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**Schemelinin Konstantin Sergeevich**

**ORCID:0000-0002-3636-1583**

## **SYSTEM OF PUBLIC BALANCE EQUATIONS**

**Annotation.** The system of social balance equations allows a rational balance between the costs of society and the state budget, distributed between three groups of people (children, adults and the elderly) using the coefficient of life and death of society, the ratio of the financial burden on adults, as well as using the tax system.

**Keywords:** balance of interests, society, pension, youth, taxes, econometrics, economic and mathematical methods and models.

### ***Problems***

What should a person's retirement age depend on? What should determine the amount of taxes that citizens pay to the solidary pension system? What determines the amount of money that needs to be spent on education young people? These and other issues are addressed in different ways by different governments. So how should it be?

### ***Problem analysis and problem statement***

The life of an ordinary person from birth to natural death in old age is divided into three stages:

1. When it is not working yet.

It is generally accepted that children do not work, that is, the first stage ends with the onset of coming of age.

2. When he works.

The second stage is the time from adulthood to retirement, that is, at this time an adult is actively working: earning money, building a family, protecting the state, and so on.

3. When he no longer works.

It is generally accepted that the third stage is life in retirement, that is, at this time a person can no longer work, and therefore lives using the labor of other people.

Working adults are the foundation of any society: they are the ones who create everything. But adult life is not endless, so society needs children who will replace the current adults; in addition, people differ from wild animals in that they care for the elderly members of society.

Thus, the entire human society is divided into three parts:

1. Children are the future life of society.
2. Adults are the real life of society.
3. Old people are a dying part of society.

Society must exist fully, that is, with all its three parts, so the task is as follows: to link into a single, financially balanced whole, the costs of children and older persons that people will have to bear working adults.

***To work and not to work***

To divide a person's life into three stages in relation to work, it is necessary to clearly describe what it means to work and what it means to not work.

To work:

1. To be an employee.
2. To be a self-employed worker.
3. To be an active founder of your firm.
4. Actively to manage your capital.

Not to work:

1. Live on interest from deposits or dividends.
2. Live on the income of parents or relatives.
3. Live dependent on the state.
4. Live on the income from ownership of property copyrights.
5. Live on the founders' income, without interfering with the management of your company.

Thus, if an adult does not work, then the costs of society for his maintenance should be taken into account in the column "children"; and if a middle-aged person (not a pensioner) does not work, then the costs of society for his maintenance should be taken into account in the column "pensioners".

***The solution of the problem***

Adults spend money on themselves, on children, and on the elderly.

Children live on the money that adults spend on them.

Old people live on the money that adults share with them.

As you can see, money can tie children, old people and adults into a single whole.

Thus, a system of equations is obtained that links together the gross domestic product and the tax system of the state under consideration with the costs of children, adults and the elderly:

$$\begin{cases} GDP_S = G + M + D \\ G = K_{GD} * D \\ GDP_S = K_{FM} * M \end{cases} \quad (1)$$

The system of equations (1) can be called social balance equations; the equation  $G = KGD_{GD} * D$  can be called the formula (equation) of the youth pension balance, and the equation  $GDP_S = K_{FM} * M$  can be called the formula (equation) of the return of adults to the whole society.

### ***GDP<sub>S</sub>***

$GDP_S$  is the total GDP of the society in the year under review.

$GDP_S$  is absolutely everything that was produced by the society in the reviewed year, without exceptions.

The letter "S" is chosen from two words: "sum" in English stands for "sum" and "society" in English stands for "society".

Dimension [ $GDP_S$ ]=money.

For example, [ $GDP_S$ , Russia at the beginning of the XXI century] = rub.

The  $GDP_S$  is larger than the country's usual GDP: the  $GDP_S$  also includes the GDP of the shadow economy, self-produced GDP and consumption, the GDP of unpaid assistance to adults, and other GDP.

