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METHODOLOGICAL APPROACHES TO ACCOUNTING THE DEPLETION OF NATURAL RESOURCES, CHANGES IN THE ENVIRONMENTAL AND HUMAN CAPITAL IN THEGROSS REGIONAL PRODUCT[1]

A key indicator of the System of National Accounts of Russia at a regional scale is Gross Regional Product characterizing the value of goods and services produced in all sectors of the economy in a country and intended for final consumption, capital formation and net exports (excluding imports). From a sustainability perspective, the most weakness of GRP is that it ignores depreciation of man-made assets, natural resource depletion, environmental pollution and degradation, and potential social costs such as poorer health due to exposure to occupational hazards. Several types of alternative approaches to measuring socio-economic progress are considering for six administrative units of the Ural Federal District for the period 2006-2014. Proposed alternatives to GRP as a measure of social progress are focused on natural resource depletion, environmental externalities and some human development aspects. The most promising is the use of corrected macroeconomic indicators similar to the "genuine savings" compiled by the World Bank. Genuine savings are defined in this paper as net savings (net gross savings minus consumption of fixed capital) minus the consumption of natural non-renewable resources and the monetary evaluations of damages resulting from air pollution, water pollution and waste disposal. Two main groups of non renewable resources are considered: energy resources (uranium ore, oil and natural gas) and mineral resources (iron ore, copper, and aluminum). In spite of various shortcomings, this indicator represents a considerable improvement over GRP information. For example, while GRP demonstrates steady growth between 2006 and 2014 for the main Russian oil- and gas-producing regions – Hanty-Mansi and Yamalo-Nenets Autonomous Okrugs, genuine savings for these regions decreased over all period. It means that their resource-based economy could not be considered as being on a sustainable path even in the framework of "weak" sustainability, i.e. sustainability under the assumption that the accumulation of producible physical capital and of human capital can compensate for losses in natural non reproducible resources.

Keywords: Ural Federal District, green gross regional product, genuine savings, adjusted net savings, depletion of natural resources

Introduction

A key indicator of the System of National Accounts of most countries is the gross domestic product (*GDP*), characterizing the final result of production activity of economic entities (residents), which is measured by the value of goods and services produced by these entities for use. In accordance with established practice, the Russian Federation's *GDP* is calculated by production method—it is the sum of the gross added value of all sectors and institutional sectors at current basic prices and net taxes on products, but less products subsidies. The analog of *GDP* at the level of a subject of the Federation is the gross regional product (*GRP*).

GDP as the main indicator of economic growth is being criticized over the past decades. Among other shortcomings of *GDP*, we can mention the fact, that at its calculation the depletion of natural resources and environmental degradation in the course of the economic activity are not taken into account. As a result, an impression is given of rapid economic growth at the parallel depletion of the resource base, degradation of ecosystems, environment pollution and public health deterioration. Underestimating these negative consequences can give a distorted picture of the state of economics and lead to the choice of a false path of development.

Attempts to improve the System of National Accounts, in order to take depletion of non-renewable natural resources into account at macroeconomic indicators calculation, have been made from the end of the 1960s. The history of the issue is represented, for example, in [1]. At the moment, the most famous alternative macroeconomic indicators of social progress is an index of sustainable economic

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welfare (*ISEW*) and its modification—genuine progress indicator (*GPI*); environmentally adjusted or "green" *GDP*; genuine savings indicator (*GS*) and its variant—adjusted net savings (*ANS*), as well as a number of integral indices, such as a human development index (*HDI*). As a recently published review of alternative approaches to assessment of social development sustainability, we can be recommend [2] and [3].

The problem of taking the resource and environmental factors into account, when economic development sustainability is being assessed, is relevant for both the Russian Federation as a whole and for its regions. The aim of this study is an approbation of the most globally generalized macroeconomic indicators of sustainable development through the example of subjects of the Federation included in the Urals Federal District.

