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Environmental Capital: a Reason for Interregional Differentiation or a Factor of Economy Stimulation (the Case of Russia)

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Abstract. On the basis of the statistical data analysis of the regional economic development in Russia, as well as the models to evaluate the role of natural capital in enhancing the regional economic growth (proposed by the authors), and the intensity of natural capital industrial consumption across the regions, assumptions are made about modern resource potential for Russia's economic growth, the factors of its internal interregional economic differentiation, along with suggesting the most optimal directions for modernization of the national policy of environmental management and industry planning with a view to offset the challenges to sustainable and environmentally friendly development.

1. Introduction

Despite the rapid development of international services market, high-tech industries, the basis for economic progress and material well-being of the majority of modern countries continues to be the extraction, processing and export of natural resources, as well as the agriculture, which in its essence is associated with exploitation of land along with active use of climatic and geographic advantages of individual states and territories. The Russian Federation has a considerable amount of strategic stocks of natural raw materials (hydrocarbons, metals), as well as arable land, water resources, intensive use of which determines the trajectory, dynamics and potential for its economic activities and growth. The uncontrolled depletion of Russia's natural capital accompanying the exaggerated growth of raw materials and export-oriented sectors of the Russian economy at the expense of domestic demand-oriented industries and high value added manufacturing has turned into a major social and economic challenge for the country, and in the nearest future might entail rapid increase in spending and the reduction of economic effectiveness.

Adopted in the 2000s, the today's concept of sustainable economic development implies inter alia the mandatory accounting of natural capital depletion in the assessment of economic effectiveness both at the state level overall and of its particular regions and industries. It can be assumed that the higher contribution of natural capital is (against other production factors, i.e. labor, capital, innovation) in generating the regional (national) income, the more aggressive the government economic strategy towards environmental management should be, and consequently, the more limited economic growth



prospects future generations will have. Hence, long-term investment projects and the national socioeconomic strategy should be underpinned by an assessment of the effectiveness and commercialization feasibility of localized natural capital, as well as the joint efforts of business and the state to preserve and maintain it.

The extractive export-oriented sector of the economy currently makes up the basis of the Russian economic growth, ensuring about 44% of its foreign exchange earnings (taking into account the related areas of processing and transportation of raw materials). Despite the enormous natural wealth of Russia capable to be converted into the powerful potential of structural economic transformations and higher rates of the local population welfare increase (Shabunina et al., 2017), Russia's natural capital triggers a whole range of perennial problems, one of which is the huge interregional differentiation (both at the level of regional material well-being and the quality of its social infrastructure, human capital development, etc.). While 10% of the Russian Federation regions, rich in carbon raw materials, generate more than a quarter of the national GDP, yet there are quite a few economically depressed regions on the map of Russia, being actively funded by the federal center and having little attraction for both business and the population (Ushakov & Kozlova, 2016).

This model of socioeconomic development of the vast country cannot be regarded as sustainable. The Russian economy is very sensitive to world hydrocarbon prices fluctuations (that was demonstrated over 2014 – 2015), the interregional differentiation in Russia increases social tensions in the country and claims for expanding the public budgetary spending. Extractive regions reveal the growing problems of environmental security, in spite of the relatively high incomes of the population, they are becoming less attractive for the major long-term investment, even related to the exploitation of natural resources (Rodionov & Rudskaya, 2017).

The research aim is on the basis of the current practices of estimating the natural resources potential and statistical data to assess the impact of the environmental factor on the regional economic development in the Russian Federation, and to provide recommendations as to the levelling the natural resources determining role in the socioeconomic growth of Russia in the long term perspective.

The research objectives are set as follows:

- to analyze the environmental and economic development indicators framework;
- to assess the feasibility of implementing the existing methodology for estimating the natural resources value based on the open access statistics data;
- to develop a system of indicators that reflect the contribution of natural capital in the territorial development and the level of its economic development sustainability;
- to estimate Russia's environmental and economic indicators at the macroeconomic and regional levels;
- to provide recommendations on the modernization of the Russia's national economic development strategy aimed at offsetting the determining impact of the natural resources on the country's economic growth.

