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METHODOLOGICAL ISSUES ON ASSESSMENT OF THE ECONOMIC DAMAGE CAUSED BY MORTALITY OF THE POPULATION EMPLOYED IN THE REGION'S ECONOMY

The aim of the study is to determine the most appropriate method to assess the society's losses caused by premature mortality. The authors compared the possible methods of quantitative evaluation of the extent of economic damage caused by mortality of the working-age population. The hypothesis of the study consisted in an assumption that when assessing the economic losses caused by premature mortality, a problem of choosing indicators for analyzing various socio-demographic groups of the population, external conditions and the target orientation of the calculations arose, and that could lead to completely different results. Based on the analysis of domestic and foreign publications, the authors analyzed the methodological tools used to estimate economic losses and determined the factors influencing the estimated parameters. Through the example of the Sverdlovsk region and the city of Ekaterinburg, the authors analyzed the dynamics of the level and structure of the able-bodied population mortality and estimated the economic damage caused by mortality of the able-bodied population for the years 2015 and 2016. The economic damage caused by premature mortality was estimated within the framework of calculations using two methods, which allowed to obtain different estimates of the scale of losses of the working-age population and to consider the issues of modifying the methodology used for assessment of the socio-economic damage caused by premature mortality of the population on the basis of regional characteristics. Gender and territorial differences in indicators of economic damage have been determined. Depending on the goal and tasks to be solved, the methodological tools allow economic assessment of the society's losses caused by mortality of the working-age population, both at the level of individual regions and at the level of municipalities. The obtained results can be used to develop state policies aimed at reducing the mortality of the working-age population, increasing life expectancy, and forming regional social policies.

Keywords: demographic indicators, working-age population, premature mortality, economic damage, evaluation, region, city, employment, economic activity, methodology

Introduction

The relevance of the study can be explained by modern the processes of depopulation and aging of the Russian population, which require a comprehensive and in-depth approach to solve the problems not only by increasing the birth rate, but also by reducing the high mortality rate of the population, and especially that of the working-age population. It is this part of the population, whose health is destructive, which determines the need for scientific justification for effective measures to preserve and improve it.

Note that there was an increase in mortality in many European countries in the 60–70's of the 20th century, but there was no long-term decline in life expectancy. This was explained by the fact that alarming demographic trends in these countries triggered a timely and adequate response from the public: expanded environmental protection measures were taken; preventive activities to reduce morbidity and promote healthy lifestyles were performed. An evident effect from the implementation of these measures in Europe could be observed already in the late 70's.

In Russia, the causes of increased mortality included increased consumption of alcohol, poor quality of working life, a sharp decline in the purchasing power of household incomes. The last decade of the 20th century can be called the most unfavorable in the post-war demographic history of Russia. At the same time, two-thirds of the total increase in mortality fell on the working-age population, primarily men. In 1994, the minimum life expectancy was 57.6 years for men and 71.2 years for women. By the early 2000's, the average life expectancy was 59 years for men and 72.2 years for women.

As studies show, the greatest increase in the average life expectancy for men can be achieved by preventing deaths from accidents, poisonings, and injuries (more than six years); heart and vascular diseases (five years); malignant tumors (less than two years) [1].

The rating of causes of female mortality is different: The greatest impact is made by heart and vascular diseases (five years), as well as malignant tumors and accidents (two and a half years each).

The actual duration of the labor activity significantly affects the volume of the GRP per capita. Therefore, in carrying out various studies to identify factors that increase life expectancy and, in particular, its labor period, it is very important to calculate the scale of economic damage caused by premature mortality of the population.

The concept of economic damage is used to estimate losses, mainly in monetary form, caused by harm inflicted by negative factors in various spheres of life, the content of which is determined by relevant state standards[1]. The scientific literature often uses this concept in assessing the economic damage incurred by the environment because of economic activities. In a narrower aspect, it is used by insurance companies, social and pension funds in actuarial calculations of the cost of living. But in both cases, when assessing damage, specific subjects arise — those who are interested in underestimation or overestimation of their values.

This article examines the issues on assessment of socio-economic damage in the context of real losses of the population engaged in labour activities caused by premature mortality. And the society is the main subject interested in this kind of assessment.

