Managing the Demographic Risk of Pension Systems

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Abstract. Demographic changes observed at present on the European markets strongly determine the sustainability of pension systems. The most important changes in this context include: increase of life expectancy, decline of fertility rate, ageing of societies, and migration flows. All the above trends pose a major risk, mostly for public pension systems that finance the distribution of retirement benefits from mandatory contributions collected from earners in the working-age population. Pension policies should be designed to minimize the demographic risk and limit the risk of old-age poverty. The risk of longevity, associated with the steady increase of life expectancy rates, is another important aspect to be managed by all institutions involved in effective distribution of pension benefits, be it from the base part of the pension fund or any supplementary funds. This paper aims to emphasize the significance of demographic risk in a pension system, identify the types of demographic risk and the associated risk management methods, and to present the projected impact of demographic risk upon the replacement rate.

Keywords: pension system; demographic risk; longevity bonds; replacement rate.

Управление демографическим риском в пенсионных системах

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Аннотация. Демографические изменения, которые наблюдаются в европейских странах, жестко регламентируют устойчивость пенсионных систем. Наиболее существенными изменениями в этом плане являются: рост продолжительности жизни, падение коэффициента рождаемости, процесс старения общества, направления миграционных потоков. Указанные изменения создают основные риски, особенно для публичных пенсионных систем, распределяющих пенсионные накопления из средств, отчисляемых работающим населением. Пенсионная система должна минимизировать риски и ограничить риск попадания пожилых людей в зону бедности. В статье подчеркнута значимость анализа демографических рисков для пенсионных систем, идентифицированы типы демографических рисков и связанных с ними методов управления рисками, а также представлен прогноз влияния демографического риска на коэффициент замещения.

Ключевые слова: пенсионная система; демографический риск; долговечность; коэффициент замещения.

1. INTRODUCTION

It seems that the present demographic changes observed on European markets have already made a notable impact upon the operation of public pension systems in practically all countries of the region. The most vulnerable elements of the system are the so-called base funds, i.e. those funded from mandatory pay-as-you-go contributions collected from the working-age earner population. However, the supplementary part of the pension system — funded from voluntary contributions declared on an individual base — is also fairly susceptible to the effects of demographic changes. Within the present framework of a supplementary pension plan, the sums collected from present earners are not used to cover the outstanding pension claims, but invested on the market. This part, together with accrued interest, is stored on individual pension accounts, to be returned to the contributor at retirement, in the form of supplementary pension instalments. Thus, depending on the adopted form of financing, the demographic changes will exert a greater or lesser impact upon the volume of benefits paid by the system.

Taking into account the fact that retirement benefits covered from the mandatory part of the pension system (i.e. from public retirement plans) represent the main source of income for the ever-increasing population of old-age pensioners in Europe [1, p. 5], it seems that retaining an adequate level of pension benefits is a major challenge for both the pension systems and the national health insurance systems. The most important problem to be faced is how to reconcile the need for retaining long-term stability of the pension system (with no detriment to public finance or to realization of other socially vital objectives, such as education or housing policy) with the equally essential need of retaining the adequate (socially acceptable) level of pension benefits paid [2, p. 442].

This paper aims to emphasize the significance of demographic risk in a pension system, identify the types of demographic risk and the associated risk management methods, and to present the projected impact of demographic risk upon the replacement rate.

2. THE PRESENT DEMOGRAPHIC SITUATION OF THE EUROPEAN MARKET

Demographic fluctuations and development trends exert a considerable impact upon the stability and sustainability of European pension systems. The most important determinants of the present demographic situation include the following:

- life expectancy
- fertility rate
- old age dependency ratio
- migration flows.

The most notable change in this context is the steady increase of at-birth life expectancy in European countries observed from 1960 onward (Figure 1). In the years 1960–2013, the highest rates of life expectancy at birth were reported for Spain, Italy (an increase of more than 13 years), France (ca. 12 year), Switzerland, Germany, Greece, and Slovenia (more than 11 years). All the above countries are fairly affluent, with average income levels decidedly higher than those in Central and Eastern Europe. Slightly lower at-birth life expectancy increases were recorded for Sweden, the Czech Republic, Poland, and the United Kingdom. This trend may be associated with geographic location (Sweden and the UK) or the level of economic development (Poland and the Czech Republic). It may be useful to note that, in 2013, the longevity rates were the highest for Switzerland, Italy, France, Spain, and Sweden.

