Econometric models of tax reforms

Экономико-математические модели налоговых реформ

WORLD EXPERIENCE AND RUSSIAN PRACTICE OF THE PENSION SYSTEM'S REVENUE FORMATION: MATHEMATIC METHODS OF ESTIMATION

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ABSTRACT

The article is devoted to the methods of revenue formation of the Pension system. Effective functioning of the Pension system in any country depends on the applied methods of revenue formation of the State Pension system. Thus, the problems of the Russian pension system disclosed in the article are caused by the inefficient methods of revenue formation of the Pension Fund of Russia. The theoretical views on conditions that determine the quality of the work of the pension system are reviewed. The methods of revenue formation of State pension systems in different countries of the world and conducted pension reforms are analyzed. The studies evaluating the effectiveness and sustainability of State pension systems usually use mathematical methods and actuarial calculations. Mathematical apparatus applied in the article allowed calculating the formal conditions of balance of the State pension system, considering compliance with the equivalency and compensatory contributions and payments. The publication outlines the mathematical formulas that describe the conditions of equivalence and retribution observance. The study revealed that the methods of revenue formation of State pension systems are social insurance and social security. Social insurance applies the techniques of pension social risks redistributing insurance and social security uses tax tricks redistribution of the National income. The method of social security reduces the motivation of contributors to pay obligatory payments to the State Pension Fund. Therefore, in Russia there is significant evasion. The authors considered using the distribution and accumulation method of revenue formation of the State Pension system. The article demonstrates that, various methods of revenue formation of the State Pension system are actively used in the world

HIGHLIGHTS

1. The balance between the pension system revenue and the expenses for pensions is an important characteristics of a national pension systems

2. The stability of the pension system based on the distribution method of forming revenue is ensured by the compliance of the insurance premium tariff with the macroeconomic and demographic conditions of the country's development; the stability of the pension system based on a funded method of forming revenue is ensured by the real annual return of pension savings placed in investment assets

3. The Russian pension system is unbalanced due to the significant scale of evasion from the pension insurance contributions

4. Mathematical calculations have shown that solving the problems of the Russian pension system is possible by increasing the motivation of citizens and organizations to pay the pension insurance contributions; expand the application of the funded method of pension system revenue formation and ensure a real level of return on the assets of pension savings

МИРОВОЙ ОПЫТ И РОССИЙСКАЯ ПРАКТИКА ФОРМИРОВАНИЯ ДОХОДОВ ПЕНСИОННОЙ СИСТЕМЫ: МАТЕМАТИЧЕСКИЕ ПРИЕМЫ ОЦЕНКИ

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АННОТАЦИЯ
Статья посвящена исследованию методов формирования доходов пенсионной системы. Эффективность функционирования пенсионной системы любой страны мира во-многом определяется применяемыми методами формирования доходов национальной пенсионной системы. Поэтому раскрытые в статье проблемы российской пенсионной системы в немалой степени вызваны неэффективным применением методов формирования доходов Пенсионного фонда России. Рассмотрены теоретические взгляды различных авторов на условия, определяющие качество работы пенсионной системы. Проанализированы методы формирования доходов национальных пенсионных систем, применяемые в различных странах мира, и проводимые в них пенсионные реформы. Выявлено, что исследования, посвященные оценке эффективности и устойчивости функционирования пенсионных систем обычно опираются на математические методы, а также актуарные расчеты. Примененный в статье математический аппарат позволил рассчитать формальные условия сбалансированности национальной пенсионной системы с учетом соблюдения эквивалентности и возмездности взносов и выплат. В публикации изложены математические формулы, описывающие условия соблюдения эквивалентности и возмездности. В ходе исследования было выявлено, что методами формирования доходов пенсионной системы является социальное страхование и социальное обеспечение. Социальное страхование применяет страховые приемы перераспределения страхуемых в пенсионной системе социальных рисков, а социальное обеспечение использует налогово-бюджетные приемы перераспределения национального дохода. При этом метод социального обеспечения снижает мотивацию плательщиков уплачивать обязательные платежи в государственный пенсионный фонд. Поэтому в России наблюдаются значительные масштабы уклонения от их уплаты. Авторами рассмотрено использование распределительных и накопительных методов формирования доходов национальных пенсионных систем. В статье продемонстрировано, что в странах мира активно используются различные методы формирования доходов национальных пенсионных систем, опыт которых может быть востребован в России

КЛЮЧЕВЫЕ СЛОВА
Пенсия, пенсионный фонд, пенсионное страхование, доход, налог, дотация, уклонение от уплаты налогов, математические методы, пенсионные накопления, международный опыт

ОСНОВНЫЕ ПОЛОЖЕНИЯ

1. Важнейшей характеристикой национальных пенсионных систем является сбалансированность между собранными доходами и расходами на выплату пенсий

2. Устойчивость пенсионной системы, основанной на распределительном методе финансирования, обеспечивается благодаря соответствию тарифа страхового взноса макроэкономическим и демографическим условиям развития страны; для пенсионной системы, основанной на накопительном методе, устойчивость определяется обеспечением реальной годовой доходности пенсионных накоплений, размещенных в инвестиционные активы

3. Российская пенсионная система является несбалансированной из-за значительных масштабов уклонения от уплаты страховых взносов

4. Проведенные в ходе исследования математические расчеты показали, что решение проблем российской пенсионной системы возможно за счет повышения мотивации граждан и организаций к уплате страховых взносов, а также за счет расширения применения накопительного метода финансирования и обеспечения реального уровня доходности активов пенсионных накоплений

Introduction

Russian Pension system is in crisis. The average month pension size in 2016 was 180$ US, it doesn't meet the requirements of the Convention of the International Labor Organization of June 4, 1952 No. 102 "On Minimum Standards of Social Security", where the size of the pension is 40 % of the prior salary of a pensioner. The average pension in Russia in 2016 was 34 % and it has not reached the required size for the last 20 years. Meeting social responsibilities in social sphere is getting more complicated by the fact that recently about a half of Russian Pension Fund revenue is made by the grants from the federal budget of Russia, but not the fund's own finance, and at the same time a significant extent of the shadow economy takes place as well as evasion from payment of pension insurance contribution caused by the lack of payers' trust to the State pension system. According to experts' opinion, about a half of payers hide their income from taxation on contributions to compulsory pension insurance. The efficiency of State pension system functioning depends mostly on the applied methods of generating revenue.

