Budget Financing of Social Risks in Ukraine: Current State and Macro-level Model of Development

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Abstract **–The relevance of the study is due to the need to develop theoretical foundations and applied tools for budget financing of social risks. The results of the study aim at identifying the peculiarities of structuring social risks in Ukraine, as well as directions for minimizing the negative consequences of their actualization. The purpose of the article is the theoretical substantiation of optimization of budget financing of social risks on the basis of the constructed predictive mathematical model.**

Keywords- **expenditures, social policy, budget resources, optimization tasks, macro-level model.**

1. Introduction

Classical theory allows us to determine the essence of risk through the scientific concept of uncertainty, using, for its formalization in exact sciences, a number of adjacent categories: chance, probability [11]. In neoclassical theories, the risk, as an objective component, reflects a degree of uncertainty about the subject's activity environment [13].

DOI: 10.18421/TEM82-22
https://dx.doi.org/10.18421/TEM82-22

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Received: 02 March 2019.
Accepted: 24 April 2019.
Published: 27 May 2019.

Risk refusal especially in modern conditions, would mean a waiver of rationality. But if a person has the intention to observe a rationalist tradition, then it is necessary to break away from the inherent perception of the problem, realizing that the person cannot see what she /he cannot see [15].

Today, the integrative approach, which involves the combination of various aspects of technological risks, has become quite popular. The effectiveness of forecasting in the area of technological risks depends on satisfying two conditions: the first is the need to apply a systematic approach to a large number of often independent factors; the second is the need to master technological risk management techniques in conditions of insufficient information [17].

Among the latest scientific developments in the economic theory of risk, it is necessary to highlight a theory based on four segments. The criteria for division are economic or non-economic motives of behavior, as well as rationality or irrationality of individuals [2].

The category of risk in the context of social development has a number of features that are due to the specificity of social processes. Social risks are an expression of the positive probability of restructuring the institutional field in favor of certain social groups, supporting these changes by the largest and (or) most active parts of society [14].

Budget financing of social risks is one of the key functions of a social state. One of the important components of the management theory of social processes is a set of quantitative research methods, through which you can not only optimize the management process, but also minimize the element of subjectivity when choosing a managerial solution.

The development of a macro-level model of the system of budget financing of social risks will allow to determine the parameters of predictive structural changes and will open new possibilities for shifting the corresponding parameters to the normative (ideal) level, keeping changes in permissible intervals and avoiding devastating tendencies in the socio-economic development of the country.

2. Literature review

In the process of analyzing the theoretical fundamentals of social risk financing and constructing relevant mathematical models, the uncertainty that arises as a result of inadequate knowledge of the projected estimates of the state finances, as well as uncertainty due to the lack of a commonly accepted criterion for assessing the adequacy of social budgeting indicators, differs by most researchers. These two types of uncertainties are comparable, since their formal probabilistic parameters can be considered as a component-vector criterion for the status of an object. Usually, they are considered separately: the first - within the theory of probability, the second - within the theory of multicriteria optimization.

According to the ESSPROS methodology, the list of social risks that can serve as an objective precondition for the emergence of secure legal relations in the European Union countries is as follows: illness (medical care); invalidity; old age; dependents who have survived the breadwinners; family (children); unemployment; dwelling; social isolation. The following list of social risks clearly outlines the scope of social protection in the areas that are considered most expedient for EU member states [5]. The state's obligation to finance social services motivates the private sector to improve its quality and optimize the management of social infrastructure objects. Implementation of social criteria for the effectiveness of budget financing will create additional incentives for equalizing the opportunities of the public and private sectors in the social sphere. With this optimization, governments in many countries will be able to address the urgent problems of financing other problems, for example, environmental problems [15]. The main objective of European social policy is not only to manage social risks, but also to eliminate the asymmetry between the economic and social components of European development [18]. Despite the existence of national minimum social funding criteria and the rules for verifying their spending, the responsibility of each local government body is to determine their own needs for social expenditures [9]. The uncertainty of the model and the parameters of budget financing of certain types of social risks is a fairly widespread practice today. If a person has an ambiguous complex situation, then it is expedient to use a stochastic model for its formalization, but there is also a choice between other models. Even after constructing a particular parametric model, the correct definition of its parameters remains a rather complicated task. However, the use of stochastic models provides new opportunities for their simplification, especially for solving financial problems [10]. In the coming years, new rules for financing social risks should be introduced that will be able to intensify the development of alternative ways to address the growing risks of aging populations. Among the practical measures, a rigid government policy of saving budget funds is allocated, from the theoretical point of view - the construction of mathematical models of financial replication associated with demographic factors [16].