The available projections of life expectancy at birth suggest a continuous growth trend in Europe; by 2060, the projected life expectancy at birth in male population will increase by an average of 7.2 years (reaching 84.7 in 2060). For females, it is projected to increase by 6.0 years, reaching 89.1 in 2060 [3, p.13]. This represents a significant increase in the total projected duration of retirement. If this projected increase is not balanced by a respective increase of the saved pension capital (both from the mandatory and the supplementary plans), the value of paid benefit instalments will decrease in time.

Another important factor to be considered here is the fertility rate, a measure of simple replacement of generations. On average, the total fertility rate at replacement should exceed 2.1. Lower index values lead to an increase of ageing across population, resulting in rapid depopula-

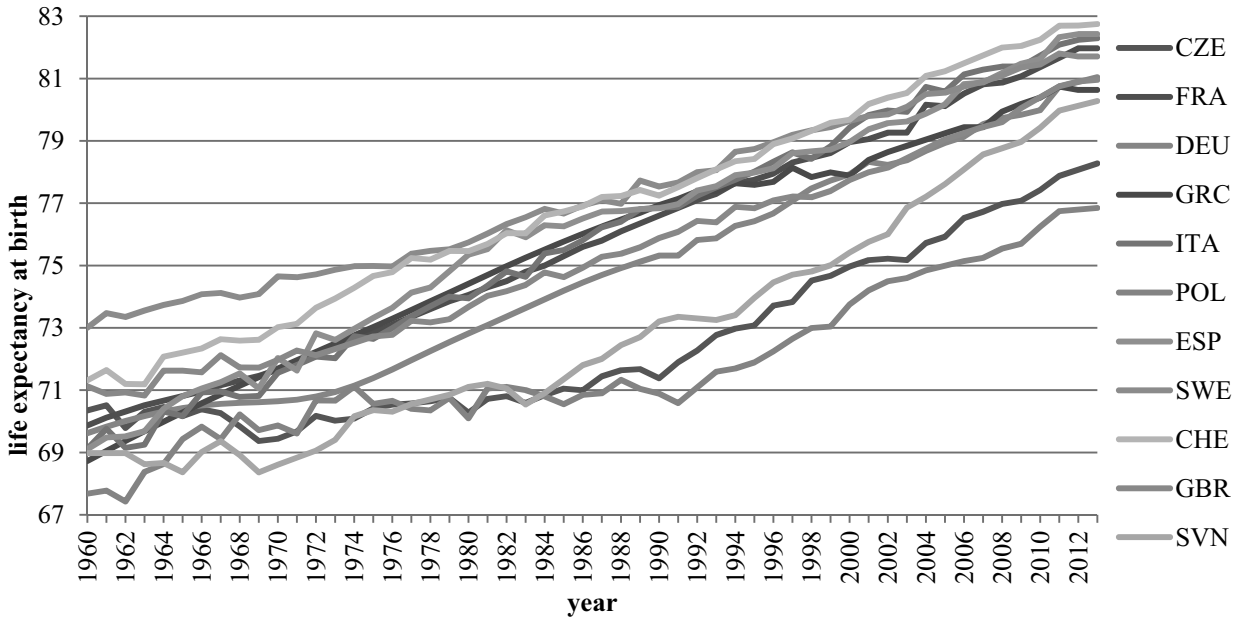

Figure 1. **Life expectancy at birth in the selected European countries, in the years 1960–2013**

Source: Based on www.data.worldbank.org.

tion. As such, they pose a significant risk mainly to the public (base) pension systems. A decrease in the number of active earners, coupled with the increase in the number of pension beneficiaries past their retirement age will gradually exert pressure upon public finance to increase state budget support for pension systems.

As shown in Figure 2, the years 1960–2013 brought a significant decline of fertility rates for all the European countries under study. Simple generational replacement threshold has not been recorded in any of the countries under study ever since the second half of the 1990s. In the year 2013, the highest fertility rates were registered in France, Sweden, and the United Kingdom; and the lowest — in Greece, Poland, and Spain.