$GDP_S = GDP$  (official GDP of the country) + GDP (shadow economy) + GDP (self-produced GDP and consumption) + GDP (unpaid assistance) + GDP (other)

The GDP of the shadow economy includes the natural shadow economy (criminal offenses against the person) and the forced shadow economy - a constant and variable part (business owners who evade taxes and wage-earners who do not pay taxes) [2, p. 97-101].

The GDP of self-produced and consumption includes those results of human labor that he himself produced for his personal consumption.

The GDP of unpaid aid includes all types of free aid that children, adults and the elderly provide to each other (for example, help with house repairs, agricultural work, etc. other people's accounts, etc; services babysitting, housekeeping, and so on; plus donation of money, payment of some other people's bills, etc.). Also, the GDP of unpaid aid includes all services that people provide voluntarily or forcibly to their schools, businesses, the army, and so on.

Other GDP is those goods, products and services that are made by people, but were not included in the previous categories, for example, loans issued to foreign structures; gratuitous aid to foreign allies, receiving indemnities, and so on.

### ***G***

$G$  – is all the financial costs of society in a given year for the birth, upbringing and education of children until the moment when they do not start working.

The letter "G" is chosen from two words: "girl" in English and "жизнь" ("life") in Russian.

G stands for life, childbirth and the future of society.

Dimension [G] = money;

e.g. [G, Russia at the beginning of the XXI century] = rub

**M**

M is all the financial costs of society in the year under consideration for all the expenses and savings of adults.

The letter "M" is chosen from three words: "main" in English, "man" in English and "мужчина" ("man") in Russian.

Dimension [G] = money;

e.g. [M, Russia at the beginning of the XXI century] = rub

**D**

D is all the financial costs of society in the year under review to support the existence of unemployed elderly people, including some savings that the old people make, as well as the costs of their funerals.

The letter "D" is chosen from two words: "death" in English and "дед, бабушка" ("grandfather, granddad") in Russian.

D means completion, dying, and ultimately death.

Dimension [D] = money;

e.g. [D, Russia at the beginning of the XXI century] = rub

**K<sub>GD</sub>**

K<sub>GD</sub> is the life and death ratio of a society

K<sub>GD</sub> is a dimensionless quantity and can be measured in both units and percentages.

$$[K_{GD}] = \frac{[G]}{[D]} = \frac{rub}{rub} = 1$$

Children are the coming future of society, and non-working elderly people are society's passing past, so working adults should not spend more money on old people than on children, so K<sub>GD</sub> in a society which is increasing its numbers should be greater than 1.

**K<sub>FM</sub>**

K<sub>FM</sub> is the ratio of financial burden on adults in society.

The letter "F" is chosen from two words: "finance" in English and "финансы" ("finance") in Russian.

K<sub>FM</sub> is a dimensionless quantity and can be measured in both units and percentages.

$$[K_{FM}] = \frac{[GDP_s]}{[M]} = \frac{rub}{rub} = 1$$

$K_{FM}$  directly depends on the level of tax burden in society: the higher the level of tax burden, the greater the ratio of financial burden on adults in  $K_{FM}$  society.

$K_{FM} > 1$  and  $K_{FM} \neq 1$ , since the costs of society for adults cannot exceed all the income of society (if you do not borrow money).

***Analysis of the system of social balance equations***

The general meaning of the system of social balance equations is as follows:  $GDP_S$  is everything, absolutely all the income of society for the year.

$G + M + D$  is everything, absolutely all the expenses of society for the year.

As you can see, in any society, it is equal to all the expenses of society for the year (if you do not borrow money).