3. Data and methodology

3.1. Hypothesis of the study

The optimal strategy of social-oriented behavior of the private sector derives from the opportunities for profit to minimize its own costs, as well as taking into account the specifics of social contributions. A generalized model of such a strategy may have the following form. The focus on cost minimization in the planning process for the long-term perspective is possible by solving the problem: to find a value y^0 that would ensure the following conditions:

$$\max_{0\le y\le F(x)} J(y),$$
$$\max_{0\le y\le F(x)} \{-C(y)\},\ x \ge 0,$$

where: $F(x)$ - production function,
$J(y)$ - the value of income,
$C(y)$- output costs in volume y.

The given problem can be modified by assuming an equal importance to the investor of the criteria of $J(y)$ and $C(y)$ using Carlin's theorem [3] for the problem: to find such the value y^0, which will provide

$$\max_{0\le y\le F(x)} [J(y) - C(y)]$$

To find the optimal solution:

$$y^0 = \arg \max_{0\le y\le F(x)} [J(y) - C(y)]$$

It is advisable to use the Kuhn-Tucker [12] conditions:

$$\begin{cases} P\dfrac{dy}{dx_i} - \omega_i \le 0,\ i = \overline{1,n} \\ \left(P\dfrac{dy}{dx_i} - \omega_i\right)\cdot x_i = 0, \quad \text{if } x_i > 0, \quad i = \overline{1,n} \\ \left(P\dfrac{dy}{dx_i} - \omega_i\right)\cdot x_i < 0, \quad \text{if } x_i = 0, \quad i = \overline{1,n} \\ y = F(x),\ x = (x_1, x_2, \ \dots\dots\dots x_n). \end{cases}$$

Then, standard methods for solving a system of four equations with four variables are implemented. As a result, we obtain data indicating the institutional imperfection of the state - the problem is the imperfection of effective legal and social institutions.

3.2 Social protection and social security of the population of Ukraine as an objective condition for minimizing social risks

A generally accepted approach to defining social costs can be considered a definition contained in OECD guidance notes: providing state and private institutions with assistance to households and individuals, as well as the allocation of financial contributions to them, that should provide support during a period of circumstances that adversely affects their welfare, provided that the provision of this assistance does not constitute a direct payment for a particular product or service, or an individual contract or transfer [1]. Since this definition covers only types of assistance provided by institutions, transfers between households - even if they have a certain social nature - are not included in the category of social expenditures.

Currently, financing social expenditures in Ukraine is carried out not only at the expense of budget revenues, but also at the expense of accumulated insurance premiums (social payments to the Social Insurance Fund for temporary disability, expenses of the Fund for compulsory state social insurance against unemployment, expenses of the Insurance Fund against accidents at work). The financing of social insurance is, to a greater or lesser degree, implemented by all major social partners - workers, entrepreneurs and the state, whose costs from social insurance are socially necessary for the reproduction of the labour force and its attribution to the cost of production, which is the recognition of non-tax nature of these costs.

Consequently, social protection is the content of the social function of the state and is a system of economic, legal, organizational measures to ensure the basic social rights of man and citizen in the state. The basis of an integrated system of social protection of the population should be grounded on socio-economic relations between the state, private and public sectors. On their basis, the social policy of the state will be formed and mechanisms for realization of the basic rights and guarantees of citizens will be created, and hence effective mechanisms of social risk management of Ukrainian society have been found.

3.3. Analysis of indicators of budget financing of social risks in Ukraine

Based on the analysis of the current legislation of Ukraine, one can distinguish the following forms of social protection aimed at reducing social risks:

- social and compensatory payments (provided in cash and provide various types of benefits, allowances, surcharges and compensations of a social nature);
- social services (services provided to persons who suffered material or life-related difficulties due to the fault of the state, services to socially vulnerable groups of the population, services aimed at restoring normal person's livelihoods);
- privileges (partial or full exemption from payment for services or goods).