The calculation methodology of the economic damage caused by premature mortality takes into account the conditional time period that a representative of a certain age group of the population is to live with at the current mortality level existing in this group. The demographic potential of an individual is measured in person-years and, depending on the purpose of the study, is calculated for the entire period of life (full potential) or for a specific period (partial potential) [2], for example, the period of a person's labor activity.

The economic damage caused by premature mortality is determined by the irreplaceable losses of the most economically and socially active part of the population, a significant part of the national income, a decline in the capabilities of the national economy and the society to develop steadily and dynamically. The quantitative assessment of the amount of the public losses can be performed by calculating the losses caused by mortality of the working-age population.

The issues on assessment of the economic damage caused by premature mortality of the population have been quite actively considered by a wide range of experts (researchers and practitioners) both in Russia and abroad. In assessing the economic damage, income and cost approaches are mainly used [3, 4]. The first one allows to calculate the potential income that could have been earned by the deceased for the upcoming (current) labor period. The second one allows to calculate the state's expenses (investments) needed to reproduce the labor potential, which will not be compensated in the future because of the person's death. At that time, there are many other calculation methods based on the above-mentioned ones.

Based on our analysis of methodological approaches, all the existing assessment models can be divided into two groups (Table 1).

The first group is based on the calculation of the cost of human life by the costs spent by the state, the society and the person to reproduce the human capital.

The model called the "Burden of disease" allows to estimate the costs of public health measures (the cost of treatment, care and medical rehabilitation of patients, etc.) and social transfers (disability pensions, survivors' pensions, social insurance payments) [5]. This method of assessment of the human life cost has undeniable advantages in the form of an open access to the necessary data and the possibility to get comparable assessments to compare various territories. However, the authors using such a method (for example, [6, pp. 165–167]) did not distinguish the sex and the age structure of the deceased population, and therefore it is impossible to determine the contribution of certain population categories to the overall mortality rate in the country.

[1] GOST R 54003–2010 Ekologicheskiy menedzhment. Otsenka proshlogo nakoplennogo v mestakh dislokatsii organizatsiy ekologicheskogo ushcherba [GOST R 54003–2010 Ecological management. Assessment of the past ecological damage accumulated in places of organizations' dislocation]. (2011). Moscow: Standartinform; GOST R 2.1.10.1920–04: Rukovodstvo po otsenke riska dlya zdorovya naseleniya pri vozdeystvii khimicheskikh veshchestv, zagryaznyayushchikh okruzhayushchuyu sred [GOST R 2.1.10.1920–04: Regulation on assessment of the risk to health of the population in case of exposure to pollutive chemical substances]. (2004). Moscow: Federal Sanitary and Epidemiological Supervision Center of the Ministry of Health of the Russian Federation; GOST R 22.10.01–2001: Bezopasnost v chrezvychaynykh situatsiyakh. Otsenka ushcherba. Terminy i opredeleniya [GOST R 22.10.01–2001: Safety in emergency situations. Damage assessment. Terms and definitions]. (2002). Moscow: State Standard of Russia.

Table 1

The main approaches to assessment of the socio-economic damage caused by premature mortality

