FINANCING THE GREENING OF ENTERPRISES IN INDUSTRIAL REGIONS OF UKRAINE IN THE CONTEXT OF SUSTAINABLE DEVELOPMENT

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Abstract
The work is devoted to the study of improving the environmental situation in industrial regions with metallurgical production in Ukraine. It was revealed that monitoring and purification of air, water environment and land resources requires immediate development and implementation of greening projects. This requires finding additional financial resources that are lacking in local budget deficits. To improve the quality of formation and use of local budgets, a method of monitoring the revenue side of local budgets is proposed, which consists in processing a set of data imported from monthly revenues and processed using predictive analytics tools. The methodology allows to identify significant and insignificant factors in a timely manner, including the environmental tax in the resulting factor - local budget revenues. With the development of analytical systems and the expansion of their application in the greening of industrial regions, the developed methodology will not lose its relevance. The developed methodology for monitoring the environmental tax and other taxes, fees and charges is aimed at identifying additional (indirect) sources of funding for greening projects in industrial regions, including metallurgical production. The method was tested on the revenues of local budgets of cities with metallurgical production – Zaporizhzhya, Dnipro for the period 2018-2020. The use of the methodology allowed to show that the revenues of the environmental tax are the most insignificant. It is also proposed to use the experience of developed countries in the mechanism of calculating the environmental tax in order to increase its amount.

Keywords: ecological tax, greening projects, local budgets, metallurgical industry.
JEL Classification: H7, H20, O47.

Introduction

The task of greening regions with metallurgical production is to prevent emissions, monitor and clean the air, water environment and land resources from harmful inclusions. In the metallurgical industry of Ukraine, the output of waste exceeds the output of the target product by 6-7 times (Glushchenko, 2021). Considering the crisis phenomena in the economy of Ukraine, the issues of development of greening projects, including innovative technologies for cleaning the atmosphere, processing of industrial waste are especially relevant (Mikelsone et al., 2021). In this regard, the search for sources of funding for the development and implementation of projects for the greening of industrial regions of Ukraine is relevant, especially in the context of acute budget...
deficits of emerging communities. These projects will be aimed not only at improving the ecology of the regions, but also at increasing the economic efficiency of this production (Meshram, Pandey, 2019; Kostetska et al., 2021). Some of the projects aimed at waste disposal will expand the resource base of metallurgy for many types of scarce raw materials, such as expensive alloying and rare earth metals.

Bolshina (2012) considered ways to improve the environmental and economic efficiency of metallurgical production.

Table 1. The main components of emissions from metallurgical production [1, 2]

| Emission components        | Sinter production, kilog./t. | Blast furnace production, kilog./t. | Steel production, kilog./t. | Rolling production |
|----------------------------|------------------------------|------------------------------------|----------------------------|--------------------|
| Dust                      | 20-25                        | 100-106                            | 13-32                      | 0.7-0.2 kil./t. of rolled metal |
| Carbon monoxide           | 20-50                        | 600-605                            | 04.-06                     | 0.7 t / m. of metal surface |
| Sulfur oxide              | 3-25                         | 0.2-0.3                            | 0.4-35                     | 0.4 t / m. of metal surface |
| Nitric oxide              | 0.3-3.0                      | 0.5 t / m. of metal surface        |

In order to develop and implement projects aimed at greening industrial regions, especially regions with metallurgical production, it is necessary to identify sources of funding, including indirect funding. According to the Tax Code of Ukraine (2014), one of the sources of funding for greening projects of industrial regions with metallurgical industry in Ukraine may be an environmental tax, which must be paid by all legal entities, if their activities lead to: emissions of harmful substances into the air, including carbon dioxide; discharge of harmful substances into rivers, ponds, lakes, canals, reservoirs, seas or groundwater;

Environmental tax rates, depending on the type of harmful substance, are presented in the Tax Code of Ukraine and depend on the amount of harmful substance (in tons) that enters the air, watercourses or reservoirs. The procedure for calculating each type of pollution or type of harmful substance is as follows. Thus, the amount of tax levied for emissions of pollutants into the atmosphere by stationary sources of pollution, are calculated based on the actual emissions, tax rates by the formula (Tax Code of Ukraine, 2014):

\[ P_{VC} = \sum_{i=1}^{n} (M_i \times H_{ni}) \]  

(1)

Where: \( M_i \) – is the actual emission of the \( i \)-th pollutant in tons (t); \( H_{ni} \) – is the tax rate in the current year per ton of the \( i \)-th pollutant.

