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VARIABILITY OF THE STRUCTURE OF INVESTMENT EXPENDITURES FOR ENVIRONMENTAL PROTECTION IN POLISH VOIVODESHIPS IN THE YEARS 2005-2022

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ABSTRACT: The article discusses the issue of the changes in the structure of financing environmental protection in Poland and the voivodeships in the years 2005-2022. The study aims to assess changes in the structure of expenditure on fixed assets for environmental protection according to the directions of investment, divided into voivodeships. The analysis uses a research method based on the angle θ measure to analyse the intensity, pace and monotonicity of structure changes. This measure allows for precise assessment of structural changes, assigning different weights to shifts depending on the share size. The analysis is supplemented by assessing the evolution of structures by determining the average pace and their monotonicity. The study covered 288 seven-element structures, and the results indicate high intensity and chaotic changes in the examined structures of expenditure on environmental protection in the voivodeships. The presented research method can be one of the methods for assessing the effectiveness of implementing environmental policy provisions by observing changes in the expenditure structure.

KEYWORDS: sustainable development, environmental protection expenditure, structural variability, public policy

Introduction

Human economic activity and all anthropogenic changes disrupt the relationships between individual elements of the natural environment. While in previous centuries, the community, satisfying its needs, used specific environmental resources in a way that guaranteed its survival and did not strain the ecosystem, the industrial revolution and rapid population growth caused irreversible changes in almost all spheres of the environment. Only the catastrophic state of the natural environment triggered reflections on the possibility of mitigating unfavourable environmental changes and considering preventive measures. The main problem related to actions towards environmental protection is the issue of the size and redistribution of financial resources according to the provisions of public policies in the field of environmental protection. The article aims to assess the process of changes in the financing structure of fixed assets for environmental protection according to the directions of investment in the years 2005-2022 in the voivodeships.

An overview of the literature

Awareness of the adverse impact of broadly understood human economic activity on Earth is one of the key premises of the world economy, both on a global and local scale. The growing interest in the need to protect the natural environment has been observed since the publicization of the global climate change, excessive and predatory deforestation, and, paradoxically, since the awareness of the state of economic backwardness of many areas of the globe (Górska, 2013). The Report of the World Commission on Environment and Development, which was presented during the 2nd Conference in Rio de Janeiro in 1992, was significant for the interest in environmental protection issues, which addressed many current topics and indicated potential problems (Eurostat, 1994). The regenerative and absorption capacities of nature are no longer sufficient for the energy- and material-intensive global economy, which is why attention has been drawn to the need for better and more rational use of the environment and respect for the basic rights and principles of ecology (Marciniak, 2013; Gołębiewska, 2013). Along with this thinking, the concept of so-called sustainable development has developed, the aim of which is to ensure the continuity of such economic and social development that would consider the issues of environmental protection and natural resources necessary for human activity. This idea was included in the EU Treaty in 2002 in the provisions of the Community Framework Action Programme on the Natural Environment, which served as the basis for developing tools for presenting the impact of economic activity on the environment. Research on environmental protection expenditures is one of the elements in the economic aspects of environmental protection (Domańska & Jabłonowski, 2012). Environmental protection activities include the collection, disposal, reduction, prevention or elimination of pollutants or losses resulting from human activity (Broniewicz, 2006). Maintaining economic growth that takes into account the needs of the environment requires a wide range of information about the environment, as well as financial resources that would cover the costs of implementing improvements in currently used production processes, creating new infrastructure that interferes with the natural environment to the least extent possible, as well as expenditures on all preventive measures, such as education and actions compensating for environmental damage.

The requirements placed on the European Union member states are associated with the need to incur financial resources to meet the Community's requirements in the field of environmental protection and the implementation of tasks provided for in the programmes (Grzebyk, 2010). The amount of expenditure on environmental protection has been increasing in recent years (Oszczapińska, 2019; Gołębiewska, 2018; Kierepka-Kasztelan, 2018; Kożuch, 2018; Pajewski, 2015; Gołębiewska, 2013; Górska, 2013; Grzebyk, 2010; Barrell et al., 2021; Jarczok-Guzy et al., 2024) along with the increase in the ecological awareness of society. The emerging public policies, which concern broadly understood environmental protection, assume action plans aimed at eliminating environmental problems and protecting environmental resources. The assumptions of public policies should indicate the directions of spending financial resources and designate priority issues not only at the level of a given country but also at every level of conducting environmental policy. The problem in the management of financial resources remains the still current issue of redistributing funds for specific environmen-

tal protection purposes according to needs, as well as the issue of spatial redistribution. Observation of spending financial resources on environmental protection is crucial for assessing the effectiveness of actions indicated in the environmental provisions of public policies. The formation of the structure of expenditures for categories of expenditures for environmental purposes should reflect real steps taken to implement the provisions of public policies.