Literature review

The issue of national pension system revenue formation is considered in the works of various authors. Taking into consideration the fact that the mechanism of social risk management is the basis of national pension system, a number of works are devoted to the methods of social risk management. Having endogenously inherent social risks creates the necessary prerequisites for designing the ways of their assessment, measurement, decrease and prevention. The totality of these methods forms a mechanism for managing social risks. This mechanism is based on the condition that one can determine more or less veraciously the material damage as a result of social risks implementation. V. D. Roik says, "The risk nature and the degree of its probability allow working out the system of preventive prophylactic measures to reduce the risk and to evaluate the necessary types and scale of the compensation means — compensation payments, replacing the lost salary" [1, p. 30]. Similar problems are considered in the works by T. A. Fyodorova [2, p. 82–83], D. Y. Fedotov [3, p. 386–395].

A significant number of foreign publications are devoted to considering the methods of national pension system revenue formation in various countries. N. Barr writes about the international trends of national pension system development [4]. N. Barr and P. Diamond criticize the World Bank activity on the promotion of pension reforms implementation in various countries [5]. The number of works demonstrates the peculiarities of pension systems functioning in certain countries. B. Bothworth and G. Burtless worked

on the methods of national pension system balancing applied in the USA [6]. The studies of pension fund investments was carried out in Australia by A. Basu and M. Drew [7]. Certain aspects of pension funds formation and management in Chile are considered in the research of S. Bewrstein, G. Larrain, and F. Pino [8].

The analysis of pension system functioning on order to evaluate their efficiency and the sustainability of their functioning usually relies on mathematical methods and actuarial calculations. Application of mathematical methods in pension fund revenue formation is demonstrated in the publications by A. P. Arkhipov [9], H. Gerber [10], G. I. Falin [11], H. Ferr, S. Jokisch, M. Kallweit, F. Kindermann, L. J. Kotlikoff [12].

At the same time modern studies focus on the research of distributive and accumulative methods of financing, and are mostly limited by describing the main characteristics of certain pension insurance systems [13–16], which might be enhanced by providing the standard conditions of a certain level of a pension system balance with the condition of comply with the equivalence and reimbursement of contributions and payments and applying the mathematical apparatus as shown below.

Applied methods and approaches

The formation of the State Pension Found is caused by the need to redistribute the consequences of social risks due to loss of labor income of economically active population. At present there are several mostly spread methods of social risk management, two of which are the alternative methods shown on Figure 1.

The difference between the methods of social insurance and ones of social security shows in the fact that social insurance has key insurance signs, which often do not exist in the method of social security that is based on tax-budget ways to finance social expenses. Because of that the methods of social risk management differ according to the degree of insurance sign implementation (Table 1).

The only insurance characteristic, which exists in both social security and social insurance, and gives the opportunity to the mutual exchange of the given methods of social expenses funding is the probabilistic character of the start for the ground for social payments. In both cases not all citizens implement their right to receive social payments, but only several people. This common characteristic is caused by the essence of the objects of these forms of social finance, which is social risk with its random character of implementation.

Dividing the concepts of social insurance and social security as the alternative methods of financing social expenses by the state requires to divide the methods of resource mobilization for their implementation. The first is based on the insurance principles, and the second is based on the principles of taxes. The main financial source of the compulsory social insurance system is insurance premium. This differs the methods of compulsory insurance from social security, which uses the
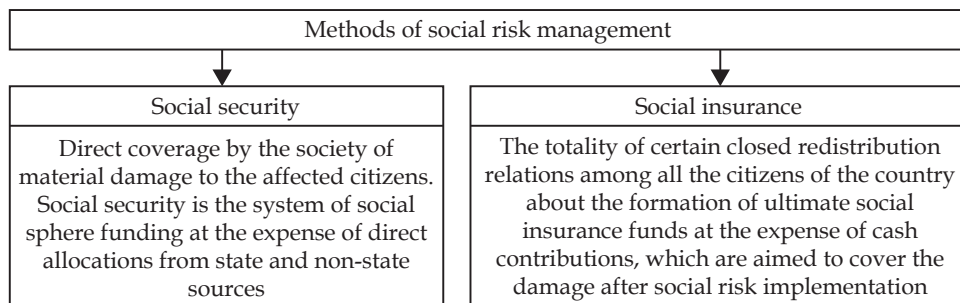
Methods of social risk management	
Social security	**Social insurance**
Direct coverage by the society of material damage to the affected citizens. Social security is the system of social sphere funding at the expense of direct allocations from state and non-state sources	The totality of certain closed redistribution relations among all the citizens of the country about the formation of ultimate social insurance funds at the expense of cash contributions, which are aimed to cover the damage after social risk implementation

Figure 1. Comparison of the character of insurance sign simplementation in social security and social insurance

tax mechanism of revenue mobilization, since the economic nature of insurance premiums differs from taxes and has not a fiscal, but compensation character, and is a deferred part of the wage aimed at the coverage of insurance cases.

The process of social risk management exists in a more or less degree at most studies of the general reproduction process.