The main means of distributing and redistributing public funds and financial resources of local self-government bodies are budget expenditures. They must satisfy the most urgent needs of society in the development of the economy, social sphere, public administration, ensuring state security, defence, public order, etc. The analysis of the State Treasury Service of Ukraine reports testifies that the planned performance of the expenditure part of the budget, including the general and special fund, in 2017 was UAH 870 billion. Actual implementation of the planned indicators amounted to 839 billion UAH (96%). The amount of non-fulfilment of the expenditure part of the budget in the monetary equivalent amounted to 31 billion USD. Compared to 2016, the last indicator increased by 1% (amounted to 23 billion USD) [7]. Based on the ratio in the consolidated budget of Ukraine to the expenditures of state and local budgets on social protection and social security, one can state that in our country there is predominantly a centralized system of social protection of the population. The practice of European countries mostly comes from different levels of centralization of the social protection system, but the centralized system is considered less effective. During 2012-2016, the coefficient of decentralization of budget expenditures for social protection and social security in Ukraine was about 40%. As to the total expenditure on social protection and its share in the GDP of the country, they were distributed as follows (Table 1., *Source:* [19]).

Table 1. General expenditures on social protection (according to the methodology of the European system of integrated statistics of social protection)

	2012	**2013**	**2014**	**2015**	**2016**
Total, UAH million	350363,3	361164,6	352224,2	408242,9	433359,0
% of GDP	24,0	23,7	22,2	20,5	18,2

An analysis of the subsistence minimum, minimum wage and minimum pensions in Ukraine has made it possible to compare them with European standards. Thus, in accordance with the standards of the European Social Charter [6], the minimum wage would have to be at least 2.5 living wages and one third of the average wage (in accordance with the recommendations of the International Labour Organization, the minimum wage should not be below 40-60% of the average wage). The minimum age pension should be set in the statutory minimum living wage for disabled workers. The data presented in Table 2. (Source: [21]) illustrate that the indicators reflecting the level of social guarantees in Ukraine do not meet the European standards; moreover, in recent years, there is a complete lack of their approximation at least in dynamics. State social standards and norms are established for the purpose of determining the mechanism of realization of social rights and state social guarantees of citizens, established by the Constitution of Ukraine. On the basis of social standards, the size of the basic social guarantees is determined: minimum wage, minimum age pension, and other types of social and compensatory payments. They are used to define and justify the expenditures of the State Budget of Ukraine.

Table 2. Common Core State Standards in Ukraine

State Standards	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**
Living wage per person per month (at the end of the year), UAH	1095	1176	1176	1330	1544	1700
Minimum wage (at the end of the year), UAH	1134	1218	1218	1378	1600	3200
Minimum pension (at the end of the year), UAH	884	949	949	1074	1247	1373
Correlation between minimum wage and living wage	1,04	1,04	1,04	1,036	1,036	1,882
Correlation between Minimum pension and living wage	0,807	0,807	0,807	0,807	0,808	0,808

Analysis shows, that the system of social protection measures and the existing social programs are not effective means of reducing poverty or eliminating poverty in Ukraine. This also means that the amount of social transfers aimed at reducing poverty can be greatly reduced if they are addressed and directed directly to low-income groups of the population [23].

In general, the expenditures of the state budget are determined by the nature of the basic functions of the state and show the directions and objectives of budget allocations. The main social functions of the state are expressed in the expenditures of the consolidated budget on social protection and social security of the population (Table 3., Source: [19]. The data in the table show, that although this kind of expenditures changes in absolute terms, but its relative values in recent years remain almost unchanged.

Table 3. Expenditures of the consolidated budget on social protection and social security of the population

	Expenditures	% to total consolidated budget expenditures	% to GDP
2012	125306,9	25,4	8,6
2013	145062,6	28,7	9,5
2014	138004,7	26,4	8,7
2015	176339,8	25,9	8,9
2016	258326,1	30,9	10,8
2017	285761,7	27,0	9,6

Based on the dynamics and the corresponding list of social risks, which are recognized by the state at the legislative level, one can assess the effectiveness of the social protection system in one or another country (Table 4., Source: [21]). The system is based on such a mechanism for responding to social risks, which enables the development of certain social standards, as well as the corresponding state guarantees for their provision. In turn, social standards are based on an ordered set of social risks, each of which has a unique set of indicators.