The amount of tax levied for the discharge of pollutants into water bodies (Ps) is calculated quarterly based on the actual amount of discharges, tax rates and adjustment factors by the formula (Tax Code of Ukraine, 2014):

\[ P_{C} = \sum_{i=1}^{n} (M_{ni} \times H_{ni} \times K_{oc}) \]  

(2)

Where: \( M_{ni} \) – is the volume of discharge of the \( i \)-th pollutant in tons (t); \( H_{ni} \) – tax rates in the current year per ton of the \( i \)-th type of pollutant; \( K_{oc} \) – is a factor that is equal to 1.5 and is used in the case of discharge of pollutants into ponds and lakes.
Related works

The concept of “environmental tax” in EU countries includes (Korshunov et al., 2012): energy taxes (on coal, petroleum products, electricity, etc.); transport taxes (payments for imports, operation, recycling, sale of vehicles); taxes for environmental pollution (for emissions of pollutants into the atmosphere and water resources); minerals, special water use, etc.).

In EU countries, the main part of environmental tax revenues is formed by energy taxes - 76.9%. In Ukraine, 100% of the environmental tax is payments for environmental pollution. The purpose of environmental taxes is to help reduce the negative impact of business activities on the environment. This goal can be achieved in two forms. The first approach is to set high rates of environmental taxes. In this case, companies will prefer to implement environmental measures to reduce the cost of paying environmental taxes. As a result, the negative impact on the environment will be reduced. The second approach to the use of environmental taxes is to finance environmental measures that can compensate for environmental pollution. In this case, the higher the share of environmental tax used to cover environmental costs, the more efficiently the funds are used (Kvach, Piatka, Koval, 2020).

The collected amounts of environmental tax do not meet the requirements of the environmental situation in industrial regions, including metallurgical production. Thus, in 2017, Ukraine collected 1.7 billion UAH of environmental tax in the state budget, and environmental measures were financed in the amount of 2.8 times more (4.7 billion UAH) (Glushchenko, 2021).

At 1.1% of ecological tax revenues were used to finance environmental protection expenditures in Donetsk oblast, 11.9% in Dnipropetrovsk oblast, and in Zaporizhzhya oblast the efficiency of ecological tax use is close to zero (Glushchenko, 2021). According to Database on Policy Instruments for the Environment, collected by the Organization for Economic Cooperation and Development, the environmental subsidy mechanism in force in the European Union includes: grants; tax rebates; soft loans (Filin et al., 2018). There are no such environmental financing instruments in Ukraine, and the funds are distributed within budget programs. Implemented measures are remotely related to environmental protection.

Thus, in Krivoy Rog the proceeds of the environmental tax were used to conduct research and substantiate measures to control quarantine plants, in Zaporizhzhya for the reconstruction of sewers and clearing the reservoir in the city park, in Lviv region - to develop documentation for peat extraction. However, most of the works reveal only some aspects of the research topic, and therefore, there is no doubt about the need for further study.

Due to the creation of conditions for innovative activity for industrial enterprises, industrial regions were able to pursue environmental policies (Dotsenko, Ezdina, Mudrova, 2018). Environmental taxation and the use of environmental assets in Ukraine and the EU have common problems with shortcomings: the inefficiency of the organization of budget revenue collection; with a lack of transparency and inefficient use of environmental tools (Jishkariani, 2010; Saxena, Kumar, 2020). Problems are added - inefficiencies in the formation and use of local budgets, which are mostly deficient. In Ukraine, problems of inefficient use of extracted natural resources on the principle of "extracted-processed-discarded" are added. This happens when the methods and principles of innovative methods of economic management - circular economy - are introduced in world practice (Kostetska, Smol, Gaska, 2018; Gubanova et al., 2019; Zhang, Zhang, Wu, Liu, 2021).
Methods

