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INFORMATION ANALYTICAL CENTER"
ECONOMICS EXPERT GROUP

THE PENSION SYSTEM:

A MODEL FOR RUSSIA AND INTERNATIONAL EXPERIENCE

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The first part of the book describes the model of the Russian pension system designed by the Autonomous Not-for-profit Organization "Independent Actuarial Information Analytical Center (ANO "IAIAC). The purpose of the model, which constitutes the basic element of actuarial examination of the pension system, is to study the long-term financial prospects of the RF Pension Fund, which involved modeling its fundamental financial parameters, namely, pension contributions, notional and real accumulations, pension payments, and the size of the NDC and funded parts of labor pension for different groups of contributors and pension recipients.

When drafting the model, special emphasis was laid on the adequacy of its algorithms to the current and (or) prospective legislation, especially as regards the calculation of pension accumulations (notional for the NDC and real for the funded part of labor pension).

The second part of the book is a work reviewing international experience in the organization of public pension funds with elements of the funded system, as well as the mechanisms of government regulation of their work, including the choice of investment policy and management of the structure of the investment portfolio. The author analyzes the performance of public pension funds in different countries.

International experience can be used as "examples of best practice" in the course of RF pension reform.

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About the Independent Economic Analysis Series

The Independent Economic Analysis Series includes papers by participants in the program for the support of independent economic analytical centers in the Russian Federation. Its purpose is to give the public in Russia and outside it an informed idea of the scientific and analytical potential of the association of nongovernmental nonprofit centers dealing in applied economic analysis. Most or them are very young, especially if compared with the institutes within the Russian Academy of Sciences or the long established economic research and educational establishments. Nevertheless, they have already made an important contribution to public debate on such crucial economic policy issues as deregulation, advancement of socially responsible entrepreneurship, banking reform, tax policy, social sphere economics, and expansion of the country's foreign economic contacts. Many members of this economic expert community have the ear of key government officials in charge of economic reforms in Russia. The community is developing at a fast pace, embracing both well-known research establishments (e.g., the Institute for Economies in Transition, the "Public Contract" National Project Institute, the Fiscal Policy Center, the Leontieff Center, and the Institute of Urban Economics), and centers that are not yet known outside he professional community.

The social role of nongovernmental nonprofit centers for applied economic analysis is to provide easier access to professional economic examination. Although they do not attempt to supplant the academic institutes engaged in basic research or the analytical departments of industrial ministries drafting concrete economic plans; the community of independent professional analysts is can make an independent forecast of the consequences of decisions, suggest alternatives to the interested agencies, identify mid- and long-term development trends, and convince the public that action is essential. The community is a resource for political parties and public movements aware of the need for reform. In the situation when qualified personnel in the regions is scarce, the nonprofit centers for applied economic analysis can significantly raise the quality of the decisions made at the level of regions and municipalities.

This series provides a good idea of the potential of the community generally and of its more brilliant members who in 1999 – 2000 took part in the Program for the Support of the Independent Economic Analytical Centers. It publishes both narrowly applied works (analytical notes / thematic reports are the main product of the centers involved in the program) brought together in thematic collections, and larger monographic works (proving that these centers base their work on a solid scientific and methodological foundation).

The series does not aspire to present all the works produced within the Program or all the centers. participants in the program, as research establishments. Nevertheless, the publications within its framework are an effective way to popularize the Program's outcomes. We are planning to hold a presentation of the series and dispatch its products to the interested agencies, leading academic and university libraries in Russia and the United States; the publications within the series will be distributed during the events planned for the second stage of the Program, in 2003 – 2005.

Editors
of the Independent Economic Analysis Series

About the Program in Support of Independent Economic Analytical Centers in the Russian Federation

This Program is implemented by the Moscow Public Scientific Fund (MPSF) in collaboration with the Center for Institutional Reforms in the Non-formal Sector and Maryland University (IRIS), and is supported by the US Agency for International Development (USAID).

The purpose of the Program is to promote the establishment and development of Russian economic analytical centers and expand their capacity for high-quality independent analysis of the country's economic policy in the interests of both the government bodies which shape economic policy, and the civil society institutes which focus on social and economic development issues, so as to set up a national network of economic analytical centers and consulting analysts, and mobilize the inner intellectual and professional resources to deal with the economic problems facing Russia.

To achieve these goals, the Program distributes grants on a competitive basis, provides technical support to the recipients, helps popularize the outcomes of their studies, and promotes cooperation within the association of independent economic analysis centers.

Some outcomes of Program implementation in 1999 – 2002

At the first stage of Program implementation, 10 rounds of grant contests were held. The Program's expert council examined 588 applications and awarded 90 grants. The fact that there was, on average, 6.5 applicants for each grant indicates considerable interest in the Program on the part of the scientific community. 32% of the grants was awarded to research teams in the regions (outside Moscow and St. Petersburg).

The Program supported the establishment of 11 new independent centers for economic analysis, five of them in the regions. Network relations, which the Program promoted, helped found the Association of Independent Centers for Economic Analysis (AICEA), whose work is designed to raise the quality of economic policy in Russia so as to ensure its sustainable economic development, promote public welfare, advance the professional community, provide information to the public and involve it in a debate on economic development issues, and coordinate the work of the Association's members and champion their interests in government and other agencies.

The Program supported the establishment of an open-access database containing information provided, on a voluntary basis, by over 120 economic research establishments of Russia. It supplies the contributors' contact telephones and addresses and specimens of their analytical products. The database introduces the potential users of analytical products to the Association of Centers for Economic Analysis, gives the latter an opportunity to compare notes with colleagues so as to evaluate their own performance, and serves as an instrument facilitating and encouraging communication inside the expert community. Access to the database is through http://SETT.mpsf.org, as well as through the Chief Leaf Node of the MPSF's www.mpsf.org.

In 1999-2003, the Program held eight events (conferences, seminars, and round tables) dealing with various economic policy aspects. Counts such events held directly by the grant recipients, their number exceeded 100.

The Program and its participants – centers for economic analysis – make a point of conducting research with a definite addressee in view and making a practical use of the outcomes of their studies. The materials produced with the Program's support were used by the RF President's Administration, the RF Ministry for Economic Development and Trade, the RF Government Administration, the Analytical Department of the Administration of the Council of the Federation of

the RF Federal Assembly, the Finance Ministry, the Ministry for Agriculture, the Bank of Russia, and the RF Pension Fund. Works by the Program participants were used in the public discussion on many crucial economic reform issues, e.g., economic deregulation (papers of the "Social Contract" National Project Institute), alternative civilian service (Independent Institute for Social Policy), and pension system reform (Independent Actuarial Information Analytical Center), to name but a few. The Program participants in the regions provided information and analytical support to decision making at the level of Federation constituent members and local self-government bodies.

Program development prospects in 2003-2005

In 2003-2005, the focus will be on supporting the established independent centers for economic policy analysis which have made a name for themselves thanks to their earlier performance. The Program expects the contestants to suggest socially significant research subjects, adequately developed institutional development plans, and well-substantiated proposals on the forms and methods of introducing the interested organizations to the outcomes of their work, from users of economic analytical information to the general public. Somewhat larger support and more distant deadlines are planned correspondingly. At the same time, the standards set to the submitted applications will be raised, so that winning a grant may prove more difficult.

The Program will concentrate more than even at the first stage on the regions, the support of regional analytical centers. We intend to introduce small development grants, which will be awarded to regional centers if, in the view of the Program's Council, the lack of expertise prevents a regional center from drafting a work and development plan giving an adequate idea of its potential. Such grants will be used to provide consulting services to the center in question and give it an opportunity to compare notes with leading analytical centers in Russia and outside it, so that this center is better prepared to take part in the next contest for regular (basic) grants available under the Program.

The Program is planning to substantially increase technical support for the analytical centers, such as trainings designed to consolidate the organization management skills and raise its institutional stability, "centralized" events at which the results obtained by the grant recipients will be popularized (in addition to their own efforts towards this end), introduction of advanced foreign expertise in think tank development, building network relations, encouraging partnership relations among the centers, and the grant recipients' more active effort aimed at publishing the outcomes of their work.

V.N. Baskakov, A.L. Lelchuk, and D.V. Pomazkin,
Independent Actuarial Information Analytical Center

Modeling the Pension System of the Russian Federation[1]

1. Preface

Pension system modeling is the basic element of actuarial examination[2].

In the general case, actuarial examination implies that a trained actuary analyzes issues that are relevant to the operation of the given country's pension and/or insurance system and that involve future financial risks and uncertainties using specialized knowledge of applied mathematics, economics, finances, statistics, demography, and management.

In the presence of crises accompanied by a deterioration of the economic, social, and demographic situation and other undesirable processes which periodically occur in Russia, it is much more difficult to make effective decisions: the prevailing situation needs to be objectively evaluated so as to find effective solutions. This poses a natural question: is a society in the state of social and economic flux really doomed to a delayed response to the arising risks, factoring them in when they are more or less obvious? In our view, it is high time we tried to develop preemptive responses, which would go into action not after but before the risk has become evident. The following factors pave the way for adequate measures of this kind in the sphere of insurance:

1. Any insurance schemes and technologies are a source of risk for the various subjects of insurance, be it the policyholder,, the insurer or the insured (see below); many of these risks are usually known apriori.
2. These risks and their undesirable consequences often prove unexpected not because it is impossible, in principle, to predict them but because when the laws and statutes regulating the given type of insurance were being drafted, adequate steps were not taken.

It follows that today, under a radical reform of the pension system and the entire sphere of social insurance, we need to make a systematically organized effort to predict the risks posed by the introduction of new and the use of old insurance schemes and technologies, namely, provide complex analysis of both the draft laws and draft legislative resolutions and decisions on insurance and pension provision. In our view, the core of this effort should be constituted by actuarial examination as a necessary part of the general examination (juridical, ecological, gender, etc.) of government draft decisions.

Actuarial examination rests on the Actuarial Control Cycle[3] proposed in 1985, which is a particular case of the general control cycle used in all business spheres. The main stages of the actuarial control cycle adapted to actuarial examination of Russia's pension system are:

[1] The Russian-language version of this paper allocates a great deal of space to the analysis of international experience and the possibility of its use when introducing pension reform in the Russian Federation. In the English translation, some information well known to English speakers was replaced by a more detailed analysis of Russia's pension provision and its long-term development prospects.

[2] V. Baskakov, A. Lelchuk, and D. Pomazkin, The Pension System of Russia: Actuarial Examination (methodological approach). *Sotsialnyi vestnik pensionnykh i sotsialnykh fondov stran SNG i Baltii*, 2002, No. 1-2.

[3] Goford, J. The Control Cycle: Financial Control of a Life Assurance Company / Presented to the Institute of Actuaries Students' Society on 12th February 1985.

0) Preliminary stage (the context of actuarial examination)

It involves a study of the overall economic, commercial, social, and demographic environment in which the RF pension system functions, that is, a study of the "context" of actuarial examination.

1) Specifying the issue

The main substance of this stage is identification and assessment of the risk facing all the participants in insurance and determining the risk factors and the possibility of risk reduction/redistribution. The findings of risk analysis help specify the goals of examination and set the criteria of assessment of the obtained outcomes.

2) Developing the solution

The main task of actuarial examination of the country's pension system is to assess the expected outcomes of the latter's performance from the stand of the interested parties. At this stage, the actuary examines the possibility of using the available models in dealing with the tasks facing him/her and, whenever necessary, adjusts them and/or develops new ones. The actuary then proceeds to analyze the available data (demographic, macroeconomic, etc.) and sets the values of the model parameters, possibly using non-formal techniques, since the exact values of many parameters, especially ones connected with forecasting, cannot be determined.

3) Monitoring the outcomes

The next stage of actuarial examination is the monitoring of indicators relevant to the pension system. At this stage, the actual outcomes of the system's performance is summed up and compared wit the expected one. The findings of the monitoring may pose the need to more exactly formulate the task and/or the way of tackling it. This necessitates going back to a revision of the stages of the work, and the control cycle is closed.

Note. An important element of monitoring is identifying the reasons why actual outcomes differ from expected ones.

The actuarial control cycle is schematically presented in Fig. 1. The double arrows indicate the presence of feedback.

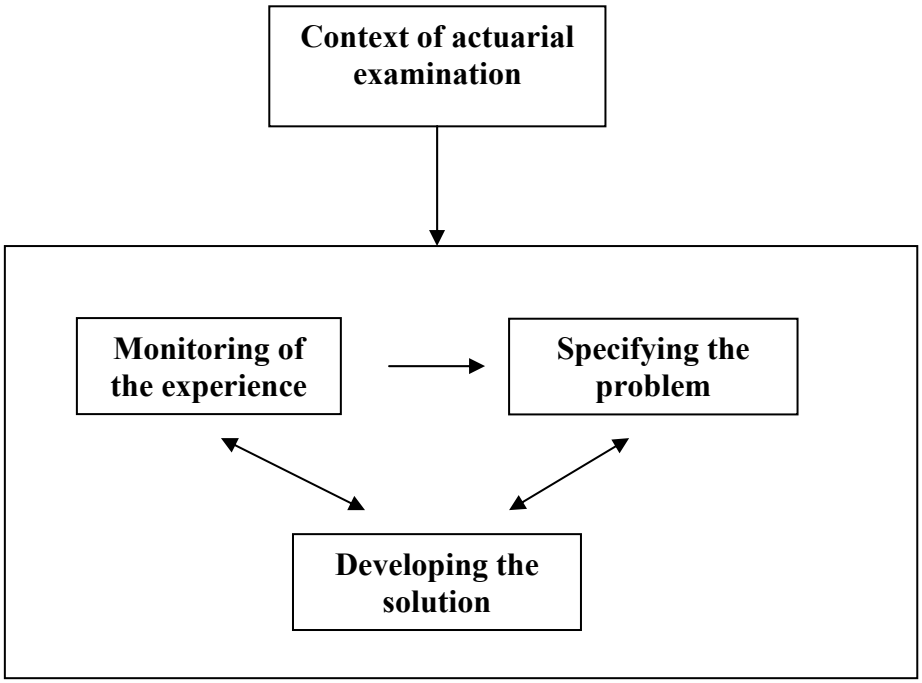
Context of actuarial examination
Monitoring of the experience
Specifying the problem
Developing the solution

Fig. 1

2. The Current Pension Law: A Brief Characteristic

2001 can by rights be called the year of radical pension reform in the Russian Federation. The laws passed in this year replaced (since January 1, 2002) the pension system founded on the strictly PAYGO principle with a mixed system which combines the PAYGO and the funded principles.

As the RF Pension system is quite complicated, we shall just describe its principal, fundamental characteristics.

The core of the public pension system is the so-called labor pension, which is assigned upon the prospective pensioner's reaching a retirement age established under the law (provided the recipient has at least a five-year pensionable service), the onset of disability (provided the person has an employment history of any length[4]), and in the case of loss of breadwinner.

The funded element of labor pension is mandatory and rests on individual accumulation accounts with defined contributions (DC). To calculate funded pension at the date of retirement, individual accumulations are divided by the expected duration of pension payment. At this stage, the funded element of labor pension is subject to indexation in accordance with the pension fund investment returns.

The PAYGO element of labor pension comprises: (1) flat basic pension and (2) notional defined contributions (NDC) pension, which is based on individual notional accounts.

Under the law, the basic element of labor pension is indexed to the rate of inflation of retail prices. The rate of indexation may also be higher so as to gradually bring up basic pension to a pensioner's subsistence minimum.

For the persons who entered employment before January 1, 2002, "starting" notional pension capital is calculated, which increases thanks to the subsequent contributions and indexation. To calculate NDC pension size at the date of retirement, notional capital is divided by the expected duration of labor pension payment at the date of pension assignment. At the stage of pension payment, the notional funded part of labor pension is subject to indexation. The current law sets the same indexation rate for both notional accumulations and NDC pension (at the stage of pension payment). The rate of indexation is determined by the index of the growth of per person RF Pension Fund revenues (contributions for the NDC pension).

The current legislation also envisages a minimal guaranteed size of PAYGO (basic plus NDC) pension expressed in nominal monetary units, and does not contain instructions regarding the indexation of this element.

The basic part of pension is financed from the social tax, and the NDC and funded elements, from the insurance contribution. The latter is, in turn, divided into the NDC and the funded parts. For most contributors, the tax rate for the basic pension element is 14% of the wage, and the rate of insurance contribution (to the NDC and funded elements) is equal to the rate of the contribution for the basic pension element. The subdivision of contributions into the NDC and the funded parts depends on the year of the insured person's birth; for the persons born in 1967 and after, the contribution for the notional funded and funded parts of the pension are 8% and 6% respectively.

Let us also note that the Russian Federation has a regressive social tax scale, that is, these tax/contribution rates are charged only on the first 100,000 rubles of annual income, eventually to decrease and cease altogether as the annual income exceeds 600,000 rubles.

Comparing Russia's pension system with the reformed pension systems of some other countries, one sees that notional accounts have recently become one of the main pension reform instruments[5] used in Sweden, Italy, Poland, and Latvia, to name but a few states, although there is an ongoing debate between the advocates of such accounts, who view them as the last word in public pension provision[6], and their critics, who believe that the NDCs have no advantage of

[4] The persons with no employment history receive a social pension.

[5] Fox, Louise and Edward Palmer (2001), "New approaches to multipillar pension systems: What in the world is going on?", in: New ideas about old age security (R. Holtzman and J. E. Stiglitz, eds.), The World Bank, Washington D.C.

[6] Marek Gora and Edward Palmer (2003), "Shifting Perspectives in Pensions". Processed.

principle over a well-organized PAYGO systems with defined benefits[7]. However, supplementing an NDC pension with a flat basic pension appears unnecessarily complicated. What is more, it defeats one of the main purposes of the introduction of notional accounts, i.e., to tie up the contributions with the benefits so as to reduce the risk of evasion of pension contributions. In the situation when basic pension is financed from a wage tax, which equals the sum of the contributions for the NDC and the funded elements, it would be pointless to talk about promoting participation in the pension system. The coexistence of basic pension and a minimal guarantee is not very logical, since the purpose of flat basic pension is, as a rule, precisely to provide minimal guarantees. It would also be more logical to set a minimal guarantee for total summary pension, as was done, for example, in Poland[8]. In Sweden, where, like Russia, the guarantee extends only to the PAYGO part of the pension[9], the funded element is relatively small: the contributions to this part are only 2.5% of the wage, while those to the NDC part reach 16%.

[7] Disney, Richard (2000), "Notional accounts as a pension reform strategy: An evaluation", World Bank Pension reform primer, Washington D.C.

[8] A. Chlon, M. Gora, and M. Rutkowski, Shaping Pension Reform in Poland: Security through Diversity. Social protection discussion paper No. 9923, 1999, World Bank Pension reform primer, Washington D.C..

[9] Palmer, Edward (2000), "The Swedish pension reform – Framework and issues", World Bank Pension reform primer, Washington, D.C.

3. The Basic Algorithms of the Model

The introduction of NDC and funded elements of labor pension complicated the modeling of the RF pension system, because now we have to factor in the history of the payment of contributions, not just the wage at the date of retirement and the length of service.

In mathematical terms, the calculation of conventional accumulations for the NDC part of the pension is the same as the calculation of real accumulations.

The modeling of the RF pension system uses the method of social cohorts, which we shall explain using the calculation of NDC old-age pension as an example. Calculated on the basis of this method, pension sizes are, in fact, the sizes of the pension of the "averaged man" and the "averaged woman" who in the past were wageworkers, self-employed, unemployed, student, serviceman etc.

Let us note, first of all, that for the purposes of the modeling, each age and gender group is broken down into five subgroups:

1. *Recipients of labor old-age pension (hereafter, old-age pensioners*). As regards the age and gender groups, which have not reached the retirement age established by Art. 7 of the Federal Law # 173-FZ (55 years for women and 60 years for men), the reference is to early old-age pension in conformity with Arts. 27 and 28 of this law.
2. *Recipients of labor disability pension (hereafter, disability pensioners)*.
3. *Recipients of survivor pension*.
4. *Social pensioners, that is,* the recipients of social pension.
5. *"Non-pensioners",* that is, the persons who do not draw any pension. For the age and gender groups that have not reached the retirement age set by Art. 7 of the Federal Law # 173-FZ, this subgroup is the principal one (the largest).

The model examines in more detail subgroups 1, 2, and 5 because of their significance (in terms of the size of currency flows connected with them) and the availability of adequate statistics. To be more precise, three social cohorts defined on the basis of this classification are studied.

By social cohort, we imply groups of individuals: "non-pensioners", "old-age pensioners", and "disability pensioners" who were X years old in forecasting year Y. The model considers these cohorts as they evolve.

One must be aware that this categorization is not based on employment (or the payment of contributions). Members of the "non-pensioners" cohort need not be employed: they may be students, homemakers, or be idle, while part of old-age and disability pensioners may continue to hold jobs and pay contributions thus raising their pensions.