Table 4. Dynamics of individual social expenditures of the state budget of Ukraine, mill.

	2014	2015	2016	2017
Expenditures of the state budget, total	430217,8	576911,4	684743,4	839243,7
Social protection and social security (including social protection of pensioners)	80558,2 (75813,9)	103700,9 (94811,6)	151965,5 (142586,2)	144478,3 (133458,6)
Healthcare	10580,8	11450,4	12456,3	16729,1
Specific weight of social protection and social security expenditures (including social protection of pensioners)	0,1872 (0,1762)	0,1798 (0,1643)	0,2219 (0,2082)	0,1722 (0,159)
Specific weight of state budget expenditures on health care	0, 0246	0,0198	0,0182	0,0199

In order to ensure proper social protection of every citizen of Ukraine, in 2017 a gradual increase in the subsistence minimum was made from May 1 and December 1. Compared to 2016, the subsistence minimum per person increased from December to December of the previous year by 10.1 per cent from 1544 UAH up to 1700 hryvnias.

Taking into account that the subsistence minimum in accordance with the Law of Ukraine "On State Social Standards and State Guarantees" is the basic state social standard, on the basis of which the size of the basic state social guarantees is determined, in 2017 the amount of pensions and state benefits respectively increased (Table 5., Source: [21].

Table 5. Expenditures of the State Budget of Ukraine by functional classification in 2017

Expenditures	2017	Growth rate, until 2016
Total expenditures, including:	839,5	122,6
State functions (without debt servicing costs)	32,0	144,0
Debt service	110,5	115,3
Defences	74,3	125,3
Public order, security and judiciary	87,9	122,6
Economic activity	47,0	149,6
Environmental protection	4,7	99,3
Utilities	0,02	135,4
Healthcare	16,7	134,2
Spiritual and physical development	7,9	159,3
Education	41,3	118,6
Social protection and social security	144,5	95,1
Interbudget transfers	272,6	139,5

To provide financial resources for disbursements, the total amount of subventions from the state budget for the payment of benefits to families with children, low-income families, disabled since childhood and disabled children, temporary assistance to children and assistance for the care of disabled persons of group I or II was in 2017 51.6 billion UAH, which is 4.4 billion UAH more than in 2016.

In general, in 2017, expenditures for the implementation of state social protection programs to provide benefits, subsidies and assistance to the population financed by subventions from the state budget to local budgets amounted to 124.7 billion UAH, which is more than in 2016 at 30, 5 billion UAH or 32.4 per cent.

Thus, in Ukraine, not only excessive socio-economic stratification of the population is observed, but also the reproduction of unfair redistributive mechanisms that create new social imbalances. The main way of correcting this situation is to introduce new approaches to reallocating income in the system of “social policy - income distribution - tax policy”. In economically developed countries, a policy of equalizing the material position of various income groups has been introduced for decades, and such a system appears to be the most important component of the income redistribution mechanism [8]. One of the possible ways to reduce the size of the "social gap" in Ukraine may be to align the income distribution structure with the average European structure, where relative poverty is in the range of 12-15%, and the coefficient of differentiation does not exceed 10. In the countries of the European Union, one of the indicators of the effectiveness of the poverty reduction policy is the Katz index (the ratio between the minimum wage and the average

wage - should be at least 60%). In Ukraine, starting from 2010, there are negative trends in the dynamics of this ratio and by the end of 2017 it was only 38%.

3.4 Construction of macro-level model of budget financing of social risks

Most of the managerial decisions in the social sphere are traditionally considered in the area of solution of the tasks of optimizing the choice, management and distribution of resources. Their theoretical model is the problem of linear programming, in which the variables $a_x; b_y; c_z$ are always deterministic and have exact numerical values. However, actually, such determinism is almost not found: the social sphere is characterized by the presence of a significant number of social risks, and therefore the manifestation of causal relationships is multifactorial and multidimensional, which causes the uncertainty of the relevant managerial strategies. Since probabilistic processes can be described by their quantitative characteristics (mathematical expectation, dispersion, mean square deviation, coefficient of variation, etc.) or distribution laws, the question of the peculiarities of constructing the theoretical model and solving problems of optimization and distribution of social budget resources in conditions of uncertainty is relevant. The problem of formalizing and constructing an appropriate mathematical model for budget financing of social risks is currently poorly investigated, and therefore requires in-depth consideration.

