Transaction costs and green economy potential in Russian regions

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Abstract. The concept of a “green” economy and “green” growth has a clearly expressed social context. It declares the improvement of well-being, the reduction of inequality, and the eradication of poverty in the development processes. This article aims to explore the problem of transaction costs in forest management in the different Russian regions in the context of the concept of “green economy”. We can argue, on the base of results of this study, that Russian regions have very different “starting conditions” on the way to sustainability in the context of carbon balance. The calculations revealed a high degree of heterogeneity of the Russian regions in terms of the socio-environmental indicators. The analysis of spatial distribution of the transaction costs in the Russian regions also showed their high heterogeneity. Therefore, the establishment of a “carbon tax”, which is now widely discussed by the scientific community, should not be based on uniform approaches and procedures for the whole country.

1. Introduction
Russian forests are not only a source of valuable resources. They perform environmental functions that are essential to the quality of life of the citizens, including the absorption of greenhouse gases and climate control. Forest conservation is an important state task that requires the functioning of special state institutions. In accordance with the already established consensus in the scientific literature [1], we relate the costs of maintaining these institutions to the transaction costs (TC) in the management of natural resources. This article aims to explore the issue of TC in forest management in the different Russian regions in the context of the concept of “green economy”.

2. Methodology
The idea of our quantitative tools is based on the P. Victor’s model proposed in [2] for gross domestic product (GDP) and carbon emission for time analysis. We have modified this model and adopted it for spatial analysis. The first results of the comparative analysis of regional heterogeneity in Russian forestry the readers can find in [3]. The detailed model used in this article is presented in forthcoming paper [4].

In this article we considered two quantitative factors that characterize the welfare of the population: the total wage fund and own revenues of the regional budgets per capita ($W/N$). The key ecological and economic indicators used in this work are indicators of eco-intensity ($EI$) [5]:

- $CO/tax$ – the volume of carbon monoxide emissions per 1000 rubles of taxes, fees and other mandatory payments to the consolidated budgets of the Russian sub-federal regions (kg / 1000 rubles);
- **CO/wage** – the volume of carbon monoxide emissions per 1000 rubles of the wages fund (kg / 1000 rubles).

We also introduce indicator **CO/N** – the volume carbon monoxide in per capita terms. It is an important socio-ecological indicator for the regional economic systems. It shows the “environmental cost” of providing human habitation in the region.

On the basis of these indicators, ecological-economic zones have been identified; the characteristics of zones are given in table 1.

### Table 1. Ecological-economic zones in the concept of “green growth”.

| Zonea | Characteristics |
|-------|-----------------|
| “Green” zone Gr+: all three indicators are better than the Russian average | Higher per capita welfare (W/N) than the Russian average, with lower rates of both EI and anthropogenic pressure per capita (CO/N) |
| “Brown” zone Br+ | EI is lower than the Russian average with higher welfare per capita (W/N), but higher negative impact per capita (CO/N) |
| “Black” zone Bl+ | EI is higher than the Russian average with higher welfare per capita (W/N), and higher negative impact per capita (CO/N) |
| “Black” zone Bl –: all three indicators are worse than the average | Both environmental indicators –EI and negative impact per capita (CO/N) – are higher, i.e. worse, while the per capita welfare indicator (W/N) is lower. |
| “Green” zone Gr – | The decline in the per capita anthropogenic load takes place on the background of increase of the EI indicators, i.e. by reducing indicators of well-being. |
| “Absolutely green” zone AGr – | Both environmental indicators EI and negative impact per capita (CO/N) – are lower, i.e. better than the national average, but per capita welfare (W/N) is also lower. |

*a*The symbols “+” and “−” mark the zones where per capita indicators of welfare are higher and lower than the Russian average, respectively.

The study used official data of the Federal state statistics service, the Federal tax service of Russia (monetary indicators were given to a comparable form) characterizing: the volume of carbon monoxide emissions from stationary sources; average annual number of employees and average monthly wages of employees, taxes, fees and other mandatory payments to the consolidated budget of the Russian regions; population.

The analysis of spatial distribution of the considered indicators in the study was performed using GIS tools.

### 3. Results and discussion

#### 3.1. Transaction costs in forestry

One of the assessments of the transaction costs in the forest sector of the region is the amount of expenses for its management, aimed at the conservation and reproduction of resources, and the performance of their environmental functions. It consists of the volumes of subventions of the Federal and regional budgets for the management of forest ecosystems and revenues from other sources.

The spatial distribution of the amount of TC per unit area of forest land (FL) of the regions is presented in figure 1. The analysis of this distribution shows that for Krasnoyarsk region and Irkutsk region which are the main exporters of forest products, the value of TC per 1 ha of FL is one of the lowest – less than 20 rubles per hectare (15.1 and 18.1 rubles, respectively). In Tyumen region and Khanty-Mansi Autonomous Area – Yugra, these indicators are significantly higher – 90 and 39 rubles, respectively. The highest value of the index is in Lipetsk region – more than 1 800 rubles. Here and
below the region names are presented in accordance with the official translation of the Russian Constitution.