To understand what happens to these cohorts in time, let us consider the men who were 15 in 2002. It is obvious that the old-age (including early) and disability pensioner cohorts will be empty and that a large "non-pensioners" cohort will exist. As time goes on, in the following forecasting years, the "non-pensioners" cohort will diminish and the old-age and disability pensioner cohorts will grow by incorporating the persons who have left the non-pensioner cohort. Upon reaching 60, all members of the non-pensioner cohort will begin to draw an old-age pension, leaving the non-pensioner cohort empty.

The transfer of individuals from one cohort to another can be described through the multiple states model. Below, we present a four-state model, on which the basic calculation formulae of the model are based. The less significant states, such as social and loss-of-breadwinner pensioners, are factored into the RF pension system model under a simplified scheme.

Multiple states model

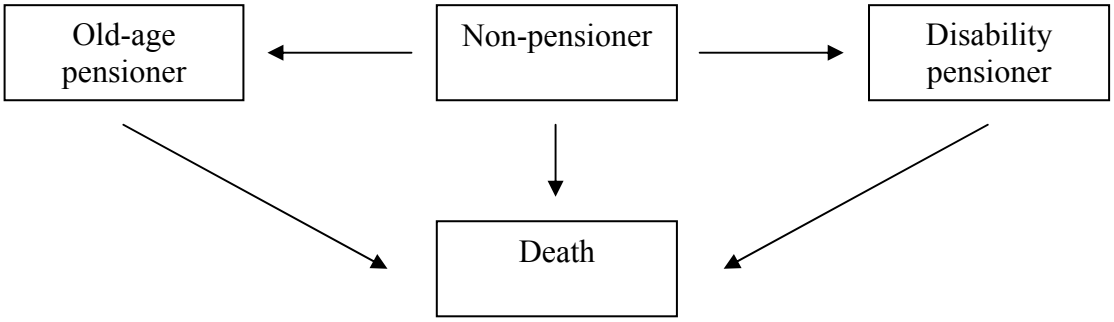

Fig. 2

The model uses the following assumptions/premises:

1. Leaving non-pensioner state, one can go over to disability pensioner, old-age pensioner, and death states.
2. The state of death is absorbing.
3. The only state possible upon leaving the old-age and disability pensioner states is death.
4. There are no transitions determined by migration (emigration and immigration) because the State Statistical Committee of the Russian Federation (RF Goskomstat) forecasts envisage a low migration level (see Chapter 5). If need be, this model, as well as the formulae presented below, can be easily adjusted so as to directly factor in migration.
5. The probability of transition from disability pensioner to non-pensioner state is zero. The model does not provide for a person ceasing to be disabled.
6. On reaching an age entitling a person to labor old-age pension, all the persons thus entitled begin to draw an old-age pension. This is, in fact, equivalent to the assumption that individuals do not, as a rule, use the right to postpone the date when they begin to draw an old-age pension so as to draw a higher pension later.

In actual fact, this assumption has more to do with scenarios than with the modeling program itself.

7. There is no transition from disability to old-age pensioner state. Under current legislation, such transition is pointless.

Determining the size of notional pension capital (notional accumulations)

The input data for further modeling is the average starting notional pension capital (NPC) determined as of January 1, 2002, and the size of the NDC part of labor pension calculated for pensioners as of the same date[10].

The starting size of total notional pension capital for the non-pensioner cohort (NPCx) equals the average starting value of NPC multiplied by the size of the cohort as of January 1, 2002.

Above, we said that in 2002, the cohort of non-pensioners who were x years old in 2002 will undergo the following events:

1. The cohort will lose some of its members as:

[10] All paid labor pensions were subdivided onto base and NDC parts.

- some persons will die in 2002;
- some of its members will go over to the cohort of persons drawing an (early) old-age pension;
- some members of the cohort will go over to the cohort of disability pensioners.

2. NPC will be subjected to indexation.
3. The annual contributions for the NDC part of the pension will be paid.

The size of summary calculation capital at age x+1 is determined using the recurrent formula:

$$NPC_{x+1} = (NPC_x (1+Index) + ContNP_x)(1- q_x - ShOAP_x - ShDP_x), \quad (1)$$

where:

NPC_x is total notional capital of the cohort at age *x* in the relevant forecasting year;
q_x is the annual probability of death at age *x* in the relevant forecasting year;
Index is indexation of NDC pension and NPC in the relevant forecasting year;
$ContNP_x$ are total contributions of the non-pensioner cohort at age x in the relevant forecasting year;
ShOAP is the share of NPC of the persons who became old-age (possibly early) pensioners at age x in the relevant forecasting year; and
$ShDP_x$ is the share of NPC of the persons who were disabled at age x in the relevant forecasting year.

The meaning of formula (1) is very simple:

- expression $(NPC_x(1+Index) + ContNP_x)$ equals the size of total notional pension capital one year later;
- the second factor of the right-hand side $(1 - q_x - ShOAP_x - ShDP_x)$ removes the shares of those who die or go over to the cohorts of disability and old-age pensioners.

Note. Strictly speaking, this formula implies that all the transitions from the non-pensioner to the other states take place at the end of the year. This assumption is used in actuarial calculations often enough for the sake of simplicity.

The share of the NPC of the persons who became disability pensioners at age x, $ShDP_x$, is, in the general case, determined by two indicators:

а) the ratio of the share of persons who became disability pensioners at age x (in the given forecasting year) to the share of non-pensioners. Hereafter, for the sake of brevity, we shall refer to it as the share of new disability pensioners; and
б) the ratio of the NPC of these persons to the average NPC value for the cohort.

In this paper, we assume that the NPC of new disability pensioners is equal to the average NPC value for the cohort, so that only the first indicator is significant. In algorithmic terms, this assumption is easy to cancel; however, statistics (or substantiated assumptions) would be required.

The share of new disability pensioners in the total size of an age and gender group is calculated under the formula:

$$PcNDP_{x+1} = PcDP_{x+1} – PcDP_x (1- q_x^d), \quad (2)$$

where:

PcDP is the percentage (share) of disability pensioners aged x in the total number of the age and gender group; and

q_x^d is the over and above "normal" annual probability of death at age x.

To obtain the share of NPC of the new disability pensioners, $ShDP_x$, we need to divide $PcNDP_{x+1}$ by the share of non-pensioners in age and gender group x.

Formula (2) takes account of the fact that the mortality rate of the disabled is higher than among the population generally, with q_x^d being the difference between the mortality rate among the disabled and the mortality rate among the population generally.

An important merit of formula (2) is that its application requires only the percentage shares of disability pensioners in each age and gender group and the excess of disability pensioner mortality over average mortality in the age and gender group generally.

The share of the NPC of the persons who became old-age (possibly early) pensioners at age x, $ShOAP_x$,, is, in the general case, determined by two indicators:

а) the ratio of the share of persons who became old-age pensioners at age x (in the given forecasting year) to the share of non-pensioners. Below, for the sake of brevity, we shall refer to this group as the share of new old-age pensioners; and

б) the ratio of the NPC of these persons to the average NPC value for the cohort.

As in the case of new disability pensioners, this paper assumes that the NPC of the new old-age pensioners is equal to the average NPC value for the cohort, so that only the first indicator is significant.

The share of new old-age pensioners in the overall size of an age and gender group is determined under the formula:

$$PcNOAP_{x+1} = PcOAP_{x+1} - PcOAP_x , \qquad (3)$$

where $PcOAP_x$ is the percentage of old-age pensioners aged x in the overall number of the given age and gender group.

Having compared formulae (3) and (2), it becomes obvious that formula (3) is based on the assumption that the mortality of old-age pensioners is the same as in the age and gender group as a whole.

To obtain the share of NPC of new old-age pensioners, $ShOAP_x$, it remains to divide $PcNOAP_{x+1}$ by the share of non-pensioners in age and gender group x.

The non-pensioners' total contributions in year x, $ContNP_x$, comprise the contributions of non-pensioners only. The contributions of old-age or disability pensioners are factored in when recalculating average pension size (see below).

Calculating the size of old-age pension

In the general case, people begin to draw an old-age pension at different ages. This is why the subgroups of old-age pensioners aged x+1 include both persons who already were old-age pensioners at age x and new old-age pensioners.

The pension of the new old-age pensioners is equal to their notional capital divided by the expected period of the payment of old-age labor pension T. Total notional pension capital of the new old-age pensioners is:

$$(NPC_x\ (1+Index) + ContNP_x) \times ShOAP_x. \qquad (4)$$

The number of new old-age pensioners is:

$$N_{x+1} \times PcNOAP_{x+1}, \tag{5}$$

where N_{x+1} is the size of the age and gender group at age x+1 years.

Thus the NDC pension of the new pensioners, $NDCOAP'_{x+1}$, is:

$$\frac{(NPC_x(1+Index)+ContNP_x)\times ShOAP_x}{N_{x+1}\times PcNOAP_{x+1}\times T} \tag{6}$$

The pension of those who were already pensioners at age x will be indexed and will be

$$NDCOAP^*_{x+1} = NDCOAP_x(1+Index), \tag{7}$$

where $NDCOAP_x$ is the NDC pension of old-age pensioners at age x.

The average NDC pension of all old-age pensioners at age x+1 is equal to the average weighted value of the pension of those who was already a pensioner at age x and the pension of the new pensioners, as well as the growth of pension at the expense of the contributions made by the employed old-age pensioners.

$$NDCOAP_{x+1} = \frac{NDCOAP^*_{x+1}\times(PcOAP_{x+1}-PcNOAP_{x+1})+NDCOAP'_{x+1}\times PcNOAP_{x+1}}{PcOAP_{x+1}} + \\ + \frac{ContOAP_x}{N_{x+1}\times PcOAP_{x+1}\times T}, \tag{8}$$

where $ContOAP_x$ are the contributions made by the old-age pensioners aged x.

Note. As was mentioned above, the formulae for calculating the NDC part of the disability pension and the funded part of the old-age and disability pension are similar to formulae (1) – (8).

4. RF Pension System Model

This chapter contains a concise description of the RF pension system model designed by Independent Actuarial Analytical Center (IAIAC). Work on the model began with a study of international experience in this field, first of all, the World Bank PROST program drafted for the study of the financial state of the pension systems of the countries introducing pension reform and the International Labor Organization "Social budget" program designed to forecast the financial flows in the social sphere.

The PROST model was used to model the financial state of Russia's pension system since 1996. However, it eventually became clear that this model is not quite adequate to the needs of actuarial examination of the RF pension system under radical reform. We were aware of this in 1997- 2001 when making actuarial calculations for the RF Government as pension reform was being prepared[11], and when conducting independent actuarial examination of government decisions on pension provision for various social and demographic population groups[12]. The team of RF State Pension Fund experts who are working on a pension fund model reached the same conclusion[13].

Any imitation model of a pension system must meet one fundamental demand, namely, be adequate to the operating and/or planned pension legislation. Specifically, it must provide an opportunity to model the pension contributions and payments differentiated by pension type (basic, NDC, and funded) and the principal social and demographic groups whose pension provision has specific features under the law or de facto, e.g., wageworkers and the self-employed, old-age and disability pensioners, early pensioners, etc. If this condition were not met, it would be pointless to talk about a pension system model (hereafter, it is tacitly assumed that the model is fully in line with the current legislation). At the same time, to meet this condition by using a model whose development disregards the concrete circumstances is extremely difficult: any changes in the pension system cause the need to change their program code. This was the main reason why these models did not become popular enough, and provided a stimulus for developing a new model.

Drawing on the practice of imitation modeling, we formulated the additional demands to the future pension system model, which the available models do not fully meet. They include flexibility and user friendliness, the ease of adjusting the model to different scenarios and organizational patterns of the pension system itself, and availability of different report formats. But we also made a point of using the valuable aspects of the existing systems, specifically, the most efficient solutions and calculation algorithms that have already been tested in the PROST and Social budget models.

IAIAC began work on the model in 2000. At its different stages, the project was financially supported by the MPSF (and USAID), the RF Ministry for Economic Development and Trade, the Soros Foundation, and the Russian Social Reform Fund.

At all stages of the modeling, we had an opportunity to use the advice and recommendations of Jean-Noel Martineau and other international experts and consultants thanks to the World Bank, USAID, ILO, and the TACIS Program of the European Union[14].

Any model is merely a simplified description of reality whose adequacy depends on the quality of the assumptions and premises. The main assumptions of our model pertain to the forecast of demographic and macroeconomic indicators. For economies in transition, of which the Russian Federation is one, the problem of long-term (up to 50 years and even more) forecasting is complicated by the impossibility of using demographic and macroeconomic trends as the forecast basis.

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[11] Dmitriev, M.E., Pomazkin, D.V, Sinyavskaya, O.V., et al, Pension Reform in Russia. Transactions of the Institute for Economies in Transition, No. 11R, 1999.

[12] Baskakov, V.N and Baskakova, M.E., On Pensions for Men and Women: The Social Aspects of Pension Reform, Moscow: Moskovskii filosofskii fond, 1998.

[13] Solovyov, A.K., Burnashova, R.A., et al, An Actuarial Model of the Pension Fund: Construction Principles to Deal with Pension Reform Issues in 2002, *VestnikPFR*, No. 3, 2001.

[14] See http://www.tacis-medt.ru/eng/pensref.htm

The significant uncertainties as regards the value of the principal model parameters makes it necessary to examine the pension system stability to their changes, including analysis of the model's sensitivity, which made it necessary to vary the values of a large number of model parameters (indexation of all types of pensions, investment profitability, retirement age, tax/contribution rates, and others). This largely determines the standards set to the structure of the model and the service, especially when it comes to input data formation, variation of model parameters, and report formats. In addition, the construction of the pension system legislative framework is not yet completed, which means that the model must leave room for prompt tuning necessitated by the expected changes in the legislation.

The architecture of the program described in this paper took into account the standards formulated above: our goal was to provide an instrument for actuarial examination of a broad range of pension system versions. We used the module principle in the programming, under which the model can be divided into the following logical blocks:

- the macroeconomic block, to determine the wage level depending on macroeconomic assumptions and the labor market forecast;
- the demographic block, to determine the time-dependent age and gender composition of all groups of payers and pensioners;
- the revenues block, to calculate the total contributions made by each group for the different types of pension, and to calculate the accumulated benefits; and
- the expenditures block, which makes it possible to calculate the size of paid pensions and the summary volume of payments for each group of pensioners and each type of pension.

These blocks are standard functional elements in this class of models. When designing them, we used the above-described basic principles of financial and actuarial mathematics adapted to the RF pension legislation. Two supplementary blocks were added to make the system flexible and user friendly, and the presentation of the obtained outcomes full and clear:

- preparation of the scenario of calculations and input data (values of model parameters); and
- report drafting.

The model consists of several Excel working books with macros at generally accessible VBA interpreter for Excel united into a single integrated system, which makes it easy to be used by a broad range of users both in terms of modeling and analysis of the input data and the used algorithms. The core of the system is the model.xls book, which is, in fact, the executive program, which contains VBA interface forms and codes of the principal algorithms.

The main form of the model.xls book is presented in Fig. 3. It gives the user an opportunity to select the previously designed pension system development/reform scenario, modify it, build a new scenario, activate the system blocks described above, examine the outcomes of the calculations, and draft an output report.

The data of the basic pension system development scenario can be found in the electronic tables united in the datareform.xls book. This book also incorporates the outcomes of calculations for individual sub-scenarios[15] with a full range of the values of all parameters of the system's adjustment used to make the calculations. This option makes it possible, first, to conduct a comparative analysis of the outcomes of calculations for individual scenarios using both the opportunities provided by the system itself (see below) outside programs; and, second, to make a second calculation (if need arises) for any previously saved scenario having a guarantee that the same result will be obtained.

[15] As a rule, the data of individual sub-scenarios differ as regards the value of parameters which can be changed using the options offered by the system itself (e.g., indexation rate, some demographic and macroeconomic parameters, etc.), or can be loaded from an outside file (e.g., an outside demographic or macroeconomic forecast).

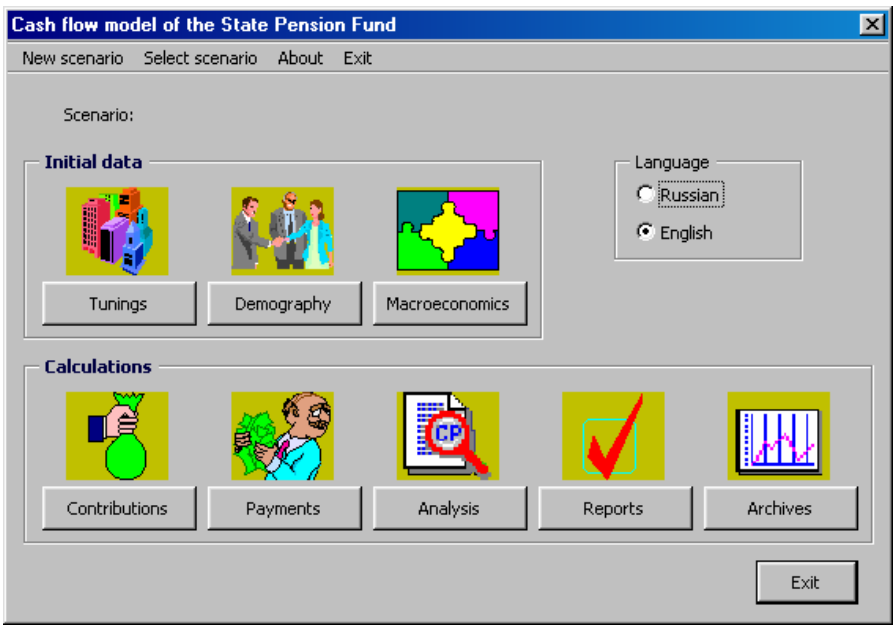

Fig. 3

The system provides an opportunity to create supplementary scenarios as Excel books named data*.xls similar to the datareform.xls book, which store the relevant information. The simplest way to create a new scenario is to modify the basic (or any other) scenario and save it under a new name. The modeling system provides a special instrument, makeID.xls, which enables the user to load outside input data arrays, including the data of outside demographic and macroeconomic forecasts, to the data*.xls book.

The input data contain demographic and macroeconomic forecasts and pension system parameters. The RF pension system model described in this paper incorporates a block, which forecasts population size[16]. Its algorithms, which use the standard age shift with migration technique, are practically the same as those employed by the RF State Statistical Committee. This makes it possible to introduce into the model any assumptions on the basic parameters of the demographic forecast.

1. *Fertility*: total fertility rates and the mother's average age at the birth of a child.
2. *Mortality*: expected longevity at birth for men and women, as well as infant mortality.
3. *Migration:* total number of persons leaving and entering the country.

The model may also use outside demographic forecasts.

To identify the payers' and recipients' groups and determine their size, we used the share matrices containing the percentage ratio of the given group to the given category or the population at large. Share matrices have the dimensionality of demographic matrices, which provides an opportunity to model the payers/recipients ratios in time. Forecasting the share ratios of individual groups is a more complicated matter, which calls for the introduction of supplementary assumptions and hypotheses lying outside this model. The number of payers is determined proceeding from the size of employable population; to estimate it, we need to set the employment and unemployment rate for each gender, age, and forecasting year.

The macroeconomic forecast comprises one-dimensional time series and includes such values as the wage, inflation, and DGP growth rates.

The supplementary pension system parameters include retirement age, contributions rates, collection rates in time, etc. Most system parameters are set as one- or two-dimensional arrays. Thus, payers of different ages currently make contribution under different rates, which depend on the forecasting year and the payer's age; the contribution rate array is also prepared as a two-dimensional matrix. Although the storage of input data as matrices somewhat overburdens the

[16] Developed by E.M. Andreev.

system (in Excel, the procedure is, however, easy), this inconvenience is more than made up for by the resultant high flexibility of the model and the opportunity to adjust it to practically any pension system reform version.

Many model parameters can be varied directly from the model.xls book using the system-tuning block, which comprises the following elements (see Fig. 4):

- Basic parameters
- Indexation
- Social groups
- Options.

Among other things, this block enables the user to employ the automated regime to scan through the group of pension contribution payers and recipients set in the selected scenario and the basic parameters of the selected pension system development scenario, and, whenever necessary, to change some of them, setting the parameters of wage indexation (separately for wageworkers and the self-employed) and pension indexation (basic, NDC, funded, early, etc.). Indexation may be to wage growth (W), consumer prices inflation (CPI), fixed interest rate, or any combination of these parameters. In the general case, indexation is determined under the formula:

$$(1+ a*Inflation) * (1+ b*W\_growth)*(1+c),$$

where W_growth is real wage growth (over and above CPI); and

a, *b,c* are parameters.

The model also provides for introducing an outside vector index and setting a number of supplementary parameters.

To make the model even more flexible and ensure prompt access to input data and the results of calculations, the information exchange between individual blocks of the system takes place though a data exchange buffer, which is an ordinary Excel list.