The conceptual statement of the problem of constructing a mathematical model is to obtain the function of interpolation of the specific weight of the state budget expenditures on social protection and social security in general state expenditures and predict the investigated value.

The mathematical formulation of the problem of constructing a mathematical model is to calculate the local extremes of the cubic polynomial weight of the state budget expenditures on social protection and social security.

The basic initial assumption of a macro-level model of budgetary provision of social risk management is that the social protection and social security system is the main compensatory mechanism of social risks. The purpose of the social protection function is to maximize the satisfaction of social or personal needs that arise as a result of actualization of social risks at a certain point in time. It is expedient to construct the function of interpolation of the specific weight of the state budget expenditures on social protection and social security in general expenditures using Wolfram | Alpha [22] computational algorithms and the data in Table 4. Similar calculations should also be made on the indicators of health expenditures. Since there is a slight variation in the output data set, in this case it is expedient to use interpolation using the local polynomial method (Fig. 1.):

interpolating polynomial (social security)
$\{(1,0.1872306),(2,0.1797775),(3,0.2219481968),(4,0.17234141)\};$
interpolating polynomial (health care)
$$\{(1,0.024576314),(2,0.019777632),(3,0.0182334),(4,0.01987921)\}$$
.

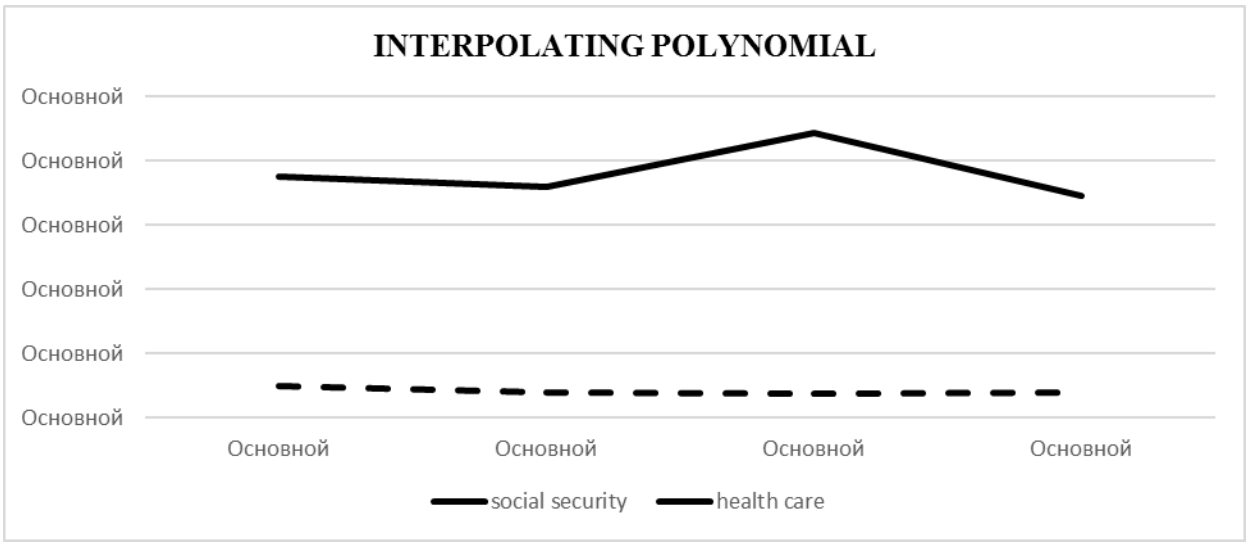

Figure 1. Graph of the interpolating polynomial of the specific weight of the state budget expenditures on social protection, social security and health
Source: author's development

The use of the analytic expression of the Lagrange Interpolating Polynomial [20] as a function:

$$y = -0{,}0152x^3 + 0{,}106x^2 - 0{,}2119x + 0{,}3117 \quad (1)$$

makes it possible to calculate the local extrema of a cubic polynomial in the Wolfram | Alpha algorithm:

$$max\{-0.0151903x^3 + 0.105952x^2 - 0.211868x + 0.31166\} \approx 0.220876$$

at $x \approx 3.1947$;

$$min\{-0.0151903x^3 + 0.105952x^2 - 0.211868x + 0.31166\} \approx 0.180905$$

at $x \approx 1.45528$.