Improving the environmental situation in industrial regions with metallurgical production is associated with the search for additional - indirect sources of funding. For this, the authors propose to process datasets formed from monthly receipts of Openbudget, Opendata. Using the correlation analysis toolkit, the authors found that tax revenues to local budgets of Ukraine are insignificant. The most insignificant is the environmental tax in the revenues of local budgets. The amount of the environmental tax is insignificant for financing projects for the greening of regions with metallurgical production. The most urgent project at the present time is the development of a project for an installation for monitoring and purifying atmospheric air. The project requires additional funding, which is not provided for in the plans of metallurgical plants. The proposed data processing toolkit for Openbudget (Zaporizhzhia City Council, 2021; Dnipro City Council, 2021) and Opendata allows for timely adjustment of the significance of factors - tax revenues to the budgets of the united territorial communities being formed. It is known that the united territorial communities of Ukraine are in dire need. However, with the advent of Openbudget data, Opendata has an opportunity to improve the quality of local budget management. Timely adjust the indicators of input factors (revenues) in the resulting factor - the total revenues of local budgets. To monitor the revenue side of local budgets, the authors used modern analytical systems.

Results and Discussion

Datasets were imported from monthly Openbudget receipts for cities with metallurgical production - Zaporizhzhya, Dnipro. It was revealed that the environmental tax in Zaporizhzhya has an insignificant value and weak growth dynamics over the years (Fig. 1).

![Figure 1. Dynamics of ecological tax (X5) at the budget of the city of Zaporizhzhia, 2018-2020, hryvnia](image-url)
The environmental tax (X5) is the smallest in the revenues of local budgets of the city of Zaporozhye for the period 2018-2020. To finance projects on the greening of Zaporizhzhya, there is a need for an increase in the cost of an ecological tax to the budget (Fig. 1). There are several ways to increase the environmental tax: change the rate of the environmental tax; increase the rates of the environmental tax: increase the rates of the ecological tax (X5) with budget revenues (Y) in Zaporizhzhya for the period 2018-2020 (Table 1).

To optimize the calculations, formula (3) takes the following form (Draper, Smith,2007):

$$r_{xy} = \frac{n \sum x_i y_i - (\sum x_i)(\sum y_i)}{\sqrt{[n \sum x_i^2 - (\sum x_i)^2][n \sum y_i^2 - (\sum y_i)^2]}}$$

(4)

where: $x_i$ - the value of the variable X; $y_i$ - the value of the variable Y; $\bar{x}$ - the arithmetic mean of the variable X; $\bar{y}$ - the arithmetic mean of the variable Y.

In order to optimize the calculations, please, look for the formula (Draper, Smith,2007):

$$r_{xy} = \frac{\sum(x_i - \bar{x})(y_i - \bar{y})}{\sqrt{\sum(x_i - \bar{x})^2 \sum(y_i - \bar{y})^2}}$$

(3)

The results of the projects are presented in Table 1. - a matrix of correlation factors (X1-X5) with the budget revenues (Y) in Zaporizhzhya for the development of sources of additional (indirect) financing of environmental projects, 2018-2020 (Table 1).

Table 1. Matrix of the correlation factor - ecological tax (X5) with budget revenues in Zaporizhzhya, 2018-2020