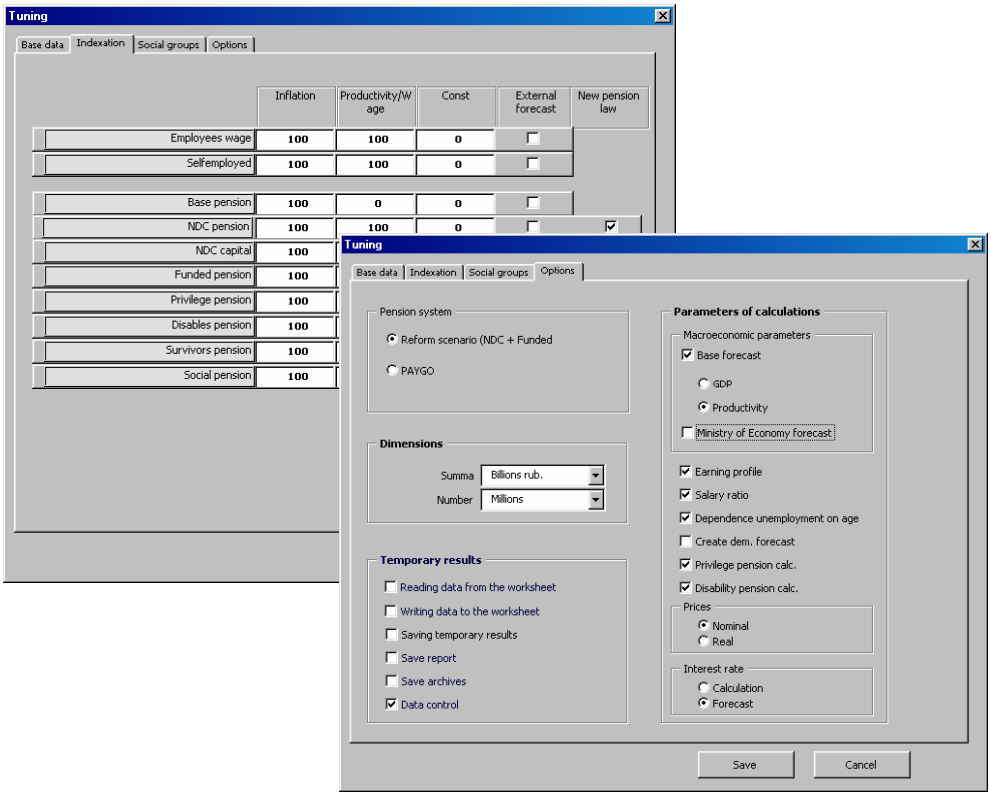

Fig. 4

This data exchange organization has a number of advantages. First, all the input data of the given pension system development scenario and the results of calculations (including intermediate ones) are stored on separate lists, which provides prompt access to them (the input data of the model comprise more than 100 two-dimensional arrays with a dimensionality of 100x50 and approximately 60 one-dimensional arrays). Second, the user is able to intervene into the modeling process at any stage to make changes into the data (input or intermediate), thereby altering the scenario with a minimum outlay of time and changes in the program.

The next stage in the work of the system is loading the selected demographic and macroeconomic development scenario and calculating the required derivative parameters. The program makes it possible to scan through the demographic and macroeconomic data presented as tables and charts (see Fig. 5).

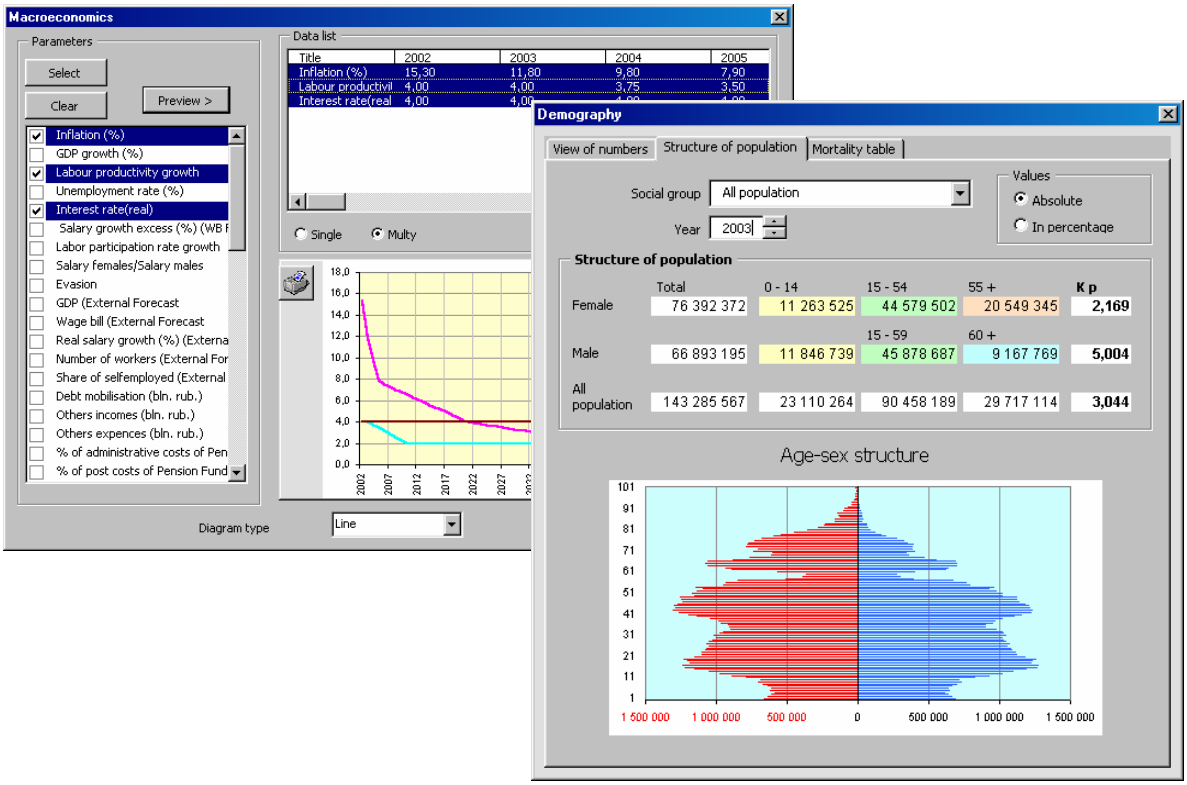

Fig. 5

An important element of the model is the reports block. In view of the large volume of output information (more than 450 time series), the model provides for three main formats for the presentation of the obtained outcomes, which enable the user to conduct detailed, summary, and comparative analysis both as tables and as charts.

Detailed analysis helps scan through the intermediate calculations and obtain access to any element of the array used in them. The data can be scanned presented as tables or charts. In the latter case, one can build a variable against both the age of the group and the forecasting year; for instance, male wageworkers' contributions to the funded element of the pension system against age in the year 2024, or the number of 60-year-old males receiving an NDC disability pension against the forecasting year (see Fig. 6). One can also build a chart with two independent variables, age and forecasting year.

The summary form was designed so as to present the main outcomes and helps to quickly build the desired report format by automatically arranging the output data in the required order. One can also document the outcomes by including headings and commentaries.

To speed up the search for the desired calculation outcomes, we added filters selecting the outcomes that meet the set conditions, e.g., the number of pensioners, by groups, who draw

different types of pensions. To build such a sample, four conditions need to be set (see the opening lists when the "Analysis" option is selected, Fig. 7): gender (no option, which means both genders), parameter (pension types, all, which means all types of pensions), the desired parameter (number, pension size, replacement rate), and pensioner group. The technique for report production used in the model is analogous to the client – server system, when the user works with the database through a system of queries. Historically, such models use a consecutive architecture, step-by-step calculations and report formations. Our model provides for both a standard and a parallel architecture analogous to the client – server system

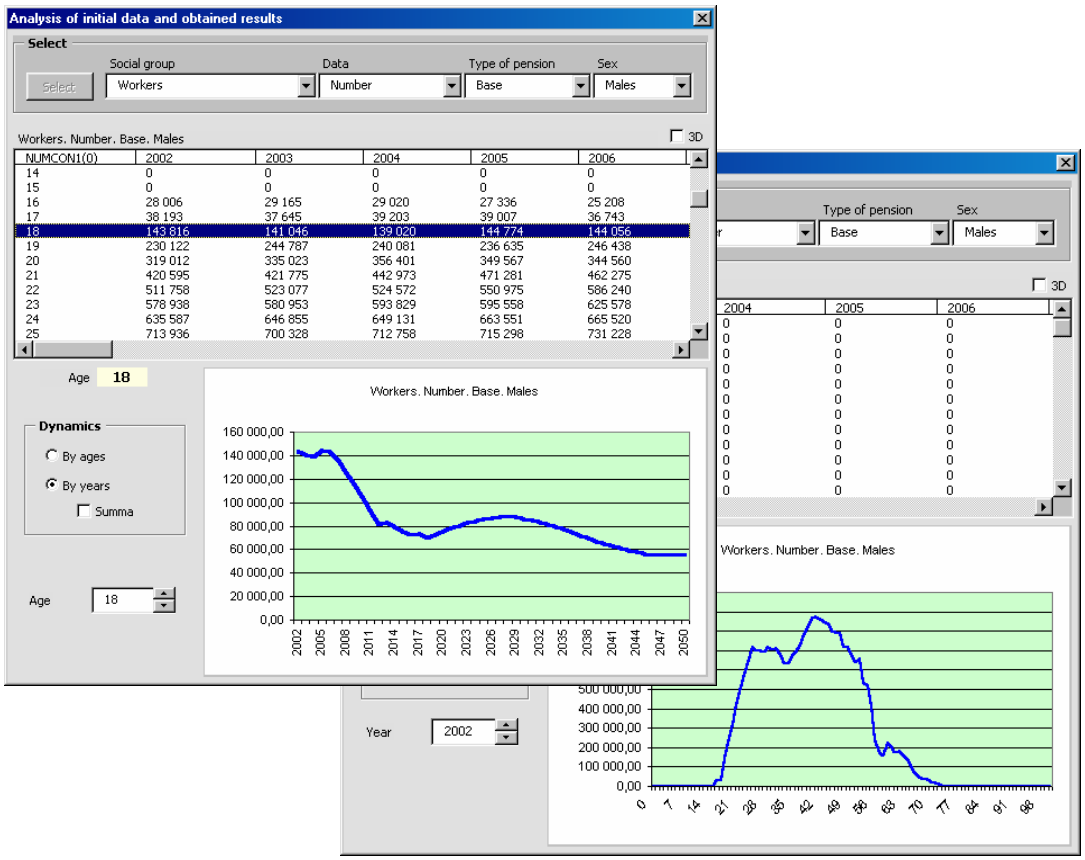

Fig. 6

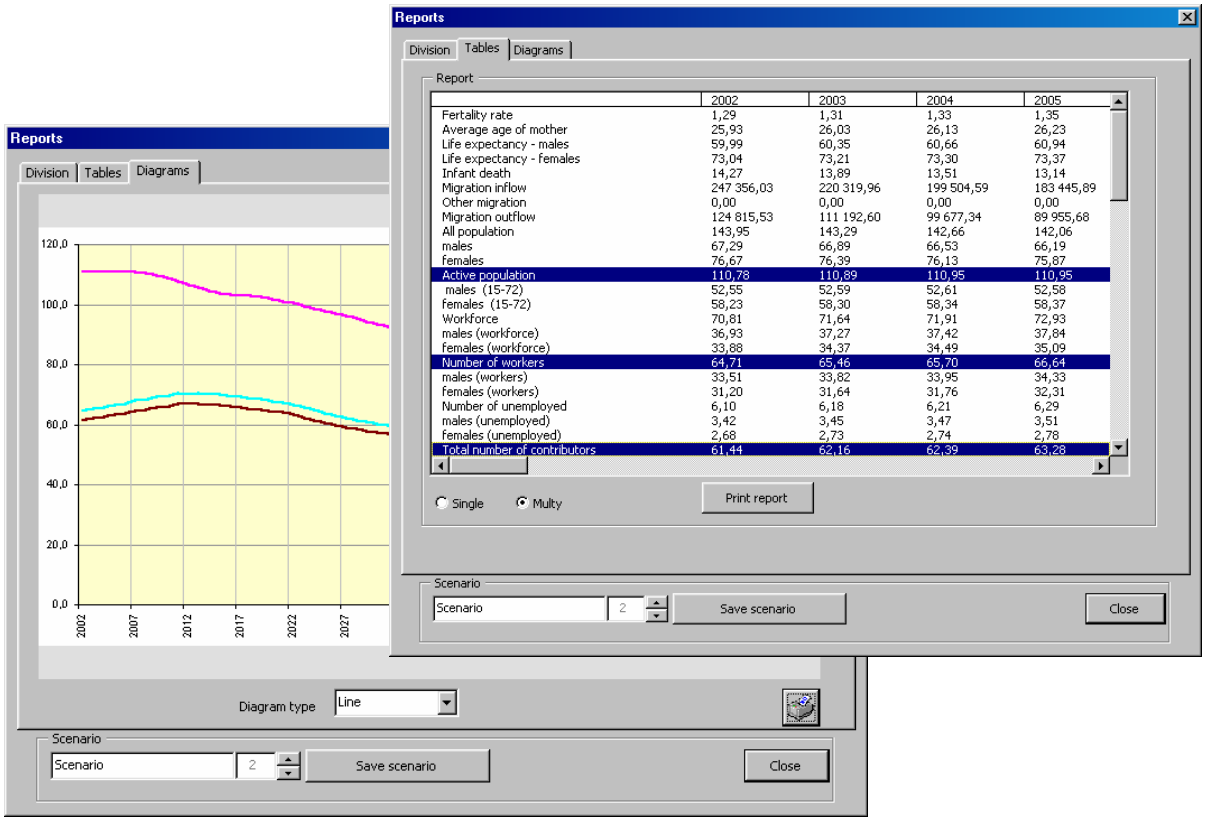

Fig. 7

The comparison of scenarios, which are called from the main form by pressing the "Archive" key, is intended for promptly comparing the modeling outcomes. The form is shown in Fig. 8. It is build analogously with the "Report" form, the difference being that comparative analysis involves the same indicators calculated for different scenarios. This form enables the user to assess the sensitivity of the modeled system to input data changes. This option raises the accuracy of calculations under different scenarios and the flexibility of the model.

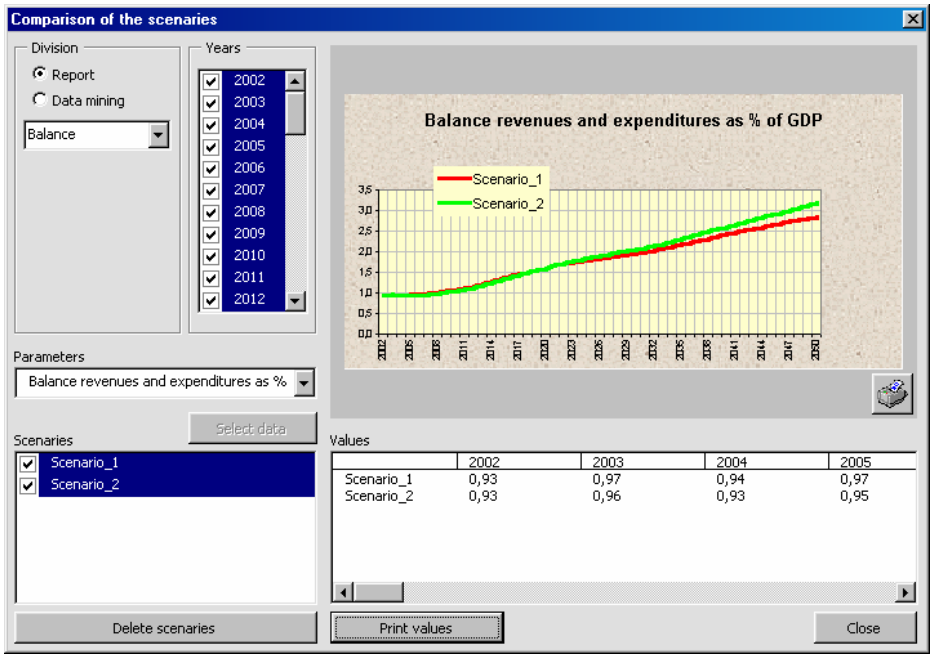

Fig. 8

5. Age/Gender Population Structure: A Forecast

Demographic indicators are probably the most important pension system parameters. It is the demographic crisis caused by higher longevity and a sharp drop of birth rate that has made pension reform one of the most pressing concerns in many countries. The share of the aged in total population is rising. Russia also has to cope with this problem, although unlike most other countries, the aging takes place through a fall in fertility alone, in the absence of higher longevity.

The dynamic of the age and gender structure of the population is shaped by three factors, birth rate, mortality, and migration.

In the second half of the 20th century, total fertility rates in many countries fell below the level that ensures reproduction (approximately 2.1 children per one woman). This also happened in Russia, where fertility fell in the 1990s.

Table 1
Total fertility rate[17]

Country	1960	1970	1980	1990	2000
Great Britain	2.72	2.43	1.90	1.83	1.65
France	2.73	2.47	1.95	1.78	1.89
Germany	2.37	2.03	1.56	1.45	1.36
Italy	2.41	2.42	1.64	1.34	1.23
Russia	2.42	1.97	1.89	1.89	1.21

In 1999, total fertility rate in Russia reached its lowest value, 1.17; in 2000 and 2001, it began to rise insignificantly.

Below, we offer a brief analysis of the RF State Statistical Committee's forecast of Russia's population based on report "On demographic development trends in Russia in the first half of the 21st century"[18], which, although not an official document, conveys the view of the Committee on this issue.

The report examines three fertility scenarios:

1. Low, with the total fertility rate falling to the minimal European one, 1.09.
2. Middle, with the total fertility rate rising to 1.4.
3. High, with the total fertility rate rising to 1.75.

Another demographic forecast parameter is the mother's average age at the birth of a child. The low scenario assumes that it stabilizes at a slightly lower than the present age, 25.7 years, while the middle and high scenarios envisage its rise to 27.8 and 30.6 years.

Figs 9 and 10 show two integral mortality indices, expected longevity at birth and the death rate in employable age. They make it quite clear that unlike the advanced countries, longevity in Russia did not increase over the past forty years. What is more, in 1994, mortality reached the maximum

[17] The Demographic Yearbook of Russia. Collection of Statistics, Moscow: Goskomstat, 2002.
Population of the Countries of the World. Reference Book, Ed. By B.Ts. Urlanis, Moscow: Statistics, 1978.
E.M. Andreev, L.E. Darsky, and T.L. Kharkova, A Demographic History of Russia: 1927-1957.
Recent demographic developments in Europe. 2001, Council of Europe. Strasbourg, Council of Europe Publishing, 2001.
INED. Base de données. La conjoncture des pays développés en chiffres.
2001 Statistical Abstract of the United States.
US Census Bureau. International data base.

[18] *Voprosy statistiki*, 2002, No. 3, pp. 3-10.

level in more than forty years, and the reverse trend, which manifested itself in the next few years, was again replaced by new growth in 1999 and 2000.