Research methods

To assess the processes of change in the structure of environmental protection expenditures, a review of available research methods was conducted, which allows for the assessment of characteristics related to the variability of structures (Kukuła, 1996; Małuszyńska, 1993; Wyżnikiewicz, 1987; Moore, 1978). In the first stage of the study, data on environmental protection expenditures in Poland were collected and sorted by voivodeship. The data used in the article comes from the resources of the Local Data Bank of the Central Statistical Office. They concern the category of expenditures on fixed assets for environmental protection by investment directions, which for this article will be briefly referred to as environmental protection expenditures. The time range of the study is from 2005 to 2022, and this range was selected based on two main premises. The first year of the analysis is the first full year of Poland's membership in the European Union, as well as the first year in which data was collected considering the methodological changes introduced a year earlier to the method of calculating the amounts of environmental protection expenditures in Poland. The spatial scope of the analysis is Poland divided into voivodeships. The subject of the study was the structure of expenditure on environmental protection by investment directions, i.e. 1) protection of atmospheric air and climate, 2) sewage management and water protection, 3) waste management, 4) protection and restoration of the utility value of soil, protection of underground and surface water, 5) reduction of noise and vibration, 6) protection of biodiversity and landscape, 7) other activities. Other tasks included protection against ionising radiation and research and development activities because data for these separate categories of expenditure appeared only in several years of the observed period. This division is consistent with the recommendations of the European System of the Collection of Economic Information on the Environment (SERIEE) and the classification of environmental protection activities (CEPA).

In the second stage of the study, 288 seven-element structures (18 years for 16 voivodeships) were analysed in terms of the intensity, pace, and monotonicity of changes occurring in the structures. The intensity of changes was estimated first. A measure called angle θ or the cosine of angle θ , which is used in studies of the intensity of transformations, was used. This indicator very carefully reflects the essence of structural changes because its construction is not based on the rate of increase in the value of structure elements, but using mathematical transformations, it assigns different weights to the same shifts in the structure, depending on the size of the changed share (Wyżnikiewicz, 1987). The indicator is described by the following formula:

$$\cos \theta = \frac{\sum_{i=1}^n f_i^0 f_i^1}{\sqrt{\sum_{i=1}^n (f_i^0)^2} \sqrt{\sum_{i=1}^n (f_i^1)^2}}, \quad (1)$$

where:

f_i – share of the i -th element in the population ($i = 1, 2, \dots, n$),

f^1 – share of the element in the studied structure,

f^0 – share of the element in the base structure.

In the literature, you can also find another name for this measure, derived from the name of the scientist who used it. This measure is called the Moore Q measure (Moore, 1978). It is interpreted as follows: the measure reaches a value of 1 for identical structures, i.e. when the angle $\theta = 0^\circ$ and a zero value for the largest change in the structure, in the case when the angle $\theta = 90^\circ$. When examining the variability of structures, small changes of about 10° are most often observed, which is why in the presentation of results, for their clarity and precision of interpretation, the value of the angle θ (in degrees) is used, not its cosine.

The observation and assessment of the intensity of changes in structures were then supplemented by the analysis of the evolution of structures, which consists of determining the average rate of structural changes and determining the stability of these changes (Kukuła, 1996). To calculate and assess the rate of change, the v measure was used, which describes the value of the average speed of structural transformations in dynamic terms and is expressed by the average value of chain measures of structural diversity distinguished for a given area.

$$v = \frac{\sum_{t=0}^{n-1} \sum_{i=1}^k |\alpha_{it} - \alpha_{i(t+1)}|}{2n}, \quad (2)$$

where:

$$\alpha_i = \begin{bmatrix} \alpha_1 \\ \alpha_2 \\ \vdots \\ \alpha_k \end{bmatrix} - \text{vector structure of object A, so that } \sum_{i=1}^k \alpha_i = 100,$$

k – number of components,

n – number of structure elements,

$t = (0, 1, \dots, t)$.