The research hypotheses:

- despite certain positive trends in economic development of the Russian Federation as a result of the implementation of its anti-sanctions policy and the fall of the national currency, the highest dynamics of economic growth rates is still observed only in the regions with maximum degree of natural resources exploitation;
- despite insignificant restructuring of the Russia's national economy over the period 2014 – 2016 in favor of processing and light industries and agriculture, the intensity of the country's natural resources consumption demonstrates the overall growing trend, even in the conditions of reduction of currency earnings from the traditional for the country hydrocarbon exports;
- the dependence of economic growth in Russia on the whole (and its most advanced regions in particular) on the irresponsible consumption of natural resources has a tendency to growth that dramatically reduces the stability and viability of the country's economic development and the homogeneity of its internal economic space.

2. Literature Review

The role of the natural factor in ensuring national or regional economic growth as a socio-economic problem was originally addressed subject to the predominance of the theoretical or practical focus of a particular scientist or concept suggested.

The theoretical concepts were primarily focused on defining the essence and content of natural capital (Toman, 1998), as well as revealing the vectors of the environmental factors determining impact on the economic development (expressed in GDP growth, GDP per capita, national economy restructuring, reduction of the public debt, the overall growth of the country's share on the world market of goods and services, etc.) the value of the environment. Thus, Nordhaus (1992) argued that the steady-state rate of growth of output per capita in an economy with natural resources is proportional to the rate of alumni progress adjusted for a "population growth drag" due to diminishing returns, as well as a "natural resource depletion drag" due to declining levels of exhaustible natural resources. Auty (2001) and Gelb (1988) found that huge natural resource cooker/oven may create opportunities for rent-seeking behaviour on a large scale on the part of producers, thus diverting resources away from more among fruitful economic activity. Corden (1984) provided insights into the ability of natural resources not only to facilitate the national economy development but spur its stagnation, like in the case of economic effects on the back of Dutch disease. Gylfason et al. (1999) explored the implications associated with the reduction of human capital along with the increase in the proportion of population living on earnings from the natural resources rent.

A vast area for scientific research up to the present time is the issue of interdependence between natural capital and regional investment attractiveness.

Thus, Iranian scientists Maryam Asghari, Nathalie Hilmi and Alain Safa (2014) have examined whether natural resources and environmental policy in Persian Gulf countries alter the relationship between FDI and Persian Gulf's economics growth, found that the impact of arable land, forest area and the interaction between FDI and environmental policy on economic growth is negative, but renewable internal freshwater resources flows, mineral depletion and energy use have a positive effect. A Marsiliani, Laura, Renström, Thomas I. (2012) explored the relationship between environmental protection and international capital movements, when tax policy is endogenous (through voting).

A number of researchers were the proponents of the evaluation approach focused rather on the search for a single methodology to assess the role of a natural resource factor in regional economic progress.

Thus, a certain contribution to the research on the natural capital evaluation which was taken into account in this study had been made by the following research findings: in the USA – (Thampapillai, Dodo J & Uhlin, Hans-Erik, 1997), in Scandinavian countries – (Bovenberg, A Lans & van der Ploeg, Frederick, 1994), in Ghana – (Kwabena Asomanin Anaman, Felix Agyei-Sasu 2014) and in the Russian Federation (Anikina, 2005).

This study also employed the official information from the Russian Federal State Statistics Service, as well as the evaluation results from the Russian expert groups.

3. The Research Methodology

The traditional system of macroeconomic indicators, the core of which is the GDP, fails to capture the economic role of natural capital in view of the lack of its expression in value terms.

As an option, we can explore the anomaly in GDP productivity, i.e. changes in GDP as a result of natural hazards or negative phenomena (cold winter, natural disasters, epidemic diseases, environmental disasters, etc.), which might indirectly translate the impact of a natural factor into the economic growth dynamics.