The available projections of fertility rates suggest a steady growth of the average fertility rate for the whole European market (up till 2060, at least). Similar rising trends will also be registered on national level by most of the European countries. However, all of the projected national rates for European countries are reported well below the threshold of 2.1 [3, p. 10]. Therefore, national policies of individual European countries should place proper emphasis on promoting family friendly instruments, designed to stimulate the rise of fertility rates, at least to the level that offers simple generational replacement, with the purpose of lessening the financial burden of pension systems upon the national budget.

Another important factor to determine the sustainability of base pension systems is the old age dependency ratio, calculated as a ratio of population past the age of 65 to the working age population (i.e. between the age of 15 and 64). The rising trend of this ratio suggests a growing financial pressure from pension systems upon the national budgets. For every European country under study, over the span of 1960–2014, the values of old age dependency ratios were on the rise (Figure 3). In the year 2013, the lowest ratios were registered in Poland, Slovenia, and the Czech Republic. Those countries represent developing economies, meaning that their affluence levels are still below the Western Europe averages. Therefore, it can safely be assumed that their family models and perceptions are also different, at least to some extent.

It must be noted that the projected development trends of the old age dependency ratio are quite alarming. For some countries of the region (e.g. the Czech Republic, Greece, Slovenia, Romania, Slovakia, Portugal, Poland), the projected old age dependency ratio values in the year 2060 will be past the 50% threshold [3, p. 28]. If the forecasts are accurate, the resulting problems in financing the increased burden from the base part of their pension systems may prove unbear-

able, before we even take into account the rapid increase of public health expenditure needed to sustain the ageing societies.

Migration flows are last on the list of the most important demographic factors to affect the sustainability of pension systems. The negative values of the migration flow balance (calculated as difference between the numbers of permanent outflow to permanent inflow) present a detriment to the pension systems, particularly when the majority of the permanent migration outflow are persons in their productive (and reproductive) age. Based on the available data, it may be interesting to note that Poland was the only country of the region to register negative migration balance values for the whole duration of the period under study (2000-2013). Negative values were also registered in Spain from 2009 onwards (Figure 4). These are typically attributed to labour market specificities. In Spain, the

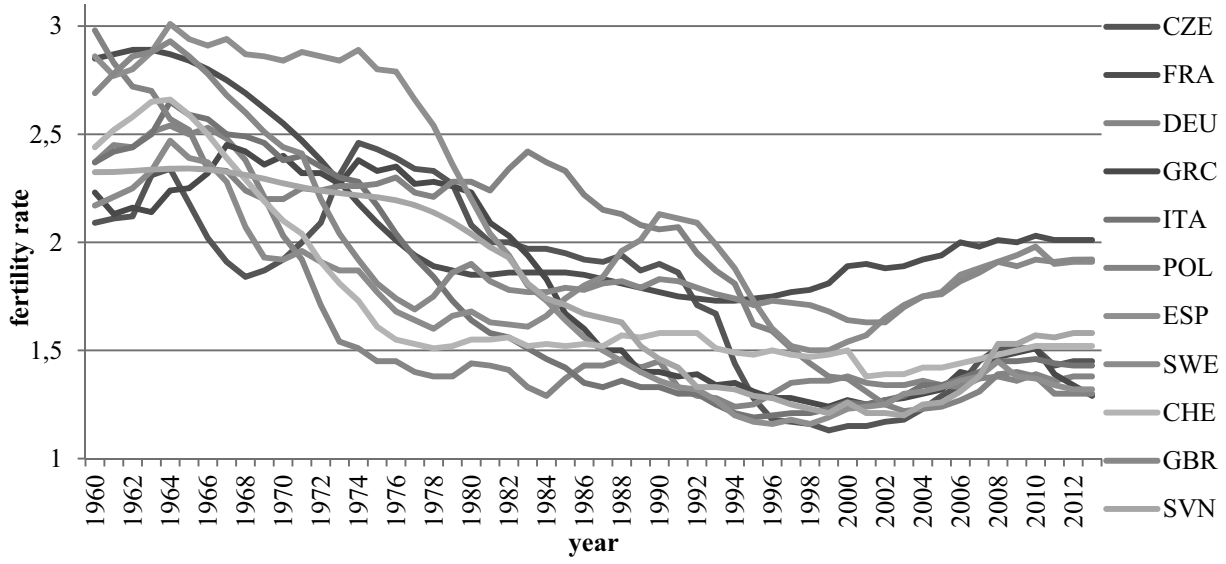

Figure 2. **Fertility rates in selected European countries, in the years 1960–2013**

Source: Based on www.data.worldbank.org.