The process of reproduction includes four stages of a new value creation:

production, distribution, exchange, and consumption. The relations of risk management take place at the stages of production, distribution, and consumption. Figure 2 demonstrates the scheme of creating and redistribution of value in the process of social risk management. The reproduction process is shown at Figure 2 in a reduced variant, the stages of cost movement which are not connected with social risk management are excluded.

Table 1

**Comparison of the character of insurance sign implementation
in social security and social insurance**

| An insurance sign	Social insurance	Social security
The distribution of material damage in time and space	Yes: There is damage due to social risks; it distributes among all citizens paying insurance (distribution in space), and during the whole period of pensioner's work (distribution in time)	No: There is no redistribution, the damage is covered by the state
Recurrence of financial payments	Yes: The working citizens are returned the deferred part of the product made by them	No: There is one way moving of finance from the financial aid giver (the state) to its receiver
Presence of the main insurance subjects	Yes: Insurance subjects (insurant, insurer, insured) take an obligatory part in the system of social insurance	No: Two subjects are enough for the organization of social security relations — the representative of a social payment, and the receiver of a social payment
Probabilistic character of the start for the ground for social payments	Yes: The probabilistic character is the feature of the given management method object — social risk	No: The probabilistic character is the feature of the given management method object — social risk
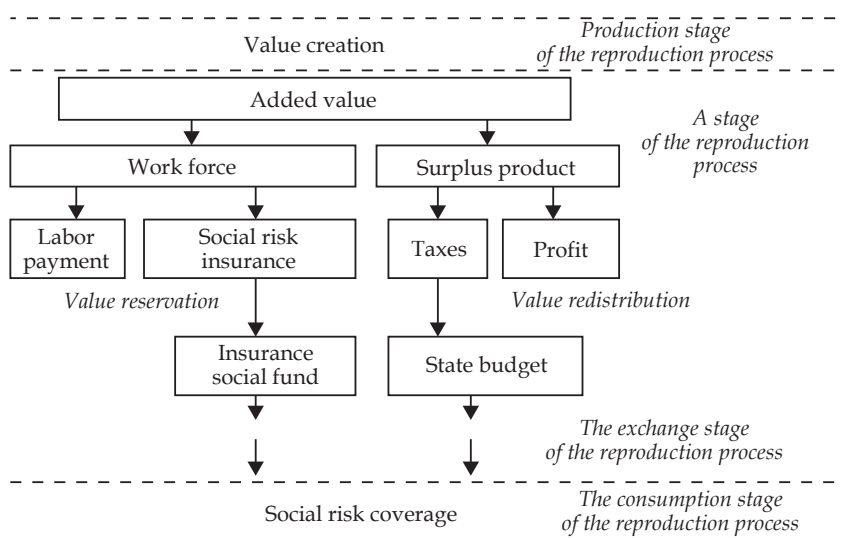
**Figure 2. The chart of creation and redistribution
of value in the process of risk management**

The reproduction process starts with the production stage, when the added value is created in all production and social spheres of the state; the aggregate value added in the process of goods, services, and work production makes gross national product of the country. Social risks are endogenous to the carriers — the hired workers, whose labor ability is a factor of production. Thus, labor as a factor of production, which takes part in creating a new value, brings social risks to the production stage of the reproduction process. This stipulates the necessity of social risk management system organization, which usually includes preventive measures aimed to decrease the level of social risks having professional character at this stage of the reproduction process.

Social risks are implemented in the lives of their carriers with a more ore less probability degree. So, the relations aimed at social risk management are built at the stage of reproduction process distribution during value redistribution relations. The value added at the production stage is created at the expence of estrangement of a part of the necessary product from the produced product value. The part of the necessary product is intermediate consumption at the production stage (raw material cost, equipment depreciation, etc.). In turn, the added value is distributed between the remained part of the production costs, covering labor ("workforce" at Fifure 2), and added product.

The established social risk management methods (social security and social insurance) arrange the process of value redistribution in different ways to cover social risks. Social insurance method means redestribution of risks among their carriers based on the reservation of a part of the added value in an insurance social fund.

The alternative method of social security is based on redestribution of revenue: here the added value primarily distributed among the participants of the production process is subject to the distribution through taxes by the state budget mechanism.

The relation of social risk management do not occur at the stage of the re-

production process, because a social risk carrier — a hired worker does not take part in the relations that occur during the process of product buying and selling.

Consumption of the added value takes place at the stage of reproduction process consumption. One of the consumption forms is social risk coverage. The considered methods of social risk management apply the alternative technologies of social risk coverage. Social insurance method means individual measurement and calculation of risk level determined by the individual characteristics of its carrier (the qualification of a hired worker and his labor productivity). The method of social security means equalizing procedure of social risk measurement and calculation, which is covered from the budget at the expence of the collected taxes.

The system of Russian compulsory pension insurance is grounded on the combination of both social security and social insurance methods. It is demonstrated by the fact that a part of Russian Pension Fund revenue comes in a form of insurance premiums (by the social insurance method), and another part comes in a form of grants from the federal budget of Russia, which, in turn, is formed at the expence of the tax sources (by the social security method). There are two ways to form the insurance premiums that go to the Pension Fund of Russia: distributive and cumulative.

According to the distributive way funding of pension payment is done at the expence of insurance premius paid in the same period, and its balance as a mathematical construction can be expressed with the following formula:

$$Sb_N + (Su) = Sw_N + (T), \qquad (1)$$

where Sb_N — the volume of pension payments in period N; Su — the surplus of receipts over payments; Sw_N — the volume of premiums in period N; T — the surplus of payments over receipts.