Model	Description	Advantages / disadvantages
Assessment according to expenses of the state and the society		
"Burden of diseases"	Expenses for measures to protect the public health (the cost of treatment, care and medical rehabilitation of patients, etc.) and social transfers (disability pensions, survivors' pensions, social insurance payments) [5–8]	Advantages: Open access to the data needed for calculations; the assessments are averaged, which allows them to be compared. Disadvantages: The authors did not distinguish between the age and sex structure of the mortality of the population, which makes it impossible to determine the contribution of certain population categories to the overall mortality rate in the country
"Readiness to pay"	The cost of living is expressed by the amount that people are willing to spend on investments in reducing the likelihood of dying or an amount they want to receive for additional risk [7]. It is based on a sociological survey that measures the "willingness or consent of the population to pay" for the improvement of the life quality and public safety (willingness to pay approach — WTP) and the "willingness of the population to accept a certain amount of money as compensation" (willingness to accept — WTA) [9, 10]	Advantages: Obtaining a subjective assessment of the cost of living by the country citizens; the calculation results can be used in forming budget expenditures in accordance with the demands of the population. Disadvantages: The assessment of the cost living often does not depend on the real "willingness to pay"; a wide range of quantitative estimates is usually formed according to the survey results, which makes it difficult to obtain a real value of the cost of living; it requires significant time and money
Average life cost (ALC)	The amount of expenses needed to maintain life throughout the life cycle divided into separate periods, with different amounts of such expenses. The ALC depends on the investments in human capital assets (expenses for education, health, social security) and life expectancy. Thus, the ALC has higher values in rich countries and the lowest ones in poor countries [7, 11]	Advantages: Open access to the data needed for calculations; the estimates are averaged, which allows them to be compared when calculating the damage for various territories and observing trends in dynamics. Disadvantages: Inequality of incomes of separate socio-economic groups of the population is not taken into account, which does not allow to receive reliable values of the damage for low- and high-income groups of the population
Cost of lost years of the potential life	The cost of the number of years not lived before the age of the average life expectancy [7, 12]	
Assessment by lost income of the state and the person		
Loss of potential birth rate	A decrease in the number of girls who live up to the fertile age results is a reduction in the number of children they could give birth to, and in the future—the number of people employed in the economy [5]	Advantages: The socio-economic damage caused by the person's death is assessed depending on his/her social and economic effectiveness; availability of statistical data on the indicators used in calculations Disadvantages: The cost of living of the economically inactive and the unemployed population is not calculated; the incomes received by a person out of the bounds of work life are not taken into account; the moral damage and deterioration of the life quality of dependents and relatives of the deceased are ignored
Human capital theory	Loss of profit due to underproduction of the GDP as a result of loss of workers in the production process [7, 11, 12]	
	The cost of a person's living is calculated as a total amount of the person's income that he/she earns during the life. Thus, the damage caused by the person's death is the lost income that could be earned by the person with certain socio-demographic and professional qualifications, i.e. this is the total labor return of the person during his/her forthcoming life [1, 7, 8, 10, 13–15]	
Complex approach	Combines several assessment methods of those mentioned above [7, 8, 11, 12]	Allows to get rid of such disadvantages due to the complex assessment

The second model is called “Willingness to pay” due to the fact that the researchers used a sociological survey and thus tried to measure the amount that people are willing to spend on investments in reducing the likelihood of dying, or the amount they want to receive for additional risk [7]. Such studies were conducted both abroad [9] and in Russia [10]. In the opinion of T.S. Karabchuk, A.A. Moiseyeva and N.E. Soboleva, the results of such calculations can be used to determine budget expenditures in accordance with the population's requests [10]. This issue is especially relevant at the local level. At the same time, the high subjectivity of the respondents' assessments, their theoretical view and a wide range of numerical estimates make it difficult to apply this method.

Another method of the assessment of the person's, family, and the state costs for reproduction of the human capital throughout life is an assessment of the average life cost (ALC). The higher the ALC, the higher the investment in the human capital and the longer the life expectancy [7]. Availability of data and comparability of the assessments make this method attractive for researchers. At the same time, as noted in [10], this approach does not take into account income inequality of individual socio-economic groups of the population, which does not allow to get reliable values of the damage for low- and high-income groups of the population.

The approach of the ALC assessment has been developed in the form of assessment of the cost of lost years of a potential life, which allows both to calculate the lost investments in the current year and to estimate the investments that have not been repaid and the lost profit of the state and the society for the future. Thus, this model is a transition to the second group of estimates—the lost income of the state and the person.

This approach is a calculation of both the GDP (GRP) lost by the state [11] and the lost labor income of the person [8, 13–15] in the current year and for the future. The relative ease of calculations, availability of statistical data, the possibility of differentiating the deceased by various classification characteristics make this approach popular among both domestic and foreign researchers. However, when using this method, the cost of living of the economically inactive population and the unemployed is not calculated, the incomes received by a person outside his work life are not taken into account, the moral damage and deterioration of the life quality of dependents and relatives of the deceased are ignored [10].

It is interesting to calculate the economic damage caused to the society (lost GDP) as a result of a loss of potential birth rate due to a decrease in the number of girls who survive to the fertile age, which reduces the number of children they could give birth to, and later the number of people employed in the economy [5].