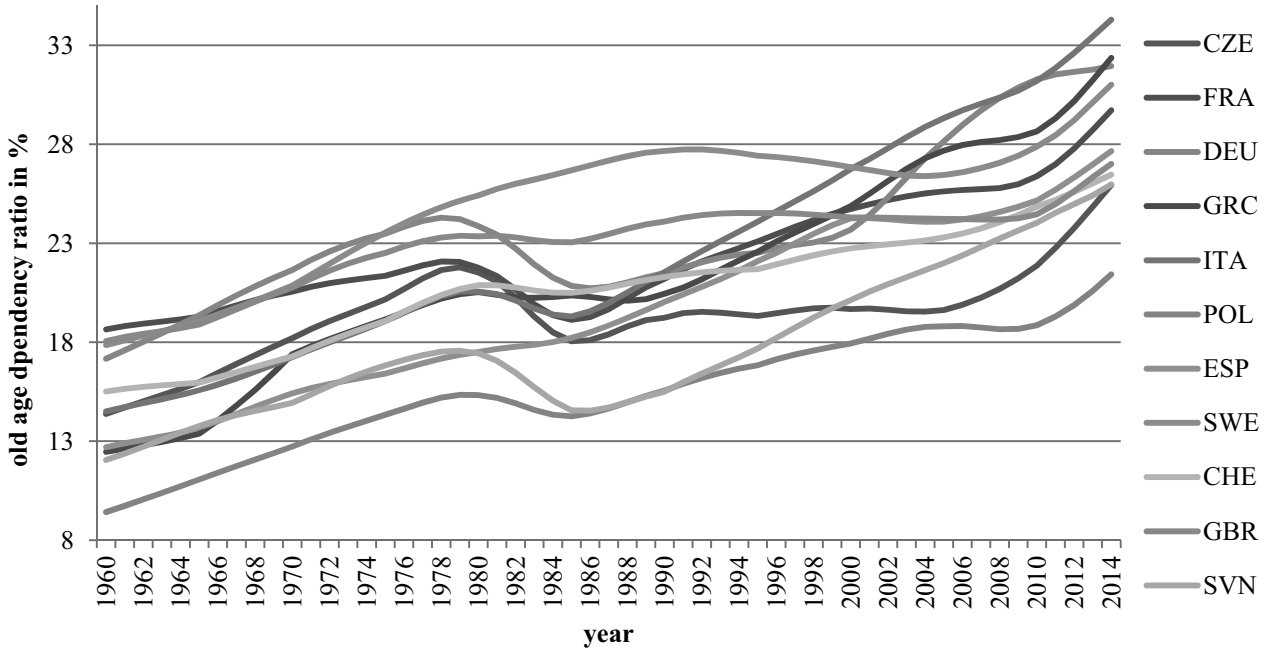

Figure 3. **Old age dependency ratios for selected European countries, in the years 1960–2014 (in %)**

Source: Based on www.data.worldbank.org.