The average speed (rate) of changes in the structure is also a necessary element to estimate the next measure, which describes the stability of the direction of changes. The values of the next presented measure – η , describe the process of transformation of structures from the point of view of consistency in choosing the direction of changes. It can therefore be said that the η indicator illustrates the monotonicity of structural changes:

$$\eta = \frac{v_{m,0}}{\sum_{t=0}^{m-1} v_{t,t+1}}, \quad (3)$$

where:

$v_{m,0}$ – average speed of structural transformations in the m -th period under study in relation to the base structure provided with subscript 0,

v_t – degree of structural change over time t .

This measure allows us to determine whether the evolution of the structure is characterised by a relatively stable direction of changes. The value of the monotonicity index of structural transformations is in the range $<0;1>$. The higher it is (the degree of monotonicity is closer to 1), the more the structures evolve consistently and are resistant to instability, which can be caused by chaotic transformations of components, which in the long term are not the cause of changes in the structure found at the beginning of the period.

Results of the research

In the period under review, expenditure on environmental protection in Poland increased from approximately PLN 6 billion in 2005 to as much as PLN 14 billion in 2022, which means a more than two-fold increase in the amount allocated for investments (at current prices). In the period under review, the highest level of expenditure was recorded not at all at the end of the period under review, but in 2015. After this period, as can be seen in Figure 1, there was a significant decrease in the amount of expenditure, which was repeated in the following year. Because a large part of investments in environmental protection in Poland are financed from EU funds, it can be assumed that this situation could have been caused by the stagnation related to the transition to the new financial perspective of the European Union. At the beginning of each new financial perspective, arrangements are made regarding the guidelines and procedures that beneficiaries must meet, and the actual effect of the investment appears with a time delay.

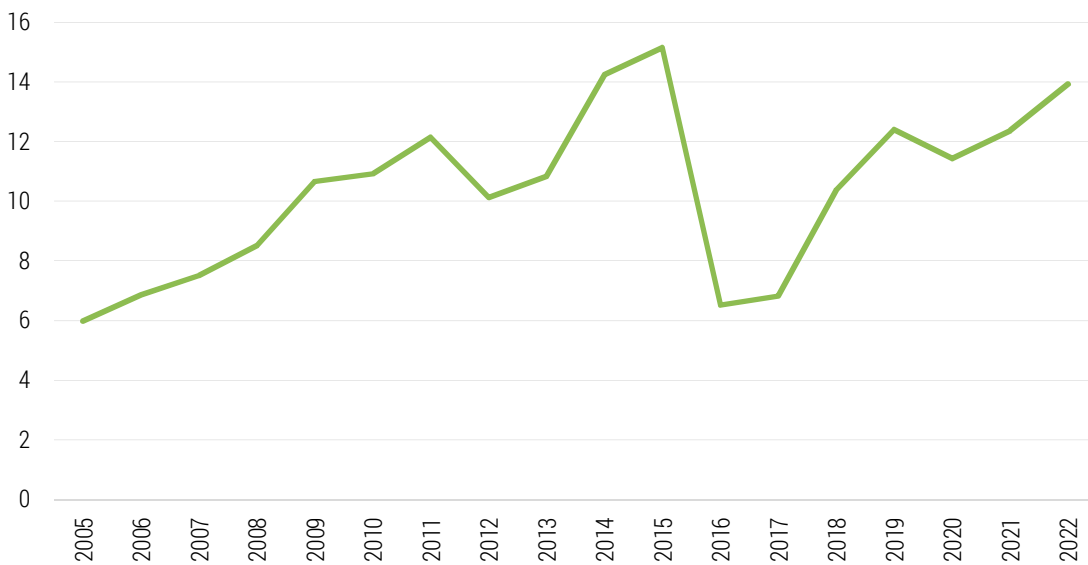


Figure 1. Expenditures on environmental protection in the period 2005-2022 [billion PLN]

Source: author's work based on www.bdl.stat.gov.pl [08.10.2024].