Scientific and Methodical Bases of Regional Sustainable Development Macroeconomic Indicators Formation

The first indicator of sustainable ecological and economic development became known as the Index of Sustainable Economic Welfare (*ISEW*), proposed by Redefining Progress, an American non-profit organization and calculated for the first time for the USA in 1989. [4]. Later, first of all, in order to attract more public attention, the *ISEW* was called the Genuine Progress Indicator (*GPI*) [5]. Over time, the procedure for *ISEW/GPI* calculation was changed, but it remained the same in essence. Unlike other national development sustainability indicators the *ISEW/GPI* is not based on *GDP*, but on expenses for private consumption, adjusted to a number of variables, taking positive and negative economic, social and environmental components of social life into account (in monetary terms). For example, in article [6], published in 2007, the benefits of an individual from public spending on healthcare and education, from public and voluntary works of other persons, from unpaid works around the house, performed by other persons, from roads exploitation, as well as costs associated with crimes, unemployment, divorces, traffic accidents, noise, air and water pollution, ozone depletion, depletion of fossil resources, loss of forests, farmland, natural wetlands draining, and a number of other benefits and costs were used as such variables. Obviously, the monetary evaluation of all these components is an extremely subjective procedure and obtained results can hardly be evaluated from a scientific point of view. However, a surprising amount of research is dedicated to *ISEW/GPI* calculation. Following the pioneer work [4], there appeared publications with results of *ISEW* and *GPI* calculation for Austria, Great Britain, Vietnam, Germany, India, Italy, Japan, Netherlands, New Zealand, Poland, Portugal, Thailand, France, Sweden, and Japan [7, 8]. Along with studies at a state level, *ISEW* and *GPI* indices are widely used at the regional level (Table 1). According to the dates of these publications, we can see that interest in *ISEW/GPI*, as in social well-being indicators, remains unchanged despite ongoing criticism. As the author of study [20] noted, it can be explained by an understandable, but yet unreasonable, desire to characterize both the current private consumption and social development sustainability by a single indicator.

Table 1

Research with *ISEW* and *GPI* utilization at regional level

Country	Regional Level of Research	Year of Results Publication and Link to Results
Austria	1 state	2006 [9]
Belgium	1 province	2015 [8]
Great Britain	9 regions	2010 [10]
Italy	3 provinces 1 province	2006 [11] 2012 [12]
Canada	1 province 1 city	2009 [13] 2009 [14]
China	4 cities 1 city	2008 [15] 2015 [16]
United States of America	32 counties 5 cities 3 states	2012 [17] 2010 [18] 2014 [19]

Another macroeconomic indicator that takes environmental externalities of economic development into account is an environmentally adjusted *GDP*.

In 1993, the United Nations Statistical Commission published the Guidelines for Joint Accounting of Environmental and Economic Performance in the System of National Accounts [21]. The document had the status of an intermediate document, but the proposed system of environmentally adjusted macroeconomic indicators was tested very extensively, in countries with different economic structures and at different levels of socio-economic development: Ghana, Indonesia, Canada, Colombia, Korea, Mexico, Papua New Guinea, the United States of America, Thailand, the Philippines and Japan. The testing has shown that the main difficulties are associated with the lack of (or poor) comparability of necessary statistical information and principal inability to give a univocal monetary estimation to negative environmental consequences of economic activities. However, efforts in this area were continued, and in 2003, under the auspices of the United Nations, a new edition of substantially modified Guidelines for Joint Accounting of Environmental and Economic Performance in the System of National Accounts was published. [22] Net domestic product (*NDP*), which is calculated as the difference between gross domestic product (*GDP*) and the value of depreciation (consumption) of fixed capital (*DFC*) was offered as a basic measure of economic development stability. The total annual production, which the economy, in general, is able to consume, without damaging the productive capacity of subsequent years, is traditionally measured with the help of *NDP*. For the economic development environmental sustainability assessment, the net domestic product *NDP* is to be adjusted for the depreciation of non-renewable resources in the course of economic activity and for the damage caused by environmental degradation. The Guidelines [22] introduced two kinds of environmentally adjusted net domestic product. NDP_1^E is defined as the difference between the net domestic product and the cost of depreciation of natural assets (depletion of non-renewable resources) *DNNR*:

$$NDP_1^E = NDP - DNNR. \quad (1)$$

NDP_2^E is calculated as the difference between NDP_1^E and the damage caused by the degradation of the environment in the course of economic activity (for example, due to contamination) *EPC*:

$$NDP_2^E = NDP_1^E - EPC. \quad (2)$$

In literature, the environmentally adjusted net domestic product NDP_2^E was called environmentally adjusted *GDP* or "green" *GDP*. The latest version of the Guidelines for Environmental-Economic National Accounting, published in 2014 [23], differs from the previous version with better elaboration of issues related to taking flows and assets (in real terms) into account. Unfortunately, despite 20-year efforts, there is no acceptable solution of the problem of a univocal monetary estimation of natural assets and damages caused by environmental degradation.

Another example of sustainable development macroeconomic indicator is an indicator of Genuine Savings (*GS*), proposed in the 1990s. [24, 25]. The theoretical basis of this indicator is a "weak" sustainability concept. Within the framework of this concept, it is assumed that development is sustainable in the event of keeping (or increasing) the aggregate social capital, which is a sum of produced (physical) capital, natural capital and human capital. All three types of capital are considered fully complementary and interchangeable, and, therefore, the reduction of one type of capital may be fully compensated by the increase of the other one. Genuine savings (*GS*) are calculated as gross domestic savings (*GDS*), adjusted for depreciation of fixed capital (*DFC*), depletion of non-renewable natural resources (*DNNR*), environmental pollutant cost (*EPC*) and education expenses (*EE*) (the latter ones are taken with a "plus," as they increase the human capital):

$$GS = GDS - DFC - DNNR - EPC + EE. \quad (3)$$

All the values, used in the calculation, are expressed as a percentage of *GDP*. Genuine savings can be both positive and negative.

At the moment, the World Bank regularly calculates the indicator for various countries and publishes relevant reviews (using a synonym for "genuine savings"—"adjusted net savings" (*ANS*)). In the latest review, published in 2013, the adjusted genuine savings indicator was calculated for 213 countries. [26] Here is an *ANS* calculation procedure:

$$ANS = GDS - DFC - ED - MD - FD - CO_2D - PMD + EE, \quad (4)$$

where *ED* is the depletion of non-renewable energy resources; *MD* is the depletion of non-renewable mineral resources; *FD* is the depletion of forest resources; CO_2D is the damages caused by greenhouse gas emissions; *PMD* is the damages from air pollution, caused by suspended solids. The remaining symbols are the same as in formula (3). All the values, included in formula (4), are expressed as a percentage of gross national income.

The main drawback of this indicator is the same as that of other similar environmentally adjusted macroeconomic indicators—the principal inability to give a univocal monetary estimation to components of natural and human capitals.

We also know about other attempts to establish macroeconomic indicators of sustainable development. Some of these indicators were not widely used, like the one developed in the Netherlands in the early 1990s (and used for some time at a national level), an index of Sustainable National Income [27]. Others, such as the Human Development Index, have become very popular [28].

Russian specialists are also involved in the development of new methodological approaches to the creation of macroeconomic indicators for sustainable development of territories, exploring the general theoretical aspects of the problem [29–31] and testing various techniques at a regional level [32–34].

Below, the results of calculation of environmentally adjusted gross regional product, genuine savings, and adjusted net savings for the federal subjects of the Urals Federal District within 2006–2014, are presented and analyzed.

Results of Calculating Macroeconomic Indicators of Sustainable Development for Federal Subjects of UFD

Environmentally adjusted gross regional product. The calculation of environmentally adjusted gross regional product for the federation subjects of UFD within 2006–2014 was carried out in accordance with the recommendations of the UN Statistical Commission [22, 23]. The basic measure of the regional development stability is a net regional product (*NRP*), which is calculated as the difference between the gross regional product (*GRP*) and the depreciation (consumption) of fixed capital in the course of economic activities (*DFC*). Accounting depreciation of fixed assets (depreciation and amortization recognized in the accounting and reporting) of commercial and non-profit organizations (of all forms of ownership), accrued for a year, was used as the depreciation of fixed capital (Table 2).