Of a special importance is the system of Environmental-Economic Accounting (SEEA), developed and proposed by the UN 1993. A key indicator in this system is the environmentally adjusted GDP, the GDPE, which is an adjustment of GDP to the value of the natural capital depletion, consumption of environmental goods and services (quantitative reduction of mineral resources or the volume of bioresources).

Another indicator of environmental and economic accounting is environmentally adjusted net domestic product – NDPE which is obtained by a subtraction of fixed capital consumption from a GDP value and then the consumption of natural capital is subtracted. The adjusted in this way GDP reflects the amount of net value added generated in the economy and targeted at further reproduction and development. The comparison of GDPE and NDPE with traditional indicators allows for mapping the natural capital contribution to value added creation. It can also be used for economic sustainability evaluation.

At the first stage of the research an analysis of the relationship between the dynamics of the GDP and the dynamics of the basic factors of production was conducted.

At the second stage of the research all the subjects of the Russian Federation (Moscow and Saint Petersburg regions were excluded from the general scope of the analysis due to their exceptional status, the Republic of Crimea and the city of Sevastopol - due to the lack of information).

Have been grouped by means of a cluster analysis method. Thus, 7 clusters were identified by several economic development indicators considered simultaneously: GRP per capita, GRP per person employed in the economy, industrial production volume per worker, GVA per worker by industry, industrial output volume per worker (production of raw materials and basic processing industries).

At the third stage of the research the adjustment of the gross domestic product and net domestic product values to the volumes of natural capital and fixed capital consumed in the process of a value added creation has been performed. Environmentally adjusted GRP represents the GRP adjusted to the value of natural capital consumption:

$$GRPE = GRP - \text{natural capital depletion} == GRP - \text{qualitative depletion} - \text{quantitative depletion} = \\ = GRP - \text{damage} - \text{rent}$$

Environmentally adjusted GRP complements GRPE reflecting the outflow of both natural capital and fixed capital in the process of regional economic activities:

$$NRPE = \text{fixed capital depletion} - \text{the depletion of natural capital}$$

The amount of damages to the economy resulted from regional economic activities and the rent income received from extracting and exporting of region's natural resources, as well as the depreciation of fixed capital for the estimated period have been calculated for each of the regions.

4. Research Results

The research findings demonstrated that the growth in consumption of natural resources, the most important of which is oil, in the process of industrial production contributes to the value added increase created by the Russia's economy. According to various estimates, the contribution of export-oriented raw materials sector of the economy to the GDP makes up 13% to 25% (Table 1).

Thus, the estimates of the contribution of natural capital to the GDP formation received on a nationwide scale as well as the conclusions on the country's economic development status and sustainability are rather rough (average).

To achieve more accurate results, the regions were distributed by internally homogeneous clusters (Table 2).

The income of 18 regions consisting of the most developed raw materials clusters in the aggregate exceeds 32% of total GRP. Most of the regions that lack natural resource potential are characterized by a low level of economic development. This fact once again confirms that the driving force behind the growth of macroeconomic indicators in recent years is the active consumption of natural capital.

Table 1. The Gross Value Added contribution to GDP by industry in 2015 (made by co-authors).

Industry	Value added specific weight	Industry	Value added specific weight
Electric Power	0,466	Oil Extracting	0,706
Refining	0,165	Natural Gas	0,677
Coal Mining	0,535	Iron and Steel	0,386
Non-Ferrous Metals	0,397	Chemical and Petrochemical	0,365
Mechanical Engineering and Metalworking	0,38	Forestry, Woodworking and Pulp and Paper	0,431
Construction Materials	0,398	Consumer Goods	0,294
Food Processing	0,275	Other	0,349

Table 2. Selected clusters and their characteristics (made by co-authors).

Cluster title	Number of regions in a cluster	Cluster key industries	Contribution to the economy of the Russian Federation, %	Export
Raw materials minus	4	Agriculture, Coal Mining industry, Iron and Steel industry	1	Not Developed
Manufacturing minus	34	Low-tech industry	20	Not Developed
Raw materials	18	Petroleum sector, Metal and Steel industry	27	Developed
Manufacturing	5	Mechanical Engineering and Chemical Industry	5	Developed
Raw materials plus	15	Raw Materials Production	32	Developed
Manufacturing plus	4	High-tech industries	13	Developed
Offshore regions	3	Major part of gross value added in these regions is created not within local industries but in other regions	2	

At the same time, the core economic basis in most regions is represented by the manufacturing sector.