***In the system of social balance equations, the key is the  $K_{GD}$  coefficient, which connects the values of  $G$ ,  $M$  and  $D$ , preventing them from existing independently of each other.***

By solving the system of equations (1), the following four solutions can be obtained:

$$M = GDP_S - G - D = GDP_S - K_{GD} * D + D = GDP_S - D (K_{GD} + 1) \quad (2)$$

$$M = GDP_S - G - D = GDP_S - G - \frac{G}{K_{GD}} = GDP_S - G \left(1 - \frac{1}{K_{GD}}\right) \quad (3)$$

$$D = \frac{GDP_S - M}{1 + K_{GD}} \quad (4)$$

$$G = \frac{GDP_S - M}{1 + \frac{1}{K_{GD}}} \quad (5)$$

Expenditures in society are interrelated, in particular:

1. If someone says that “we need to increase spending on pensions,” this means that this person is calling for an automatic reduction in the costs of adults, and vice versa.

2. If someone says that “we need to increase spending on education,” this means that this person is calling for an automatic reduction in the costs of adults, and vice versa.

3. If someone says that we need to "increase taxes", it means that the person is calling for an increase in the level of return from adults to society as a whole.

***$K_{GD} \neq const$ , which allows society to regulate itself.***

***Conclusion***

The system of social balance equations ties together all the expenses and incomes of society, making it possible to calculate costs on the younger generation, form the level of the tax burden, calculate the age of retirement, and so on.

**Appendix № 1. Approximate calculation of indicators  $G$ ,  $D$ ,  $M$ ,  $GDP_S$ ,  $K_{GD}$  and  $K_{FM}$  for Russia at the beginning of the XXI century**

Due to the lack of data, the indicators  $G$ ,  $D$ ,  $M$ ,  $GDP_S$ ,  $K_{GD}$  and  $K_{FM}$  will be calculated approximately, so no conclusions can be drawn from the results obtained for Russia.

Table 1. Statistical indicators of Russia in 2010-2016

№	Index	2010	2014	2015	2016
1	Number of children in kindergartens, million people [1, p. 175]	5,4	6,8	7,1	7,3
2	Number of pupils in secondary schools, million [1, p. 175]	13,6	14,4	14,8	15,2
3	Number of students per skilled worker or mid-level specialist, million people [1, p. 175]	4,1	2,8	2,9	2,9
4	Number of university students, million people [1, p. 176]	7,0	5,2	4,8	4,4
5	Total number of unemployed youth, million people (sum of lines 1 through 4)	30,1	29,2	29,6	29,8
6	Number of pensioners, million people [1, p. 49]	39,7	41,4	42,7	43,2
7	Education costs, RUB trillion [1, p. 495]	1,9	3,0	3,0	3,1
8	Health care costs, RUB trillion (1, p. 495)	1,7*	2,5	2,9	3,1
9	Average monthly per capita income, thousand rubles / person [1, p. 140]	19,0	27,8	30,5	30,7
10	Pension payments from the Pension Fund trillion rubles [1, p. 146]	4,0	5,8	6,3	6,7
11	Average size of assigned pensions, thousand rubles / person [1, p. 140]	7,5	10,8	12,0	12,4
12	GDP of the country, trillion rubles [1, p. 49]	46,3	79,2	83,2	86,0
13	Total fertility rate, children per woman [1, 97]	1,57	1,75	1,78	1,76

\* plus the cost of physical education and sports

Formulas for approximate calculation of  $G$ ,  $D$  and  $GDP_S$  according to table 1:

$$G = row5 * \frac{row9}{2} + row7 + \frac{row8}{4}$$

$$D = row10 + \frac{row8}{3}$$

$$GDP_S = 1,5 * row12$$

Table 2. Calculation of indicators

№	Index	2010	2014	2015	2016
1	G, trillion rub	2,6	4,0	4,2	4,3
2	D, trillion rub	4,4	6,6	7,3	7,7
3	$K_{GD}$	0,59	0,61	0,58	0,56
4	GDP, trillion rub	46,3	79,2	83,2	86,0
5	GDP <sub>S</sub> , trillion rub	69,5	118,8	124,8	129,0
6	M, trillion rub	62,5	108,2	113,3	117,0
7	$K_{FM}$	1,112	1,098	1,102	1,103

Even an approximate calculation shows the correspondence between the life and death rate of society in Russia in 2010 and 2014-2016 (Table 2, line 3) and the total fertility rate in the country (Table 1, line 13):  $K_{GD}$  in Russia was much less than the required unit, therefore the total fertility rate was also much less than the required 2.1, that is, Russian society spent too little money in these years on raising its younger generation, therefore it is natural that the birth rate in Russia was low, from - why the population of the country decreased.