The variety of existing approaches to the assessment of the human life cost and the socio-economic damage caused by premature mortality allows to explore this issue from different viewpoints, which is used by many authors preferring to combine some of such methods summing the assessments into an integral indicator of the socio-economic damage of the state, society, and the person [7, 8, 11, 12].

Foreign studies primarily focus on the relationship between health and economic growth. As noted in some studies, the per capita income is closely related to health measured by life expectancy and a number of other indicators, and the authors of these studies conclude that the cause-effect relationship works in both directions. Healthy people work more efficiently, study better, and as they live longer, they have additional incentives to accumulate human capital assets [16]. In this context, it is relevant to analyze the factor structure of the data on the population mortality and its relationship with the dynamics of growth of the gross domestic product, health care expenditures, and lifestyle-related mortality risk factors, followed by the assessment of losses caused by them [17].

Foreign studies pay a great deal of attention to the problem of assessment of the mortality risk as a key risk factor for life insurance companies. Dividing the mortality risk into several types, such as unsystematic risk, adverse selection, and systematic risk, they propose measures to manage risks and reduce mortality losses in the sphere of assessment of the cost of living for insurance companies [18].

From the viewpoint of seeking measures to reduce the economic damage caused by premature mortality, studies of the relationship between life satisfaction and death likelihood are very acute. As a result of the study, it is noted that the relationship between life satisfaction and death probability is stronger for married men and women, as well as for single men, but it does not matter much for single women. There is a link between life satisfaction and mortality, which can be determined through mortality rates, for example, caused by accidents and social stress, and it is concluded that life satisfaction is a powerful factor to postpone death. The numerical relationships between life

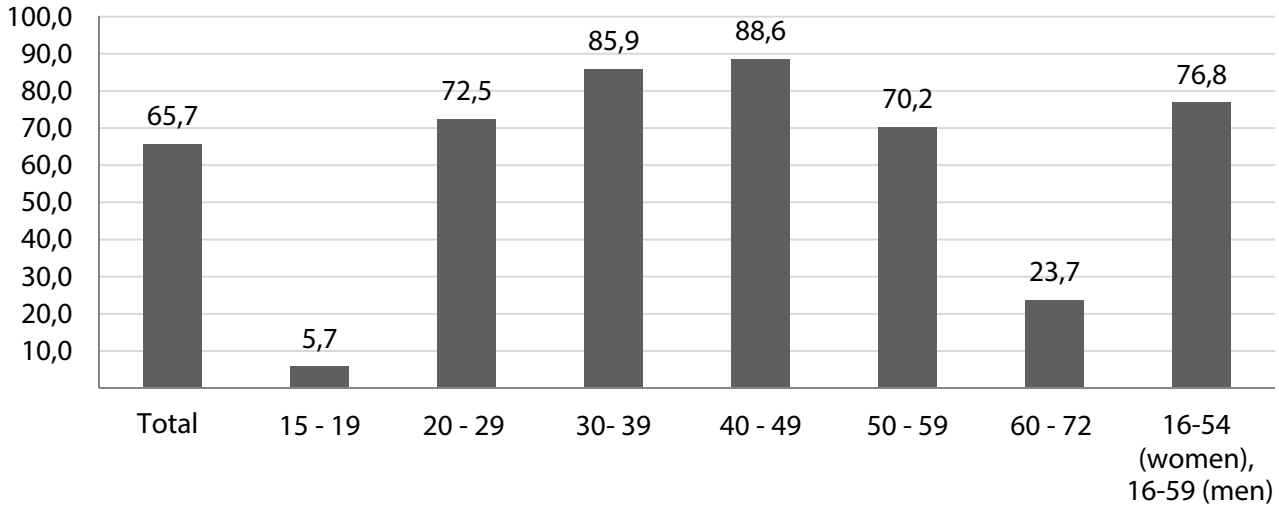

Fig. 1. *Employment level of the population in the Sverdlovsk region by the age groups for 2015, %*

satisfaction indicators and mortality within the period from 1984 to 2007 showed that an increase in life satisfaction in the amount of 10 % meant a reduction in death probability of approximately 4 % [19–20].