Table 1. Structure of expenditure on environmental protection by voivodeships in 2005 and 2022 [%]

Voivodeship	2005		2022	
	in thousands of PLN	%	in thousands of PLN	%
ŚLĄSKIE	874,662.70	14.6%	1,708,129.40	12.3%
MAZOWIECKIE	856,907.90	14.3%	2,586,999.70	18.6%
MAŁOPOLSKIE	575,274.60	9.6%	1,106,639.20	7.9%
WIELKOPOLSKIE	526,386.10	8.8%	1,513,813.30	10.9%
ŁÓDZKIE	499,096.30	8.3%	937,493.50	6.7%
KUJAWSKO-POMORSKIE	461,993.00	7.7%	534,880.10	3.8%
DOLNOŚLĄSKIE	429,489.60	7.2%	1,226,477.00	8.8%
ZACHODNIOPOMORSKIE	284,326.10	4.7%	429,479.20	3.1%
PODKARPACKIE	277,916.60	4.6%	509,888.20	3.7%
POMORSKIE	232,914.80	3.9%	776,867.20	5.6%
LUBELSKIE	225,295.30	3.8%	659,071.30	4.7%
OPOLSKIE	202,927.00	3.4%	420,427.70	3.0%
ŚWIĘTOKRZYSKIE	154,823.60	2.6%	394,686.10	2.8%
LUBUSKIE	154,368.20	2.6%	395,029.70	2.8%
WARMIŃSKO-MAZURSKIE	131,184.80	2.2%	357,717.00	2.6%
PODLASKIE	98,933.30	1.7%	368,397.90	2.6%

Source: author's work based on www.bdl.stat.gov.pl [08.10.2024].

The amount of expenditure on environmental protection in the voivodeships was related to the number of their populations (Table 1). In 2022, there were minor differences in the level of expenditure compared to 2005. The most populated voivodeships also recorded the largest expenditure on environmental protection. In both 2022 and 2005, the four most populated voivodeships, i.e.

Mazowieckie, Śląskie, Małopolskie and Wielkopolskie, generated almost half of all expenditure on environmental protection. It is worth noting that four voivodeships: Podlaskie, Warmińsko-Mazurskie, Lubuskie and Świętokrzyskie, i.e. those with the smallest population, together accounted for approx. 10% of expenditure on environmental protection.

Despite the disproportion between the number of financial resources for environmental protection, it is worth mentioning that in comparison to 2005, the number of resources for environmental protection increased in all voivodeships. The largest increase in the value of expenditures, by as much as 372%, was recorded in the Podlaskie voivodeship. There were also high increases in the Pomorskie (333%) and Mazowieckie voivodeships (301%). The smallest gains were in the Kujawsko-pomorskie (116%) Zachodniopomorskie (151%) voivodeships. The structure of expenditures for environmental protection in Poland in the period under review changed from year to year, however, the proportions between expenditure categories did not differ much from each other at the beginning and at the end of the period under review (Figure 2).

The largest part of expenditures for environmental protection were investments related to sewage management and water protection. The share of these outlays decreased in the period under review by approx. 14 percentage points (from 60.4% in 2005 to 46.7% in 2022), but still accounted for almost half of all investments in 2022. This situation is primarily related to the deficiencies in the sewage infrastructure, which are still felt locally in almost all parts of the country. The problem of the deficit in sewage collection infrastructure concerns areas located far from large urban agglomerations, as well as rural areas with highly dispersed development.

