a given age and annuity type LACs are no more exposed to the risk of the gender structure

Such a Clearing House would not necessarily be a state institution – it could possibly be just a specialised reinsurer, possibly founded by LACs themselves. The essence of the solution, however, is not the origin of the Clearing House, but its aim to balance tax returns and subvention outlays in the short-term.

Solution 3.

The solution is similar to the solution 2, but the taxes and subventions are to be balanced in the long term, which is necessary to ensure that tax and subvention rates are stabilized in the long term. The basic difference (compared to solution 2) is that it requires a huge capital, to cover (for each cohort) the time gap between outlays and returns, which amounts to approximately five years (difference between nominal retirement age for males and females). In this case one can hardly imagine other solutions than the establishment of a Clearing House by the state.

4.1. A closer look at solution 1

This solution means that the entire risk of the gender structure of the portfolio is borne by individual LACs. Of course this risk does not appear, if gender is perfectly identified on the

basis of age. Such situation could happen, if LACs were to offer only individual annuities, and the possible retirement age were 60 – 64 for females and no less than 65 for males. Then the rates (officially uniform as to gender) would be calculated by LACs on the basis of female mortality tables for ages under 65, and on the basis of male mortality tables for the ages of 65 and more. The illustration is included below in the Table 1, where “officially uniform” rates are printed in bold.

TABLE 1. Monthly rates (PLN) of individual annuities per 1000 PLN of transfer sum², by age and gender, no guaranteed period

age	Male rate s_m	Female rate s_f	Rate of growth (by age) of “officially uniform” rate
60	5.26	4.09	-
61	5.47	4.26	4.1%
62	5.70	4.44	4.3%
63	5.94	4.63	4.4%
64	6.19	4.84	4.5%
65	6.46	5.07	33.5%
66	6.75	5.31	4.6%
67	7.06	5.56	4.7%
68	7.39	5.84	4.8%
69	7.75	6.14	4.9%
70	8.12	6.47	4.9%

The growth of the rate for a female successfully delaying retirement until 65 is impressive. Of course if the number of males retiring under 65 and/or the number of females retiring over 64 is more than marginal then the basis for setting rates has to change.

More closely, let us denote the proper gender-uniform rate by s , the proper male rate by s_m and the proper female rate by s_f . Then (provided both genders are represented):

$$s_f < s < s_m.$$

Assume, that a male with transfer sum T enters the individual contract – which, under the actuarially fair rate, will result in setting up the reserve of the same amount. Since, LAC offers him annuity at the rate s , it has to set up the reserve of amount $T \cdot \frac{s}{s_m}$. The immediate

profit made on the contract will then amount to:

$$T - T \cdot \frac{s}{s_m} = T \cdot \left(1 - \frac{s}{s_m}\right).$$

Similarly, when a female with transfer amount T enters the individual contract, then – offering her annuity at the rate s , the LAC suffers immediate loss of amount:

$$T \cdot \left(\frac{s}{s_f} - 1\right)$$

² All calculations further on (unless stated otherwise) are based on Polish population official mortality tables 1995/1996, for the urban subpopulation, technical rate of interest at 0.00, cost margin at 0.00

Assume now that the LAC expects that in a certain age group (say, 65-years-olds) in the nearest future there will come n_m males with the average transfer sum T_m and n_f females with the average transfer sum T_f . Then the rate s should satisfy the condition:

$$T_m \cdot n_m \cdot \left(1 - \frac{s}{s_m}\right) = T_f \cdot n_f \cdot \left(\frac{s}{s_f} - 1\right),$$

which means that the losses on females are cancelled out by profits made on males. Solving the equation we obtain the “balanced level” of the uniform rate s :

$$s = \frac{1}{w \cdot \frac{1}{s_f} + (1-w) \cdot \frac{1}{s_m}}.$$

where the weight (of the weighted harmonic average) equals:

$$w = \frac{T_f \cdot n_f}{T_f \cdot n_f + T_m \cdot n_m}$$

which is the share of total transfer sums by women in total transfer sums by both men and women. It is obvious that the smaller w is attained by a particular LAC, the more competitive is this LAC’s offer. The temptation for aggressive acquisition is therefore very high, and any prohibition here will probably not be efficient.