In our country, the loss of labor potential has traditionally been estimated for persons of the working age. Formally, the working age is 44 for men (from 16 to 60 years), and 39 years for women (from 16 to 55 years). In our opinion, this is not entirely correct, since economic activity beyond the working age is also quite high (Figure 1).

The calculations of the authors of this article, obtained on the basis of data mining techniques for Russia as a whole for the period from 2005 to 2014, allowed to identify five factors that have a significant impact on the development of mortality rates of the population at the working age (the coefficient is calculated within the limits of 1):

— A number of registered crimes (0.26).

— Employment in harmful and dangerous working conditions (0.18).

— The quantity of own cars (0.11).

— The share of the employed population having higher education (0.08).

— The capacity of outpatient institutions (0.07). The rest of the factors had values below the level of statistical significance of 0.05, and therefore did not have a significant impact on the formation of mortality rates of the population at the working age in this time period. In addition, the approbation of the author's approach showed that the factor of the quality of working conditions, as well as the efficiency of the healthcare system, have much more impact during the period of economic and social instability [21].

The loss of the labor potential is expressed by the number of man-years not lived by the deceased person since the age of 16 years and up to the end of the working-age period (54 years for women and 59 years for men). The total number of the man-years of a certain generation not lived until the end of the working age is considered as social damage. The economic damage to the society caused by premature mortality is a product of the sum of the man-years not lived by a certain cohort of the population and the gross regional product per one person employed in the economy in the corresponding year.

Methodology

The methodology for assessment of the socio-economic damage caused by mortality of the population employed in the economy is based on a calculation of the city's and the region's lost income. The assessment was carried out on the example of the Sverdlovsk region and the city of Ekaterinburg for the years 2015–2016. The following tasks were set within the research:

— To conduct an analysis of the mortality dynamics for the population employed in the economy at the regional and municipal levels.

— To determine the indicators that adequately reflect the economic losses caused by mortality of the employed population and formation of a database.

— To assess the socio-economic damage at the regional level based on the GRP indicators, the level of employment of the population and the average labor productivity in the economy.

Translation

— To assess the socio-economic damage at the city level using the author's methodology for calculating the gross municipal product based on the application of the Cobb-Douglas production function[2].

— To make a comparative analysis of the assessment results.

The information and empirical base of the research consist of official information resources of the Federal State Statistics Service of Russia (Rosstat) and the results of the applied research conducted by the authors of the article.

Based on the statistical data on the natural movement of the population and employment of the population differentiated by age at the regional and municipal levels, the number of the deceased population of economically active age employed in the economy was calculated for the 5-year age groups (15–19 years, 20–24 years, etc.) using the following formula (1):

$$D = \sum D_i = \sum d_i e_i, \quad (1)$$

where D is the number of the economically active population employed in the economy, who died during the year; D_i is the number of the economically active population of the i-th age group employed in the economy, who died during the year; d_i is the number of the economically active population of the i-age group, who died during the year; e_i is the average annual employment rate for the i-th age group of the economically active population.

Accordingly, the socio-economic damage caused by premature mortality in the current period is calculated as the lost gross regional (municipal) product in the current year using formula (2) and the lost wage according to formula (3):

$$GDP_{lost} = \frac{GDP}{E} D, \quad (2)$$

$$WAGE_{lost} = wage * 12 * D, \quad (3)$$

where GDP_{lost} is the lost *GRP* (*GMP*), *GDP* is the *GRP* (*GMP*) in the current year, E is the average annual number of the employees in the economy in the current year, $WAGE_{lost}$ is the lost wages, wage is the average nominal monthly wage.

Assessment of the potential socio-economic damage caused by premature mortality of the economically active population engaged in the economy is the calculation of the income of the region (municipality) and the population, that they could have received, if those, who died in the current year, would live to the end of the age of economic activity (72 years), with the existing level of employment in the economy. Thus, it is necessary to calculate how many man-years were not lived by the deceased in the current year using formula 4:

$$AGE_{potential} = \sum D_i \left(72 - t_i\right), \quad (4)$$

where $AGE_{potential}$ is the non-lived man-years caused by the death rate of the economically active population employed in the economy in the current year; ti is the average age of the i-th age group.