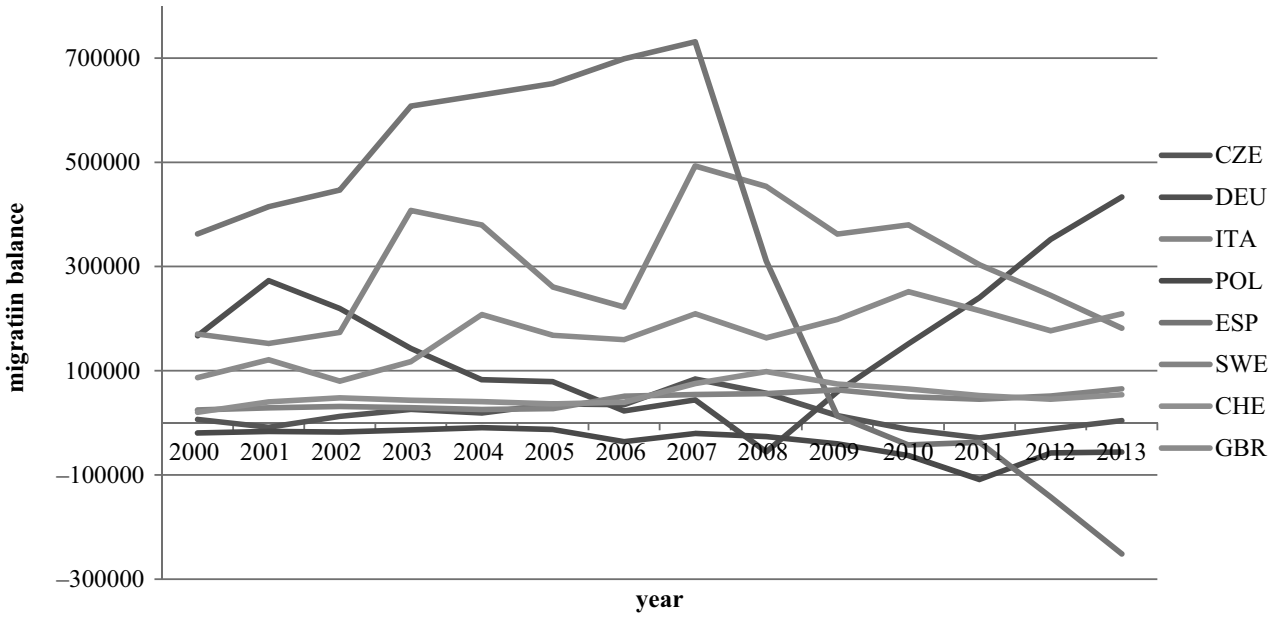

Figure 4. **Migration balance for selected European countries, in the years 2000–2013 (in the number of persons)**

Source: Based on data from Population Database Eurostat.

unemployment rate rose from 17.9% in 2009 up to 26.1% in 2013; and Polish wages are among the lowest in the region.

The above trends in the development of major demographic determinants of public pension system operation suggest that many countries of the region will soon be forced to redesign their existing pension systems. Some of them have already initiated certain instruments, such as the extension of the formal retirement age thresholds.

3. THE NATURE AND THE SIGNIFICANCE OF DEMOGRAPHIC RISKS, IN THE CONTEXT OF PENSION SYSTEMS

The significance of demographic risks in a pension system stems from the need to finance current benefit expenditures from current income (mainly from monthly contributions from earners on the market, but supplemented by fiscal sources in case of deficits). As a result of the ongoing demographic changes (both existing and anticipated), the relation of expenditures to collected contributions is subject to fluctuations. Assuming the consistency of tax rates and pension system contributions, the best measure of demographic risk is the number of persons contributing to the system (paying earners) and the number of persons receiving their pension benefits. Based on the above approach, demographic risk applies mainly to the base (public) part of the pension system and, as such, is a risk borne by the state as the sole party obliged to provide material support for the retired.

Data presented in the previous section, particularly the growing trend of the old age dependency ratio for all European countries under study, suggest that detrimental effects of demographic changes are unavoidable, and — for some European countries — already well underway. To counteract them, state authorities need to increase the effective contribution rates or accept the consequences of decline in the level of pension benefits distributed among the entitled population. It must be remembered, however, that either of the above scenarios can only be implemented on a limited scale. Each state is formally obliged to provide minimum living standards to their citizens — this means that the reduction of benefits paid to pensioners should not decrease below a certain threshold. Similarly, the increase of mandatory contributions from earners cannot go past a certain level without detriment to the cost of labour or consumption patterns in the household segment.

Following this line of reasoning, one can expect that demographic risk will soon generate the risk of poverty in the elderly population. Two separate notions must be defined in this context (for more details, see: [4, p. 114], [5, p. 2]):

severe material deprivation — represents an enforced inability to sustain basic cost of existence, bearing the risk of gradual deterioration of biological functions

relative poverty — represents a situation where total household disposable income falls below the poverty threshold, calculated at 60% of the national median disposable income level (See: http://ec.europa.eu/eurostat/statisticsexplained/index.php/People_at_risk_of_poverty_or_social_exclusion).