***Appendix № 2. Calculation of the average retirement age at different  $K_{GD}$  and  $K_{FM}$  coefficients and different target pension values for Russia in 2016***

(2016 was chosen as an example as a year during which the economic situation in Russia was generally calm)

To calculate the options for the average retirement age, you should set the target indicators  $K_{GD}$  and  $K_{FM}$ , while the indicator M will be constant. Using formula 4, through GDP<sub>S</sub> and M, we find D, and then, using the formula for the youth-pension balance, we find G.

The checks for the calculations will be, firstly, the ratio  $GDP_S - M = G + D$  from the system of equations (1), and, secondly, the value of G found by formula (5), which should be equal to the value of G found by the formula of the youth pension balance.

An increase in  $K_{GD}$  means an increase in the costs of society for children, and an increase in  $K_{FM}$  means an increase in the tax burden on society. The increase in the tax burden has its limits, as business will begin to go into the shadow economy [2, p. 97-101], therefore it is best to have a tax system that is not strong in terms of the degree of pressure on the business sphere.

Comparing the calculated G and D with the actual ones, you can determine how much money should be taken from pensioners and given to children or taken from children and given to pensioners in accordance with:

1. with the opportunities of the society expressed in the GDP<sub>S</sub>;

2. with the selected government policy, fixed by the coefficients  $K_{GD}$  and  $K_{FM}$ .

Next, the average pension that the state would like to pay to its pensioners is set, and the number of pensioners is calculated using the formula:

$$row11 = \frac{row5}{row10 * 12}$$

Then, using statistical data, the approximate average retirement age is determined. As of January 1, 2017, the number of Russian citizens of the respective ages was approximately [1, p. 89]:

1. Over 70 years - 13.2 million people.
2. From 65 to 69 years old - 7.6 million people.
3. From 60 to 64 years old - 9.6 million people.
4. From 55 to 59 years old - 11.2 million people.
5. From 50 to 54 years old - 9.8 million people.

There can be many calculation options, but for an example, let's focus on seven.

Table 3. Seven options for calculating the average retirement age and the target value of the average pension for Russia for 2016 using social balance equations

№	Index	№1	№2	№3	№4	№5	№6	№7
1	$K_{GD}$	1,0	1,1	1,2	1,2	1,3	1,1	1,4
2	$K_{FM}$	1,1	1,05	1,1	1,15	1,1	1,15	1,1
3	GDP <sub>S</sub> , trillion rub	129,0	129,0	129,0	129,0	129,0	129,0	129,0
4	M, trillion rub	117,3	122,9	117,3	112,2	117,3	112,2	117,3
5	D, trillion rub	5,9	2,8	5,3	7,6	5,1	8,0	4,9
6	G, trillion rub	5,9	3,4	6,4	9,2	6,6	8,8	6,8
7	Real G in 2016, trillion rub	4,3	4,3	4,3	4,3	4,3	4,3	4,3
8	Real D in 2016, trillion rub	7,7	7,7	7,7	7,7	7,7	7,7	7,7
9	Money that should not be given to pensioners and sent to children (+) or not given to children and sent to pensioners (-) in 2016 to balance costs in accordance with the selected option, trillion rub	1,8	4,9	2,4	0,1	2,6	-0,3	2,8



10	The specified size of the average pension, thousand rubles / person per month	12,0	13,0	13,0	13,0	15,0	15,0	20,0
11	Estimated number of pensioners, million people	40,7	17,9	34,2	49,0	28,3	44,5	20,4
12	Approximate average retirement age regardless of gender and benefits, years	55	66	56	51	61	53	65

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