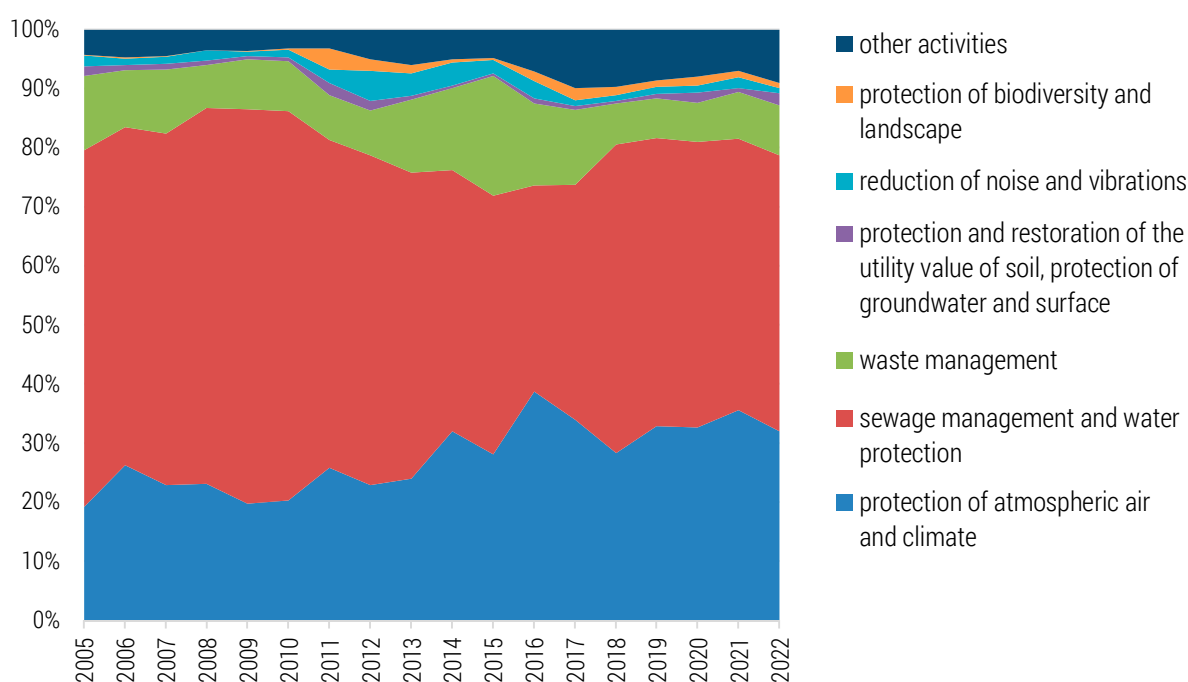


Figure 2. Structure of expenditure on environmental protection by investment directions in Poland in 2005-2022 [%]

Source: author's work based on www.bdl.stat.gov.pl [08.10.2024].

An equally large share, which has increased since 2005 by about 13 percentage points to 32%, was spent on protecting the air and climate. In the period from 2010 to 2017, an increase in the share of expenditure on protecting biodiversity and landscape, as well as reducing noise and vibrations, could be observed. After 2015, an increase in the share of financial resources classified as other activities, including, for example, research and development activities, can also be identified.

Analysing the results of the transformation of the structure of expenditure on environmental protection in Poland in 2005-2022 based on Figure 3, it can be concluded that the directions of change can be easily identified, the changes were relatively stable, and no sudden changes were observed.

The intensity of changes, measured using the angle θ index (Moore's Q index) from year to year over 18 years, also turned out to be small (Table 2). Only in three cases did it exceed 10° , which means that the observed changes were minor, and the result did not differ from the typical results most often encountered when examining the variability of structures. The greatest transformations in the structure of inputs took place between 2017 and 2018, while the year 2010 was most like the previous year.

The situation was different in the case of individual voivodeships. The average Moore's Q index for the entire period ranged from 10.21° in the Opolskie voivodeship to 23.02° in the Podlaskie voivodeship. The changes in structures in the voivodeships were therefore clearly more intensive than for the entire country. Very visible changes were recorded in the following voivodeships: Podlaskie, Świętokrzyskie (Figure 3). Figure 3 shows a high intensity of changes, as well as alternating, rapid declines and increases in the shares of individual input categories. The intensity of changes in the structure of environmental protection expenditures between 2008 and 2009 in the Podlaskie Voivodeship amounted to as much as 50.5° and between 2013 and 2014 almost 47° (the maximum possible change is 90°). High intensity and rapidity of changes can also be observed in the Świętokrzyskie Voivodeship. Observations based on the Figure 3 confirm the calculations of the angle index θ , which reached 43.3° between 2007 and 2008.