For the calculation of environmentally adjusted ("green") *GRP*, net regional product (*NRP*) is reduced by the cost of non-renewable natural resources spent in the course of economic activity (*DNNR*) and by the damages caused by environmental contamination (*EPC*) (Formulas 1 and 2).

As previously mentioned there are no unambiguous and generally accepted methods of monetary valuation of natural resources, of damages from environmental pollution and degradation. Any method is based on more or less realistic assumptions and its selection is always subjective.

To estimate the cost of consumed non-renewable natural resources, the method of market valuation was used based on average world prices for extracted energy and mineral resources[2] (Table 3).

In order to assess the damage caused by environmental pollution, it is principally impossible to use market prices. Payments of natural resource users for emissions (discharges) of pollutants and waste disposal were used as a "surrogate measure" of the damages caused by environmental contamination (*EPC*) (Table 4).

Obtained values of the environmentally adjusted gross regional product (EA *GRP*) at current and constant prices of 2008, calculated using the deflator index applied by the Federal State Statistics Service, are shown in Table 5.

Genuine savings. Calculation of genuine savings for the Federal subjects of UFD for 2006–2014 was performed according to Formula 3. Instead of the value of gross domestic savings (*GDS*) at the level of the Federal subjects an indicator was used, calculated by the Federal State Statistics Service,—gross fixed capital accumulation. The depreciation of fixed capital, depletion of natural resources and damages, caused by environment pollution were taken into account in the same way as in the calculation of environmentally adjusted *GRP*. The initial data that was not previously presented and final results are presented in Table 6.

Adjusted net savings. Adjusted net savings for the subjects of the Federation of UFD are calculated according to Formula 4, in accordance with the procedure, used by the World Bank in its latest review

[2] According to data of annual public reports on state and usage of mineral resources of the Russian Federation (see: https://www.mnr.gov.ru/regulatory/list.php?part=1257)

Table 2

GRP, Depreciation of Fixed Assets and Net Regional Product of Federal Subjects of UFD, bn RUB (at current prices)*

Indicator	Year								
	2006	2007	2008	2009	2010	2011	2012	2013	2014
Kurgan Region									
Gross Regional Product	68.4	81.1	106.2	107.9	117.9	136.3	146.0	165.2	172.0
Depreciation of Fixed Assets	5.7	7.5	8.6	9.6	10.8	10.9	13.4	14.9	15.5
Net Regional Product	62.7	73.6	97.6	98.3	107.1	125.4	132.6	150.3	156.5
Sverdlovsk Region									
Gross Regional Product	653.9	820.8	923.6	825.3	1,046.6	1,291.0	1,484.9	1,586.2	1,676.0
Depreciation of Fixed Assets	47.8	56.8	74.7	81.0	91.6	112.5	130.9	158.7	150.8
Net Regional Product	606.1	764.0	848.9	744.2	955.0	1,178.5	1,354.0	1,427.5	1,525.2
Khanty-Mansiysk Autonomous Region									
Gross Regional Product	1,594.1	1,728.3	1,937.2	1,778.6	1,971.9	2,440.4	2,703.6	2,789.7	2,837.6
Depreciation of Fixed Assets	169.9	210.3	248.7	347.3	364.7	391.6	445.7	488.9	496.6
Net Regional Product	1,424.2	1,518.0	1,688.4	1,431.4	1,607.2	2.048.8	2.257.9	2.300.8	2.341.0
Yamalo-Nenets Autonomous Region									
Gross Regional Product	546.4	594.7	719.4	649.6	782.2	966.1	1.191.3	1.373.5	1.490.0
Depreciation of Fixed Assets	106.0	118.6	162.0	170.3	195.1	229.0	279.9	317.6	350.2
Net Regional Product	440.3	476.0	557.4	479.3	587.1	737.1	911.4	1.055.9	1.139.9
Tyumen Region (without Autonomous Regions)									
Gross Regional Product	410.9	435.8	464.8	442.0	547.5	706.1	730.6	854.8	918.9
Depreciation of Fixed Assets	24.0	25.6	31.1	37.3	41.4	49.7	124.7	84.9	91.9
Net Regional Product	386.9	410.2	433.7	404.7	506.1	656.3	606.0	769.9	827.0
Chelyabinsk Region									
Gross Regional Product	446.9	575.6	664.5	557.0	652.9	774.4	842.0	879.3	972.0
Depreciation of Fixed Assets	28.1	40.4	45.0	50.2	55.5	63.5	70.1	75.6	82.6
Net Regional Product	418.8	535.2	619.5	506.8	597.4	710.9	771.9	803.6	889.4

* Hereinafter, wherever not specified, the data source is the Federal State Statistics Service.