The risk imposed on LACs is that each LAC, on the basis of a predicted share w , offers to the public a rate s ; then the actual share appears to be w^* , which means that the proper (ex post) rate has been s^* . Realized profit (or loss, if negative) then amounts to:

$$(T_f \cdot n_f + T_m \cdot n_m) \cdot \left(\frac{s^* - s}{s^*}\right)$$

which stands for the same percentage of the reserve, as the relative prediction error of s^* .

In order to appraise the sensitivity of LACs to this risk, let us assume, that LACs are required to have free assets covering at least 5% of the reserve. Then a prediction error of 1% results in a loss (or profit) in amount equalling 20% of the free assets (at least that part of them which corresponds to the reserve set up for new contracts). Generally there is a high probability to that the prediction error will be larger than 1%.

So a high risk means that profits will be strongly differentiated across LAC’s. That in turn means one of two possible outcomes for the whole market:

- provided average profits of LACs are moderate, some of them will make high profits, while others will suffer substantial losses, which in turn will mean relatively frequent bankruptcies
- provided offered rates will follow a “conservative attitude to risk”, then frequent bankruptcies are avoided at the (relatively high) cost of reduced rates. It means that the average profit rate for LAC’s shareholders will exceed the normal rate in other sectors of the economy. In the light of obligatory character of contributions to the II pillar it is hardly acceptable.

In both cases the system does not account for one of two postulates – either it is not safe for pensioners, or it offers them safety at the (relatively high) cost of risk premium for LAC’s shareholders. In both cases, the rates are additionally reduced by high acquisition costs.

4.2. A closer look at solution 2.

One can ask whether the competition between LACs (in respect of the share of male clients) is a zero-sum game. The answer is crucial in order to appraise whether the Clearing House, founded in order to free individual LACs from this risk, is exposed itself. In fact the question relates to the uncertainty of predicting share w (and the corresponding rate s) in respect of the whole market, for each age group.

Example

Consider a balance of taxes and subventions resulting from the setting (for a given calendar year) of a uniform rate for all clients of age 65. Assume that from demographic data we know that there are 130 females per 100 males in the group. According to mortality tables proper rates for them are:

$$s_m = 6.46 \text{ and } s_f = 5.07 \text{ (PLN monthly per 1000PLN of transfer sum).}$$

Assume the system offers only individual annuities without guarantees.

Assume also that we know that OPF participants are in different proportions, because 50 out of 130 females have already retired, so that there are only 80 females per 100 males potentially wishing to retire. Assume also, that from OPF's data we know that the average transfer sum gathered by a male in this group is larger by 20% than the average transfer sum of a female.

Assume now (*scenario 1*) that 100% of the group will retire during the year. Under this assumption taxes and subventions will be balanced when the weight is presumed to be:

$$w = \frac{80 \cdot 100}{80 \cdot 100 + 100 \cdot 120} = 40\%$$

which results in the rate s being equal to:

$$s = 5.82.$$

It means that the balance will be cleared when the tax rate for males is set at a level of:

$$\frac{6.46 - 5.82}{6.46} \approx 10.0\%, \text{ and the subvention rate for females is: } \frac{5.82 - 5.07}{5.07} \approx 14.8\%.$$

Consider now that we have made an error: ex post we observe that all females from the group have retired, whereas half of the males decided to delay their retirement (*scenario 2*). Assume moreover, that these males who decided to retire with no delay, have (on average) transfer sums higher by 10% than females, whereas those who decided to delay retirement have (on average) transfer sums higher by 30% than females. Hence the actual share now equals:

$$w^* = \frac{80 \cdot 100}{80 \cdot 100 + 50 \cdot 110} = 59.26\%.$$

which results in a higher actual rate s^* equal to:

$$s^* = 5.56$$

Still each LAC (provided the rate offered has been at 5.82) gain from the clients assets, which - reduced by taxes and complemented by subsidies - are equal to the corresponding increment of liabilities. Thus each LAC separately remains immunized against the risk of the unforeseen change in the structure of its portfolio. At the same time the Clearing House suffer a loss equal to the ratio:

$$\frac{s - s^*}{s^*} = \frac{5.82 - 5.56}{5.56} \approx 4.7\%$$

multiplied by the aggregate transfer sum. This loss could be covered by the tax raised later on from those males, who decided to delay retirement. This would mean, however, at least three complications:

- the Clearing House must then have enough assets to finance temporary deficit

- the Clearing House has to be able to force taxes from LACs – though in the next year LACs would be no longer exposed to risk, since the group of 66-years-olds consists then exclusively of males.
- the last complication results from some problems in predicting the aggregate transfer amount of lasting males – most of their savings will increase till next year, but, on the other hand, some of them will die, and finally will evade from the system, leaving all savings to their successors (in some cases leaving savings to women, entitled to take out the annuity, burdening additionally the system).

By the way, the above example illustrates the scale of risk borne by the individual LAC, when the risk is not transferred to the Clearing House (solution 1). The example is based on assumptions (the extent of differences between scenario 1 and scenario 2), which are probably exaggerated as for the entire market – real behaviour of clients will be probably much easier to predict in this context. On the other hand, in the case of individual LAC the prediction error could well happen, and thus the loss of 4.7% of reserves should be regarded as quite possible.

The risk associated with the structure of portfolio by gender (as well for individual LACs, as for the whole market) could be substantially reduced, provided all clients take out only couple variant of annuity.

In the case of couple variant of annuity one can interpret the prohibition of differentiating rates by gender as a rule, that LACs are allowed to set rates on the basis of the age of both spouses, but that the rate offered to the couple:

- husband x -years old and wife y -years old

has to be identical to the rate offered to the couple:

- husband y -years old and wife x -years old.

Obviously also in this case there is some possibility to identify the gender (of that, who is younger) on the basis of age. It is the case when one of spouses is 60-64 years old and the other is under 60. Then the younger has to be male, because otherwise no one has attained the retirement age.

Exemplary rates for these cases are presented in the Table 3.

Table 3.
Monthly rates (PLN) of couple annuity per 1000PLN of transfer sum, by age of both spouses

	$S_f = 60\%$		$S_f = 80\%$		$S_f = 80\%$	
Husband's age	Wife's age					
	60	64	60	64	60	64
50	3.67	3.94	3.35	3.56	3.07	3.24
51	3.74	4.02	3.41	3.63	3.13	3.32
52	3.80	4.10	3.47	3.71	3.19	3.39
53	3.87	4.18	3.53	3.79	3.24	3.46
54	3.94	4.26	3.59	3.86	3.30	3.53
55	4.01	4.35	3.65	3.94	3.35	3.61
56	4.08	4.43	3.71	4.02	3.40	3.68

57	4.15	4.52	3.77	4.10	3.45	3.75
58	4.22	4.60	3.83	4.18	3.50	3.82
59	4.29	4.69	3.88	4.25	3.55	3.89

For all other cases (when both spouses are at least 60 years old), both combinations are possible. However, the difference of rates in respect of that who is older is usually (when the difference of ages is moderate) quite small (as compared to differences between individual annuity rates). Tables 4a, 4b and 4c presents exemplary rates for spouses in the ages of 60 to 70.

Of course the actuarially fair rates for a couple, say, of ages 62 and 65, are lower when husband is that one who is older, and higher otherwise. The difference increases together with the increasing difference of spouse's ages. However, in the worst case (ages 60 and 70, $sf = 100\%$) the difference of rates is 13%. It is also obvious, that large difference of ages will be relatively rare in the population, and in this relatively narrow group one of cases (old husband, young wife) will prevail over the opposite case. Remind that fair rates of individual annuities for 65-years-olds differ by 27.4%. Thus the risk associated with the unforeseen structure of the portfolio by gender could be radically reduced as far, as the reduction of the share of individual annuities (in favour of couple variant annuities) is possible.