Figure 1. Total transaction costs per 1 hectare of forest land in the sub-federal Russian regions.

The next step in our study was an analysis of the spatial differentiation of the Russian regions by forest charges per 1 hectare for all types of forest use (figure 2).

Figure 2. The contribution of private business to the costs of forest management in the regions.
In 22 regions, mainly the regions of Western and Eastern Siberia, charges for the use of FL are less than 20 rubles per hectare. In 12 regions of the European part of Russia, these charges exceed 100 rubles. Maximum value of this indicator is 881.4 rubles per 1 hectare of FL in Belgorod region. The amounts of forest use fees for all types of forest management exceed the total TC in 14 forest regions (figure 2).

The different shares of business in the costs of forest management in the regions can be partly explained by the different shares of the leased forest land. More than 90% of all forest lands are the leased in Leningrad (99.8%), Tula (93.5%) and Kurgan (91.5%) regions, in Primorye Territory (93.4%).

Some indicators of the forest sector in these regions are given in table 2.

### Table 2. Comparative characteristics of the forest sector in some Russian regions.

| Regions                        | FL area in the region, thousand hectares | Total TC in the region, thousand rubles | TC per 1 ha of FL, rubles | Forest use charge on all types of forest, per 1 ha of FL, rubles | Share of leased FL, % |
|--------------------------------|----------------------------------------|----------------------------------------|--------------------------|---------------------------------------------------------------|-----------------------|
| Krasnoyarsk Territory (24)    | 158 727.9                               | 2 404 595.6                            | 15.1                     | 8.81                                                          | 16.7                  |
| Khabarovsk Territory (27)     | 73 732.4                                | 963 692.8                              | 13.1                     | 7.98                                                          | 21.1                  |
| Irkutsk Region (38)           | 69 419.2                                | 1 254 455.8                            | 18.1                     | 15.61                                                         | 28.1                  |
| Khanty-Mansi Autonomous Area – Yugra (86) | 49 350.3 | 1 922 963.4                            | 39.0                     | 25.75                                                         | 8.2                   |
| Trans-Baikal Territory (75)   | 32 614.8                                | 907 997.4                              | 27.8                     | 10.32                                                         | 24.4                  |
| Yamal-Nenets Autonomous Area (89) | 31 655.4 | 638 818.8                              | 20.2                     | 13.44                                                         | 15.7                  |
| Amur Region (28)              | 30 515.2                                | 609 670.7                              | 20.0                     | 9.04                                                          | 13.8                  |
| Tyumen Region (72)            | 11 389.2                                | 1 025 580.7                            | 90.0                     | 31.65                                                         | 20.9                  |
| Belgorod region (31)          | 228.5                                   | 168 129.8                              | 735.8                    | 881.41                                                        | 29.4                  |
| Lipetsk Region (48)           | 180.5                                   | 329 654.9                              | 1 826.3                  | 91.07                                                         | 3.3                   |

*The region numbers (indicated in brackets) are given in accordance with the map on figures 1 and 2.

In the Eastern Russian regions very little square of the leased lands are in Republic of Tuva – only 1.5%, less than 10% – in Omsk and Kemerovo regions, in the rest – from 10.3 – Republic of Buryatia – to 29.8 – on Sakhalin.

Thus, it can be concluded that the Eastern regions of Russia have lower TC and the maintenance of their costs for resource-saving and environmental functions are covered from public financial funds. In the forest regions of the North of the European part of the country, by contrast, most of the transaction costs are covered by business.

The results presented at figures 1-2 and table 2 show both a high spatial differentiation of per hectare TC share and of TC covered private business.

### 3.2. Development of the Russian regions in the context of “green” economy

In numerous works devoted to the development of the “green” economy, great attention is paid to greenhouse gas emissions [6], the reduction of which is considered as a necessary condition for “green growth”. Our analysis revealed not only a high degree of spatial heterogeneity in terms of CO/tax and CO/wage. The distribution of the Russian regions by ecological and economic zones is presented on figure 3 and in table 3. They show that only a very small number of regions belong to the “green zone”, i.e. all three types of indicators are better than the average for the Russian Federation. This is true for both quantitative factors that characterize the welfare of the population. In the “brown” zone (Br+), which includes only a few Eastern regions, relative socio-environmental well-being (i.e. higher
per capita incomes) occurs at higher eco-intensity. Thus, we cannot say that these regions are more successful in terms of social and environmental modernization.

Figure 3. Allocation of ecological-economic zones in Russia: (a) by indicator CO/tax; (b) by indicator CO/wage.