Table 3

Depletion of Non-Renewable Natural Resources in Physical Units and in Value Terms (at current prices)

Resource	Units	Year								
		2006	2007	2008	2009	2010	2011	2012	2013	2014
Kurgan Region										
Uranium ore	tons	300	350	380	440	509	590	529	553	570
	bn RUB	0.886	1.960	1.285	1.425	1.601	2.166	1.639	1.483	1.578
Total, bn RUB		0.886	1.960	1.285	1.425	1.601	2.166	1.639	1.483	1.578
Sverdlovsk Region										
Commodity iron ore	mln tons	20.0	20.3	17.3	19.5	17.1	17.8	16.3	17.4	9.8
	bn RUB	28.800	30.114	39.990	37.116	68.549	87.619	71.461	72.594	37.653
Bauxites (in terms of Al)	thousand tons	950	890	886	862	841	870	740	639	647
	bn RUB	66.283	60.046	56.629	46.991	55.662	60.892	46.455	37.574	46.372
Copper ore (in terms of Cu)	thousand tons	61	66	71	75	85	86	83	77	77
	bn RUB	11.141	12.016	12.275	12.253	19.451	22.345	20.566	17.886	20.254
Total, bn RUB		106.22	102.18	108.89	96.360	143.66	170.86	138.48	128.05	104.28

Ending Table 3

Resource	Units	Year								
		2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**
Tyumen Region (without Autonomous Regions)										
Oil	mln tons	0	1.4	1.2	3.0	5.2	6.7	7.8	9.7	10.8
	bn RUB	0	17.678	20.994	41.709	89.903	156.67	195.10	242.66	294.84
Total, bn RUB		0	17.678	20.994	41.709	89.903	156.67	195.10	242.66	294.84
Khanty-Mansiysk Autonomous Region										
Oil	mln tons	275.6	278.4	277.6	270.5	266.0	262.5	259.9	255.1	250.2
	bn RUB	3.347.1	3.592.4	4.776.9	3.760.7	4.598.9	6.138.2	6.500.7	6.381.8	6.830.4
Total, bn RUB		3.347.1	3.592.4	4.776.9	3.760.7	4.598.9	6.138.2	6.500.7	6.381.8	6.830.4
Yamalo-Nenets Autonomous Region										
Natural gas	bn m3	578.4	569.5	575.2	485.3	542.5	559.8	534.9	548.4	516.2
	bn RUB	3.394.5	3.404.1	5.199.7	3.838.0	4.379.1	5.575.3	5.792.8	5.978.4	6.287.2
Oil	mln tons	36.1	33.2	29.8	26.9	24.3	23.0	22.7	21.7	21.5
	bn RUB	438.43	428.40	512.80	373.99	420.12	537.82	567.78	542.87	586.94
Total, bn RUB		3.832.9	3.832.5	5.712.5	4.212.0	4.799.3	6.113.1	6.360.6	6.521.3	6.874.1
Chelyabinsk Region										
Copper ore (in terms of Cu)	thousand tons	50	53	56	61	63	68	67	93	112
	bn RUB	9.132	9.649	9.682	9.966	14.416	17.653	16.488	21.733	29.418
Total, bn RUB		9.132	9.649	9.682	9.966	14.416	17.653	16.488	21.733	29.418

Table 4

Payments of Natural Resource Users for Emissions (Discharges) of Pollutants and Waste Disposal, bn RUB (at current prices)