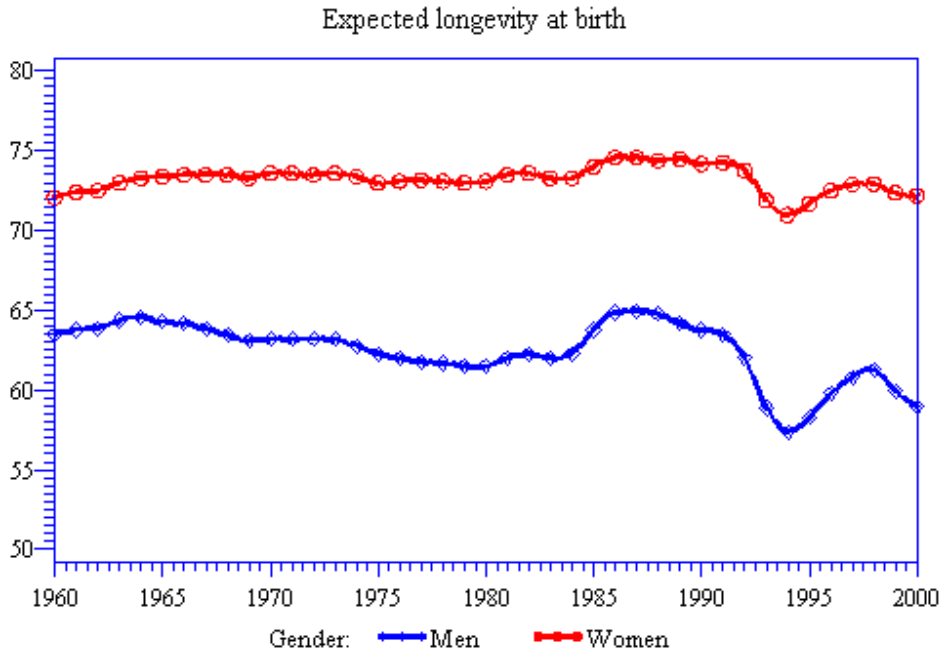

Fig. 9

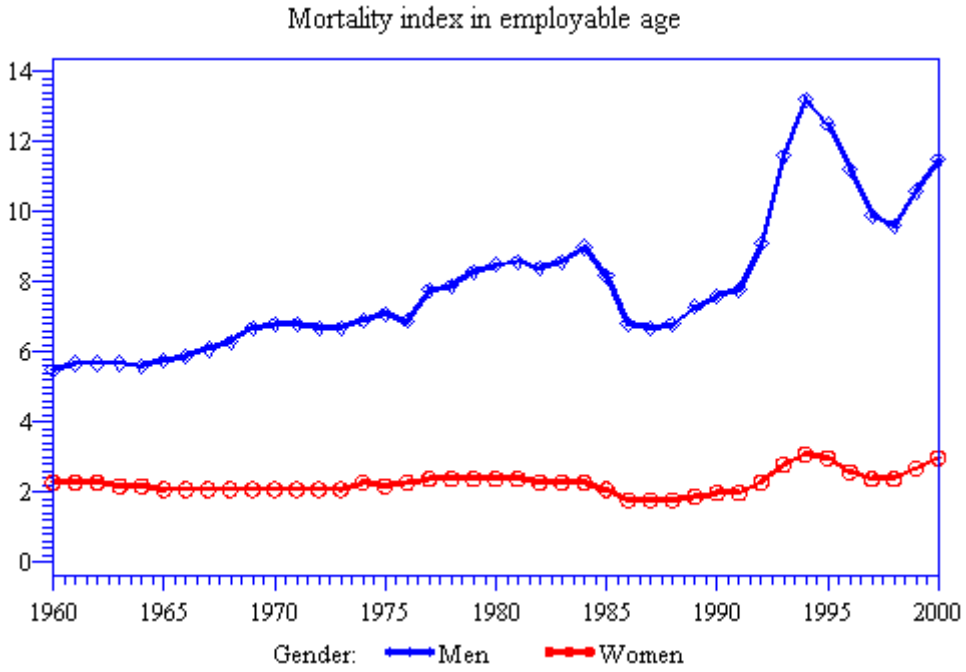

Fig. 10

The report scrutinizes three mortality scenarios:

1. Low, under which male longevity is expected to reach 62.4 years, and female longevity, 75.2 years, which means, in fact, that before 2050, longevity in Russia will not exceed the 1986 figures.
2. Middle, under which these figures will be 66.3 and 77.7 years respectively.

3. High, which expects male longevity to rise to 70.3 years, and female longevity, to 81.0. Even if this happens, longevity in Russia in 2050 will still be lower than it currently is in some advanced countries.

All scenarios provide for a significant decrease of infant mortality rate, from 15.3 deaths for 1000 infants to 5.0, 3.8 and 3.5 in the low middle, and high scenarios respectively.

All three scenarios envisage low international migration to Russia. It is expected to fall from 45 000 in 2005 to 30 000 in 2050 in the low scenario, from 96 000 to 61 000 in the middle scenario, and from 127 000 to 90 000 in the high scenario. There is also a fourth (supplementary) scenario, under which net migration will be approximately 270 000 persons a year.

The report presents the outcomes of the population forecast based on the four scenarios (see Table 2).

Table 2
Scenario parameters and expected population size in Russia

	Scenario			
	low	*middle*	*middle with high migration*	*High*
	Total fertility rate			
2000	1,2	1,2	1,2	1,2
2025	1,09	1,4	1,4	1,66
2050	1,09	1,4	1,4	1,75
	Expected longevity at birth (men), years			
2000	59,0	59,0	59,0	59,0
2025	60,2	63,1	63,1	65,5
2050	62,4	66,3	66,3	70,3
	Expected longevity at birth (women), years			
2000	72,2	72,2	72,2	72,2
2025	73,4	75,0	75,0	76,9
2050	75,2	77,7	77,7	81,0
	Growth through migration, thousand persons			
2001-2025	1050	2204	4609	3104
2026-2050	790	1675	6650	2470
	Permanent population, as of year end, thousand persons			
2000	144819	144819	144819	144819
2010	134685	138186	138601	140116
2020	121983	130990	131836	137323
2030	107311	121501	123994	132758
2040	92129	111568	115920	127036
2050	77162	101921	107605	122634

6. Analysis of the Age and Gender Structure of the Population

Having determined age/gender population structure, each age and gender group needs to be broken down into subgroups (social cohorts). We analyzed the available statistics, including the relevant official State Statistical Committee statistics (form 94-SOBES, 1995 – 2002), the findings of the National Survey of the Well-being of Households and Participation in Social Programs, State Statistical Committee 2001, and the findings of the medical and sociological survey of the disabled in the City of Moscow conducted by IAIAC in 1999 – 2000. The information was processed with the help of the Statistical Analysis System (SAS), license # 89917.

Under the Russian pension law, three types of labor pensions are paid:

- old-age and length of service;
- survivor pension; and
- disability pension,

as well as social pensions.

Old-age and length of service pensioners currently constitute 77.0% of the total number of pensioners, followed by disability pensioners (11.6%), loss-of-breadwinner pensioners (6.5%), and recipients of social pensions (4.2%). The other pensioner cohorts account for less than 1% and will not be examined. In the past decades, the shares of these pensioner categories were stable enough. The absence of pronounced trends, even in Russia's recent complicated social and economic situation, makes one expect these indicators to remain stable in the future.

6.1. Old-age pensioners and length of service

The current legislation divides old-age pensions into the following main types[19]:

- regular old-age pensions;
- pensions assigned on the grounds of labor conditions;
- pensions for workers in the Far North;
- early privileged pensions unconnected with labor conditions;
- pensions for length of service;
- pensions assigned to survivors of radiation accidents and catastrophes;
- pensions for persons officially recognized as unemployed; and
- pensions for the deputies of the 1990-1995 convocation.

The type of pension actually assigned usually depends on the combination of the insured person's age, general and specialized length of service, and type of occupation[20]. In terms of subsequent analysis, the significant distinction between these types of old-age pensions is that of actual or possible retirement age. Under the current legislation, retirement on account of old age may be possible starting with the age of 33, although most men may begin to draw an old-age pension at the age of 50, 55, or 60, and women, at the age of 45, 50, or 55.

The largest group of old-age pensioners is constituted by the recipients of regular old-age pension (68.1%), followed by the recipients of pensions connected with labor conditions (16.6%), workers in the Far North (6.4%), recipients of early privileged pensions not connected with labor conditions (6.1%), and the recipients of length-of-service pensions (2.3%). The recipients of the other types of old-age pensions taken together account for less than 1% of the total number of old-age pensioners.

[19] This list of old-age pensions is far from complete. Many types of pensions in it allow of further classification.
[20] In a number of cases, the type of old-age pension many be changed.

The present age and gender structure of old-age pensioners was largely formed under the old pension and labor law (possible retirement age and operating restrictions for some categories of persons engaged in hard manual labor or working in hazardous conditions), as well as the employment sphere (the number of persons holding jobs entitling them to an early old-age or length-of-service pension).

By way of example, Fig. 11 presents the age and gender structure of male old-age pensioners as percent of the total number of men of relevant age. The age and gender structure of female old-age pensioners has a similar aspect. The rise of the number of pensioners is observed upon reaching the retirement age set under the law: 33, 45, 50, 55 and 60 years for men and 33, 45, 50 and 55 years for women (these ages are marked by vertical dotted lines on the charts).

Fig. 11

In the older ages (over 60 for men and over 55 for women), the charts of the age and gender structure of old-age pensioners are not stable, although it follows from the analysis of the current pension legislation that after the onset of retirement age, the relative number of old-age pensioners should be constant. This inconsistency arises because the structure shown in the charts was formed under the old pension law and the features of the country's development in the past century. The "leap" in the number of male old-age pensioners aged 60, and female old-age pensioners aged 55 was determined by two factors: first, the legislatively set retirement age for the largest category of old-age pensioners, recipients of a regular pension, and, second, the fact that upon reaching retirement age, a number of disability pensioners who had the required length of service switched over to regular old-age pension[21]. For disability pensioners, the switch had direct economic sense, since the old-age pension is usually about 40% higher than the disability pension (according to the RF Pension Fund, as of March 31, 2001, the average size of these pensions was 1441.89 and 1062.56 rubles respectively). In our estimate, the rise of the number of old-age pensioners of retirement age is accounted for by the change of pension type in 10% of the cases as regards men, and 7% of the cases as regards women. Under the new pension law, such transition has no economic sense: a change of pension type does not entail a recalculation of the NDC and funded pensions, and the basic pension can be raised only if the pensioner has a category 3 restriction of capacity for work (it is irrelevant whether he/she draws an old-age or a disability pension).

[21] The Disabled in Russia: Disability Causes and Dynamic and the Controversies and Prospects of Social Policy, // T.M. Maleva, S.A. Vasin, O.Yu. Golodets, and S.V. Besfamilnaya, Bureau of Economic Analysis, Moscow: ROSSPEN, 1999, 368 pp.

The number of old-age pensioners goes down after the age of 70, although not in the same way among the men and among the women. In men, it occurs due to the onset of disability: in this age, the share of category 1 and 2 disability pensioners sharply increases. As regards women, there is an increase in the number of survivor and social pension recipients. An explanation can be found in the past (the generation who are now over 70 are a wartime generation), so there is no reason to assume that this situation will repeat itself. A good illustration is analysis of the number of women who draw a social pension. Let us note, first of all, that the size of social pension is minimal, so that switching over to it from any other pension is economically senseless. Consequently, the new recipients of social pension are those who have not drawn any pension before. But there are practically no such women aged 55 – 70, which means that the number of female social pensioners will not increase in the future.

The number of disability pensioners may, in theory, rise in the older ages because this is when the share of disabled persons rapidly increases. This scenario is, however, unlikely, since the current pension law does not offer economic grounds for switching over from an old-age to a disability pension. At present, all the social benefits are tied to the very fact of disability, not to the type of pension. It can, therefore, be assumed that in the future, the share of old-age pensioners will remain constant.

6.2. Disability pensioners

Number of disability pensioners

Current legislation divides the disability pensioners into the following main categories:

- due to a general disease;
- due to an industrial injury or occupational disease; and
- due to radiation accidents and catastrophes.

The largest group of disability pension recipients are persons disabled in consequence of a general disease (95.4 %), followed by those disabled by an industrial injury or occupational disease (4.3%), and the persons disabled in consequence of radiation accidents and catastrophes (0.3%).

Not all disabled persons by far are recipients of (labor) disability pension. In the younger ages, this happens because disability pensions are assigned only to persons who used to have a job regardless of the general length of service. In theory, a person may be assigned disability pension upon turning 15, but will begin to actually receive it at the age of 17 (see, for instance, Fig. 12). Before this age, disabled persons usually draw a social or a survivor pension. Most employable age disabled receive a disability pension because, if a person disabled since childhood got a job (according to statistics, this happens after the age of 17), the old pension system made it worthwhile to switch from the previously assigned social pension to a disability pension. A person disabled in employable age has no alternative but to apply for a disability pension. In this age, the number of disability pensioners is determined by the rate of the onset of disability among the population, which is easily approximated by an exponential curve[22]. We already said that upon reaching retirement age, many disabled persons switched from a disability to an old-age pension, and did not, as a rule, apply for a disability pension becoming disabled in retirement age. In this age, most people were already drawing an old-age pension and had no economic reason to accept a smaller disability pension. The only exception are the Great Patriotic War veterans who became disabled as a result of a war wound and some other categories entitled to draw two pensions simultaneously. This is why, most older-age disabled persons are recipients of an old-age pension.

[22] Insurance Against Industrial Accidents: Actuarial Grounds // Ed. by V.N. Baskakov, Moscow: Akademia, 2001, 192 pp.

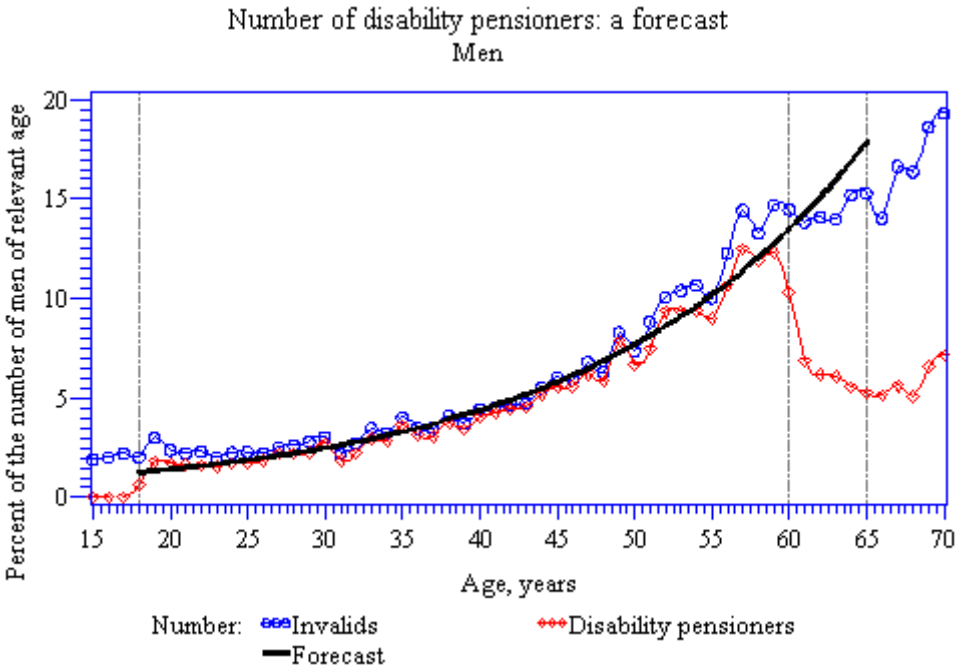

Fig 12

These motives of disabled persons and the previous pension legislation largely determined the age and gender structure of disability pensioners. Fig. 13 presents the age and gender structure of male disability pensioners as percent of the total number of men of relevant age differentiated by disability categories. A noteworthy trend is the rising share of disabled persons with a severe restriction of the capacity for work (categories 1 and 2) in the older ages. However, the rapid increase of the number of disability pensioners among men aged over 70 is most probably determined by past history. This group of pensioners includes the Great Patriotic War veterans who receive two pensions; they constitute 30.3% of all and 60.2% of the male two-pension recipients. True, this category is only 6.2% of all male disability pensioners over 70. For the female disability pensioners, these figures are almost two times lower, equaling 18.5%, 36.1%, and 3.6% respectively.

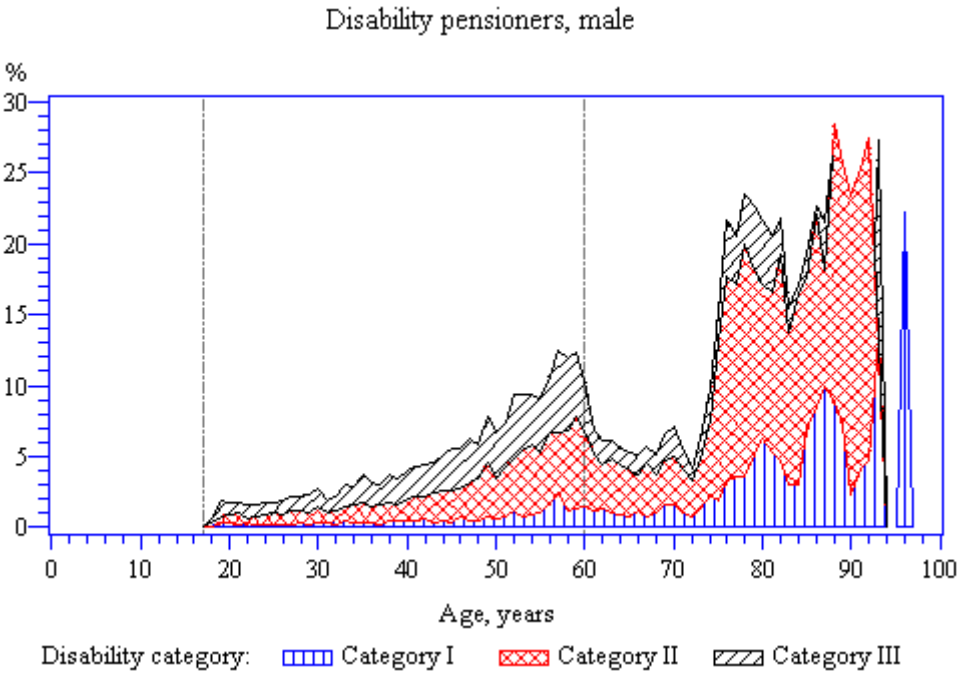

Fig. 13

Under the current pension law, labor pension comprises a basic, and NDC, and a funded part.

The size of the funded and the NDC elements of old-age and disability pensions is determined under practically the same procedure[23] with account of the size of the pension capital (notional or actual) and the expected duration of the payment of labor old-age pension; a supplementary coefficient, K, is factored in when determining the size of disability pension. Upon reaching retirement age, disability pensioners continue to draw their NDC pension, the size of which is determined by (1) the starting size of NDC pension at the date of the outset of its receipt, (2) NDC pension indexation, and (3) contributions for the NDC element of the pension (whenever present) paid during the receipt of the disability pension[24].

This is why, the NDC pension size should not change as a result of switching from a disability to an old-age pension. The formerly common transition from a disability to an old-age pension will not, in the future, make sense; under the new system, there should not be a decrease of the number of recipients of the NDC element of disability pension when retirement age is reached.

The payment of the funded part of labor pension to labor disability pension recipients does not begin before they reach an age entitling them to labor old-age pension. The number of disability pensioners drawing a funded pension is thus determined by the number of disability pensioners of a given age, and should not increase in the future either.

Analysis of the consequences of pension age changes

Let us now analyze the possible change (rise) of retirement age. As was said above, disability and disability pension are concepts whose interrelation depends on the current pension law. This is particularly important in retirement age, when a disabled person has a choice, being able to draw either a disability or an old-age pension. In employable age, the effect of the relevant legislation upon the number of disability pensioners is minimal; the main factor here is the rate of disability onset. This is why, the number of disabled persons and disability pensioners (monotonously) exponentially increases, and the difference between the two groups remains minimal up to retirement age. When retirement age is reached, the old pension system displayed a rapid decrease of the number of disability pensioners, while under the new one, their share will probably remain constant (see above). Retirement age does not really have a connection with the number of disabled persons, which continues to rise under the same exponential law. There is, therefore, every reason to assume that if retirement age is raised, the number of disability pensioners will increase along with the number of disabled persons. Thus, the solid line in Fig. 12 shows a curve, which projects the growth of the share of male disability pensioners if retirement age is raised to 65.

Disabled extra mortality

Another factor affecting the number of disabled persons and, consequently, disability pensioners, is disabled extra mortality. The difference in the mortality of disabled and non-disabled persons was noted by T. Maleva et al[25]. They mentioned that:

- mortality of the disabled who draw a disability pension is significantly higher than of the rest of the population aged under 60; and
- the distinctions become less significant with age."

[23] # 173-FZ, December 17, 2001.

[24] If there were contributions to the NDC part of the pension, its size may be periodically revised under Paragraph 3, Art. 17 of the Federal Law # 173-FZ, December 17, 2001.

[25] The Disabled in Russia: Disability Causes and Dynamic and the Controversies and Prospects of Social Policy // T.M. Maleva, S.A. Vasin, O.Yu. Golodets, and S.V. Besfamilnykh, Bureau of Economic Analysis, Moscow: ROSSPEN, 1999, 368 pp.

The latter reflects the diminishing qualitative differences between the disabled and the non-disabled confirming the hypothesis that "in retirement age, disability has a drastically different character due to situational and motivational factors". This conclusion is corroborated by our studies of disabled extra mortality. Below, we present the findings of analysis obtained after smoothing the rates of disabled mortality[26] in conformity with the Gompertz law[27]. Fig. 14 shows (for men and women) the excess of annual probabilities of disabled mortality over general mortality of the population as the function of age x. These are the same q_x^d indicators used in the basic formulae of the model (see Chapter 3).

Fig. 14

6.3. Non-pensioners

Government statistics do not refer to the group of persons we define as "non-pensioners". This is not surprising, since this group is very compositionally heterogeneous, including all the persons under retirement age who do not draw a pension. Specifically, it may embrace children, students, wageworkers, the self-employed, and other groups of persons represented in government statistics. However, only the members of each of these groups who do not draw a pension would belong to the group of non-pensioners

Let us note that it is not difficult to identify the age and gender structure of non-pensioners: it is the difference between total population and the number of pensioners in each age x[28].