The amount of old age pension payments in the period is calculated on the formula

$$Sb_N = \sum_{j=N-t-m}^{N-t} \sum_{i=0}^{W_j} \left(\overline{\sum_{k=N-t-m}^{N} PR_{i,\,k}\, I_{k,N}} \cdot A \right), \quad (2)$$

where j — the years of payers' birthc $N - t - m$ до $N - t$; m — the number of ages from t to 100; t — a generally established age of old age pension assignment; W_j — the participators of j year of birth; I — the payer of j year of birth; $PR_{i,k}$ — annual remuneration fund I of a payer in the year k; $I_{k,N}$ — indexation of contributions k of the year in year N;

$$\sum_{k=N-t-m}^{N} \overline{PR_{i,k}I_{k,N}} \cdot A \ -$$

the amount of old-age pension payments to the participant in the period N;

$$\sum_{i=0}^{W_j} \left(\overline{\sum_{k=N-t-m}^{N} PR_{i,k}\,I_{k,N} \cdot A} \right) \ -$$

the amount of old-age pension payments to the participants j of the year of birth in the period N.

At the time N participants make contributions in the amount of, calculated with the formula:

$$Sw_N = \sum_{j=N-t}^{N} \sum_{i=0}^{W_j} PR_{i,k} Rst_j, \qquad (3)$$

where $PR_{i,N}$ — annual remuneration fund i of an insured person in a given year N; Rst_j — an insurance contribution rate according to the distribution component for i participant j of the year of birth; W_J — the participants paying N;

$$\sum_{i=0}^{W_j} PR_{i,k} Rst_j \ -$$

the sum of contributions from participants j of the year of birth.

The insurance premium rate is determined on the basis of a sufficient level of income compensation with socially determined period of contributions and payments according to the formula:

$$Rst_j = \frac{A\overline{m}}{\overline{n}}, \qquad (4)$$

where Rst_j — payer's contribution rate j of the year of birth; A — a sufficient level of income compensation; $\overline{m}$ — the average period of payments; $\overline{n}$ — the average period of contributions.

In the conditions of the balanced distribution method of financing the value Su and T of the formula (1) are absent, then we put data Sb_N from (2) and Sw_N from (3)

into (1) with the change Rst_j for the value from (4) and receive the formula:

$$\sum_{j=N-t-m}^{N-t} \sum_{i=0}^{W_j} \left(\overline{\sum_{k=N-t-m}^{N} PR_{i,k}I_{k,N}} \right) = $$
$$= \sum_{j=N-t}^{N} \sum_{i=0}^{W_j} PR_{i,k} \frac{\overline{m}}{\overline{n}}. \qquad (5)$$

So, formula (5) allows determining the conditions of resources provision for payments under the influence of external factors. In terms of the stable demographic structure (constant value of the demographic burden of old age pensioners) the volume of payments should match the fund of wage, multiplied by the ratio of the period of payment implementation to the period of contribution implementation. Macroeconomic changes result in the decrease of wage fund in economy, and the sum of coming contributions might be compensated by increasing the contribution rate or decreasing the average pension payment, with the changes of the corresponding parameters shown through the formula (5) change.

In terms of a constant real size of the wage formula (5) will be

$$\frac{\sum_{j=N-t-m}^{N-t} \sum_{i=0}^{W_j} \square}{\sum_{j=N-t}^{N} \sum_{i=0}^{W_j} \square} = \frac{\overline{m}}{\overline{n}}. \qquad (6)$$

Formula (6) characterizes the demographic aspect of pension insurance system sustainability based on the distributive method of funding, i.e. the coefficient of demographic support for the elderly should match the average repayment period to the contribution period. The growth of life expectancy ($m</s>$) can be compensated by the increase in the average contribution period ($\overline{n}$), according to the right-hand side of formula (6). The increase of payments due to the growth in the number of pensioners ($\sum_{j=N-t-m}^{N-t} \sum_{i=0}^{W_j} \square$) needs to change the number of the payers correspondently ($\sum_{j=N-t}^{N} \sum_{i=0}^{W_j} \square$) with the unchangeable level of rate to provide formula (6) or to change the insurance contribution rate. It is necessary to notice that economically insurance payments are a form of withdrawal of a part of wages, which provides the delayed consump-

tion in connection with the onset of the inevitable risk of disability due to old age, disability, or loss of breadwinner. In connection with this their growth conditioned by the decrease in the number of workers related to the number of receivers due to the demographic reasons leads to the economically not grounded growth of labor costs which contradicts modern economic situation in Russia.

On the other hand, solving the problem of Russian Pension Fund disbalance, which is caused by demographic reasons, leads to the decrease of correspondence between pension payments and former individual incomes. These circumstances show the inner contradictions characteristic to the distributive method of financing.

Generally negative influence of macroeconomic and demographic indicators on the maintenance of pension insurance system provision based on the distributive financing method by its own means might be changed by the change of the parameters, i.e. by implementing formula (5) or by increasing the level of involvement of the insurance payers, decreasing the share of hidden and mixed incomes.

At the stage of the development of compulsory pension insurance the leading role of the distributive method of financing was conditioned by the favorable macroeconomic and demographic situation characterized by the growth of the number of payers, real wage, a high coefficient of pensioner demographic maintenance. As notices E. V. Ageeva, aging of the world population is caused by the result of two long-term trends: the decrease of birth and the increase of the average life expectancy, which causes the second "demographic transition", connected with forming the new model of balance in the age structure of the population with the increase of the gap between biologic and "social-economic" aging [17, p. 23]. The rise of labor productivity and increase of the payroll fund in the GDP structure do not overlap the negative impact of the changes, which leads to insecurity of distributive pension systems with their own resources, need for external stabilization donations, the opportunities to use which are limited in the conditions of budget reduction and due to economy development cyclicity.