Most of the oil and gas extracting areas, as well as some regions of Siberia and the Far East, rich with natural resource, fall into the Bl+ zone, i.e. per capita welfare factors are higher than the average Russian ones, but they have worse environmental indicators. However, for a number of industrialized regions (Irkutsk, Kemerovo, Sverdlovsk, Chelyabinsk, Vologda regions, etc.), these welfare indicators
are lower than the national average, despite the fact that the socio-environmental indicators of eco-intensity are worse. This means that people living there have both environmental discomfort and the lower welfare conditions at the same time.

**Table 3.** Allocation of the Russian sub-federal regions by ecological-economic zones.

| Zone | Russian sub-federal regions |
|------|-----------------------------|
|      | (a) CO/tax                   |
|      | “Black” zones – 22 sub-federal regions |
| Bl+  | Khanty-Mansi Autonomous Area – Yugra (86); Komi Republic (11); Krasnoyarsk Territory (24); Republic of Sakha (Yakutia) (14); Yamal-Nenets Autonomous Area (89) |
|      | Altai Territory (22); Amur Region (28); Astrakhan Region (30); Chelyabinsk Region (74); Irkutsk Region (38); Jewish Autonomous Region (79); Kemerovo Region (42); Lipetsk Region (48); Novgorod Region (53); Orenburg Region (56); Republic of Khakassia (19); Sverdlovsk Region (66); Tomsk Region (70); Tula Region (71); Udmurtian Republic (18); Vologda Region (35) |
| Br+  | Chukotka Autonomous Area (87); Magadan Region (49); Sakhalin Region (65) |
| Gr+  | Kamchatka Territory (41); Khabarovsk Territory (27); Leningrad Region (47); Moscow; Moscow Region (50); Murmansk Region (51); Republic of Tatarstan (16); Ryazan Region (62); St. Petersburg; Tyumen Region (72); Yaroslavl Region (76) |
| Gr−, Agr− | other sub-federal regions |
|      | (b) CO/wage                  |
|      | “Black” zones – 23 sub-federal regions |
| Bl+  | Amur Region (28); Chukotka Autonomous Area (87); Khanty-Mansi Autonomous Area – Yugra (86); Komi Republic (11); Krasnoyarsk Territory (24); Republic of Sakha (Yakutia) (14); Yamal-Nenets Autonomous Area (89) |
|      | Altai Territory (22); Astrakhan Region (30); Chelyabinsk Region (74); Irkutsk Region (38); Jewish Autonomous Region (79); Kemerovo Region (42); Lipetsk Region (48); Novgorod Region (53); Orenburg Region (56); Republic of Khakassia (19); Sverdlovsk Region (66); Tomsk Region (70); Tula Region (71); Udmurtian Republic (18); Vologda Region (35) |
| Br+  | Magadan Region (49); Sakhalin Region (65) |
| Gr+  | Arkhangelsk Region (29); Kamchatka Territory (41); Khabarovsk Territory (27); Moscow; Moscow Region (50); Murmansk Region (51); Primorye Territory (25); St. Petersburg; Tyumen Region (72) |
| Gr−, Agr− | other sub-federal regions |

*a* The region numbers (indicated in brackets after region names) are given in accordance with the map on figures 1-3.

4. Conclusions and Recommendations

A joint comparative analysis of the distribution of the Russian regions in the ecological and economic zones and the data presented in figures 1 and 2 shows that all regions (except for Lipetsk region) that are in the “brown” (Br+) and “black” (Bl+ and Bl−) zones are characterized by lower transaction costs in forestry. At the same time, the high level of atmospheric pollution by carbon monoxide emissions necessitates the maintenance of the sustainability of forest ecosystems, which play a key role in ensuring carbon balance. The increase in financing of forest management can be achieved through payments of users of natural resources for the forest cuts, whose contribution to forest management in certain regions is very high. Thus, in the Vologda and Kemerovo regions, which are part of the disadvantaged “black” zone Bl−, the contribution of forest users exceeds 100% but the total amount of TC is low.
Our analysis showed a high differentiation in per hectare transaction costs between regions of Russia. The differentiation of transaction costs for management, protection and restoration of forest ecosystems should also be the subject of special attention in the elaboration of state policy to reduce carbon emissions.

We can conclude that the carbon dioxide emissions per 1000 rubles of well-being factors are above the national average in most sub-federal Russian regions, i.e. the regional socio-ecological-economic systems are currently set up so that for the formation of units of socially important goods they have to exceed the national rates of carbon emissions in the production processes.

We can argue, based on the results of this study, that Russian regions have very different “starting conditions” on the way to sustainability in the context of carbon balance. Therefore, the establishment of a “carbon tax”, which is now widely discussed by the scientific community, should not be based on common approaches and procedures for the whole country.

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