Table 4a.
Monthly rates (PLN) of couple annuity per 1000PLN of transfer sum, by age of both spouses, the case of $sf = 100\%$
age:

wife husband	60	61	62	63	64	65	66	67	68	69	70
60	3.60	3.69	3.78	3.87	3.96	4.05	4.14	4.22	4.31	4.39	4.47
61	3.64	3.74	3.83	3.93	4.02	4.12	4.22	4.31	4.40	4.49	4.58
62	3.68	3.78	3.89	3.99	4.09	4.19	4.29	4.40	4.50	4.60	4.69
63	3.73	3.83	3.94	4.04	4.15	4.26	4.37	4.48	4.59	4.70	4.80
64	3.76	3.87	3.99	4.10	4.21	4.33	4.45	4.56	4.68	4.80	4.91
65	3.80	3.92	4.03	4.15	4.27	4.40	4.52	4.65	4.77	4.90	5.02
66	3.84	3.96	4.08	4.20	4.33	4.46	4.59	4.73	4.86	4.99	5.13
67	3.87	3.99	4.12	4.25	4.39	4.52	4.66	4.80	4.95	5.09	5.23
68	3.90	4.03	4.16	4.30	4.44	4.58	4.73	4.88	5.03	5.18	5.34
69	3.93	4.06	4.20	4.34	4.49	4.64	4.79	4.95	5.11	5.27	5.44
70	3.96	4.09	4.24	4.38	4.54	4.69	4.85	5.02	5.19	5.36	5.54

Table 4b.
Monthly rates (PLN) of couple annuity per 1000PLN of transfer sum, by age of both spouses, the case of $sf = 80\%$
age:

wife husband	60	61	62	63	64	65	66	67	68	69	70
60	3.94	4.04	4.13	4.23	4.33	4.43	4.53	4.63	4.73	4.83	4.92
61	4.00	4.10	4.20	4.30	4.41	4.51	4.62	4.72	4.83	4.94	5.04

62	4.05	4.16	4.26	4.37	4.48	4.59	4.71	4.82	4.93	5.04	5.16
63	4.10	4.21	4.33	4.44	4.56	4.67	4.79	4.91	5.03	5.16	5.28
64	4.16	4.27	4.39	4.51	4.63	4.75	4.88	5.01	5.14	5.27	5.39
65	4.21	4.33	4.45	4.58	4.70	4.83	4.97	5.10	5.24	5.38	5.51
66	4.26	4.38	4.51	4.64	4.77	4.91	5.05	5.19	5.34	5.48	5.63
67	4.31	4.43	4.57	4.70	4.84	4.99	5.14	5.29	5.44	5.59	5.75
68	4.35	4.49	4.62	4.77	4.91	5.06	5.22	5.38	5.54	5.70	5.87
69	4.40	4.54	4.68	4.83	4.98	5.14	5.30	5.47	5.64	5.81	5.99
70	4.44	4.58	4.73	4.89	5.05	5.21	5.38	5.55	5.73	5.91	6.10

Table 4c.
Monthly rates (PLN) of couple annuity per 1000PLN of transfer sum, by age of both spouses, the case of $sf = 60\%$
age:

wife husband	60	61	62	63	64	65	66	67	68	69	70
60	4.36	4.46	4.56	4.67	4.78	4.89	5.00	5.12	5.24	5.35	5.48
61	4.43	4.53	4.64	4.75	4.87	4.98	5.10	5.22	5.35	5.47	5.60
62	4.50	4.61	4.72	4.84	4.96	5.08	5.20	5.33	5.46	5.59	5.73
63	4.57	4.68	4.80	4.92	5.05	5.17	5.31	5.44	5.57	5.71	5.85
64	4.64	4.76	4.88	5.01	5.14	5.27	5.41	5.55	5.69	5.83	5.98
65	4.71	4.83	4.96	5.09	5.23	5.37	5.51	5.66	5.81	5.96	6.11
66	4.78	4.91	5.04	5.18	5.32	5.46	5.61	5.77	5.92	6.08	6.25
67	4.85	4.98	5.12	5.26	5.41	5.56	5.72	5.88	6.04	6.21	6.38
68	4.92	5.06	5.20	5.35	5.50	5.66	5.82	5.99	6.16	6.34	6.52
69	4.99	5.13	5.28	5.43	5.59	5.76	5.93	6.10	6.28	6.47	6.66
70	5.06	5.21	5.36	5.52	5.68	5.85	6.03	6.21	6.40	6.59	6.79

It is obvious that the reduction of the extent of individual annuities is limited by demography. However, it is interesting to consider an example, which shows that the option to choose individual versus couple variant of the annuity by couples is itself destructing.