It is the manufacturing industry, not the primary sector that deploys over 76 % of total industrial workforce, more than 64 % of all major fix production assets. However, as a result of the understated national currency rate, the enterprises of these industries mainly oriented towards the internal market demand have to operate in a disadvantaged position. Apparently, high incomes received in the primary sector divert investment flows from the manufacturing industry. The volume of primary sector's fixed

asset investment exceeds 55 % of the total amount of all investment in the production fixed assets. The absence of active innovation processes in these industries spurs decumulation of labor and capital and hampers further reproduction, thus making their performance rather resource-intensive.

The analysis of the traditional macroeconomic indicators must be supplemented by the calculation of environmental-economic indicators, in particular, by the indicator of environmentally adjusted GDP, i.e., the GDPE widely applied in environmental-economic accounting.

Table 3. The impact of economic development on the amount of rent income, damage and depreciation within GRP (made by co-authors).

Groups of regions by the GRP per capita at 10% groups	Rent income	in % to GRP	
		Damage from pollution	Depreciation of fixed capital
Group 1 (with the lowest GRP)	2.2	4.0	0.6
Group 2	1.5	12.5	1.7
Group 3	1.3	11.1	1.6
Group 4	1.6	14.3	2.0
Group 5	3.4	12.7	1.8
Group 6	6.9	18	2.7
Group 7	5.3	14.9	1.8
Group 8	15.8	13.9	2.2
Group 9	13.5	15.6	2.5
Group 10 (with the highest GRP)	30.8	17	4.2

Table 4. Regional structure of damage in Russia by industry in 2013 (Rosstat data).

Refining	23%
Electric Power	29%
Ferrous and Non-Ferrous Metals	15%
Mechanical Engineering and Metalworking	7%
Forestry, woodworking and pulp and paper	7%
Food Processing	7%
Chemical and Petrochemical	4%

Based on the rent value assessment, an approximate share of rental income in the industrial production volume by industry has been determined. Information on the regional production output allowed estimating the rental income value in each of the regions. 10 % of the least developed regions exhibited on average about 5% of GRP. In 10% of the most developed regions this figure exceeds fivefold: the contribution of rent from the raw mineral extraction and export within the group is 25% on the average. The three leaders in raw materials (Khanty-Mansi, Nenets and Yamalo-Nenets Autonomous Okrugs) inherited a mono-sectoral industry structure: the share of oil and gas industry accounts for more than 90% of all production output of the region (rental incomes amounted to 39-65 % of GRP).

According to the data on the national structure of industrial production for 2015, approximate estimation of rental income value from the raw mineral extraction and export for the country as a whole has been provided (about 8.5% of the Russian GDP). For the calculation of air and water pollution damages, the industry coefficients were used. Their values and the sectoral structure of industrial production in each region have allowed to assess the degree of damage to the economy in the long term as a result of environmental pollution.

In all industrially developed regions, the damage from industrial emissions is dramatic. In 10% of the least developed regions the degree of damage is comparable to 4% of the GRP (Table 3). In 10 %

of highly developed regions this rate exceeds fourfold: the cost of economic damage resulted from industrial production, makes up 17% of the GRP. However, even greater effect on the degree of damage is associated with the sectoral structure of industry in the region. The damage exceeding 20% of the regional GRP is observed in regions with a large primary sector (Table 4). More than 60% of production output in these regions is represented by refining and metal industries.

For approximate estimates of fixed capital consumption, the overall nationwide depreciation rates by industry and the industrial production outputs in each of the regions have been used.