|        | X1       | X2       | X3       | X4       | X5       |
|--------|----------|----------|----------|----------|----------|
| 01.01.2018 - 01.01.2019 | 0.038169541 | -0.11055486 | -0.61219644 | -0.2184213 | -0.12295  |
| 01.01.2018 - 01.02.2019 | 0.038169541 | -0.11055486 | -0.61219644 | -0.2184213 | -0.12295  |
| 01.01.2018 - 01.03.2019 | 0.171861976 | -0.14431357 | -0.43217762 | -0.00306058 | 0.079316  |
| 01.01.2018 - 01.04.2019 | 0.114195424 | -0.07880786 | -0.47526288 | -0.07321552 | 0.118469  |
| 01.01.2018 - 01.05.2019 | 0.093385024 | -0.07965777 | -0.45799575 | 0.07100624 | 0.120939  |
| 01.01.2018 - 01.06.2019 | 0.153101048 | -0.07097338 | -0.44942669 | 0.12070374 | 0.180609  |
| 01.01.2018 - 01.07.2019 | 0.099076848 | -0.16682112 | -0.49947278 | 0.08045311 | 0.201624  |
| 01.01.2018 - 01.09.2019 | 0.098262364 | -0.01741263 | -0.49192205 | 0.07736423 | 0.194995  |
| 01.01.2018 - 01.10.2019 | 0.068603987 | -0.15608888 | -0.4547481 | 0.14201696 | 0.230554  |
| 01.01.2018 - 01.11.2019 | 0.052629095 | -0.15894883 | -0.45918921 | 0.1349458 | 0.238186  |
| 01.01.2018 - 01.12.2019 | 0.094026797 | -0.14695876 | -0.46415012 | 0.19847022 | 0.279557  |
| 01.01.2018 - 01.01.2020 | 0.095062020 | -0.14657302 | -0.46463832 | 0.18962757 | 0.273387  |
| 01.01.2018 - 01.02.2020 | 0.100488288 | -0.09420487 | -0.49357044 | 0.14312668 | 0.304412  |
| 01.01.2018 - 01.03.2020 | 0.090737962 | -0.09915388 | -0.49556234 | 0.11011543 | 0.282203  |
| 01.01.2018 - 01.04.2020 | 0.043099644 | -0.09412132 | -0.43119522 | 0.16645125 | 0.30931   |
| 01.01.2018 - 01.05.2020 | 0.01966745 | -0.09322085 | 0.19190186 | 0.13955355 | 0.334406  |
The values of the correlation coefficient of the environmental tax (X5) with revenues to the local budget of Zaporizhzhya for the period 2018-2020 (Table 1, Fig. 2) are insignificant compared to other (X1, X2, X3, X4) taxes, fees and charges.

The dynamics of the Pearson correlation coefficient between the environmental tax, tax revenues and the total values of all revenues to the budget of Zaporizhzhya is insignificant (Fig. 2, Table 1). There is a need to change the mechanism for calculating the environmental tax and the size of rates.

| Date         | Y         | X1       | X2       | X3       | X4       | X5       |
|--------------|-----------|----------|----------|----------|----------|----------|
| 01.01.2018   | 941 455 901 | 296 006 058 | 23 841 022 | 135 698 515 | 104 660 353 | 48 689   |
| 01.02.2018   | 1 048 435 728 | 341 758 399 | 17 726 550 | 96 568 560 | 162 033 251 | 4 008 205 |
| 01.03.2018   | 1 049 484 996 | 353 954 021 | 57 877 139 | 112 354 124 | 31 994 442 | 4 008 205 |
| 01.04.2018   | 1 362 651 107 | 359 872 041 | 33 679 822 | 180 820 082 | 90 150 617 | 78 867   |
| 01.05.2018   | 1 048 338 982 | 356 743 707 | 38 398 558 | 120 331 797 | 134 712 812 | 5 989 220 |
| 01.06.2018   | 1 032 015 188 | 411 631 273 | 36 453 875 | 120 432 310 | 33 235 450 | 14 871   |
| 01.07.2018   | 956 986 515 | 401 985 740 | 21 103 126 | 158 027 333 | 102 124 566 | 46 891   |
| 01.08.2018   | 1 129 791 963 | 373 554 191 | 21 698 121 | 135 434 412 | 141 850 509 | 4 173 884 |
| 01.09.2018   | 973 781 601 | 373 432 709 | 79 108 458 | 142 614 208 | 36 189 050 | 4 034    |
| 01.10.2018   | 1 086 597 344 | 384 324 355 | 40 779 166 | 175 793 777 | 114 130 489 | 76 336   |
| 01.11.2018   | 1 257 637 159 | 391 334 976 | 39 598 378 | 155 952 305 | 162 603 866 | 3 928 795 |
| 01.12.2018   | 1 216 239 417 | 484 891 763 | 36 393 831 | 145 559 633 | 44 871 325 | -111     |
| 01.01.2019   | 1 011 630 315 | 374 359 259 | 24 683 785 | 162 048 075 | 126 107 131 | 205 900  |
| 01.02.2019   | 1 267 934 726 | 418 202 261 | 18 944 652 | 157 518 378 | 200 960 418 | 5 553 408 |
The proposed method of monitoring the environmental tax and other tax revenues to local budgets allowed to obtain the dynamics of revenues to the local budget of Dnipro and the dynamics of the Pearson correlation coefficient between input factors - environmental tax revenues (X5), revenues of other taxes, fees and charges resulting factors. We get a similar option - insignificant values of factor X5, which require adjustment.