Subject of Federation	Year								
	2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**
Kurgan Region	0.023	0.024	0.031	0.028	0.026	0.028	0.023	0.040	0.038
Sverdlovsk Region	0.614	0.720	0.751	0.738	1.909	1.193	1.774	1.115	0.913
Tyumen Region, without the Autonomous Region	0.019	0.034	0.049	0.080	0.079	0.075	0.112	0.099	0.093
Khanty-Mansiysk Autonomous Region	1.072	1.251	1.045	1.048	0.913	0.946	3.945	3.384	1.149
Yamalo-Nenets Autonomous Region	0.298	0.551	0.686	0.375	0.387	0.357	1.199	1.394	1.253
Chelyabinsk Region	0.423	0.497	0.437	0.312	0.540	0.380	0.388	0.803	0.393

Table 5

Environmentally Adjusted *GRP* at Current and Constant Prices of 2008, bn RUB

Type of Costs	Year								
	2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**
Kurgan Region									
EA GRP	61.8	71.6	96.3	96.8	105.5	123.2	131.0	148.8	154.9
EA GRP at prices of 2008	83.0	84.4	96.3	94.9	90.5	91.3	90.3	96.9	94.0
Annual growth of EA GRP at prices of 2008, %		1.8	14.1	–1.4	–4.6	0.8	–1.1	7.3	–3.0
Sverdlovsk Region									
EA GRP	499.3	661.1	739.3	647.1	809.4	1.006.4	1.213.7	1.298.4	1.420.0
EA GRP at prices of 2008	670.2	779.6	739.3	634.5	694.8	745.5	836.5	845.3	861.6
Annual growth of EA GRP at prices of 2008, %		16.3	–5.2	–14.2	9.5	7.3	12.2	1.1	1.9

Ending Table 5

Type of Costs	Year								
	2006	2007	2008	2009	2010	2011	2012	2013	2014
Tyumen Region (without Autonomous Regions)									
EA GRP	386.9	392.5	412.7	362.9	416.1	499.6	410.8	527.1	532.1
EA GRP at prices of 2008	519.4	462.9	412.7	355.8	357.2	370.1	283.1	343.2	322.9
Annual growth of EA GRP at prices of 2008, %		–10.9	–10.8	–13.8	0.4	3.6	–23.5	21.2	–5.9
Khanty-Mansiysk Autonomous Region—Yurga									
EA GRP	–1.924.0	–2.075.6	–3.089.5	–2.330.4	–2.992.6	–4.090.3	–4.246.8	–4.084.4	–4.490.5
EA GRP at prices of 2008	–2.582.6	–2.447.7	–3.089.5	–2.284.7	–2.568.8	–3.029.9	–2.926.8	–2.659.1	–2.724.8
Annual growth of EA GRP at prices of 2008, %		–5.2	26.2	–26.1	12.4	17.9	–3.4	–9.1	2.5
Yamalo-Nenets Autonomous Region									
EA GRP	–3.392.9	–3.357.0	–5.155.8	–3.733.1	–4.212.6	–5.376.4	–5.450.4	–5.466.8	–5.735.5
EA GRP at prices of 2008	–4.554.2	–3.958.7	–5.155.8	–3.659.9	–3.615.9	–3.982.5	–3.756.3	–3.559.1	–3.480.3
Annual growth of EA GRP at prices of 2008, %		13.1	–30.2	29.0	1.2	–10.1	5.7	5.2	2.2
Chelyabinsk Region									
EA GRP	409.2	525.1	609.4	496.6	582.4	692.8	755.0	781.1	859.6
EA GRP at prices of 2008	549.3	619.2	609.4	486.8	499.9	513.2	520.3	508.5	521.6
Annual growth of EA GRP at prices of 2008, %		12.7	–1.6	–20.1	2.7	2.7	1.4	–2.3	2.6

Table 6

Initial Data and Final Results of Genuine Savings Calculation for Federal Subjects of UFD, bn RUB (at current prices)