The maximum value of the specific weight of the state budget expenditures on social protection and social security in total expenditures is 0.221, which was observed in 2016, and the minimum value, respectively, is 0.181, observed in 2017. As fluctuations in health expenditures demonstrate relative stability, further calculations should be carried out according to indicators of social protection and social security.

In order to obtain the predictive investigated value (a specific weight of the state budget expenditures for social protection and social security), we will use the extrapolation method for the obtained interpolation cubic polynomial by constructing the corresponding graph (Fig. 2.).

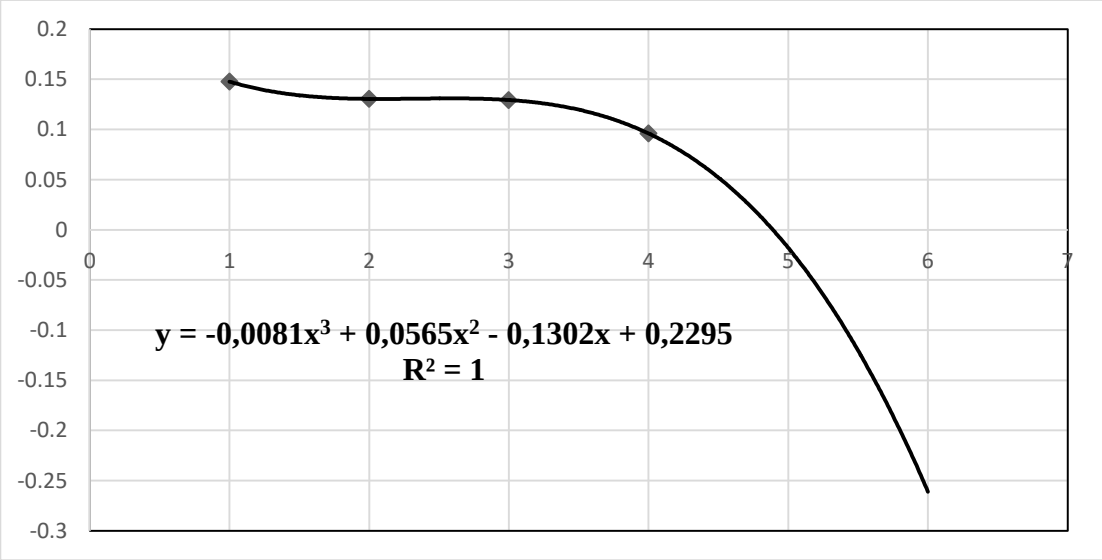

Figure 2. Extrapolation of the cubic polynomial of the specific weight of the state budget expenditures on social protection and social security in total expenditures
Source: author's development

As it follows from the figure below, starting with the point $x = 5$, which is approximately the same as in the last quarter of 2019, there will be a sharp decline in the share of social expenditures in total state budget expenditures.

It should be noted that the expenditures associated with social risks management can be successfully redistributed and this will allow in the future to significantly adjust the level of consumption and currently available distribution proportions. For this purpose, as the main one, it is proposed to choose a modal decision-making criterion: the state administration will proceed from the most probable state of the social environment for a certain period of time. The formalization of managerial functions under uncertainty will consist in conducting appropriate calculations based on available algorithms of performance indicators [4].

To construct a static decision making model under conditions of uncertainty we will proceed from the following algorithm, which implies:

- the necessity to make one solution from the group of mutually exclusive decisions $\Phi = \{\varphi_1 \dots \dots \varphi_m\}$;

-the social environment has a set of mutually exclusive states$\{\Theta_1 \dots \dots \Theta_n\}$, but the specific present or future state of the medium for the management body remains unknown;

- the estimated functional $F = \{f_{jk}\}$ characterizes the "gain" or "loss" of the management body as a result of the choice of decision $\varphi_k \in \Phi$

- $f_{jk} = f(\Theta_j; \varphi_k)$ - quantitative assessment of the decision;

- j - function of the source of information;

- $P = (p_1 \dots \dots \dots p_n)$ - probabilities distribution;

- C - strategy of social environment behavior.