The cumulative method is different from the conditions of compulsory pension insurance system balance, based on the distributive method of funding, which requires that the coming insurance premiums correspond pension payments. The cumulative method is characterized by the sustainability of the corresponding system of pension insurance, which is determined by the individual correspondence of the premiums paid and the investment income received to the sum of the pension payments, when there is a risk of decrease of the real pension payment amount or the lack of funds as a result of low investment return in the payment portfolio, which can be confirmed by the calculation.

In this case the amount of individual accumulative pension payments is calculated by division of the accumulated by the time of reaching the age of pension appointment amount of pension savings and investment income for the statistically established expected period of payments.

The years' volume of individual funded pension payments in the first year of receiving is determined with the formula:

$$P_1 = \frac{S_0}{T},$$

where P_1 — is the amount of funded pension payments in the first year; S_0 — is the amount of the pension savings at the moment of payment establishment; T — is the expected period of pension payment in years.

The individual volume of pension savings taking into account the investment income in a year can be calculated by the formula:

$$S_1 = (S_0 - P_1)I_1 = \left(S_0 - \frac{S_0}{T}\right)I_1 = S_0 I_1 \left(1 - \frac{1}{T}\right),$$

where S_1 — is the amount of pension savings at the time of determining the volume of payments in the second year; I_1 — is the return on investment in pension savings in the first year.

Then the volume of payments in the next year is determined by the formula:

$$P_2 = \frac{S_1}{T-1} = \frac{S_0 I_1}{T}.$$

The individual amount of pension savings taking into account the investment income in two years from the moment of appointment of the funded pension can be calculated by the formula:

$$S_2 = (S_1 - P_2)I_2 =$$

$$= \left(S_0 I_1 \left(\frac{T-1}{T} \right) - \frac{S_0 I_1}{T} \right) I_2 = S_0 I_1 I_2 \left(1 - \frac{2}{T} \right),$$

where S_2 — is the individual amount of pension savings, taking into account investment income two years after the appointment of a funded pension; I_2 — return on investment pension savings in the second year.

By analogy, the volume of payments in year N is calculated by the formula:

$$P_N = \frac{S_{N-1}}{T-N} = \frac{S_0 I_1 I_2 \dots I_{N-1}}{T-N} = \frac{S_0 \prod_{z=1}^{N-1} I_z}{T-N}.$$

The individual volume of pension savings taking into account the investment income in a period of N years from the moment of appointment of a funded pension can be determined by the formula:

$$S_N = (S_{N-1} - P_N)I_N =$$

$$= S_0 I_1 I_2 \dots I_N \left(1 - \frac{N}{T} \right) = S_0 \prod_{z=1}^{N} I_z \left(1 - \frac{N}{T} \right).$$

At the end of the expected period of funded pension payment, the entire amount of individual savings and investment income is converted into payments, according to formula:

$$S_T = S_0 \prod_{z=1}^{T} I_z \left(1 - \frac{T}{T} \right) = 0.$$

Thus, the correspondence of the individual amount of pension savings and investment income to the amount of pension payments makes up the precondition for ensuring the financial stability of the funded pension insurance system. However, A low level of investment return may lead to a decrease in the purchasing power of pension payments or inadequate funds while maintaining the level of payment.

The parameters which determine the sustainability of the pension system based on the cumulative method, as N. Y. Borisenko [13, p. 64] writes, are the pension contribution rate, the rate of return on the invested assets, the ratio of the number of persons paying contributions, and the recipients of pension payments, according to the formula:

$$tVL + rN = WP + \Delta N,$$

where t — is pension contribution rate; V — is the average wage in a year; L — the general number of workers; r — rate of return on invested assets; N — pension reserve; W — average annual pension; P — the general number of pensioners; ΔN — increment of pension reserve.

The increment of pension reserve is caused, on the opinion of *N*. Barr [18], by the fact that the demographic changes cause reduction of manufacturing, decrease of contributions received, and change in the ratio of supply and demand either in the commodity market or in the securities market.

The noted circumstances demonstrate the lack of direct influence of demographic changes on them from the position of maintaining the sustainability of pension systems, and lead to the problem of ensuring the real yield of pension assets.

The system of pension insurance based on the cumulative method has the following characteristics [16, p. 14; 19, p. 21]:

– a low level of political risks;

– taking into account contributions and investment income, while investment income plays a very important role in securing future payments, since it should not only protect pension contributions from the effects of inflation processes, but also ensure real profitability;

– a high level of motivation to pay contributions in full and on time;

– forming resources to provide long-term investments;

– involving the population into the process of decision-making on contribution management;

– imposing the risks of losing a part of capital in investing or a lack of savings for the future payments on the participants;

– the opportunity of transferring the obtained pension rights through professions, branches and countries in the conditions of dynamic developments of international mobility on the labor market.

This is the reason why funded pension systems face the additional risks which are not characteristic of the distributive systems. They are such risks as the risks connected with the inadequate management of pension savings, with the cyclical nature of investment processes, with a change in the actuarial value of pension annuities. None, even the most perfect system of insurance can protect a worker from the risk of a changing real rate of return on pension assets. Among other things, administration costs of the funded pension system are much higher than the costs of managing the distribution system.

The funded system of pension insurance requires regulating the procedure of attracting and informing the participants about the opportunities and consequences of their choice including the use of standard information disclosure measures which consider also low educated people. The information is often given in the legal language and is not clear to the participants of the system. This makes the choice of the pension saving investment more difficult [20, p. 21].

Applying the cumulative method needs to introduce individual saving accounts, receiving real investment yield, working out the mechanism of investment risk decrease, and the need for minimizing investment costs, which requires working out the mechanism of pension saving management.

Methods of financing pension insurance are refracted through the prism of social policy, conceptual approaches and the role of compulsory pension insurance, especially the formation of rights and determination of payments in various countries of the world.