The age and gender structure of female non-pensioners is presented in Fig. 15[29]. Its form in the younger ages is determined by the form of the age and gender structure of the children who receive survivor and social pensions. After the age of 18, most social pensioners disabled in childhood go over to the group of disability pensioners; survivor pensions are stopped at the same age, with the exception of the persons who are in full-time higher education (their pensions are stopped at the aged of 23).

[26] Insurance Against Industrial Accidents: Actuarial Foundations // Ed. by V.N. Baskakov, Moscow: Academia, 2001, 192 pp.
[27] Baskakov, V.N. and Kartashov, G.D., Methodological Instructions for Solving Problems of Actuarial Mathematics (Survival Models), Moscow: Izd-vo MGTU im. N.E. Baumana, 1997, 48 pp.
[28] The total number of loss-of-breadwinner and social pensioners does not exceed 10% of all pensioners.
[29] The calculations factor in the age and gender structures of the loss-of-breadwinner and social pensioners.

Between the ages of 23 and 35, the share of non-pensioners is relatively stable, varying from 93 to 95% of total population. After 35, the form of non-pensioner age and gender structure is determined by the form of the age and gender structure of old-age pensioners, for the most part emulating its profile. This can be clearly seen in the periods between the legislatively established retirement ages for women, 33, 45, 50, and 55, represented by vertical lines in Fig. 15.

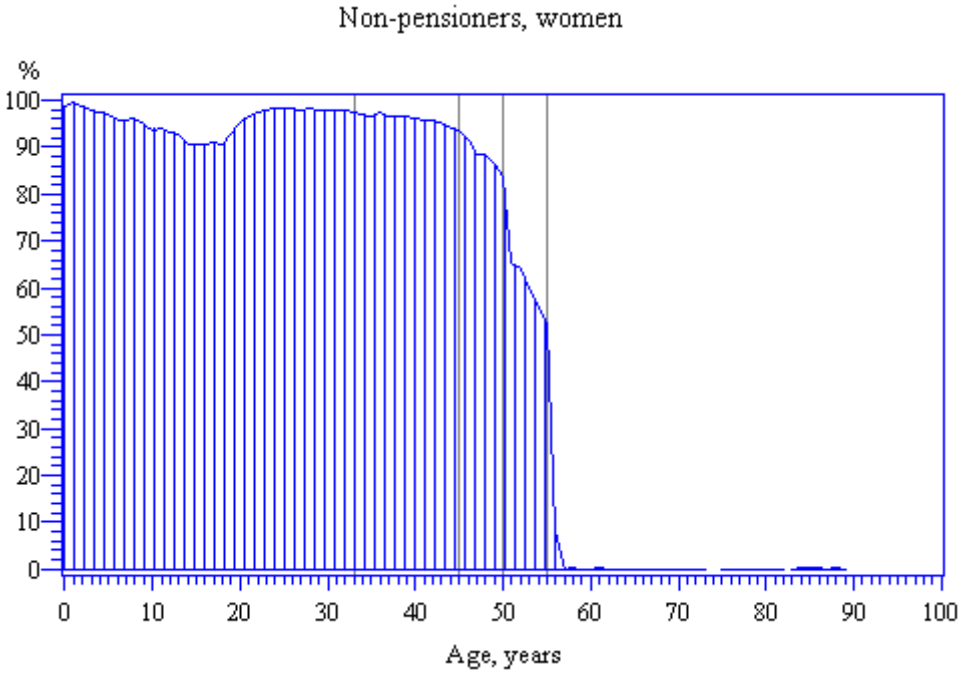

Fig. 15

6.4. The economically employed

The study of the number and the age and gender structure of the persons employed in the economy (hereafter, the employed) is very important for the purposes of this work because, first of all, most of them are payers of pension contributions. Most, but not all. Some people are released from making payments to the Pension Fund under the law (1), and some evade such payments (2). Unfortunately, there is no reliable statistics on the number of these groups; the share of payers of pension contributions among the employed is usually estimated with the help of expert techniques on the basis of these persons' age and gender structure[30].

[30] There may appear, in the future, groups of pension contribution payers who are not employed, e.g., women on maternity leave, active servicemen, unemployed persons, etc.

Fig. 16

When examining the age and gender structure of the employed, one must not forget that they are not a homogeneous group in terms of the size of pension contributions they are obliged to make under the law; that is, wageworkers, entrepreneurs, lawyers, etc. all pay different contributions. Also, depending on the category of payers, the collected contributions may go into different financial flow, e.g., the non-pensioners' contributions are used to increase pension capital (notional or actual), while those of employed pensioners, to raise their pensions. This is why, when analyzing the age and gender structure of the employed, it is also important to identify their main subgroups, including the employed non-pensioners, employed old-age and disability pensioners, and wageworkers and the self-employed.

As illustrations, Figs 16 – 19 present the shares of employed women as percent of the total size of the relevant groups. The charts break down the employed into wageworkers and the self-employed[31] and show the calculation size of the analyzed group.

Analysis of the obtained dependencies reveals the following. The share of employed persons who graduated from secondary school and completed subsequent training (aged 17 – 23) increases in linearly to 80% among men, and to 65% among women. Then the share of employed men remains practically the same, and the share of women continues to rise up to the end of the reproductive age, reaching the male employment rate by the age of 45. After 45, the share of employed persons of both genders begins to gradually diminish due to retirement on the grounds of old age. By retirement old age, the share of the employed is 40 – 50% of total population; after the age of 75 – 80, very few people are employed.

The share of employed men and women who are non-pensioners almost exactly follows the age and gender structure of the employed, the difference being that after the age of 45, too, their

[31] The self-employed group includes the respondents who gave one of the following answers to the question "Which of the following categories best describe your occupational status?"

- enterprise, company owner or co-owner, etc.;
- entrepreneur without the establishment of juridical person;
- farmer;
- employed on an individual basis;
- member of a production cooperative;
- employed without pay in a family firm or trade.

share remains stable, 80-85%, up to the onset of retirement age[32]. After that, all the members of the non-pensioner cohort go over to that of pensioners. The share of employed old-age pensioners monotonously decreases from 80 – 90%. The exception is the reproductive age in women (33 – 45 years) and the periods when large numbers of men begin to draw early pensions (33 – 45 years). The employment rate of disabled persons depends very little on age. Starting with 23, it varies within 20 – 25% almost until retirement age. In retirement age, the disabled employment rate is 5 – 10%, monotonously decreasing with time.

Fig. 17

The share of self-employed men among all employed persons is almost doubled that among the women. In employable age, these shares weakly depend on age and are approximately 10% among the men and 5% among the women.

[32] The distinctions in the shares of all employed persons and the non-pensioners arise from the differences in the calculation base. In the former case, it is the entire population, and in the latter, all non-pensioners.


Employed non-pensioners, women
%
90
80
70
60
50
40
30
20
10
0
1300
1200
1100
1000
900
800
700
600
500
400
300
200
100
0
thousand persons
10
20
30
40
50
60
70
80
Age, years
Wageworkers
Self-employed

Fig. 18

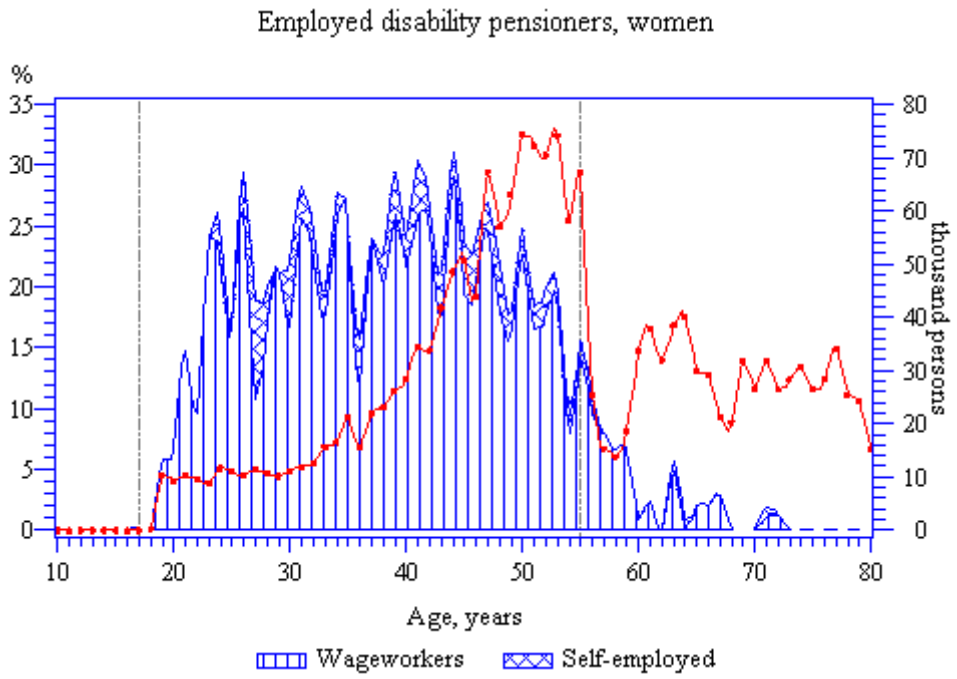
Employed disability pensioners, women
%
35
30
25
20
15
10
5
0
80
70
60
50
40
30
20
10
0
thousand persons
10
20
30
40
50
60
70
80
Age, years
Wageworkers
Self-employed

Fig. 19

7. The Modeling Program

This work includes large-scale modeling of the RF pension system under different demographic and macroeconomic development scenarios. The basic scenario uses the following indicators, which largely determine the prospects of pension provision:

1. The demographic scenario is the middle scenario of the RF Goskomstat.
2. The macroeconomic parameters (wage and GDP growth rates) were borrowed from the forecast of the RF Ministry for Economic Development and Trade.
3. The macroeconomic forecast provided the number of wageworkers indirectly determined by the size of the wage fund (WF) and average wage.
4. Retirement age is taken as constant (60/55) throughout the forecasting period.
5. The number of early (privileged) pensioners gradually diminishes in conformity with the draft law on professional pension schemes. Basic pension indexation is to the inflation of retail prices.
6. NDC pension indexation is in conformity with the current law, that is, in accordance with the RF Pension Fund revenues directed into the payment of NDC pension.
7. Real (over and above inflation of retail prices) profitability of investments under the funded element of labor pension is taken as 7%.

When drafting supplementary modeling scenarios:

1. We used the low and the high (pessimistic and optimistic) RF Goskomstat demographic scenarios and a supplementary, "extra-high" scenario, as well as combined scenarios, where birth rate and longevity were taken from different demographic scenarios, e.g. the basic birth rate was combined with extra-high longevity.
2. Retirement age varied. The following versions were used as supplementary:
    - 60 years as retirement age for both men and women;
    - 65 years as retirement age for both men and women.
3. Wage growth rate varied.
4. Investment profitability under the funded element of labor pension varied.
5. The present share of early pensioners and the abolition of this category were considered.
6. Other versions of indexation of basic and NDC pension were considered, etc.

Modeling outcomes were examined in the following order. First we analyzed the various demographic and macroeconomic forecasts; this involved examining the indicators having the greatest significance in terms of individual pension system elements: the old age dependency ratio, residual longevity at the date of retirement, wage growth rate, and investment profitability. We went on to make separate analysis of the PAYGO and the funded elements of the pension system, and summed up the modeling outcomes.

8. The Demographic Forecast

Demographic indicators are perhaps the most significant pension system parameters. It is the demographic crisis provoked by the increasing longevity and falling birth rates that made pension reform one of the most pressing concerns in many countries. There has been a sharp increase in the share of the aged in total population. Russia is also facing these problems, although unlike most other countries, aging here is occurring due to the falling birth rates unaccompanied by increased longevity (which is even diminishing).

In the paper[33], we examined the RF Goskomstat forecast of the country's total population basing ourselves on Goskomstat's report "On Russia's demographic development trends in the first half of the 21st century"[34], which, although not an official document, nevertheless provides an idea of the RF Goskmostat's opinion on this issue.

The report considers three demographic development scenarios, low, middle, and high, under which the expected population size varies within a wide range: the difference between the population sizes in the consequential scenarios is 24 – 25 million persons.

Goskomstat's procedure for the drafting of demographic forecasts, under which the combination of low birth rate and low longevity amounts to the low forecast, the combination of middle figures, to the middle forecast (which we shall heretofore designate as basic), and the combination of high figures, to the high forecast, was most probably determined largely by the goal facing this organization, namely, to estimate the extent of the variation of the country's total population under different assumptions.

However, in terms of the pension system, population size per se is immaterial. For the PAYGO pension system, the main indicator is the number of pensioners/number of the employed ratio, which shows which part of one pensioner's pension is funded by one employed person[35]. Since the number of the employed (contribution payers) and pensioners is determined by many factors (including legislative ones), which may change in future, the pension business often uses a purely demographic indicator, the old age dependency ratio, determined as the ratio of persons of retirement age to the number of persons of employable age[36].

Analysis of the RF Goskomstat demographic forecast shows that between 2002 and 2050, the pensioner dependency ratio can be expected to rise from 0.33 to 0.7 – 0.8 (depending on the forecast), which means that in 50 years' time, the problems of public pension provision will become much more serious. It is noteworthy that the old age dependency ratio changes insignificantly depending on the forecast[37]. This can probably be explained by the fact that the RF Goskomstat brings together in the same scenarios factors that have an opposite effect on the pensioner dependency ratio. A high birth rate is a factor, which reduces this ratio by raising the share of persons of employable age, while higher longevity increases it by increasing the number of retirement age persons.

Of course, in theory, there are grounds for combining mortality and birth rates in one demographic scenario, but, obviously, this is not the only possible combination. A probable scenario is a combination of low birth rates with high longevity[38] or a high birth rate with low longevity. These versions result in a much broader variation of the predicted pensioner dependency ratio values.

It is important that even the high longevity forecast can be designated as such only in comparison with present-day longevity in Russia or with the other forecasts. If we compare predicted longevity in 2050 (70 years for men and 81 years for women) with current longevity in the advanced countries, we shall see that in Great Britain, for instance, it is already 75 years for men and 80 years for women. In the mid-21st century, expected longevity in that country will be about 80 years for men and 85 years for women[39]. Thus, even the high Goskomstat forecast implies that in

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[33] Baskakov, V.N., Lelchuk, A.L., and Pomazkin, D.V., RF Pension System Model, *Sotsialnyi vestnik*, 2002, No. 3, pp. 3 – 35.

[34] *Voprosy statistiki*, 2002, No. 3, pp. 3 – 10.

[35] The inverse value is equal to the number of employed persons who fund the pension of one pensioner out of their taxes.

[36] Under the current pension system, retirement age persons include the women over 55 and the men over 60, and employable age persons, the women aged 15 – 54 and the men aged 15 – 59.

[37] This means that the demographic forecasts under which the country's population differs by more than 20 million persons are equivalent in terms of a PAYGO pension system.

[38] This version does not contradict empirical data; in Italy, for instance, high longevity is accompanied by a low birth rate.

[39] National population projections 1998-based. Series PP2 no.22. Government Actuary's Department of Great Britain, www.gad.gov.uk.

2050, male longevity in Russia will be lower than it now is in many countries, and that female longevity will reach the current value. This assumption is conservative in terms of population forecasts but not in terms of pension system issues, since the scenario envisaging much higher longevity (especially for men) is also quite feasible.

In view of the above, the authors included one more, "extra-high" scenario, which provides for raising average longevity to 74.5 years for men and 84.5 years for women, and a rise of the total fertility rate to 2.15, that is, the population reproduction rate[40].

RF Goskomstat's low scenario envisages a very low birth rate and longevity. Should the low birth rate scenario be enacted, Russia's present-day population would rapidly disappear. But even if this happens, it cannot mean that $1/7^{th}$ of dry land will become uninhabited: a void is always filled. In this case, immigration into Russia will probably be much higher than that envisaged by Goskomstat's forecast. As for low longevity, cynical though this may sound, it would only benefit the pension system. In view of the above, the authors consider it worthless to concentrate on the low birth rate and longevity scenarios.

We have already said that our basic scenario is RF Goskomstat's middle one (below, all the middle scenario parameters are referred to as basic). This decision is largely determined by it being accepted as such by the ministries and administrative departments concerned, and is used as the foundation for the macroeconomic forecast of the RF Ministry for Economic Development and Trade. The supplementary scenarios include:

- a high scenario; and
- an extra-high scenario;

as well as combined scenarios:

- basic (middle) fertility and extra-high longevity; and
- extra-high fertility and basic (middle) longevity.

The latter two scenarios are important if we want to estimate the range of the possible variation of the old age dependency ratio.

Fig. 20 shows the population forecast for the above scenarios, and Fig. 21 – the old age dependency ratio for the legislatively established retirement age, 60 years for men and 55 years for women. Fig. 21 makes it clear that the combination of an extra-high birth rate with extra-high longevity would result in an old age dependency ratio that is very close to the figures in the basic and high demographic scenarios. Only the mixed versions combining basic and extra-high figures would entail significant distinctions in the old age dependency ratios. This is a matter of principle for further modeling, helping to select the really important scenarios: in future, we shall use mostly the basic scenario and the mixed scenarios combining basic and extra-high indicators.

[40] Since this paper does not examine the effect of migration, the middle migration scenario is used.

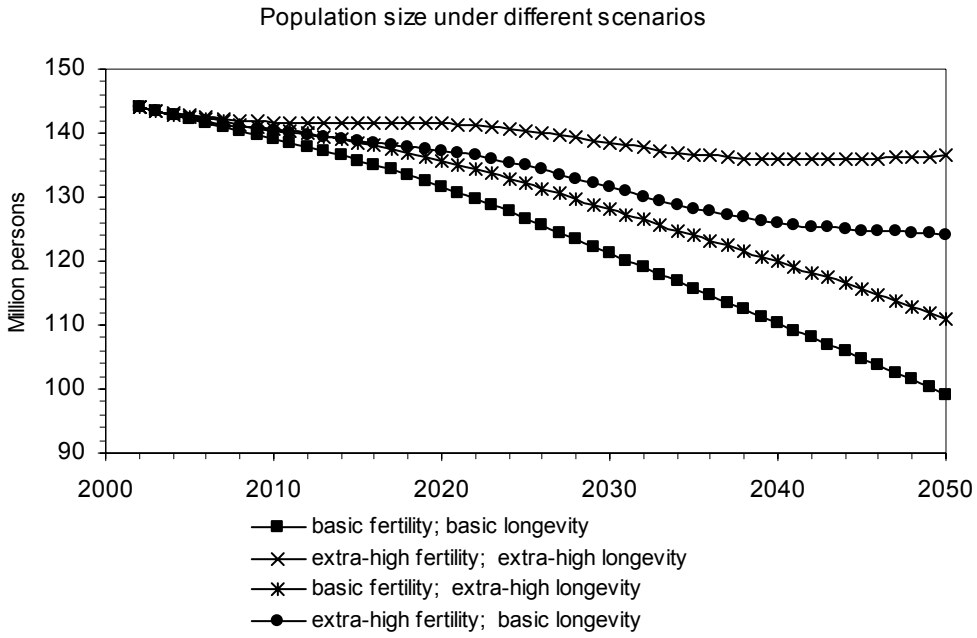

Рис. 20

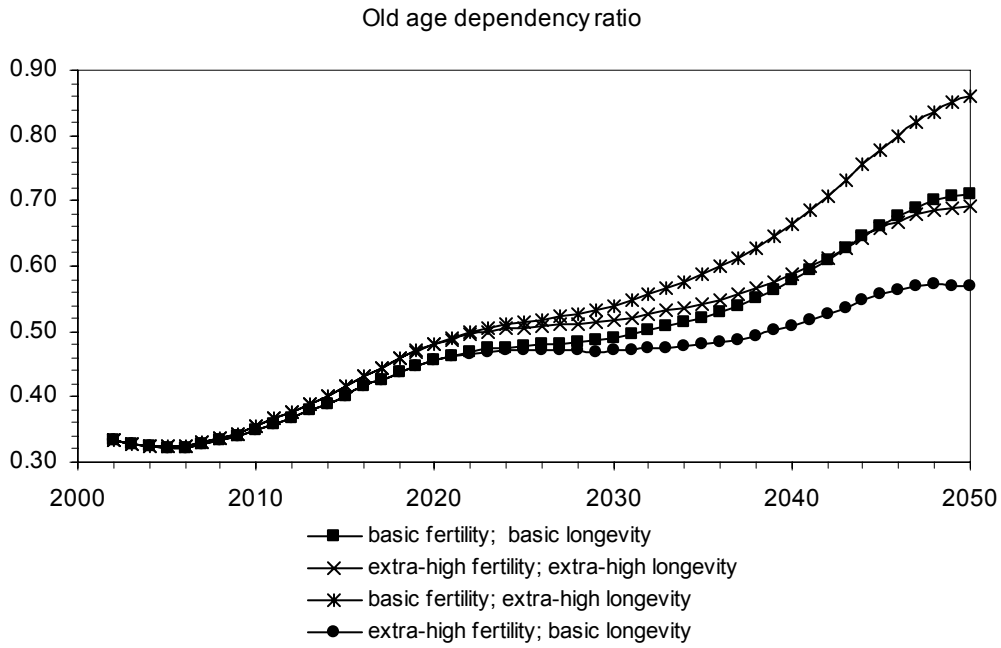

Fig. 21

The effect of retirement age on the old age dependency ratio is illustrated in Fig. 22, which demonstrates these ratios calculated for raised retirement age as percentage of the ratios obtained for the current retirement age under three different demographic forecasts. Rising retirement age for women to 60 (see the three upper curves, which match different demographic forecasts) would result in an average relative reduction of the old age dependency ratio by 20%, and if retirement age were raised to 65 for men and women, this figure would be, on average, 45%. The effect of the demographic forecast on the examined parameter is insignificant, and its variation in relation to the average value can probably be explained by the demographic waves in the age and gender structure of Russia's population.