The obtained number of the non-lived man-years allows to estimate the potential socio-economic damage in the form of potentially lost *GRP*(*GMP*) and potentially unpaid wages, which are calculated using formulas (5) and (6), respectively.

$$GDP_{potential} = GDP_{lost} AGE_{potential}, \quad (5)$$

$$WAGE_{potential} = WAGE_{lost} AGE_{potential}, \quad (6)$$

where $GDP_{potential}$, $WAGE_{potential}$ are the potentially lost *GRP*(*GMP*) and potentially unpaid wages, respectively, caused by the death of the economically active population employed in the economy in the current year.

Results

As shown in Table 2, the average annual population in the Sverdlovsk region in 2016 decreased by 1.3 thousand people in comparison with 2015, while the death rate of the population at the age of economic activity decreased slightly from 31.9 to 31.1 thousand people. In Ekaterinburg — the regional center — there is an opposite trend: the number of the population increased by 16 thousand people up

[2] GMP is the gross municipal product. It was assessed in accordance with the Cobb-Douglas production function [22].

to 1,485.5 thousand people (mainly due to a positive migration increase), and at the same time the death rate of the economically active population increased from 7.7 to 8.7 thousand people. About 65 % of those, who died at the economically active age, were men. This trend is typical for both Ekaterinburg and the region as a whole.

Table 2

Some indicators of socio-economic development of the Sverdlovsk region and the city of Ekaterinburg in 2015–2016 (in comparable prices)

Indicators	Sverdlovsk Region		Including Ekaterinburg		Contribution of Ekaterinburg to regional indicators, %	
	2015	2016*	2015	2016*	2015	2016*
Annual average population, thousand people	4,328.7	4,330.0	1,469.5	1,485.5	33.9	34.3
A number of those, who actually died at the age of economic activity (15–72 years), thousand people, including:	31.9	31.1	7.7	8.7	24.2	26.2
men	21.6	20.5	5.1	5.4	23.6	26.2
women	10.4	10.6	2.6	2.8	25.4	26.1
Number of people employed in the economy, thousand people	2,021.1	2,014.6	745.2	743.5	36.9	36.9
GRP/GMP, billion rubles	1,855.5	1,899.0	540.0	592.2	29.1	31.2
GRP/GMP per capita, thousand rubles	428.7	438.6	367.5	398.7	—	—
Labor productivity (GRP/GMP per one employed person), thousand rubles	918.1	942.6	724.6	796.5	—	—
Average monthly nominal wages accrued, rubles	30,691	30,280	41,532	40,818	—	—
Wage fund, billion rubles	744.4	732.0	371.4	364.1	49.9	49.7
Personal income tax, billion rubles	96.8	95.2	48.3	47.3	49.9	49.7

* Preliminary estimates.

In 2016, the level of economic activity of the population and, as a result, the number of the employed decreased in comparison with 2015, both in the whole region and in Ekaterinburg (the decrease in Ekaterinburg was slightly less than in the region as a whole). Due to the demographic losses and a decline in the economic activity, the number of people employed in the economy of the Sverdlovsk region decreased by 1 percentage point. The same trend was observed in Ekaterinburg.

Despite the negative dynamics of these indicators, positive economic results were achieved both in the Sverdlovsk region as a whole (102 % growth of the GRP) and in Ekaterinburg (109 % growth of the GMP), with the contribution of the megalopolis to the regional indicator of about 30 %. At the same time, the labor productivity increased from 918.1 thousand rubles up to 942.6 thousand rubles per 1 employed in the Sverdlovsk region and from 724.6 thousand rubles up to 796.5 thousand rubles per 1 employed in Ekaterinburg. Wages in 2016 slightly decreased if compared to 2015, both in the region as a whole and in Ekaterinburg. However, it should be noted that intraregional imbalances remained in the remuneration of workers: wages in Ekaterinburg exceed the average regional values by 1.3–1.4 times. As a result, the city accounts for about 50 % of the regional wage fund and the volume of the personal income tax.

The results of the calculations show that there are significant reserves to improve the economic performance in the Sverdlovsk region and its regional center by preventing the socio-economic damage caused by mortality of the economically active population (Table 3).