Analysis of the results

The considered methods of social risk management are applied in different ways in pension systems of Russia and other countries. This leaves an imprint on the nature of functioning of financial relations in national pension systems. It is possible to see the differences in providing the balance of national pension systems.

National systems of guaranteed pension protection solve the tasks of providing some guaranteed amount of payments to maintain a minimum standard of living at the expense of the state budget. One can distinguish the following types of payments:

– basic pensions — are established in the following amounts: fixed or dependent only on the number of years of contributions payment, while additional sources of income do not influence the amount of payment;

– targeted pensions — are paid at a higher rate to less well-off recipients and to a lesser extent to recipients with large income, and certain types of income are taken into account;

– minimum pensions — are established depending on the amount of payment within the insurance level, provided that contributions are paid within a certain period.

The insurance level is to guarantee a certain payment rate of lost income replacement (or the achievement of desired income in separate countries) in the following forms:

– established payments — the amount of the pension payment depends on the number of years worked, deductions and individual earnings during the work;

– established contributions — the size of the pension payment is determined based on their amount of contributions paid and investment income;

– the system of pension points — individual earnings, taking into account the payment of contributions, are converted annually into pension points, the amount of payment is determined by multiplying the sum of points by the cost of a point in the year of applying for a pension;

– savings account — the amount of the pension depends on the amount of contributions paid and their indexation on the level of inflation, GDP growth or real wages that go to the flow of payments;

– the established credit — the size of payment is established by the government, which depending on age defines the norm of deductions.

Table 2

**Distribution of the number of schemes used to finance pension payments
by the regions of the world**

Typological feature	Region/ Institutional feature							
	OECD with high income		Eastern Europe and Central Asia		Latin America and the Caribbean		Middle East and North Africa	
	govern-mental	private	govern-mental	private	govern-mental	private	govern-mental	private
The distribution level								
Basic pensions	9	–	4	–	1	–	–	–
Targeted pensions	20	–	4	–	8	–	–	–
Minimum pensions	8	–	7	–	–	–	9	–
The cumulative level								
Established payments	15	3	5	–	2	–	10	–
Established contributions	1	3	–	7	–	9	–	–
The system of pension points	3	–	3	–	–	–	–	–
Saving accounts	1	–	2	–	–	–	–	–
The established credit	–	1	–	–	–	–	–	–

The analysis of the levels and types of pension payments funding in various countries[1] (Table 2) shows that the state pension system solves the tasks of providing social stability and maintenance of a certain level of income of poor people with respect to the average wage in a certain country.

In OECD countries, Latin America and the Caribbean the level of incomes is high — mainly due to targeted surcharges; in the countries of Eastern Europe and Central Asia, the Middle East and North Africa the income is high at the expense of fixed payments. The level of payments in relation to the average wage in the regions of the world varies up to 50 % re-

gardless of the level of economic development, however, a higher level of income support prevails in higher-income OECD countries (Table 3).

Table 3

The maximum levels of pension payments within the framework of state pension provision in relation to the average wage in the economy by regions of the world

The indicator	The region			
	OECD with high in-come	Eastern Europe and Central Asia	Latin Ameri-ca and the Ca-ribbean	Middle East and North Africa
Distribu-tion level, % of average salary				
Up to 20	3	5	1	2
20–30	7	4	5	4
30–40	10	1	1	2
More than 40	3	2	0	2
The amount of payment for employ-ees with full employment history, %				
Up to 20	1	5	1	2
20–30	7	4	4	4
More than 30	16	1	3	4

Note: The table is compiled according to the World Bank data [21, pp. 21–25].

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[1] The analysis is based on the following countries: OECD countries with high income - Australia, Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Japan, Luxembourg, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Japan; countries of Eastern Europe and Central Asia — Bulgaria, Hungary, Latvia, Lithuania, Poland, Slovakia, Turkey, Czech Republic, Croatia, Estonia; countries of Latin America and the Caribbean — Argentina, Dominican Republic, Colombia, Costa Rica, Mexico, Peru, El Salvador, Uruguay, Chile; the countries of the Middle East and North Africa - Algeria, Bahrain, Djibouti, the Arab Republic, Egypt, Jordan, the Islamic Republic, Iran, Yemen, Libyan Arab Republic, Morocco, Tunisia. In the case of using more than one scheme in the national compulsory pension insurance system, accounting is carried out for each scheme. Note: the table was compiled according to the World Bank data [21, p.13–14].

There are the schemes with the established payments in the frames of the compulsory insurance level (Table 2). It is necessary to notice that the difference of the schemes based on the distributive method of funding is in the order of pension rights fixing. In general the amount of the pension depends on the length of employment history, payment of contributions, and the amount of individual income. The degree of equivalence of the really paid contributions to the amount of payments is determined by the social policy measures implemented in each country.

The analyzed schemes with the established methods of insurance level are grounded on the cumulative method of funding. The amount of the pension payment depends on the amount of contributions paid or on the amount of the saved capital on the investment accounts by the end of the working activity. In Eastern Europe and Central Asia they add the scheme based on the distributive method with the exception of several countries such as Slovakia, Turkey, and the Czech Republic. These schemes are basic in the countries of Latin America and the Caribbean, except Costa Rica and Uruguay. Provided that the positive real yield to the savings is ensured, the scheme ensures full equivalence of the contributions paid to the amount of pension payments. The dynamics of the average in the region pension net replacement rate, depending on the level of income (Table 4), indicates their higher values for low individual earnings, which is achieved through the use of schemes of state co-financing.

The decline in replacement as income increases is related to the establishment of a salary ceiling for the calculation of pensions in order to ensure the stability of the expenditure structure and to limit the growth of the compulsory insurance level of pension systems with the exception of the countries in the Middle East and North Africa, where the change in the replacement rate is almost linear.