Type of Costs	Year								
	2006	2007	2008	2009	2010	2011	2012	2013	2014
Kurgan Region									
Gross Saving	14.4	19.6	34.4	36.0	26.8	30.8	36.4	32.9	33.5
Education expenses	4.4	5.5	6.7	7.4	7.7	9.0	10.5	12.0	12.5
Genuine savings	12.2	15.6	31.2	32.3	22.1	26.7	31.8	28.6	28.8
Genuine savings, % of GRP	17.8	19.2	29.3	30.0	18.7	19.6	21.8	17.3	16.8
Sverdlovsk Region									
Gross Saving	138.2	182.4	241.2	201.6	275.7	347.3	365.8	365.2	371.4
Education expenses	24.5	34.2	40.9	38.8	42.7	55.5	64.3	74.8	78.7
Genuine savings	8.0	56.9	97.8	62.3	81.3	118.1	158.9	152.2	194.0
Genuine savings, % of GRP	1.2	6.9	10.6	7.5	7.8	9.1	10.7	9.6	11.6
Tyumen Region (without Autonomous Regions)									
Gross Saving	91.2	112.7	150.6	146.2	169.5	191.9	214.9	285.6	290.5
Education expenses	15.4	17.7	18.5	16.4	17.6	22.1	29.0	32.0	33.6
Genuine savings	82.6	87.1	117.0	83.5	55.7	7.6	–76.0	–10.1	–62.7
Genuine savings, % of GRP	20.1	20.0	25.2	18.9	10.2	1.1	–10.4	–1.2	–6.8
Khanty-Mansiysk Autonomous Region — Yurga									
Gross Saving	327.1	403.7	507.5	496.9	546.8	674.9	708.5	761.1	774.0
Education expenses	31.2	37.0	43.9	40.6	44.0	49.8	58.9	64.5	67.8
Genuine savings	–3.160	–3.363	–4.475	–3.572	–4.374	–5.806	–6.183	–6.049	–6.486
Genuine savings, % of GRP	–198.2	–194.6	–231.0	–200.8	–221.8	–237.9	–228.7	–216.8	–228.6

Ending Table 6

Type of Costs	Year								
	2006	2007	2008	2009	2010	2011	2012	2013	2014
Yamalo-Nenets Autonomous Region									
Gross Saving	177.1	298.7	408.8	346.6	393.6	486.2	589.1	607.0	617.4
Education expenses	14.4	16.4	17.3	18.5	21.8	30.3	35.0	35.7	37.5
Genuine savings	–3.748	–3.637	–5.449	–4.018	–4.579	–5.826	–6.018	–6.198	–6.571
Genuine savings, % of GRP	–685.9	–611.5	–757.5	–618.4	–585.4	–603.0	–505.1	–451.2	–441.0
Chelyabinsk Region									
Gross Saving	89.9	125.6	174.3	144.2	147.2	174.9	192.5	211.2	214.8
Education expenses	15.9	20.1	26.0	24.2	27.5	34.2	40.7	48.9	51.4
Genuine savings	68.2	95.2	145.1	108.0	104.3	127.4	146.3	161.9	153.7
Genuine savings, % of GRP	15.3	16.5	21.8	19.4	16.0	16.5	17.4	18.4	15.8

[26]. Principally, this procedure does not differ from the procedure of genuine savings calculation. The main differences of the procedures are:

— When calculating adjusted net savings the depletion of one of the renewable resources (forest) is taken into account;

— Instead of such a broad concept as "damage from environment pollution" only two of its components are considered—damages caused by greenhouse gas emissions and damages caused by suspended solids air pollution;

— All the values, used in the calculation, are expressed as a percentage of gross national income.

Based on the materials of the Federal State Statistics Service and the subjects of the Federation on the state of forest resources, it was concluded that within 2006–2014 a depletion of forest resources in the territory of the Urals Federal District was not noted, the rate of forest resources reproduction exceeded the rate of their extraction. Therefore, the cost of depletion of renewable forest resources was accepted as being equal to zero (as in the World Bank' report [26], in relation to the Russian Federation as a whole).

The damages caused by greenhouse gas emissions and damages caused by suspended solids air pollution were estimated with the help of data of the World Bank [26], and purchasing power parity. In prices of 2008 the damages amounted to 140 rubles per ton of greenhouse gases in CO2 equivalent and 14,600 rubles per ton of suspended solids.