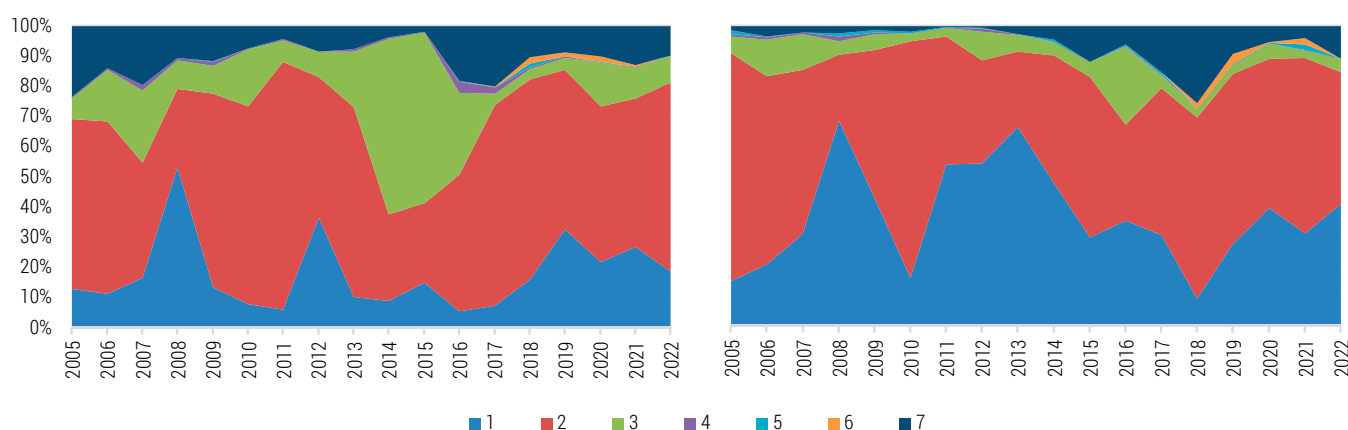


Figure 3. Structure of expenditure on environmental protection by investment directions in 2005 and 2022 in the Podlaskie voivodeship (left) and Świętokrzyskie voivodeship (right) [%]

The legend: 1 – protection of atmospheric air and climate, 2 – sewage management and water protection, 3 – waste management, 4 – protection and restoration of the utility value of soil, protection of groundwater and surface, 5 – reduction of noise and vibrations, 6 – protection of biodiversity and landscape, 7 – other activities.)

Source: author's work based on www.bdl.stat.gov.pl [08.10.2024].

The lowest average intensity of changes was identified in the voivodeships where environmental protection expenditures constituted the largest share of the expenditures of the entire country. These are the voivodeships with the highest population: Śląskie (average 10.21°), Małopolskie (13.12°) and Mazowieckie (13.52°).

A slightly different measure indicating the pace of changes in structures is the average speed of structural transformations in the dynamic approach, and it is expressed by the average value of chain measures of structure differentiation. The highest pace of changes in the structure of environmental protection expenditures in the period under study was characteristic of the voivodeships: Kujawsko-Pomorskie, Łódzkie, Podlaskie and Świętokrzyskie. The voivodeships in which low intensity of changes was observed – Mazovia and Silesia, were also characterised by low values of the pace of changes.

The assessment of the pace of change is one of the stages of estimating the monotonicity of transformations occurring in structures, which is used to identify whether the changes are chaotic or whether a clear and stable trend of changes can be observed. The applied method does not assess the direction of the trend but only focuses on assessing the consequences of the direction of changes.

Table 2. Intensity [°], the pace of changes and monotonicity of transformations in the structures of environmental protection expenditures by investment directions in voivodeships in 2005-2022