Example

Consider a population, where spouses are always in the same age. In the framework of this assumption consider a group of 230 persons - 100 males and 130 females, out of which 30 females have been already retired. Assume that now the rest of the group is retiring. The demographic structure of the group is following:

	females	males
spouses:	80	80
single:	20	20
Total:	200	

with average transfer amounts (thousands PLN):

	females	males
spouses:	62	120
single:	120	120

Actuarially fair rates for 65-year-olds amount to:

- individual rates:

female	male
5.07	6.46

- couple variant rates:

<i>sf</i>	rate
100%	4.40
80%	4.83
60%	5.37

Scenario 1:

Spouses allocate the whole transfer amount to the couple annuity. Actuarially fair monthly benefits amount to:

<i>sf</i> :	both alive	widow	widower
100%	800	800	800
80%	880	704	704
60%	977	586	586

Thus the uniform rate of individual annuities, which will result in taxes balanced with subsidies amounts to 5.681, which gives the monthly payment of the annuity at:

female	male
682	682

thus taxes imposed on single males amount to:

per 1000 of transfer sum:	121
average per one male:	14 553
total for the group:	291052

Whereas subventions for single females amount to:

per 1000 of transfer sum:	121
average per one female:	14 553
total for the group:	291052

Scenario 2:

LACs, presuming scenario 1, set the individual annuity rate at 5.681. But spouses decided to allocate all transfer sum of the husband to the couple annuity with the parameter $sf = 100%$, and all transfer amount of the wife to the individual annuity. Resulting monthly benefits amount to:

	both alive	widow	widower
husband's contribution:	528	528	528
wife's contribution:	352	352	0
total:	880	880	528

Compared to the decision according to the scenario 1 with parameter $sf = 80%$, this strategy gives the surplus (monthly):

both alive	widow	widower
0	176	-176

Effects allow to call this strategy „stake on wife’s survival”. It is not the zero-sum game, because:

- probability that the husband will live longer equals: 0.3757
- whereas probability that the wife will live longer equals: 0.6243
- conditional expected life duration of the widower since wife’s death (under the condition that he is a survivor) equals: 8.0 years
- whereas the conditional expected life duration of the widow since husband’s death (under the condition that she is a survivor) equals: 10.5 years

In this case the tax imposed on males will remain unchanged, so will amount to:

Totally for the group:	291 052
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whereas subsidies to the transfer sums of females equals:

Per 1000 of transfer sum:	121
Average per one female:	8 926
Totally for the group:	892 559

and the resulting deficit of assets to cover liabilities will appear at **601 507 PLN**.

Scenario 3:

LACs, presuming that all couples „stake on wife’s survival”, set up the individual annuity rate at: 5.351. Hence the monthly benefit levels amount to:

Single female	Single male	Married woman
642	642	332

Provided couples really „stake on wife’s survival”, then the tax imposed on males in the group again covers subsidies for females. However, the structure of the redistribution will be quite different to that of the scenario 1:

- taxes imposed on males:

per 1000 of transfer sum:	172
average per one male:	20 674
totally for the group:	413 481

- whereas the subsidies:

per 1000 of transfer sum:	56
average per one married woman:	3 483
average per one single woman:	6 742
totally for the group:	413 481

Now the value of the strategy to "stake on wife’s survival for the couple is a bit doubtful, as the benefit rates equal:

	both alive	widow	widower
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husband's contribution:	528	528	528
wife's contribution:	332	332	0
total:	859	859	528

Which as compared to the scenario 1 with the parameter $sf = 80\%$ produces the surplus (monthly):

both alive	widow	widower
-20	156	-176

Realistic scenario:

Probably only some part of couples will „stake on wife's survival". This will result in rate for individual annuity at some level between 5.351 and 5.681 PLN. Instability of couple's behaviour in this respect will cause LACs to set rates below expected proper level, as a mean to realize the risk premium.