According to the World Bank [26], the gross national income of the Russian Federation is about 80% of *GDP*. The Federal State Statistics Service of Russia does not calculate the value of gross national income or its equivalent at a regional level. Therefore, the results of the calculation of adjusted net savings for the Federal subjects of UFD are expressed as a percentage of the gross regional product (Table 7).

Table 7

Adjusted Net Savings, % of *GRP*

Subject of Federation	Year								
	2006	2007	2008	2009	2010	2011	2012	2013	2014
Kurgan Region	16.2	17.6	27.8	28.5	17.2	18.0	20.2	15.8	15.3
Sverdlovsk Region	–0.6	5.3	8.8	5.7	6.1	7.6	9.3	8.2	10.1
Tyumen Region, without the Autonomous Region	19.7	19.5	24.6	18.3	9.7	0.6	–10.9	–1.6	–7.3
Khanty-Mansiysk Autonomous Region	–199.1	–195.5	–232.0	–201.9	–222.9	–239.0	–229.6	–217.8	–229.6
Yamalo-Nenets Autonomous Region	–686.5	–612.1	–758.1	–619.1	–586.0	–603.6	–505.6	–451.7	–441.4
Chelyabinsk Region	12.9	14.4	19.7	17.0	13.7	14.3	15.3	16.4	13.8

Conclusion

The cost of natural resources spent in the course of economic activity is usually evaluated on the basis of the value of the initial rental income in extractive industries [32, 35], which is the sum of the market value of the resource and costs of its production (extraction). In practice, the rental income is more a theoretical abstraction; there are no ways to calculate it correctly. Prices, formed in the resource markets, do not reflect real social expenses and benefits from natural resources utilization. For example, within the period from 2004 till 2014, the average annual price for "Urals" oil in world markets ranged from 34.5 to 109.3 US dollars per barrel[3] [36], although there were no fundamental changes either in the extraction or in the consumption of the oil within that period. Information on the second component of the rental income (real cost of natural resources extraction) is almost always unavailable, both in Russia and in other countries.

The correct assessment of damages caused by environmental changes in the process of economic activity also involves fundamental methodological problems. Although "damages from the impact on the environment" term is ubiquitous, in fact, the value of damages caused by impact on the environment is a form of economic fiction. The insurmountable problem here is that additional costs, related to negative impacts on the environment, are never known in reality, due to many overwhelming circumstances. In particular, it is practically impossible to predict all the "material" consequences of a particular economic activity. Even greater difficulties occur at the monetary evaluation of these material consequences, such as loss of human health or species disappearance.

With regard to the adjustment of regional indicators, we believe that the common procedure when the traditional values of *GRP* subtracted the value of extracted natural resources in the region is incorrect. For the Khanty-Mansiysk and Yamalo-Nenets Autonomous Regions, the market value of annually extracted hydrocarbons can sometimes exceed the traditionally calculated *GRP*, thus explaining the huge negative values of environmentally adjusted *GRP* for these subjects of the Federation listed in Table 5. However, these extracted resources are not directed to the *GRP* production, it is incorrect to consider them as resources expended in the process of economic activity in Khanty-Mansiysk and Yamalo-Nenets Autonomous regions. Produced hydrocarbon raw materials are essentially resources produced as a result of economic activities in the Khanty-Mansiysk and Yamalo-Nenets Autonomous Regions, which in the future will be expended in the process of the Russian *GDP* production. We believe that it is more reasonable to adjust the *GRP* to the cost of only those resources that have been expended for the own needs of the territory. Thus, in 2013, in the territory of Yamalo-Nenets Autonomous Region 548.4 bn m3 of natural gas was extracted, while natural gas consumption in this region amounted to 7.6 bn m3, i.e. less than 1.4%[4] [37].

The performed analysis suggests that out of all the formed concepts of resource-adjusted and environmentally adjusted indicators of economic development, not a single one can be used as a working tool. All existing concepts are simplified and incorrect to some extent. This issue is extremely complex and requires fundamentally new approaches to its solution, which opens a wide field for new interdisciplinary research.

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