Voivodeship	Intensity																	Average intensity	Pace of changes	Monotonicity
	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022			
Poland	7.4	3.6	3.9	3.6	0.9	8.5	4.3	5.9	11.0	7.8	16.0	8.1	13.7	5.6	1.1	4.1	4.3	6.5	20.6	0.1271
Dolnośląskie	8.5	6.2	15.6	11.7	5.7	2.7	6.0	18.7	35.5	13.1	9.9	24.4	5.4	17.4	11.0	18.9	25.3	13.9	39.0	0.1348
Kujawsko-pomorskie	36.7	5.2	3.6	9.2	11.7	5.7	7.6	28.1	21.9	21.4	55.3	28.2	27.7	6.9	12.4	9.8	10.1	17.7	55.8	0.1060
Lubelskie	10.3	5.2	6.5	5.2	7.2	14.4	12.5	25.2	19.4	30.5	20.5	16.6	41.2	7.3	13.6	7.8	9.9	14.9	50.3	0.1013
Lubuskie	12.8	15.9	5.1	20.4	27.2	6.2	9.5	6.9	11.6	7.2	35.0	11.2	30.1	9.7	6.1	33.1	9.3	15.1	42.2	0.1152
Łódzkie	9.0	12.0	28.5	18.0	8.6	39.3	25.8	17.9	12.8	19.5	34.4	29.0	25.4	21.2	18.6	9.6	21.2	20.6	55.0	0.0361
Małopolskie	6.3	6.5	14.7	10.1	7.3	8.6	11.0	21.3	27.3	16.7	21.8	8.7	18.9	7.4	6.7	18.0	11.7	13.1	40.4	0.1038
Mazowieckie	7.6	15.0	15.7	6.7	8.8	10.3	16.5	15.0	17.1	7.2	7.9	12.1	2.4	21.1	22.8	17.4	26.3	13.5	30.0	0.1052
Opolskie	4.8	4.4	17.1	16.8	21.4	8.6	3.6	17.2	11.2	8.1	24.7	25.2	30.1	13.4	23.7	3.7	5.5	14.1	38.6	0.1368
Podkarpackie	10.3	13.7	9.4	9.8	2.6	9.5	14.3	14.4	17.9	12.3	7.0	21.8	33.1	4.8	6.6	12.4	4.9	12.1	41.3	0.0588
Podlaskie	12.9	19.1	43.2	50.5	10.1	12.1	34.1	29.1	46.9	6.0	38.2	26.2	10.9	18.1	13.9	7.5	12.5	23.0	54.0	0.0375
Pomorskie	2.5	6.5	6.8	20.0	7.2	6.3	10.5	23.5	15.8	23.3	27.7	10.4	36.6	14.7	17.9	12.5	13.6	15.0	43.4	0.0723
Śląskie	12.7	8.9	2.1	4.5	16.5	14.3	6.8	6.3	16.9	9.7	22.6	6.9	16.2	4.0	4.0	5.8	15.3	10.2	30.6	0.1052
Świętokrzyskie	9.4	11.1	43.3	31.5	29.3	40.1	8.6	12.3	21.3	20.2	30.2	29.6	23.3	22.0	13.2	10.9	16.8	22.0	50.7	0.1052
Warmińsko-mazurskie	3.0	9.4	12.3	20.9	7.6	18.6	15.1	6.8	12.0	28.5	28.5	18.4	7.8	20.2	16.8	20.3	31.0	16.3	41.3	0.0427
Wielkopolskie	19.7	4.9	26.4	4.2	11.4	9.7	11.3	6.3	19.0	40.0	31.1	21.8	13.4	27.2	7.3	2.7	13.8	15.9	49.0	0.1346
Zachodniopomorskie	23.9	23.3	8.0	7.6	31.9	10.7	17.9	22.0	15.4	7.5	8.3	27.1	26.6	24.2	7.1	6.0	17.1	16.7	36.7	0.0592

Source: author's work based on www.bdl.stat.gov.pl [08.10.2024].

In the period under review, the most stable changes in the structure of expenditures on environmental protection occurred in the following voivodeships: Opolskie (0.1368), Dolnośląskie (0.1348) and Wielkopolskie (0.1346), but the values of the indicators still indicated a low level of stability of changes. The quoted values of the monotonicity indicator were slightly higher than for changes identified in the structure of expenditures for the entire country (0.1271), but still, the directions of changes in structures seem to be largely random. The greatest instability of transformations of structures was characteristic of the following voivodeships: Łódzkie, Podlaskie, Warmińsko-Mazurskie and Zachodniopomorskie.

Discussion, limitation and future research

The conclusion that arises after analysing changes in the structure of expenditure on environmental protection in Polish voivodeships in the years 2005-2022 is that changes are occurring more intensively than is usually the case when examining the variability of structures, and the changes seem to be largely unstable, sudden and chaotic. The limitations of the method used in the article also include the fact that the characteristics of the change process itself are analysed, i.e. the intensity, speed, and monotonicity of structure transformations. Therefore, there is no in-depth analysis of shifts between specific shares of categories that make up the structure. Undoubtedly, an analysis of share shifts would supplement the presented analysis with further conclusions. The presented method of examining the variability of structures also does not consider an important feature of each investment process – the variability of financial expenditures over time. Fluctuations in the amount of financial resources allocated to a given category of expenditure may be caused by the uneven distribution of financial resources at different stages of the investment.

Despite the above limitations of the research approach used, the conclusions drawn from it seem to be a valuable source of information on the variability of the structure of expenditure on environmental protection. In the future, the author plans to take steps to supplement the study of structure variability with elements of analysis of shifts in the shares of individual categories. Conclusions from comparative studies of the issue in an international context may also prove valuable.