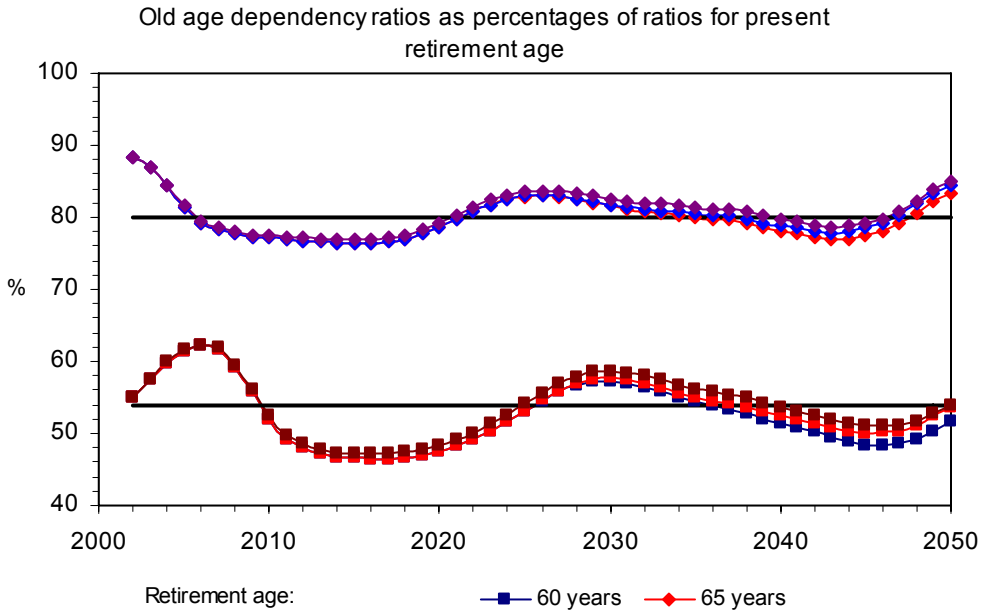

Fig. 22

Residual longevity

While in terms of the PAYGO pension system the main demographic indicator is the old age dependency ratio, for the funded system this is longevity or, to be more precise, residual longevity upon reaching retirement age.

Fig. 23 shows longevity at birth, where the bottom group of curves pertains to men, and the upper, to women. Each group contains four curves valid for different scenarios (top to bottom): extra-high, high, basic, and low. Fig. 24 illustrates the dependency of residual longevity among men and women upon their age (including retirement age) for the threshold forecasting years, 2002 and 2050. Analysis of these charts shows that:

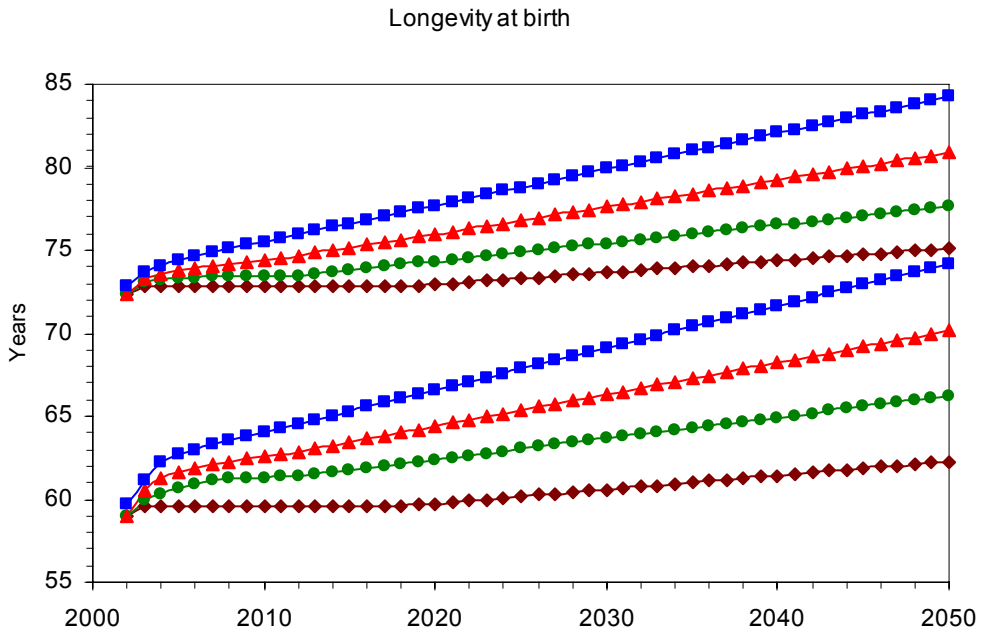

Fig. 23

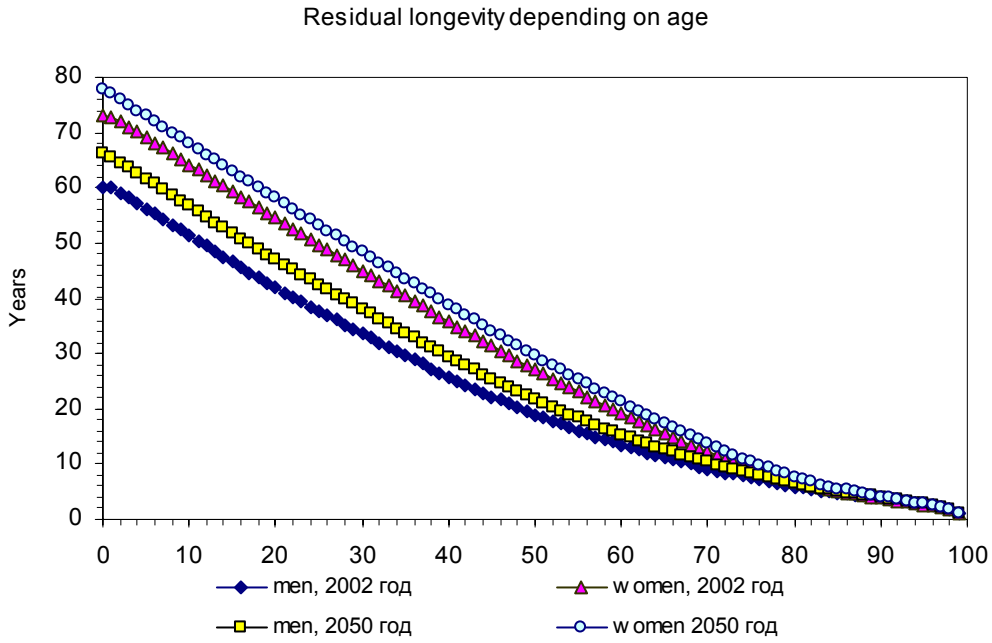

Fig. 24

1) Residual longevity among women is much higher than among men. Depending on the demographic forecast and year, the difference reaches 6.5 - 7.5 years for 55-year-old men and women, 5.5 - 6.5years for the 60-year-olds, and 4 - 5 years for 65-year-olds.
2) If retirement ages for men and for women remain different, this distinction is even greater. In 2002 (the first year of reform), residual longevity among 55-year-old women was 23 years, and among men, 13.5 years, the difference reaching almost 10 years!
3) In 2002, average weighted (from the number of 55-year-old women and 60-year-old men respectively) residual longevity was approximately 19 years; and this is, the figure indicated in the Law on Labor Pensions in the Russian Federation. In future, residual longevity will rise (see table). This is why the residual longevity "prescribed" by the law will require a revision.

	2002	Projected residual longevity for 2050, years			
		Low	Basic	High	Extra-high
Men	13.5	14.0	15.3	17.0	19.0
Women	23.0	23.8	25.3	27.6	30.0
Average	18.9	19.5	21.0	23.0	25.2
Average longevity increase		3.5%	11%	22%	34%

4) Under the RF Law on Labor Pensions, when the NDC element of labor old-age pension is assigned at an age which exceeds retirement age (i.e., over 60 years for men and over 55 years for women), the expected duration of the payment of labor old-age pension used to calculate NDC pension is reduced by one year for each full year that has elapsed since reaching retirement age. As is to be expected, real residual longevity diminishes at a slower pace. Residual longevity among 65-year-old men is lower than residual longevity among 60-year-old men not by five years but by 2.6 - 2.7 years, and residual longevity among 60-year-old women is lower than that among 55-year-old women by 3.8-4.1 years[41]. The

[41] It is obvious that the lower the mortality rate, the faster residual longevity diminishes.

legislatively established decrease of the expected payment period is really a stimulus for delaying the outset of the receipt of NDC pension.

5) Residual longevity is usually borrowed from the mortality table for the given year, e.g., 2010. As regards the group who retired at the age of 60 in 2010, real mortality is, however, different:
   - at the age of 60, mortality should be borrowed from the mortality table for 2010;
   - this cohort will turn 61 in 2011; this is why the probability of the death of 61-year-old persons should be borrowed from the mortality table for 2011; 62-year-old persons, from the 2012 table, etc.

Since it is assumed that for each following forecasting year, mortality will be lower than for the previous one, real mortality rates will be lower than the ones borrowed from the 2010 table, and actual residual longevity will be higher than that calculated based on the 2010 table.

Analysis of the possible distortion of residual longevity arising because it is calculated using the mortality table for the year of retirement (that is, without account of future mortality decrease) shows that for the basic scenario, it lies within 2%, for the high scenario, 4%, and for the extra-high scenario, 7%. Such distortions are immaterial in long-term forecasting, although they may have some significance for organizations, which sell annuities (e.g., insurance company).

9. Macroeconomics and Investment Profitability

The following macroeconomic indicators need to be projected to model the pension system:

- the rate of (retail prices) inflation;
- labor productivity and GDP growth; and
- average wage growth, often referred to as wage inflation.

It should be noted that by itself, inflation rate is required only in the calculations in nominal values (rubles). Considering that the least accurate forecast is that of inflation rate and that pension size in rubles in, say, 2023, means almost nothing, it would be much more informative to present the outcomes in today's prices. To calculate such indicators, it is enough to know the real (minus retail price inflation) growth rates of GDP and average wage.

Long-term macroeconomic forecasting is a particularly complicated matter for Russia. As a rule, forecasting is based on long-term trends obtained as a result of analysis of previous experience and the assumption that these trends will continue to operate in future in an unchanged or slightly modified form. It is well known, however, that the trends of transition periods are unsuitable for long-term forecasting. Of course, this also makes it much more difficult to project the age and gender structure of the population, but for the macroeconomic forecast, this is an even greater difficulty (see Figs 25 and 26). In this situation, it would make sense to use other data, e.g., outside forecasts (including government ones), the trends/experience of other countries, etc.

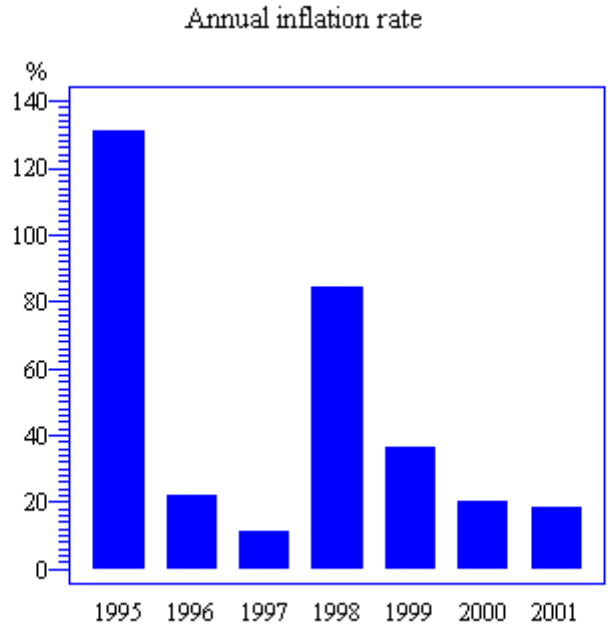

Fig. 25

Fig. 26

For a variety of reasons, the views on Russia's macroeconomic prospects are regularly revised. Thus, after President Putin's criticism of the economic growth rates on which the government founded its plans, higher rates were factored into the 2002 macroeconomic forecast. As a result, a 6% average annual wage growth up to 2050 is currently treated as a realistic proposition.

What would this mean? Assuming that in the United States, this rate will be 1% a year, by 2050 the gap between Russia and that country would become 11.5 times smaller, and the average wage in Russia (in today's prices) would be $1700 a month. Thus, at first sight, the expected wage growth rate appears realistic. There are, however, reservations.

1) How legitimate it is to compare the dollar worth of average wages in Russia and that in the United States? Since 1991, average wage in Russia rose dozens of times in dollar terms, whereas in real terms it almost halved. No one will question the fact that the dollar's purchasing power in Russia and in the United States differs substantially and that the actual difference between the average wage in Russia and in the United States is much smaller than the ratio of their dollar values.

2) The forecast assumes a steady almost 50-year-long excess of wage growth rates over the increase of labor productivity by approximately 0.6%. It is not clear how such excess can be supported.

3) Disregarding the fluctuations, the main wage growth forecast assumes that in 2005 – 2020, average wage growth will approach 7%, will decline gradually over the next 10 years to reach 5.9% by 2030, and will subsequently go down by another 0.3% over the remaining 20 years of the forecasting period. To evaluate pension system effectiveness, it is important to determine how likely it is that wage growth will behave in this manner. Is not a more realistic scenario the one under which the initial wage growth rate is higher than under the above forecast as wages "emerge from the shadow", the share of wages in GDP rises, and the incomes received from public funds in non-cash form are replaced by wages, and will then go down to the rate recorded in the advanced countries?[42]

In view of the above, the paper examines a supplementary wage growth forecast (see Fig. 27), which has already been used earlier to conduct similar calculations within the framework of the

[42] In the 1990s, wage growth rates in most advanced countries did not reach 2% a year. The Yearbook of Russian Statistics, RF Goskomstat, , 2001.

TACIS project[43] "Assistance to the Ministry for Economic Development and Trade. Project. Component 6. Pension Reform". According to this forecast, average wage g rowth rate will be 3.5% a year.

[43] A complete report on the project can be found in http://www.tacis-medt.ru/eng/pensref.htm

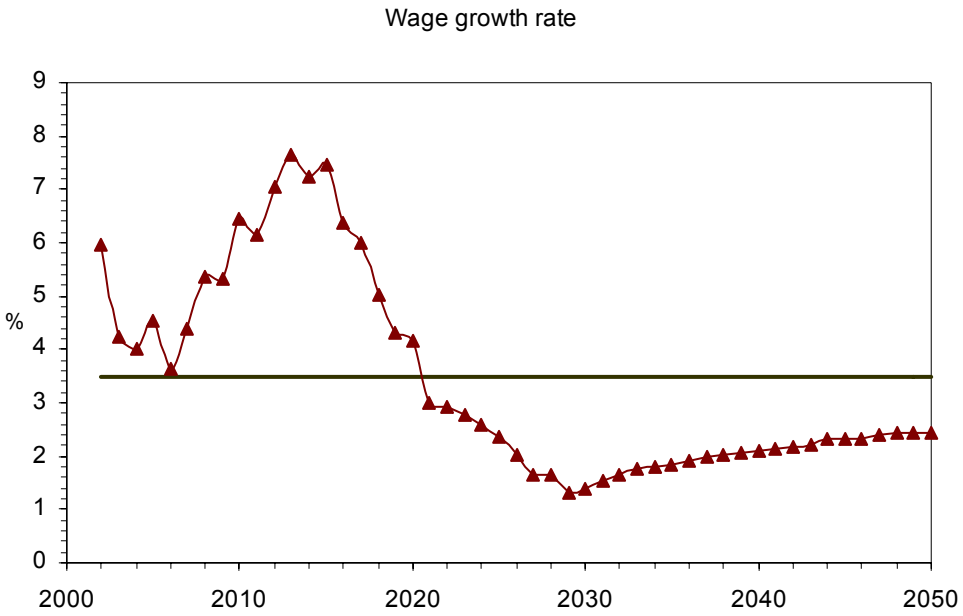

Fig. 27

Investment profitability is a major parameter determining the effectiveness of the introduction of funded pension. It should be noted that in terms of the pension system generally, real return (over and above the rate of inflation) is more important. Another important factor is the excess of investment return over wage growth rate, since the latter directly determines the size of the contributions.

Like macroeconomic indicators, investment return is very difficult to forecast; it will largely depend on the practice of legislative regulation of pension investments. Above[44], we reviewed the history of returns on different classes of investments. These data demonstrate that there is no direct dependency between wage growth rate and investment return. Just the opposite, they rather confirm the assumption, based on the purchasing power parity curve theory, that real (e.g., stocks) investments have comparable long-term real profitability.

It should be remembered that investment profitability at the stage of accumulation and at the stage of pension payment might not be the same. This can be explained by the differences in the regulation of pension accumulations at these two stages, as well as the fact that the two processes may be managed by different financial institutes: accumulations may be the business of non-public pension funds, and pension payment, of insurance companies[45].

10. The PAYGO Element of the Pension System

Above, we examined a purely demographic indicator, old age dependency ratio, which helped us to discover important relationships and formulate demographic scenarios for further study. The merits of the purely demographic old age dependency ratio is that it does not depend on a country's pension system and makes cross-country comparisons easy. This merit is, however, also its fault, since real dependency is determined by the number of pension recipients and pension contribution payers.

Fig. 28 shows the number of pensioners drawing a labor pension and the number of employed persons, making it clear that if the basic forecast is realized, by 2050 the number of

[44] Baskakov, V.N., Lelchuk, A.L., and Pomazkin, D.V., RF Pension System Model, *Sotsialnyi vestnik*, 2002, No. 3, pp. 3 – 35.

[45] See, for instance, a paper on the Polish pension system: A. Chlon, M. Gora, and M. Rutkowski. Shaping Pension Reform in Poland: Security through Diversity, Social protection discussion paper No. 9923, 1999, World Bank site.

pensioners and of the employed will become equal, that is, there will be one pensioner for one employed person.

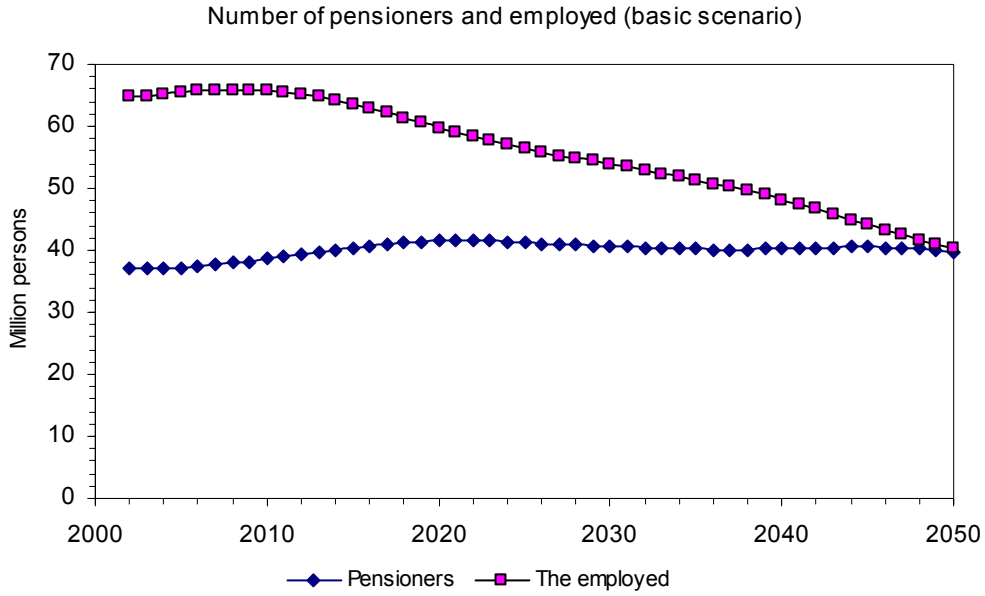

Fig. 28

Let us look at another indicator, *pensioner dependency ratio* (for the system), which is the ratio of the number of labor (old-age, disability, and survivor) pension recipients to the number of the employed (see Fig. 29).