The highest fixed capital consumption is observed in regions with a primary sector focus. This sector demonstrates high investment activity: about 50% of total fixed capital investment is accounted for only the refining industry. In this context the largest amount of depreciation expenses is accumulated in the last group of regions in which the refining industry takes leadership in the structure of industrial production (Table 3). The estimation of consumption of the fixed and natural capital in each of the regions enables to calculate such environmental and economic accounting indicators, as environmentally adjusted gross regional product and the net regional product: GRPE and NRPE.

Table 5. Performance indicators for environmental and economic accounting by clusters.

Cluster	Environmental capacity of GRP	Resource consumption intensity, %
Raw Materials minus	6.0	6.7
Manufacturing minus	13.4	15.0
Raw Materials	24.2	26.5
Manufacturing	16.1	18.2
Raw Materials plus	34.9	37.6
Manufacturing plus	67.9	73.5
Average	26.5	28.9

The calculation of average environmentally adjusted indicators by specified clusters (Table 5) supplemented the development sustainability analysis based on the use of traditional macroeconomic indicators. The leadership by the highest environmental and economic growth rates belongs to the primary industrial regions of cluster 7: Khanty-Mansi, Nenets and Yamalo-Nenets Autonomous Okrugs.

Absolute values of environmentally adjusted indicators do not provide an objective rationale for estimation of the contribution of natural and physical capital consumption into the balanced regional development. Thus, the comparison of these indicators with the traditional indicator of regional development, the GRP, would provide more evidence in this context. The reference indicators could be the following: environmental capacity and the intensity of resource consumption. The environmental capacity indicator reflects the contribution of natural capital in the creation of GRP. The most significant contribution is observed in the regions with a primary industry focus. The GRP in the Manufacturing plus cluster on average demonstrates over a 67% of natural capital depletion. The lowest contribution of natural capital into regional development is associated with clusters with low and very low development level. This occurs due to the fact that the industrial production volumes in these regions are extremely low urged forward by the predominance of inefficient manufacturing industries.

In regions with high and medium level of industrial development the least contribution to the regional value added is observed in the regions with well developed manufacturing sector. About 16% of the GRP in these regions accounts for natural capital depreciation. The driving force of value added creation within the economic systems of these regions is the high labor and capital efficiency which is achieved through the launch of high-tech industries.

5. Conclusions and Recommendations

The research findings revealed that currently high levels of development in most regions of Russia are achieved due to high consumption of natural resources entailing environmental pollution: the depreciation of natural capital amounts to 30-40% of the GRP volume. In most developed regions with primary production focus 70-80% of income is assured by the depletion of natural capital. Such an "unexploited" resource-intensive nature of regional income signals about an extremely unstable development trend which might trigger sharp deterioration in the economic situation of the region subject to fluctuations in the world market or depletion of natural resources.

Arguably, given the inhomogeneous participation of regions in value added creation (most of income is generated in the regions with high primary sector development), the overall economic development in Russia can be characterized as resource intensive, inefficient and unsustainable. To enhance the country's and region's economic growth, the economy must be oriented not on the consumption of natural resources but on the creation of value added through effective use of labor and capital factors. Extensive implementation of R&D to production significantly contributes to increasing the efficiency of these factors. Among the regions with sustainable progressive development are the regions of Samara, Yaroslavl, Moscow and Nizhniy Novgorod which are the leaders in the country's manufacturing sector, since the launch of high-tech production spurs greater value added creation.

Thus, high level of the country's economic development can be achieved only through qualitative structural transformations but not as a result of increasing the quantitative production indicators. Apparently, drastic economy reorientation is needed, both at the regional and federal levels, along with a shift from the domination of raw materials production to the development of high-tech and knowledge-intensive industries. With this purpose, accounting of natural capital consumption has to be implemented into the local government practices at different levels. The suggested method to measure environmentally adjusted indicators can be used under harmonization of the regional economic policy towards GRPE maximization. Evaluation of the natural capital contribution to the economic development of a territory is also essential to assess the investment attractiveness of a region for implementation of the internationally funded projects that require mandatory environmental impact assessment. The cost accounting of natural resources consumption is critical under designing programs for sustainable environmental management and working out charging and compensation schemes related to natural capital depletion.

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