This once again demonstrates that the existing rates and mechanism for calculating the environmental tax do not meet modern requirements for improving the ecology of industrial regions (Kvach, Koval, Hrymaliuk, 2018).

Correlation matrix (Table 3) allows you to identify significant and insignificant factors - budget revenues. Minor factors, in particular the environmental tax, are subject to immediate transformation.
Definition: correlation coefficients between variables - revenues of the local budget and -X1-personal income tax; X2-excises; X3 property tax; X4 - a single tax; X5 - environmental tax

Figure 3. Dynamics of the ecological tax (X5) in the budget of the city of Dnipro, 2018-2020, hryvnias

Table. 3 Matrix of correlations of the factor - environmental tax (X5) and others (X1, X2, X3, X4) with the budget revenues of Dnipro, 2018-2020

|        | X1     | X2     | X3     | X4     | X5     |
|--------|--------|--------|--------|--------|--------|
| 01.01.2018 - 01.01.2019 | 0.3348 | -0.0849 | 0.4716 | 0.1652 | 0.1181 |
| 01.01.2018 - 01.02.2019 | 0.3329 | -0.0450 | 0.4070 | 0.1299 | 0.1443 |
| 01.01.2018 - 01.03.2019 | 0.3935 | -0.1432 | 0.4357 | 0.2944 | 0.2920 |
| 01.01.2018 - 01.04.2019 | 0.3949 | -0.1521 | 0.4100 | 0.2600 | 0.2763 |
| 01.01.2018 - 01.05.2019 | 0.4296 | -0.0246 | 0.4213 | 0.2721 | 0.2398 |
| 01.01.2018 - 01.06.2019 | 0.5183 | -0.0138 | 0.3175 | 0.3536 | 0.3663 |
| 01.01.2018 - 01.07.2019 | 0.5257 | -0.0171 | 0.2853 | 0.2854 | 0.3272 |
| 01.01.2018 - 01.08.2019 | 0.4925 | -0.0142 | 0.2678 | 0.2807 | 0.3254 |
| 01.01.2018 - 01.09.2019 | 0.4933 | -0.0257 | 0.2610 | 0.2883 | 0.3279 |
| 01.01.2018 - 01.10.2019 | 0.5067 | -0.0376 | 0.2368 | 0.2418 | 0.2999 |
| 01.01.2018 - 01.11.2019 | 0.5040 | -0.0406 | 0.2428 | 0.2465 | 0.2876 |
| 01.01.2018 - 01.12.2019 | 0.5125 | -0.0454 | 0.2283 | 0.2668 | 0.3024 |
| 01.01.2018 - 01.01.2020 | 0.3773 | -0.0447 | 0.2346 | 0.2739 | 0.3080 |
| 01.01.2018 - 01.02.2020 | 0.3795 | -0.0415 | 0.2381 | 0.2771 | 0.2987 |
| 01.01.2018 - 01.03.2020 | 0.3725 | -0.0426 | 0.2369 | 0.2614 | 0.2971 |
| 01.01.2018 - 01.04.2020 | 0.3148 | -0.0433 | 0.2770 | 0.3012 | 0.3187 |
| 01.01.2018 - 01.05.2020 | 0.2485 | -0.0293 | 0.4761 | 0.2515 | 0.3400 |
| 01.01.2018 - 01.06.2020 | 0.2484 | -0.0283 | 0.4724 | 0.2349 | 0.3301 |
| 01.01.2018 - 01.07.2020 | 0.2481 | -0.0307 | 0.4660 | 0.2225 | 0.3234 |
| 01.01.2018 - 01.08.2020 | 0.2006 | -0.0441 | 0.4012 | 0.2019 | 0.3364 |
| 01.01.2018 - 01.09.2020 | 0.1901 | -0.0117 | 0.3940 | 0.1816 | 0.3167 |
| 01.01.2018 - 01.10.2020 | 0.1293 | -0.0094 | 0.3868 | 0.2067 | 0.3296 |
| 01.01.2018 - 01.11.2020 | 0.1462 | -0.0031 | 0.3973 | 0.2157 | 0.3139 |
| 01.01.2018 - 01.12.2020 | 0.2025 | -0.0332 | 0.3763 | 0.2737 | 0.3429 |