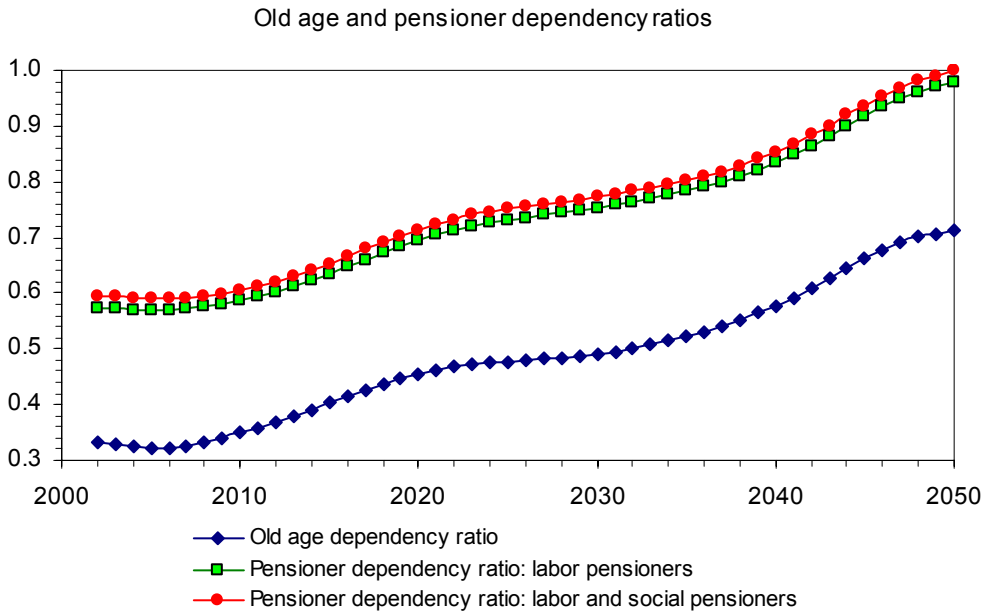

Fig. 29

Fig. 29 shows that the pensioner dependency ratio, which factors in, along with the labor pension recipients, those who draw a social pension, is very close to the ratio which factors in the labor pensioners alone. So, to simplify the presentation, we shall exclude the social pensioners from subsequent analysis.

To measure the effect of the number of early (privileged) pensioners on the pensioner dependency ratio, these ratios under the basic demographic scenario and constant retirement age were calculated for the following versions:

- the current number of early pensioners remains unchanged (as percentage of the corresponding age and gender groups);
- gradual reduction of the share (percentage) of early pensioners in conformity with the current legislation; and
- no early pensioners.

Our calculations demonstrate that the effect of the institute of early (privileged) pensioners on the pensioner dependency ratio is not great. Total disregard of this institute decreases the ratio:

- by 4 – 6% from the version under which the current number/share of early pensioners remains unchanged; and
- by 1.5 – 2% from the share envisaged by the current legislation.

Let us now scrutinize the correlation of the pensioner dependency ratio with one of the most important pension system factors, retirement age. As before, we shall consider the present retirement age, 60 years for men and 55 years for women, designating it 60/55 (Fig. 30), and two possibilities of its rise:

- 60 years for both men and women (60/60); and
- 65 years for both men and women (65/65).

Comparing the pensioner dependency ratios under different demographic scenarios and retirement ages, Fig 31 shows them as percentages of those ratios for present retirement age. Analysis of Fig. 30 and 31 reveals that:

- for all considered demographic forecasts, raising retirement age to 65 years would decrease the pensioner dependency ratio by 35-40%;
- if retirement age is raised to 65 years, under the basic demographic scenario the pensioner dependency ratio will reach the 2002 figure only in 2050; under the basic birth rate and extra-high longevity scenario, this will happen by 2040, and under the extra-high birth rate and basic longevity scenario, the current figure will not be reached by 2050; and
- in 2050, the pensioner dependency ratios under the two mixed demographic scenarios differ approximately 1.35 times.

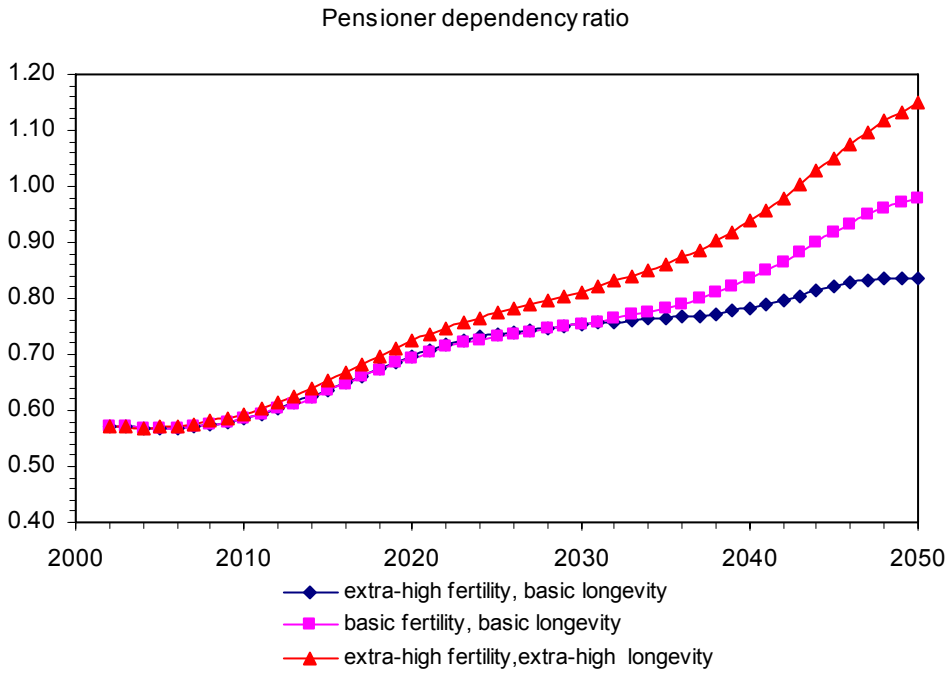

Рис. 30

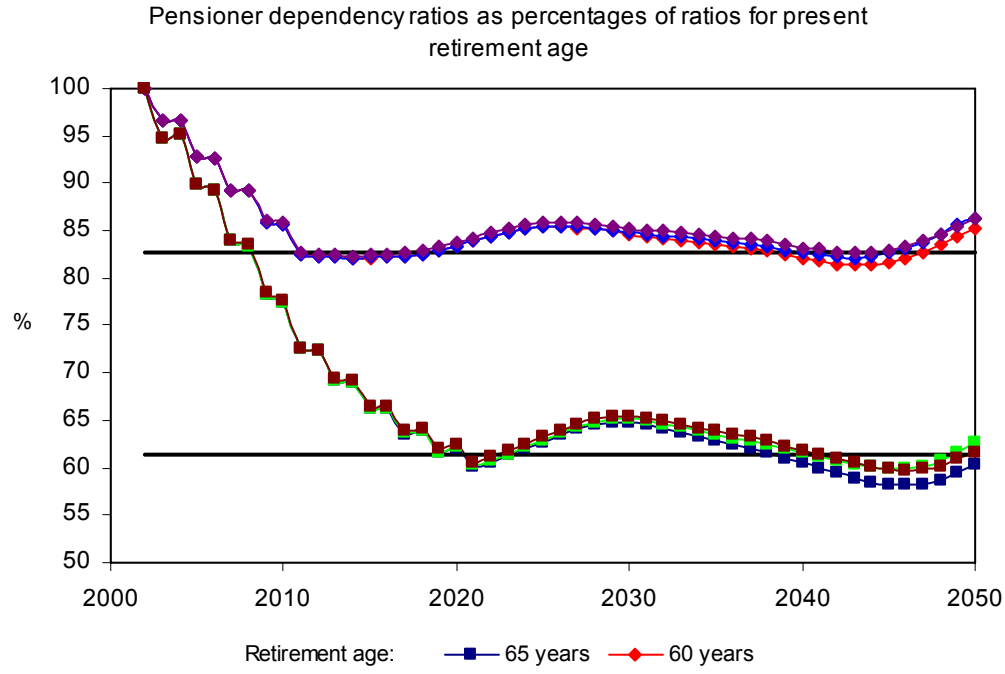

Fig. 31

When modeling, retirement age was raised by one year for two calendar years; this is why, Fig. 31 shows a transition period (10 and 20 years respectively should retirement age be raised to 60 and 65 years), during which the percentages strive towards a stationary value. The same is also true for some other outcomes (see Fig. 33).

To evaluate pension system efficiency, different criteria may be used depending on the situation and/or the set goal. In the current situation with its low standard of living, one of the principal criteria is achieving the subsistence minimum. Since we are looking at long-term

prospects, this criterion is not so important; the main criterion of pension provision is the replacement ratio, that is, pension/wage ratio.

As is known, this criterion is based on the following simple premises. Assuming that a person accepting retirement is not worried about poverty, it is believed that after retirement, he/she will need less money to maintain an unchanged standard of living. Why is that so? Because by the time of retirement, this person:

- already has grown-up children who can provide for themselves;
- has returned the loans taken earlier (e.g., for the purchase of an apartment or dacha);
- has ceased to save for the pension, etc.

The replacement ratio allowing to keep up the standard of living unchanged will, therefore, be under one. In the advanced countries, the optimal replacement ratio is accepted as 60 - 70%. The ILO recommends the replacement ratio should not be below 40%.

Under the current pension system, labor old-age and disability pension comprise the basic, the NDC, and the funded elements, with the former two being elements of the PAYGO system. It should be noted that by themselves, the basic and the NDC elements are just a way to calculate the PAYGO part. Their introduction has no direct effect on the opportunities opened up by the PAYGO system[46]. In each forecasting year, the effectiveness of the PAYGO system is determined by the volume of pension contributions/number of pensioners ratio.

The basic indicator describing the potential of the PAYGO part of the pension system is the PAYGO affordable replacement ratio. It is equal to the ratio of the average size of the PAYGO element of labor pension (i.e., the sum of the basic and the NDC elements) in a certain forecasting year to average wage in the same year, provided that the sum of the payments for the basic and NDC elements of the pension is equal to the sum of the contributions for the basic and the NDC elements. The affordable replacement ratio for the three demographic forecasts is presented in Fig. 32, and the effect of a higher retirement age on the value of this ratio is illustrated in Fig. 33, which shows the these ratios obtained with account of raised retirement age as percentages of the ratios obtained under the current retirement age for the three demographic forecasts. The modeling demonstrates that raising retirement age for women to 60 would result in a relative increase of the affordable replacement ratio by an average of 20%, and raising retirement age for men and women to 65 would increase this ratio by an average of 65%. The effect of the demographic forecast on the examined parameter is insignificant; its variation with respect to the average value can probably be explained by the demographic waves in the age and gender structure of the population[47].

The modeling also shows that for the combined scenarios determining the range of variation, in 2050, using the same retirement age:

- the old age dependency ratio differs about 1.5 times;
- the pensioner dependency ratio differs about 1.35 times, and
- the correlation is the same for the PAYGO affordable replacement ratios.

In all cases, the indicators for the basic demographic scenario lie somewhere in the middle, with the difference of the affordable replacement ratios from the basic scenario not reaching 20%.

If retirement age is raised, the share of the employed increases, and the share of pensioners goes down[48], which sharply reduces the pensioner dependency ratio, leading to a rise of the PAYGO affordable replacement ratio. In terms of PAYGO pension, the rise of retirement age

[46] It is assumed that the introduction of the NDC element will provide a stimulus to the payment of contributions, thereby, indirectly affecting the PAYGO system.

[47] In the beginning we also see the effect of gradual transition from the present retirement ages to the new retirement ages (see comments to Fig. 31).

[48] The modeling factors in the increase in the number of disability pensioners.

lengthens the period of accumulation and shortens the period of pension payment, with the latter factor much more significant than the former.

If retirement age is raised to 65 years for both men and women, in 2050:

- the old age dependency ratio will go down 1.8 - 1.9 times;
- the pensioner dependency ratio will do down approximately 1.6 times, and
- the PAYGO affordable replacement ratio will change in about the same measure[49].

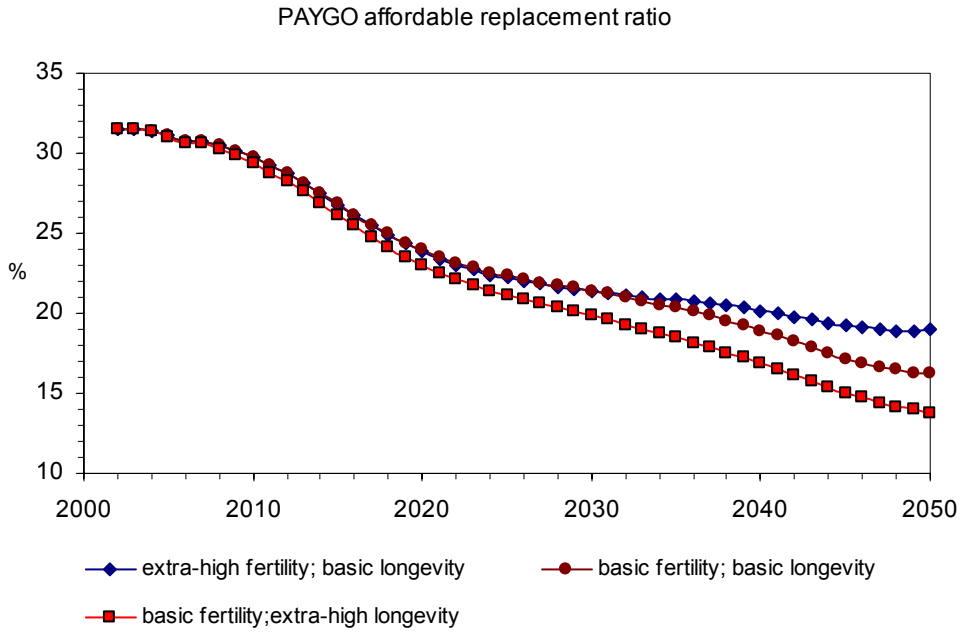

Fig. 32

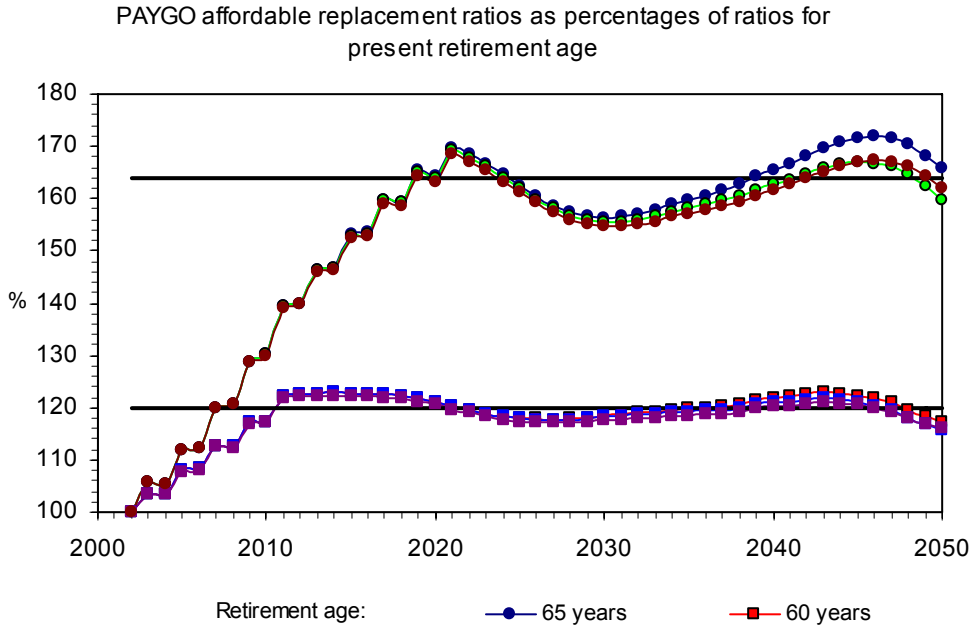

Fig. 33

[49] This outcome holds for different retirement ages.

Indexation (basic scenario)

Above, we examined the indicator describing the general potential of the PAYGO element of labor pension. But the affordable replacement ratio says nothing about the size of the basic and NDC elements of labor pension calculated under the current legislation, the payment of which may result in a deficit or surplus of the balance of the PAYGO element of labor pension.

In accordance with the current legislation, the basic part of labor pension is indexed to inflation rate. At the same time, the Law on Labor Pensions in the Russian Federation (paragraph 6, Art. 17) says that "along with indexation, the basic parts of labor pension … may be established by individual Federal laws with a view to gradually bringing them up to a pensioner's subsistence minimum". Obviously, in terms of modeling, there is no difference between indexation and establishment "by individual Federal laws", so in future, we shall refer to indexation alone.

Above, we said that the macroeconomic forecast assumes a high wage growth rate. As a result, owing to indexation to inflation, by 2050 average basic pension will be only 0.7% of average wage, that is, in the case of such indexation principle, the basic element of labor pension strives towards zero (see Fig. 34).

Under the current legislation, the NDC element of labor pension is indexed, roughly, to wage growth but not at a higher rate than "the rise of the RF Pension Fund per pensioner revenues directed to the payment of the NDC part of labor pension". In conformity with Art. 18 of the Federal Law No. 167-FZ "On Mandatory Pension Insurance in the Russian Federation", these revenues include "the money accumulated as a result of the excess of the sum of revenues from the single social tax (contribution) as regards the part received by the Federal budget over the expenditures on the funding of the basic element of labor pension …».

The NDC element of labor pension calculated on the basis of indexation prescribed by the Law (when the basic part of labor pension is indexed to inflation) is presented in Fig. 34. It shows quite clearly that the sum of the basic and NDC elements of labor pension very quickly become much smaller than the PAYGO affordable replacement ratio, that is, a large surplus appears.

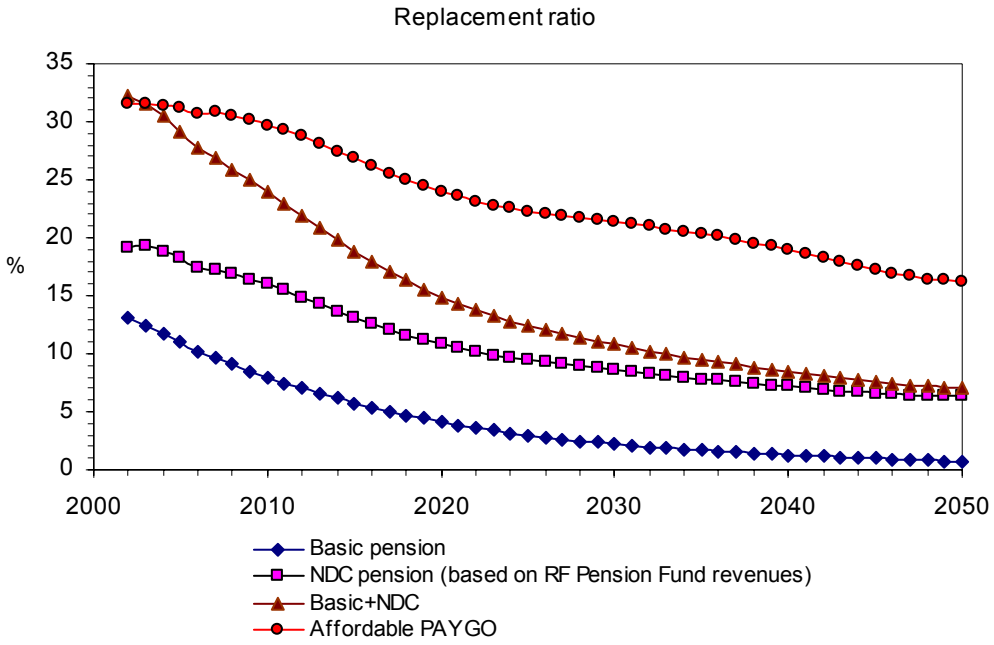

Fig. 34

When calculating the size of NDC pension shown in Fig. 34, indexation was conducted without account of basic pension surplus. This indicator provides the bottom boundary of the

possible outcome. The ceiling can be obtained with the help of indexation to wage growth rate; however, even this mode of indexation makes for a large PAYGO surplus.

The effect of residual longevity

It is easy to see that the PAYGO affordable replacement ratio does not directly depend on residual longevity, which operates indirectly through the pensioner dependency ratio. Since, as was shown above, the values of this ratio for the basic, high, and extra-high scenarios[50] are very similar, their affordable replacement ratios are also close. At the same time, residual longevity may affect the design size of the NDC element of labor pension. Thus, it follows from Fig. 23 that for retirement age of 60/55, average residual longevity under the extra-high forecast exceeds that under the basic scenario by approximately 20%. Therefore, even with the same affordable replacement ratio, the size of NDC pension may differ.