Role of the insurance market:

The strategy of „staking on wife's survival" can be quite attractive if the free insurance market offers complementary products (for example life annuities for males deferred till (possible) wife's death. However, perhaps mostly more affluent couples will be wishing to take the offer, which make them easier (and without exposure to risk) consume the subsidies avoiding at the same time taxation. It is one more example showing that evading taxation and consuming subsidies is easier for more affluent households. This phenomenon often degenerates various redistribution mechanisms introduced in order to transfer income from rich to poor.

Direct conclusion from the example 3 is that the share of couple annuities should be maximised, and the range of free choice in this respect should be minimised. It could be difficult to find a reasonable compromise between this rule and the postulate of clear and fair distinction between the joint and separated wealth of spouses.

4.3. Closer look at solution 3.

Current balancing of tax revenues and subvention outlays is a delicate task, exposed to risk as it has been shown in the previous section. The scale of assets needed for balancing temporary surpluses and deficits depends on the horizon. The more assets are on disposal, the less frequent and less radical changes of tax and subvention rates are needed. If assets are scarce, rate changes need to be frequent and possibly large. However, the goal – removal of the structure risk from the LACs need only, that for each age group the following relation holds:

$$(1 + \text{subv}) \cdot s_k = (1 - \text{tax}) \cdot s_m = s$$

where *subv* denotes the rate of subvention granted to retiring female, and *tax* denotes the rate of tax imposed on retiring male.

Assume now that the only aim is to remove the risk of the LACs and that the external source of finance exists. Then one of the rates could be set arbitrarily, and only the other one should be set according to the above equation. Possible combinations of rates for 65-years-olds are presented in the Table 5a.

Table 5a. Rates of subvention and tax, and resulting monthly rates of individual annuities for 65-years-olds (in PLN per 1000PLN of transfer sum), no guarantees

<i>subv</i>	<i>tax</i>	<i>s</i>
0.0%	21.6%	5.07
5.5%	17.3%	5.35
11.0%	13.0%	5.62
16.5%	8.7%	5.90
22.0%	4.4%	6.18
27.6%	0.0%	6.46

The first row represents the extreme case, when the system produces a huge surplus. The last row represents the opposite, when the system produces a deep deficit. All intermediate cases could produce surplus or deficit, depending on the structure of persons retiring in the period. In the Table 5b the rates for different age groups are presented together. It is shown, that the aim to choose the age-independent tax rate produce the age-dependent subvention rate and vice-versa.

Table 5b. Rates of subvention and tax and resulting monthly rates of individual annuity for the ages 60-70.

age	<i>subv</i>	<i>tax</i>	<i>s</i>	<i>subv</i>	<i>tax</i>	<i>s</i>	<i>subv</i>	<i>tax</i>	<i>s</i>
60	9.0%	15.2%	4.46	9.2%	15.0%	4.47	0.0%	22.2%	4.09
61	9.0%	15.1%	4.64	9.1%	15.0%	4.65	2.0%	20.6%	4.34
62	9.0%	15.0%	4.84	9.0%	15.0%	4.84	4.0%	18.9%	4.62
63	9.0%	14.9%	5.05	8.9%	15.0%	5.05	6.0%	17.2%	4.91
64	9.0%	14.8%	5.28	8.7%	15.0%	5.26	8.0%	15.5%	5.23
65	9.0%	14.6%	5.52	8.5%	15.0%	5.50	10.0%	13.8%	5.57
66	9.0%	14.4%	5.78	8.2%	15.0%	5.74	10.0%	13.6%	5.84
67	9.0%	14.1%	6.07	7.9%	15.0%	6.00	10.0%	13.3%	6.12
68	9.0%	13.9%	6.37	7.6%	15.0%	6.29	10.0%	13.1%	6.43
69	9.0%	13.5%	6.70	7.2%	15.0%	6.58	10.0%	12.7%	6.76
70	9.0%	13.2%	7.05	6.7%	15.0%	6.90	10.0%	12.4%	7.12

Evident arbitrariness in setting subvention and tax rates is a function of the scale of assets in disposal of the Clearing House. Since the decision about the mechanism is undertaken, the room for further arbitrariness are opened.