Proceeding on the assumption that there is a single meaning

$$p_{j_1} = \max_{\Theta_j \in \Theta} P(\Theta = \Theta_j) \quad (2)$$

If the modal criterion is applied, the control body proceeds from the fact that the social environment will be in the state $\Theta = \Theta_j$, and the optimum φ_{k_0} or $\overline{\Phi}$ will be determined from the condition:

$$f^+_{j_{1k_0}} = \max_{\varphi_k \in \Phi} f^+_{j_1 k} \quad (3)$$

If it turns out that the maximum $P(\Theta = \Theta_j)$ will be achieved only on the a priori probabilities $p_{j_1}; p_{j_2}; p_{j_3} \dots\dots\dots p_s$, then the optimal solution φ_{k_0} or $\overline{\Phi}$ is appropriate to determine from the following condition:

$$\frac{1}{s}\sum_{\gamma=1}^{s} f_{j_\gamma k_0} = \max_{\varphi_k \in \Phi} \frac{1}{s} \sum_{\gamma=1}^{s} f^+_{j_\gamma} k. \quad (4)$$

The formal part of the decision-making process in conditions of uncertainty will be to carry out the necessary calculations in accordance with the above-mentioned performance indicators, which are determined by the evaluative functional in accordance with the chosen (modal) criterion.

4. Conclusions

Despite the introduction of a number of institutional measures of a legislative nature, Ukraine failed to develop and implement an effective mechanism for the formation and use of budgetary funds. Recently, in state policy there has been a shift of advantages from centralized regulatory methods to decentralized ones as a universal means of countering the conservative forms of financial regulation. However, without changing the tax policy and improving intergovernmental fiscal relations, this approach is institutionally limited.

Aware of the special social significance of income distribution in order to ensure the stability of society, it is necessary to exclude the possibility of two extremes, namely: the formation of detentions in the low-income groups of the population and the decline of aspirations to high-income activities in the economically active part of the population. As practice shows, income equality, which is identified by many people with social justice, always leads to a decline in economic efficiency - people realize that effective employment is not needed, because society will take away one and give it to others. On the other hand, inequality in income ensures economic efficiency, but it can lead to excessive differentiation of incomes.

The positive correlation between the level of public expenditures for social purposes, the reduction of poverty and the country's ranking on the level of human development in the world proves the social importance of social expenditures of the state, which should be considered not as the cost of “retaining” social sectors or support for vulnerable population groups, but as a social investment. Accordingly, the connection of the notion of social investment with the redistributive function of the budget system, which characterizes the use of social resources, for example, financial support for the tasks of social protection, health care and education, social integration programs of the population, etc., is updated.

The constructed theoretical model of budget financing of social risks has made it possible to formalize the situation of uncertainty associated with the probabilistic nature of the manifestation of social risks, as well as make appropriate projections. Thus, based on the analysis, the share of budgetary social expenditures will sharply and in long-term decrease from the second half of 2019, which may lead to an increase in social tension in society and mass actions of social disobedience. To prevent the implementation of the above-mentioned negative scenario, it is expedient to review current redistributive mechanisms, as a significant non-inflationary growth of the indicators of state budget revenues seems unlikely.

The advantages of the proposed model are:

- the sufficiency of finding only a few of the most probable states of the social environment, while it is not necessary to determine all its quantitative characteristics;
- evaluation of functional characteristics can be carried out only for the most probable states of the social environment, which provides additional opportunities for redistribution of budget funds.

One of the most effective instruments for reducing the social burden on the state budget is social investment. The mechanism of their implementation in financing the social sphere can combine budget allocations, funds of legal and physical persons, resources of insurance funds, formed at the expense of contributions of participants of insurance programs, donor funds, loans, etc. Accordingly, the aggregate of social investment subjects will include representatives of the public sector, commercial organizations, non-profit and non-governmental organizations, international funds and organizations, as well as individuals and households. However, today, in Ukraine, the mechanisms that would ensure the profitability of investments in the social sphere, unfortunately, are absent.

A perspective direction for further scientific research in a particular vector is detalization and optimization of the constructed model, in particular, development of the function of interpolation of the shares of budget financing in accordance with the structure of social expenditures.

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