The proposed method of monitoring the processing of data sets, including environmental tax by methods of predictive analysis, allowed to obtain the dynamics of Pearson's correlation coefficients between tax revenues, including between environmental tax and local budget revenues of Dnipro (Table 3, Fig. 4).
Figure 4. Dynamics of Pearson correlation coefficients between environmental tax revenues and local budget revenues of Dnipro, 2018-2020

Algorithm proposed of the analytical system for managing environmental tax revenues to local budgets (Fig. 5).

Figure 5. Algorithm of the analytical system for managing the revenues of the environmental tax of enterprises in the industrial regions of Ukraine in the context of sustainable development
It was revealed that the development and implementation of greening projects in industrial regions, especially with metallurgical production, require additional funding, which is not provided for in the plans of metallurgical plants. One of the important projects of greening of regions today is the project on monitoring of structure of atmospheric air, including definition of harmful emissions. For the implementation of this project and subsequent work, it is proposed to reduce costs and improve the quality of management of tax revenues to the revenue side of local budgets. For this purpose, a method of processing data sets from monthly receipts in Openbudget was proposed. A toolkit of predictive analytics - correlation analyzes was proposed to identify significant and insignificant factors - revenues to local budgets. It was suggested either to transform insignificant factors by changing tax rates within the framework of the legislation, or to abandon them. Data processing was performed using analytical systems. The method was tested on the revenues of local budgets of cities with metallurgical production – Zaporizhzhya, Dnipro for the period 2018-2020. The use of the methodology allowed to show that the revenues of the environmental tax are the most insignificant. It is also proposed to use the experience of developed countries in the mechanism of calculating the environmental tax in order to increase its amount.

Conclusions

The ecological situation of industrial regions, including the metallurgical production of Ukraine, requires immediate improvement. It is necessary to develop and implement projects aimed at monitoring and cleaning of air, water and land from pollution. However, the existing rates, the mechanism for calculating the environmental tax does not allow to raise enough funds to implement environmental measures. The quality development and implementation of environmental projects requires sufficient financial resources, the lack of which does not allow for the greening of industrial regions. The paper proposes a method of identifying significant and insignificant factors - revenues in the resulting factor - the total revenue of local budgets. Minor factors can be transformed by changing rates because they are abandoned and replaced by others within the law. The proposed methodology allows for monthly monitoring of local budgets (environmental and other taxes, fees and charges) by processing Openbudget data. Implement a flexible response to the environmental tax by changing the rate within the law. The monitoring methodology will not lose its relevance even after the necessary transformation of the environmental tax.

Data processing was performed using analytical systems. The method was tested on the revenues of local budgets of cities with metallurgical production – Zaporizhzhya, Dnipro for the period 2018-2020. The analysis showed that the most dynamics of the environmental tax to the budget of the city of Dnipro was personal income tax (X1), and to the budget of the city of Zaporozhye personal income tax (X1) and property tax (X3). The use of the methodology allowed to show that the revenues of the environmental tax are the most insignificant. It is also proposed to use the experience of developed countries in the mechanism of calculating the environmental tax in order to increase its amount.

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