According to our estimates, about 17 thousand people died in the Sverdlovsk region in 2015–2016, who were engaged in the economy of the region at the time of their death, about 4 thousand people of them lived in the regional center (26 %). About 70 % of them were men. As a result, the Sverdlovsk region has not received 15.5 billion rubles in 2015 and 15.8 billion rubles in 2016 (in comparable prices), which amounted to approximately 1 % of the GRP annually. Of these losses, Ekaterinburg accounted for about 20 %, which amounted to 3.0 and 3.4 billion rubles (0.5 % and 0.6 % of the GMP, respectively).

Table 3

Assessment of the socio-economic damage caused by mortality of the economically active population in the current period (in comparable prices)

Indicators	2015			2016*		
	Sverdlovsk region	Ekaterinburg	Contribution of Ekaterinburg to the region, %	Sverdlovsk region	Ekaterinburg	Contribution of Ekaterinburg to the region, %
Number of the deceased economically active population employed in the economy, thousand rubles, including:	16.9	4.1	24.3	16.7	4.3	25.7
men	11.9	2.8	23.5	11.7	3.0	25.6
women	5.0	1.3	26.0	5.0	1.3	26.0
Lost GRP/GMP, billion rubles, including:	15.5	3.0	19.4	15.8	3.4	21.7
men	11.0	2.1	18.9	11.0	2.4	21.5
women	4.6	0.9	20.5	4.8	1.1	22.3
Lost wages, billion rubles, including:	6.2	2.1	33.0	6.1	2.2	34.6
men	4.4	1.5	32.2	4.3	1.5	34.2
women	1.8	0.6	34.9	1.8	0.7	35.5
Lost income calculated taking into account the average labor productivity in the economy, billion rubles, including:	29.3	5.6	19.1	29.4	6.5	22.1
men	19.8	3.7	18.7	19.3	4.3	22.3
women	9.5	1.9	20.0	10.1	2.2	21.8

* Preliminary estimates.

If we proceed from the assessment of the society's income lost due to premature mortality of the economically active population, calculated on the basis of the key performance indicator of the labor activity — labor productivity, the Sverdlovsk region lost 58.7 billion rubles in 2015–2016 (in 2015 — 29.3 billion rubles, in 2016 — 29.4 billion rubles), of which Ekaterinburg accounted for about 20 %.

However, in addition to the estimated economic damage in the current year, it is necessary also to take into account the potential value of those economic results that could have been obtained if the deceased had survived until the end of their economically active age (up to 72 years) being employed in the economy of the city or the region as a whole (Table 4).

Thus, the deceased in the Sverdlovsk region, who were at the economically active age at the time of their death, did not live 555.200 man-years in 2015 and 547.500 man-years in 2016. Of these, Ekaterinburg accounted for 136 (24.2 %) and 140 (26.2) thousand non-lived man-years, respectively.

Thus, the GRP in the Sverdlovsk region potentially lost due to the mortality of the economically active population amounted to 353.8 billion rubles in 2015 and 361.8 billion rubles in 2016 (in prices of 2015). For Ekaterinburg, the same indicator was 69.5 and 78.0 billion rubles, respectively (19.4 and 21.7 % of the GRP of the Sverdlovsk region). In addition, 139–142 billion rubles of wages will be potentially lost in the region (47–48 billion rubles in Ekaterinburg), from which taxes will not be paid and which will not participate in the formation of the consumer demand. Estimating the socio-economic damage from the viewpoint of the lost income in production (based on labor productivity), it should be noted that the Sverdlovsk region will not receive 509.7 billion rubles annually due to the mortality in 2015 and 516.1 billion rubles due to the mortality in 2016, of which about 20 % fall on the regional center (Figure 2).