It should be noted that the net replacement rates within the average level of individual income in the economy by

Table 4

Net norms for replacing earnings with pensions, depending on the level of income for compulsory pension programs for men, share % of pre-retirement income

The indicator	Individual earnings relative to the average					
	0.5	0.75	1	1.5	2	2.5
OECD countries with high income						
Average value	85.7	73.1	67.9	62.6	57.7	52.8
Standard deviation	15.7	16.5	19.3	23.7	25.6	26.6
Minimum value	61.4	47.0	36.6	27.4	21.9	18.1
Maximum value	125.0	115.0	109.8	105.6	104.2	100.1
Countries in Eastern Europe and Central Asia						
Average value	78.1	75.1	73.3	71.4	67.0	62.8
Standard deviation	17.0	14.9	14.8	17.5	15.4	13.7
Minimum value	58.2	59.4	58.2	42.9	35.3	31.0
Maximum value	113.2	106.7	103.3	99.9	92.6	81.8
Countries in Latin America and the Caribbean						
Average value	87.9	72.3	66.0	60.6	57.5	55.4
Standard deviation	31.3	29.1	29.6	27.1	23.3	20.9
Minimum value	50.4	43.4	39.3	37.3	31.6	32.6
Maximum value	125.1	125.3	125.4	110.8	103.2	103.2
Countries in the Middle East and North Africa						
Average value	90.5	87.5	88.0	87.4	86.7	84.7
Standard deviation	26.2	24.2	24.1	22.4	22.2	23.6
Minimum value	48.7	42.8	43.4	44.7	45.3	44.6
Maximum value	141.9	124.2	124.2	126.5	129.5	131.3

Note: The table is compiled according to the World Bank report [21, p. 51–52].

periodic payments exceed in almost all countries the proposals of the 102nd International Labor Organization Convention on Minimum Standards of Social Security, with the exception of Ireland.

Compulsory insurance pensions under various schemes are aimed at the equivalent of length of service and income replacement of individual pre-retirement income, the levels of which are predetermined by the importance of social policy and the economic conditions of a particular country.

Within the insurance level, mandatory pension insurance schemes are based on the distribution method of financing except for Australia, Argentina, the Dominican Republic, Colombia, Mexico, Peru, El Salvador, Chile. In Denmark, Sweden, Bulgaria, Hungary, Latvia, Lithuania, Poland, Croatia, Estonia, Costa Rica, Uruguay, the pension insurance system includes a component based on a cumulative method of financing.

Prevailing of the cumulative method of funding in the systems of compulsory pension insurance caused reforming of national pension systems of the developed and developing countries in terms of changing macroeconomic, demographic, and social conditions. R. Holzmann [16, p. 2] writes that the consequences of the global financial crisis have led to the reassessment of the forecast for the development of world pension systems and approaches to their reform.

Changing approaches to the policy of reforming pension systems is determined by the following factors:

– the objective need for reforms due to population aging and increase in retirement age;

– the lessons learned from the global financial crisis;

– the evaluation results of the consequences of the cumulative schemes implementation in terms of the real investment return level and the fiscal limitations of financing the transition period deficit.

In the OECD high-income countries, compulsory pension insurance reforms were parametric in nature, and consisted of lowering the threshold for assessing

contributions, increasing the contribution period, encouraging a later application of the person for the appointment of a pension, raising the retirement age, in order to ensure sustainability, which was achieved in some countries. In a number of countries, saving schemes were introduced with a personalized (individual) account of the contributions paid and their subsequent use for payment to current recipients. This innovation was realized in the second half of the 1990s in Italy, Latvia, Poland, Sweden, Eastern Europe and Central Asia.

The global economic crisis of 2008 allowed the world community to draw certain conclusions regarding the reform of pension systems:

– the fall in GDP below the pre-crisis level and the prices of assets of pension funds attract financial losses of pension systems;

– the budgetary consequences of the crisis make it difficult to finance the costs of the transition period and the introduction of cumulative elements. Problems in the balance of cash flows increase the budget deficit and the amount of public debt in the euro area, which are limited under the Maastricht Treaty. It does not take into account the fact that a clear increase in the current debt reflects a decrease in the implicit future obligations of the distribution pension systems and in a number of countries resulted in the diversion of assets from accumulative pension schemes. In Lithuania, the contribution rate has been reduced from 5.5 % to 2 in 2009 and 2010, with a subsequent increase to 6 % in 2012–2014 [22, p. 163];

– falling prices for assets of the investment portfolio allowed to expand the methodology for managing the life cycle of the investment portfolio, restricting the circulation of assets in the annuity to prevent losses;

– the financial crisis of 2008 confirmed objective estimates of the profitability of the allocation of savings and a high level of uncertainty. Expectations of high profitability in the 1990s did not materialize in the 2000s. The subsequent high volatility of assets and the absence of assets with

zero risk are characteristic of modern stock markets, raise the question of the future size of the funded pension, and, in general, of the very existence of schemes with secured financing of payments (funded). In this respect, recent data from countries such as Chile show an increase in the rate of wage growth, which is the indexation rate in the distribution systems, the rate of return on financial assets [16, p. 7].

Chile's experience showed that the transition to a fully funded system could not improve its financial sustainability, did not ensure broad coverage of workers with pensions, and did not lead to a stabilization of the financial situation of pensioners, especially those belonging to low-income groups of the population [22, p. 164], as a result, since 2008, along with a funded pension, solidary state pensions have been introduced in Chile.

In the Argentine pension system, only 41 % of employees participating in funded schemes regularly made payments. There were also problems with the investment of savings, most of which was placed in government debt denominated in national currency, the devaluation of which led to a depreciation of the assets of the funds. As a result, since 2009, Argentina has transferred pension savings to a single state pension system in order to guarantee the security of pension rights [22, p. 164].