Considerations contained herein apply to the financial situation of the elderly population. Persons in this segment rely on their income in the form of retirement pensions, which are typically well below the level of their individual earnings at the moment of take-up of pensions. Incidentally, medical expenses in this segment constitute a large part of their household budgets. Pension reductions, coupled with the mounting cost of health maintenance, may generate the risk of poverty in this segment.

With severe material deprivation cases, the key obligations are borne by the social security system. Persons with enforced inability to sustain their basic needs are entitled to receive material support from the social security system. However, this form of support is funded from the state budget. Consequently, the larger the population of the materially deprived, the greater is the financial burden imposed upon the state budget.

Women are particularly vulnerable to poverty risk, with their markedly higher longevity projections and notably lower average retirement pensions compared to men. Female earners over the course of their working lives receive lower earnings and their pension system contributions are set at a correspondingly lower level, resulting in lower pension capital used as basis for the calculation of pension benefits (for more details, see: [6, p. 49]).

Another important type of demographic risk to pension systems is the *longevity risk*, i.e. the risk of pay-out ratios going past the expected margin. This type of risk applies both to public pension systems and to institutions involved in supplementary pension plans. It must also be noted that longevity risk may apply both on individual level and that of whole generations.

Specific (idiosyncratic) longevity risk arises from the fact that an individual beneficiary of the pension system may live much longer than expected based on mortality statistics. This type of risk is particularly elevated for persons using supplementary pension schemes based on clear declarations of pay-off periods. Such persons face the risk of living past the declared timeframe, or — more specifically — losing a large part of their household income, which may lead to drastic deterioration of living standards and hamper their ability to satisfy the most vital needs. Since the determination of pay-off periods is made in tandem with institutions directly involved in supplementary pension plans (insurers, banks, pension funds), they are expected to provide some form of support for their clients in the process.

Longevity risk may also apply to whole generations or cohorts. This type of risk, referred to as *aggregate longevity risk*, reflects the unforeseen changes in average life expectancy of whole age groups. The effects may be two-fold. If the projections prove undervalued (for example, with high incidence of untimely deaths due to civilizational diseases) the risk of undervaluation of the pay-off total is borne by the beneficiary. However, with positive changes in mortality rates (resulting in increased life expectancy), the risk is carried over to the insurer. This type of longevity risk applies mainly to institutions that take up lifetime pension obligations. This means that aggregate longevity risk applies both to base (public) and supplementary pension schemes.

Some authors introduce the term *total longevity risk* as reference to the combined effects of idiosyncratic and aggregate longevity risk [7, p. 2].

In view of the demographic trends presented in earlier sections, it may be assumed that the risk to pension system sustainability will soon affect all countries under study (if not already manifested).

4. METHODS FOR MANAGING DEMOGRAPHIC RISK

Demographic risk management of public and state-supported (mandatory) part of a pension system can be obtained through (see: [1, p. 11–14]):

• increasing pension eligibility ages; prolonging the average period of work activity offers the prospect of increasing the pension capital used in the settlement of existing obligations

• increasing the mandatory contribution rates, with the intention of raising the pension capital for all participants of the public part of the system

• limiting and restricting the access to early retirement schemes (offered to certain vocational groups), with the intent of delaying the payout maturity combating of gender inequalities in the distribution of pension benefits.

All of the above solutions have potential for increasing the average level of pension benefits received by the participants and should be regarded as justified, due to the steady increase of life expectancy rates. However, it must be noted that practical implementation of these methods should be accompanied by other measures in support of prolonged work activity periods, particularly in the realm of health care provision, workplace organization and employment. Without this type of support, the effects of demographic risk management solutions may prove inadequate (for example, when the increase of pension eligibility ages results in a sizeable increase of other types of claims: unemployment benefits, disability allowances and welfare payments).

Apart from purely systemic solutions, the European countries should also consider extending their family support policies, with the view of increasing the fertility rates and — consequently — the aggregate volume of pension scheme contributions collected from earners in the future. This should also be accompanied by well-designed migration policies and other instruments that offer greater incentives for earners (particularly the young generations) to seek gainful employment in their home country.

Decidedly different methods and instruments of demographic risk management apply to financial institutions involved in provision of supplementary pension plans. Here, the range of applicable methods is largely defined by the business model (banking, insurance).