Conclusions

Expenditures on fixed assets for environmental protection are one of the very important, significant and necessary expenses aimed at preserving or improving the condition of the environment. In Poland, the amount of these expenditures doubled in the years 2005-2022, reaching a value of over PLN 14 billion. The largest beneficiaries of these funds were the Mazowieckie, Wielkopolskie, Śląskie and Małopolskie voivodeships, whose expenditures in total constituted almost 50% of all funds allocated for this purpose. The proportions between the purposes for which the expenditures were incurred remained unchanged. The largest part of the funds was allocated to sewage management and water protection, protection of atmospheric air and climate, and waste management.

Summing up the results of the analysis of the evolution of structural changes in expenditures on fixed assets for environmental protection, it can be noted that the changes in the structure of expenditures on environmental protection in Poland were milder than the changes observed in the voivodeships. In the period under review, the intensity of changes was lower for the entire country than for the voivodeship characterised by the lowest intensity of changes – Śląskie. In turn, Podlaskie, Świętokrzyskie and Łódzkie are the voivodeships with the highest intensity of changes in the studied structures. Characteristics of the change process observed in the conducted analysis also include the speed of changes and monotonicity, which assesses the stability of the nature and direction of changes. The two voivodeships in which the highest intensity of changes was identified were also voivodeships with the lowest monotonicity – i.e. those in which changes occur chaotically with low resistance to instability. These include Podlaskie and Łódzkie voivodeships, and it is worth noting that the chaotic transformations of components observed from period to period in the long term do not necessarily have to be the cause of changes in the structure observed in the initial period.

In general, it can be said that in all voivodeships, a relatively high instability of the directions and nature of changes in structures could be observed. Looking at the research method itself in the context of its usefulness for assessing progress in the implementation of public policies in the field of environmental protection, it can be said that the results achieved in individual voivodeships indicate high instability in the structural transformations of environmental protection expenditures according to the directions of investment. Assuming that the provisions of public policies are effectively implemented, one would expect increased intensity of changes, but with a simultaneous stable direction of these changes. It should be noted that the method used does not consider the specificity of uneven distribution of financing during the individual stages of the investment process and also does not take into account the analysis of shifts in the shares of specific categories of expenditures on environmental protection. Nevertheless, it can be one of many methods that are useful in determining the effectiveness of environmental protection policy implementation.

Acknowledgements

Supported by funds granted by the Minister of Science of the Republic of Poland under the „Regional Initiative for Excellence” Programme for the implementation of the project “The Poznań University of Economics and Business for Economy 5.0: Regional Initiative – Global Effects (RIGE).

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Agnieszka MROZIŃSKA

ZMIENNOŚĆ STRUKTURY NAKŁADÓW INWESTYCYJNYCH NA OCHRONĘ ŚRODOWISKA W WOJEWÓDZTWACH W POLSCE W LATACH 2005-2022

STRESZCZENIE: Artykuł omawia problematykę zmian w strukturze finansowania ochrony środowiska w Polsce i w województwach w latach 2005-2022. Wskazuje na rosnącą świadomość negatywnego wpływu działalności człowieka na środowisko i potrzebę zrównoważonego rozwoju. Celem badania jest ocena zmian w strukturze nakładów na środki trwałe służące ochronie środowiska według kierunków inwestowania w podziale na województwa. W analizie wykorzystano metodę badawczą opartą o miernik kąta θ do analizy intensywności, tempa i monotoniczności zmian w strukturach. Miernik kąta θ pozwala precyzyjnie ocenić zmiany strukturalne, nadając różną wagę przesunięciom w zależności od wielkości udziału. Analiza uzupełniona jest o ocenę ewolucji struktur poprzez wyznaczenie średniej szybkości zmian oraz ich monotoniczności. Badaniem objęto łącznie 288 siedmioelementowych struktur, a wyniki jednoznacznie wskazują na dużą intensywność i chaotyczność zmian w badanych strukturach nakładów na ochronę środowiska w województwach. Zaprezentowana metoda badawcza może być jedną z metod oceny skuteczności realizacji zapisów polityk środowiskowych poprzez obserwację zmian w strukturze wydatków.

SŁOWA KLUCZOWE: zrównoważony rozwój, nakłady na ochronę środowiska, zmienność struktur, polityka publiczna