Translation

Table 4

Potential socio-economic damage caused by mortality of the economically active population employed in the economy (in accordance with prices of 2015)

Indicator	2015			2016*		
	Sverdlovsk region	Ekaterinburg	Contribution of Ekaterinburg to the region, %	Sverdlovsk region	Ekaterinburg	Contribution of Ekaterinburg to the region, %
A number of the man-years non-lived due to mortality of the population employed in the economy, including:	385.3	95.2	24.7	383.8	97.9	25.5
men	281.1	67.8	24.1	279.8	70.3	25.1
women	104.2	27.4	26.3	104.0	27.6	26.5
Lost GRP/GMP, billion rubles, including:	353.8	69.5	19.4	361.8	78.0	21.7
men	258.1	49.5	18.9	263.7	56.0	21.5
women	95.7	20.0	20.5	98.1	22.0	22.3
Lost wages, billion rubles, including:	141.9	47.4	33.0	139.5	48.0	34.6
men	103.5	33.8	32.2	101.7	34.4	34.2
women	38.4	13.6	34.9	37.8	13.6	35.5
Lost income calculated taking into account the average labor productivity in the economy, billion rubles, including:	509.7	99.6	19.5	516.1	111.8	21.7
men	365.6	69.7	19.1	368.0	78.7	21.4
women	144.1	29.9	20.7	148.1	33.1	22.3

* Preliminary estimates.

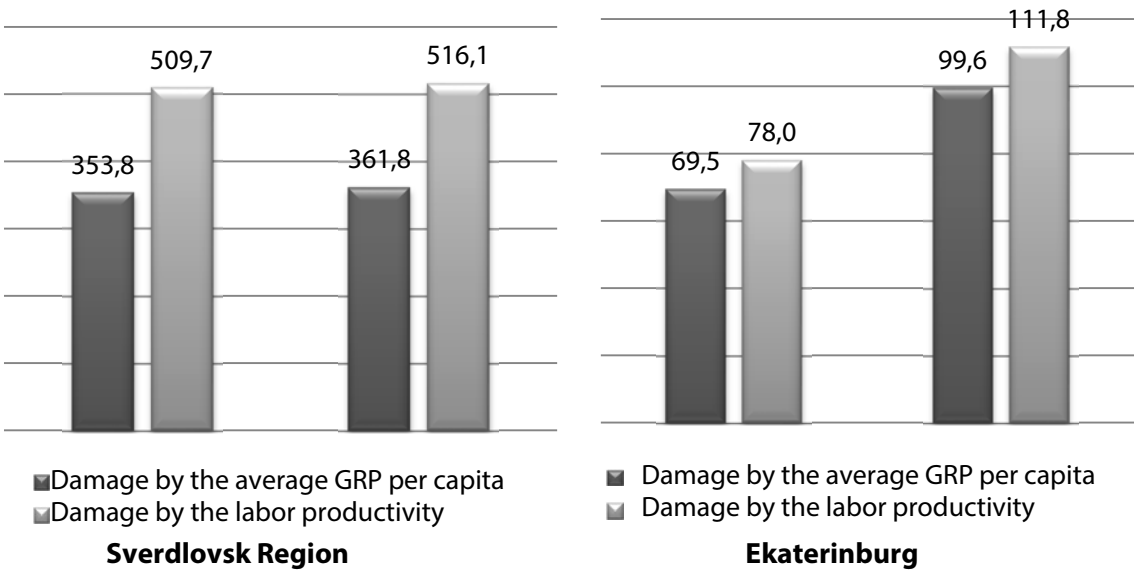

Fig. 2. *Potential socio-economic damage caused by premature mortality of the economically active population employed in the economy in the Sverdlovsk region and in Ekaterinburg in 2015–2016, billion rubles, in comparable prices*

Conclusion

Thus, a comparative analysis of various approaches (using income indicators and the average labor productivity) to assessing the economic damage caused by premature mortality indicates that difficulties can arise already at the stage of conceptualization of the problem solution. So, when assessing the damage using various economic indicators, different values of losses have been obtained, both in territorial and economic terms. Proceeding from this fact, it can be concluded that the choice of indicators, the algorithm for assessment of the socio-economic damage caused by mortality of the population and its results depend on the clearly set purpose, the tasks to be accomplished, and the rationale for the object to be assessed.

In territorial terms, the economic assessment of losses resulting from the mortality of the economically active population brings important information about regional features of forming the real damage and can be used to develop specific preventive measures for targeted regional development programs. In this regard, determination of the socio-economic damage caused by premature mortality of the population could be an important stage in assessing the effectiveness of economic and social policies and increasing their interconnectedness at all levels of the power hierarchy.

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