Life insurance companies that offer endowment funds, unit-linked life insurance schemes and (in some European countries) perpetuity plans based on equity release may adopt a range of instruments for managing their longevity risk, such as reinsurance and alternative risk transfer (see: [8, p. 198]). Both solutions are derived from methods used widely in non-life insurance policies, particularly in the reduction of catastrophic-type risks — both natural and those induced by human action.

A good solution in the area under study is securitization. Two strategies are viable in this context: direct (local) and indirect (external). With direct securitization, the risk is transferred by the insurer (in granter capacity). As a rule, the insurer is the sole issuer of securities, and the funds obtained from their sale are invested in risk-free instruments for the duration of the transaction. This type of securitization strategy is typically conducted with support from a banking institution, acting in their advisory capacity (both floating and sale). In contrast, the indirect securitization — a decidedly more popular solution — involves creation of an independent company to take over the risk based on conventional reinsurance contracts and supplemented by profits from simultaneous sale of securities [9, p. 39].

The longevity risk may be managed through the use of various types of longevity bonds. Two major categories of longevity bonds can be distinguished: those with pay-outs linked to mortality rates and those linked to survivor rates (i.e. generating the flow of funds until the death of the last representative of the target population) (see: [10, p. 168], [11, p. 37]).

Apart from longevity bonds, insures may transfer their longevity risk using other hedging instruments, such as the survivors swap forward transactions (the so-called q-forwards, with «q» representing a symbol used by actuaries to denote mortality rates). Both instruments are well-defined in professional literature. Dowd K. *et al.* define survivor swap as: "a swap involving at least one random mortality-dependent payment" [12, p. 2]. Coughlan G. *et al.* define q-forward as: "an agreement between two parties to exchange at a future date (the maturity of the contract) an amount proportional to the realized mortality rate of a given population (or subpopulation), in return for an amount proportional to a fixed mortality rate that has been mutually agreed at inception" [13, p. 2].

Considering the fact that the public part of a pension system represents a life-long obliga-

tion, the institutions involved in distribution of this part of pension benefits may, just like their commercial counterparts, make good use of the above methods for hedging their longevity risk.

5. THE IMPACT OF DEMOGRAPHIC CHANGES ON THE REPLACEMENT RATE VALUES

The demographic changes presented in earlier sections of this paper will clearly affect the payout of pension benefits, particularly those associated with the base part of the pension system. Regardless of the adopted policies and methods for hedging the demographic risk, the resulting replacement rates will follow a steadily declining trend. Table 1 presents net theoretical replacement rate values (as a ratio of the net retirement pension to the net individual earnings at the moment of take-up of pension) for selected European countries, both factual (2010) and projected (2050). Data presented in Table 1 suggest a steady decline of net theoretical replacement rate for all the countries under study bar Germany. The most pronounced decrease trend can be seen for Greece, Poland, Romania and Czech Republic. Those all represent developing economies of Central and Eastern Europe characterized by the highest population ageing rates. This means that their pension systems should employ particularly stringent and exigent methods for hedging their demographic risk.

6. CONCLUSIONS

The above considerations seem to emphasize the clear and present need to respond to demographic risk in the context of pension systems. This problem should be tackled both by institutions involved in servicing the public part of the pension system and by other financial institutions providing supplementary pension schemes on commercial terms. It is also clear that many European countries still face the need of reforming their existing pension systems if they intend to reduce the risk of poverty in the elderly segment of the population. The supplementary part of the pension system plays an important role in this context, and may be key issue to warrant adequate levels of future aggregate income for pensioners.

Table 1. **Net theoretical replacement rates for selected European countries in 2010 and in 2050**

	2010	2050
Czech Republic	70,6	43,1
France	77,6	58,8
Germany	59,1	63,7
Greece	121,3	87
Italy	89,5	69,1
Poland	75,5	43,3
Spain	94,5	86,5
Sweden	60,3	53
United Kingdom	77,2	75,1
Slovenia	59,2	53,7
Latvia	80,4	55,3
Portugal	85,8	65,9
Romania	70,7	45

Source: Based on data from: http://ec.europa.eu/europe2020/pdf/themes/04_pensions.pdf.

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