11. The Funded Element of the Pension System

The size of funded pension depends on:

- the period of accumulation;
- the expected duration of the payment of pension;
- investment profitability,

and, since our concern is not the absolute but the relative (as compared to wage) pension size,

- wage growth.

Thus, the size of funded pension is directly determined by just one demographic indicator, residual longevity.

The current legislation does not yet regulate "the expected duration of the payment of labor old-age pension used to calculate the funded part of this pension"[51]. In this paper we shall, therefore, scrutinize different ways to determine this parameter. A variety of techniques are used in Russia's and international practice:

1) Using the parameter equal to the estimate of residual longevity at the date of retirement depending on the pensioner's age and gender. This technique is usually applied by insurance companies and non-public pension funds if the law does not qualify it as discrimination on the basis of gender.
2) In many countries, the legislation forbids using different residual longevity values for men and for women. In this case, average residual longevity for the men and women retiring at the same age is used.
3) The principle of equal residual longevity for men and women retiring at different ages (60/65), used for calculating NDC pension in Russia, should, strictly speaking, be qualified as discrimination against men.

The most important indicator describing funded pension is the replacement ratio at the date of retirement. Fig. 35 and 36 shows such replacement ratios calculated under "version 1", that is, on the assumption that residual longevity is determined depending on the pensioner's age and gender.

[50] I.e., the scenarios where basic, high, and extra-high birth rates are combined with the same longevity indicators.

[51] Probably because the payment of the funded element of labor pension will begin only in 10 years.

Let us first examine the replacement ratio for 2050. For the basic scenario, which assumes an unchanged retirement age and a 7% real profitability rate, we obtain an 11.3% replacement ratio for men and only 5.3% for women. Two factors determine this disparity:

- a shorter (by five years) accumulation period in the case of women; and
- much higher (almost 1.7 times) residual longevity among 55-year-old women as compared to 60-year-old men.

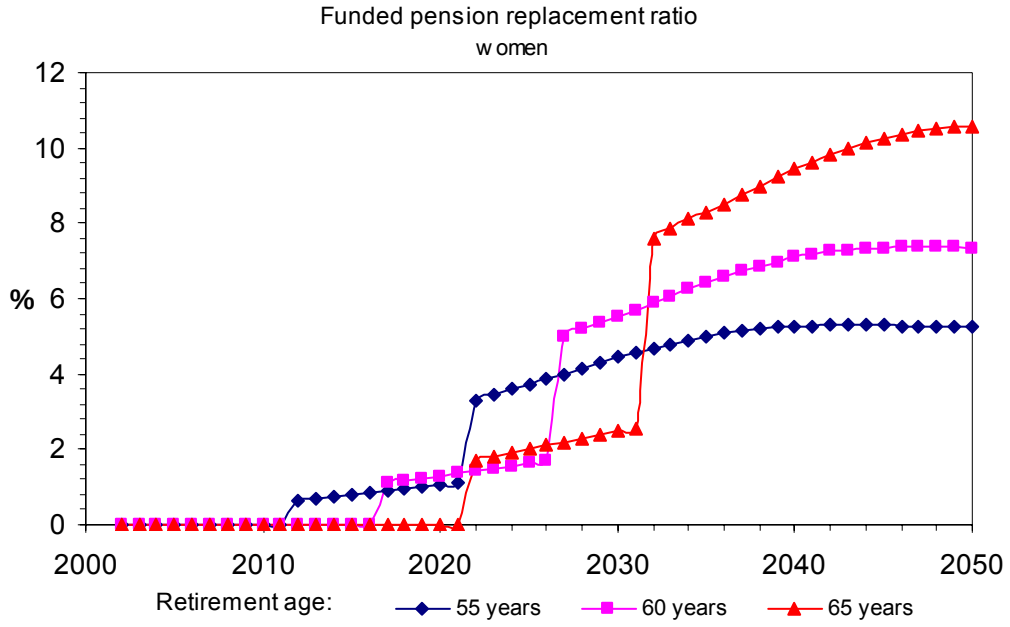

Fig. 35

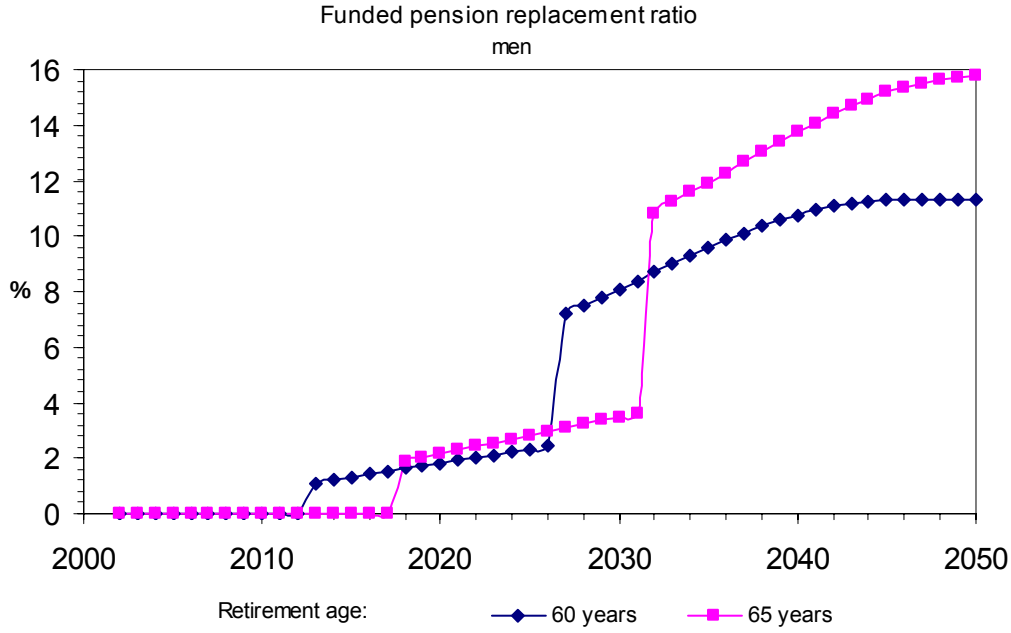

Fig. 36

Factoring in the same residual longevity for 60-year-old men and 55-year-old women (version 3), their replacement ratios would be 8.2% and 6.4%. Using the same residual longevity for men and women only on condition of equal retirement age (version 2) would produce the replacement ratios of 9.4% for men and 6.1% for women.

Let us now look at the charts in Figs 35 and 36 as a whole. At first sight, they may appear illogical: it would be natural to expect that for any age of retirement age, a higher figure should ensure a higher replacement ratio. The reason for this apparent lack of logic is that under the current law, the rate of contributions for funded pension depends on the person's age in 2002. Let us take as an example the men retiring in 2030. If retirement age is 60, the persons accepting retirement in that year turned 32 in 2002; this is why their contribution rate is 6%. If retirement age is 65, the persons accepting retirement were 37 in 2002; their contributions rate is 2%.

The next step is to find out how the replacement ratio changes depending on investment profitability. To do this, let us lower the profitability rate by 1% a year, basing our calculations on 6% return. As a result, the replacement ratio would go down 1.19 times for men and 1.16 times for women. The disparity in the decrease is determined by the different length of the accumulation period. Generally speaking, the following regularity is revealed: under constant retirement age, a 1% change of the profitability rate causes the replacement ratio to change approximately 1.15 – 1.2 times. If retirement age were higher, making the accumulation period longer, the effect would be slightly higher.

Above, we examined only the basic demographic scenario. In terms of funded pension, this means, in fact, that to calculate pension size, basic residual longevity values are used. For the scenarios envisaging a high longevity increase, practically the only distinction would be the growth of residual longevity. Its higher values would result in a corresponding decrease of the replacement ratio. To evaluate the possible effect of residual longevity, let us note that under the high scenario, residual longevity exceeds the corresponding figures in the basic scenario by approximately 10%, and under the extra-high scenario, residual longevity is about 10% higher than this value in the high scenario.

In conclusion, let us base our modeling on the alternative wage growth rate forecast (Fig. 37). With the exception of wage growth, we used the basic modeling scenario (retirement age, 60/55; investment return, 7%). Under these conditions, in 2050 the replacement ratio for men will be 21.7%, and for women, 9.5%, as against 11.3% and 5.3% under the basic scenario. As an example, Fig. 37 presents the outcomes of the basic and the alternative scenarios for men.

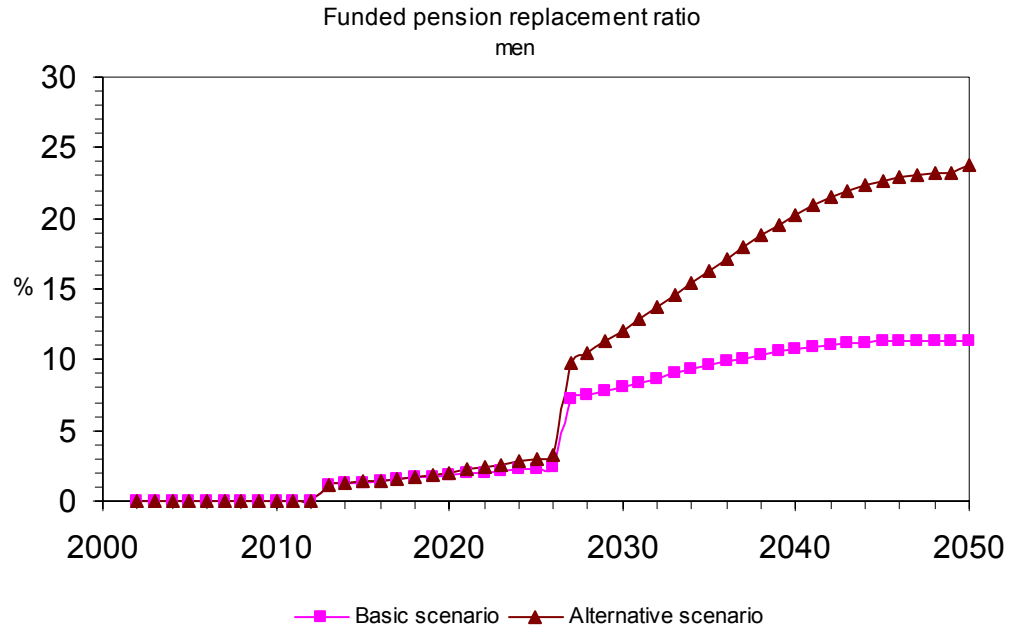

Fig. 37

The modeling prompts the following conclusions:

- The funded pension replacement ratio is strongly dependent on wage growth. Both the average growth rate and the form of the curve are important.
- The assumed high wage growth rate makes high demands on investment profitability. This makes it necessary to emphasize the regulation of the funded element of the pension system, which largely determines investment profitability.

By way of conclusion, let us note that legislative establishment of equal residual longevity in the calculation of pensions for men and women creates additional risks for the organizations which pay funded pensions. This fact must be borne in mind when drafting the legislation regulating this issue.

12. Modeling the Outcomes in Brief

Our calculations demonstrated that under the basic pension system development scenario (the middle demographic forecast of the RF Goskomstat and the macroeconomic forecast of the RF Ministry for Economic Development and Trade for 2002 – 2050):

- the old age dependency ratio will rise 2.15 times;
- the pensioner dependency ratio will rise 1.7 times;
- the PAYGO affordable replacement ratio will go down 1.95 times;
- the funded pension affordable replacement ratio at the date of retirement will, by 2050, approach 9% (funded pension was calculated at a 7% real profitability rate);
- indexation of basic pension to inflation will, to all practical purposes, result in its disappearance;
- indexation of NDC pension under the current legislation will produce a very large PAYGO surplus: the payments will take up less than half of the contributions;
- by 2050, the replacement ratio (equal to the PAYGO affordable replacement ratio plus the funded pension replacement ratio at the date of retirement) will approach 25%. That is, it will go down 20% as compared to 2002.

Our calculations show that, despite the significant disparities in expected general population under different RF Goskomstat's demographic scenarios (the estimates for 2050 differ by more than 40 million), the pensioner dependency ratio are very similar, as a result of which the affordable replacement ratios are also similar. This made us supplement the basic scenario with two more demographic scenarios defining the extent of the possible change of the old age dependency ratio. By 2050, the variation is:

- 1.5 times for the old age dependency ratio;
- 1.35 times for the pensioner dependency ratio; and
- 1.35 times for the PAYGO affordable replacement ratio. The latter deviates from the figure of the basic scenario by less than 20%.

In demographic terms, the size of funded pension is affected mainly by residual longevity. In each examined longevity scenario (low, middle, high, and extra-high), residual longevity rises by approximately 10%. This growth determines a corresponding decrease of funded pension and, in consequence, the replacement ratio.

Funded pension is strongly affected by the rate of returns on accumulations. Its change by 1% changes the funded pension replacement ratio by 15 – 25% (depending on the age of retirement).

Under the worst (in terms of the pension system) demographic forecast, in 2050 the replacement ratio will go down by 15%, falling to 21%.

As a result of the introduction of funded pensions into the new pension system, part of pension contributions are saved for the future and have to be taken out of the current revenues of the RF Pension Fund used to pay the pensions of present-day pensioners. Although formally, this is not supposed to cause a Pension Fund deficit, it is still possible that in future, additional funding of the

country's pension system will be required to raise the pensioners' standard of living. Our calculations show that the greatest decrease of the replacement ratio will occur in 2011 (by approximately 14%); subsequently, the difference between the replacement ratios supported by the pre-reform and the new systems will begin to close and, since 2031, the new system will ensure a higher replacement ratio than the pre-reform one.

We also discovered that indexation of basic and NDC pensions envisaged by the current legislation will, in the long term, significantly decrease the replacement ratio: in 2050, it may go down to 16%, while the system is able to support 25%. The greatest fall in relation to wage will be observed for basic pension. This means that the indexation scheme needs to be revised.

Contributions to the basic and NDC elements of labor pension also required adjustment. To strengthen the dependency of pension size upon the volume of contributions and encourage the future pensioners to pay them, the share of the contributions used to fund the NDC element of labor pension should be raised at the expense of the amount going to the basic element. This can be done, since in the future, a large surplus of the money funding the basic element will be formed.

To raise the efficiency of the pension system, retirement age for both men and women will have to be increased. Calculations made for all demographic scenarios show that if retirement age is raised to 65 years for men and women, in 2050:

- the old age dependency ratio will do down 1.8 – 1.9 times;
- the pensioner dependency ratio will go down 1.6 times; and
- the PAYGO affordable replacement ratio will rise 1.6 times.

Raising retirement age by five years would result in the funded pension replacement ratio going up by 40%, and by 10 years, by 100%.

The lower social tax rates enjoyed by the manufacturers of agricultural produce, family communes, and small nations of the North engaged in traditional trades would produce a noticeable decrease of the NDC element of these persons' labor pensions. To preclude this (and assuming that these tax "benefits" needs to be retained), they should be funded out of the part of the social tax directed to the basic element of labor pension.

As a result of the regressive scale and the equal size of basic pension for most pensioners, the replacement ratios of the persons belonging to the middle class will be в 1.5 – 2 times lower than on average. To enable them to ensure a higher replacement ratio, the development of non-public pension provision/insurance should be encouraged[52].

The assumptions pertaining to migration used in the basic demographic scenario, under which the country's population will fall to 100 million by 2050, appear understated. Such a large reduction combined with aging would make necessary the arrival of a large number of employable age immigrants. The aspects of the pension system connected with a high immigration rate clearly need to be studied in more detail.

The expected high real wage growth rate gives a sharper edge to the issue of investment of pension accumulations. This issue lies beyond the boundaries of this paper. It should be noted, however, that the debate on this issue does not stress enough matching pension obligations and the assets in which it is proposed to invest pension accumulations. Thus, as regards the latter, fixed-income government securities are not risk-free even if the probability of default is nil. With reference to long-term pension accumulations, the risk of unexpectedly high inflation makes investment in fixed-income securities highly risky.

The efficiency of the funded element of pension provision depends very strongly on the projected wage growth rate. This poses the need for further and more detailed study of the trends of average wage changes and their effect on the changes in the funded element of labor pension.

[52] Pension Reform in Russia: Causes, Substance, and Prospects / S.N. Vasin, E.Sh. Gontmakher, M.E. Dmitriev, et al, Ed. by M.E. Dmitriev and D.Ya. Travin, St. Petersburg: Norma, 1998, 256 pp.

About the authors

Baskakov, Valerii Nikolaevich, Dr. Sci. (Phys. And Math.), professor, Director of the ANO "Independent Actuarial Information Analytical Center", professor of the higher mathematics department at the N.E. Bauman Moscow State Technical University, and the department of mathematical methods in economics at the G.V. Plekhanov Russian Academy of Economics. Has been doing research work for 25 years, and teaching, for nine years. His scientific interests are actuarial mathematics, mathematical statistics, insurance, economics, demography, and sociology. Author of over 70 published works, including four monographs and three manuals. Since 1997, has been a member of expert councils and work groups on pension insurance at the Deputy Chairman of the RF Government, the RF Ministry for Labor and Social Development, the RF Ministry for Economic Development and Trade, and the RF State Duma. Member of the Board of the Russian Actuaries' Society, editor of the journal *Pensionnye fondy i investitsii* (Pension Funds and Investments).
e-mail: chief@actuaries.ru, http://www.actuaries.ru

Lelchuk, Alexander Lvovich, Cand. Sci. (Techn.), Deputy Director of ANO "Independent Actuarial Information Analytical Center". Has 17 years' experience of research and 10 years' experience of work as head actuary of an insurance company. His scientific interests include actuarial mathematics, insurance, economics, demography, and investments. Has more than 30 printed works, is a member of the Expert Councils on Pension Insurance at the RF Ministry for Economic Development and Trade. Member of the Board of the Russian Actuaries' Society.
e-mail: Lelchuck@actuaries.ru, http://www.actuaries.ru

Pomazkin, Dmitry Vladimirovich, Cand. Sci. (Econ.), department head at ANO "Independent Actuarial Information Analytical Center", head actuary of the Non-public Pension Fund "Regionfond". Has 16 years' experience of research work. Scientific interests: actuarial mathematics, informatics, insurance, economics, and investments. Has over 20 printed works. Since 1997, member of the expert councils and work groups on pension insurance at the RF Ministry for Economic Development and Trade and the RF Ministry for Labor and Social Development.
e-mail: Pomazkin@actuaries.ru, http://www.actuaries.ru.

Independent Actuarial Information Analytical Center

The autonomous nonprofit organization "Independent Actuarial Information Analytical Center was set up in 2000 with the support of the Moscow Public Research Fund with the money provided by the US Agency for International Development (USAID) on the basis of the Actuarial Information Analytical Center established in 1996 at the N.E. Bauman Moscow State Technical University.

The Center is headed by Professor V.N. Baskakov, Dr. Sci. (Phys. and Math.).

In 2002, the Center was accredited as a scientific research organization by the RF Ministry for Industry, Science, and Technology (research organization state accreditation certificate # 3935, April 10, 2002).

The Center is a member of the Association of Independent Economic Analytical Centers.

The purpose o the Center is to conduct independent analytical studies of the social and economic situation in Russia and develop, on the basis of their findings, suggestions on government economic policy at Federal, regional, and local level and the formation of civil society in Russia. It is the country's only nongovernmental organization dealing in actuarial examination of the more important draft laws regulating the sphere of social and economic relations and insurance.

The most significant projects implemented by the ANO "IAIAC" in the past years deal with pension reform in Russia and include Independent Financial and Actuarial Examination of the RF Pension Fund Budget up to 2050, Pension Reform Prospects in the Russian Federation, Independent Actuarial Examination of Government Economic and Social Policy in Occupational Pension Insurance (MPSF grants with the support of USAID), and Modeling Long-term Development of the Mandatory Pension System under different scenarios of the formation of the PAYGO and funded elements, including analysis of the consequences of the introduction of notional accumulation accounts (contract with the RF Ministry for Economic Development and Trade). Within the framework of the implemented projects, the Center designed an analytical model of the pension system intended to evaluate its long-term financial stability using different demographic and macroeconomic development scenarios and different organizational structures of the pension system itself, the replacement ratio, the pension system balance in time, and the needs for outside funding.

The Center's employees are members of expert groups at the RF Council of the Federation, the State Duma, and the RF Ministry for Economic Development and Trade. Most of them also act as individual consultants for the project to promote the restructuring of the system of social security at the Russian Social Reform Fund "Modeling Pension System Development and Prospective Calculation of its Parameters" (SPIL project).

Over the time of its existence, the Independent Actuarial Information Analytical Center published dozens of papers, three manuals, and several monographs. The Center has an information bulletin, *Aktuarii* (*The* Actuary), which offers information on the outcomes of the Center's studies, news of the Russian and foreign actuarial markets, analytical materials on macroeconomics, demography, social insurance, and pension provision, as well as some other economic and social aspects of the country's development.

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