The problems linked with the distributive method of funding itself enhance in the conditions of population's aging, and the devaluation of pension assets demonstrates the necessity to actualize the order of placement of pension savings assets.

The countries used the following mechanisms to decrease the risk of pension savings in the frames of the cumulative model:

– quantitative portfolio management that establishes a list of assets acceptable for investing pension savings indicating the maximum permissible share in the portfolio;

– establishment of general principles for the implementation of placements.

In the framework of quantitative portfolio management, strict restrictions on investment have been introduced in Japan, Switzerland, Germany, Denmark, Portugal, Belgium and Russia. The list of allowable assets might narrow due to implicit prohibitions related to the contradictions in the legislative acts governing the rules of investing in a particular type of asset, or the actual absence of authorized assets in the market. In addition, the procedure for implementing transactions with certain types of assets may be regulated, which can practically exclude them from the list of possible investment alternatives.

In the UK, control is exercised through monitoring the market value of the portfolio and its volatility. Based on the fund's total liabilities to depositors, the threshold value of the portfolio of assets is established. When approaching this value, the fund may be required to transfer pension savings to less risky and more stable investments. A variety of guarantees that provide a certain amount of payments are designed to reduce the impact of investment risks on participants in funded pension schemes. In Chile, the state acts not only as a regulator, but also as an insurer of the investment risks of the system.

In the United States, Canada, Australia, the United Kingdom, Ireland and the Netherlands, the authorities that monitor investment processes do not set quantitative restrictions on investment in assets, but use flexible rules. This, in turn, obliges pension funds and management companies to equally observe the balance of interests between high investment returns and the safety of trusted pension capital [20, p. 24]. It contributes to increasing the financial importance of pension funds and their becoming key participants in the financial market alongside with insurance companies and banks, as well as the expansion of risk-control methods used for the banking sector in a number of developed countries (Australia, Denmark, the Netherlands) and developing (Mexico) countries.

The most important factor in assessing and maintaining the effectiveness of the cumulative method of forming pension system's income is to minimize the costs of managing the assets of non-state pension funds and management compa-

nies, as well as insurance organizations. High expenses for investment activity (according to some calculations, the aggregate expenses for managing an individual account range from 20 to 30 % of possible savings with moderate returns and moderate wage growth) can lead either to waste of pension savings, or to a significant decrease in the future amount of payments compared with possible payments having a more effective method of asset management. High costs of private management companies are one of the main arguments against introducing such a method in the US and Canada, where there are no compulsory contributions to the funded pension system. In the world practice, there are several models of commission collection and control over costs.

In England since 2000 market methods have been used to control costs. There is a single form of information disclosure including the publication of information on cleared of commissions profitability. There are tax incentives that encourage management companies to invest through index funds with commissions that do not exceed 1 % of total assets.

The Swedish model allows mutual or pension funds to manage mandatory pension savings provided that the level of commission costs is maintained in accordance with the scale calculated by the regulator of pension funds. The scale is based on an analysis of management company's costs, its commission for investors who purchase shares in the free market, as well as the amount of funds raised by the funded system. Overly retained commissions are returned to investors.

In the United States, the rights to manage public sector pension funds are distributed at a tender every 2–4 year with an average asset management fee of 0.11 % of the value of assets, which is about ten times less than the commission of the average US mutual fund and half the commissions for index funds. This is achieved by keeping document circulation and recording funds in depositors' accounts by the federal treasury. A high average amount of savings on accounts helps to reduce costs. The implementation of centralized and transparent trades results in minimization of costs without excessive state regulation due to guaranteed amounts of contributions and limited competition.

In the Chilean model, the commission is levied once at a rate of 15.6 % at the time of the arrival of money into the system. Subsequently, only a nominal fee is collected from the assets for the maintenance of document circulation. Commission is not charged at the transition from fund to fund. The main disadvantage of this model is reduction of incentives for the successful operation in the management of funds and a rigid dependence of the fund's revenues on attracting new depositors.

At present the main problems facing national pension funds of most countries are [16, p. 14]:

– a decrease in pension differentiation;

– a decrease in the real size of pension payments due to the reduction in the number of employees and a decrease in productivity growth;

– revision of the financial mechanism to reduce the tax burden on workers and discrimination in the labor market;

– overcoming resistance to increasing the retirement age by certain age groups of voters;

– search for solutions for the portability of acquired pension rights through the profession, industry and countries, for increasing international mobility in the labor market.

Conclusions

The conducted research has revealed the influence of income formation methods of the national pension system (State pension system) on the sustainability of its functioning. In particular, the sustainability of the pension system based on the distributive method of funding is provided by matching the tariff of the insurance premium to the macroeconomic and demographic conditions of country development. For a pension system based on a cumulative method, sustainability is determined by ensuring a real annual return of pension savings placed in investment assets.

The analysis of pension systems of various countries revealed the negative impact of the global financial crisis of 2008, as well as demographic and social factors on national compulsory pension insurance systems based on the distribution method of funding. The influence led to parametric changes in OECD countries: a reduction in the ceiling of income for calculating insurance premiums and increasing the period of their payment, reducing the size of payments and raising the retirement age. In insurance systems based on a funded method of financing, the financial crisis contributed to the development of an asset management methodology in accounting the life cycle of a portfolio.

Thus, the solution of Russian pension system problems should base on an organic combination of income generation methods, firstly, increasing the receipt of insurance contributions for compulsory insurance (pension insurance contribution) by increasing the motivation of citizens and organizations in their payment, and, secondly, increasing long-term sustainability of the national pension system, by expanding the use of the cumulative method of funding and ensuring a real level of return on pension savings assets.

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