Firstly, it is possible to construct the system, which stimulates women to delay the retirement, and help this way the idea of bringing closer the nominal retirement age of females to that of males. So far this idea has been obstructed by women organizations lobbying against it. Such solution is presented in the last three columns of the Table 5b, where progressive subvention rates for the disputed age 60-65 are assumed.

Further room for arbitrariness can be opened when noticing that the postulate of equalling male's and female's rates can be realized partially: though we can allow for differentiation of rates by gender, introducing rates of subvention and tax lower than those, which suffice for complete equalization. The Table 6 presents annuity rates differentiated by gender, resulting from various levels of „partial” subventions and taxation.

Table 6. Monthly rates of individual annuities under various (arbitrary) rates of subventions and taxation.

age	rate:		rate:		rate:		rate:	
	<i>tax</i>	<i>subv</i>	<i>tax</i>	<i>subv</i>	<i>tax</i>	<i>subv</i>	<i>tax</i>	<i>subv</i>
	0.0%	0.0%	5.0%	3.0%	10.0%	6.0%	15.0%	9.0%
	Annuity rate		Annuity rate		Annuity rate		Annuity rate	
s_m	s_k	s_m	s_k	s_m	s_k	s_m	s_k	
60	5.26	4.09	4.99	4.21	4.73	4.33	4.47	4.46
61	5.47	4.26	5.20	4.39	4.92	4.51	4.65	4.64
62	5.70	4.44	5.41	4.57	5.13	4.71	4.84	4.84
63	5.94	4.63	5.64	4.77	5.34	4.91	5.05	5.05
64	6.19	4.84	5.88	4.99	5.57	5.13	5.26	5.28
65	6.46	5.07	6.14	5.22	5.82	5.37	5.50	5.52
66	6.75	5.31	6.42	5.47	6.08	5.62	5.74	5.78
67	7.06	5.56	6.71	5.73	6.36	5.90	6.00	6.07
68	7.39	5.84	7.02	6.02	6.65	6.19	6.29	6.37
69	7.75	6.14	7.36	6.33	6.97	6.51	6.58	6.70
70	8.12	6.47	7.72	6.66	7.31	6.86	6.90	7.05

It is worth to mention, that under tax and subvention rates 10% and 6% respectively, differences between annuity rates offered to women and men do not exceed ten percent – if we are ready to accept differences of this range, we can waive to tax and subsidize couples.

4.4 Most important conclusions

Equalization (full or partial) of genders in respect of annuity rates could be achieved by various means. Particular solutions differ by the degree, to which the principle of equalization is realized, by costs, and also by that, who will cover the cost.

The first solution analysed can be seen as realizing the principle in a very limited extent (only in respect of age groups, where share of both genders in all retiring at this age is substantial. Equalization will mostly take a form of rates close to that rate which is smaller, additionally causing frequent and substantial rate levels changes. In the same time system will produce high in average (but quite volatile) profit rates for shareholders of LACs.

Second solution consist on organized redistribution from males to females through the Clearing House, trying to balance cash flows on the short term basis. This solution will result in higher level of annuity rates, because it reduces acquisition costs and reduces risk premium

for LAC shareholders. Realization of the principle of equalization is not improved as compared to the first solution. Organization of the Clearing House will be costly.

The highest degree of realization of the equalization principle could be achieved under the third solution. However, the costs of equipping the Clearing House with sufficient capital will be huge. Moreover, this solution creates the danger through “softening the budget constraint” of the Clearing House, thus exposing it to high political risk. It is worth to mention here, that one of the basic foundations of the pension system reform in Poland has been to diversify risk – leave the I pillar exposed to political risk, and create the II pillar exempt from political risk (although at the cost of exposing it to market risk). Solution 3 in this context seems to be against the basic ideas of the pension system reform. There is still room for complementing the I pillar by some additional redistributive devices. There is no danger to destroy the market mechanisms, because market does not exist there. On the other hand, there is much to be spoiled in the II pillar.