


## Article

# The Relationship between ROP Funds and Sustainable Development—A Case Study for Poland

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**Abstract:** The aim of this research is to analyse the correlation between public intervention in Poland within the Regional Operational Programmes and the key macroeconomic variables for the sustainable development of regions, i.e., the labour market, with particular emphasis on the unemployment rate and the level of employment; the average monthly remuneration; the residential construction market, with particular emphasis on the number of permits issued for the construction of apartments and the number of apartments under construction. The research and the analyses carried out on the basis of the above-mentioned aspects made it possible to indicate the relations between the studied macroeconomic indicators and the EU funds spending in Polish provinces, which will enable the implementation of the sustainable development policy. The capitals used in the research process are very important components of the region's and country's sustainable development. In the research, a calculation methodology was applied based on the analysis of time variability of the examined determinants, their correlation and regression relationships. The tools and methods of data analysis used allowed the quantification of the relationship between the macroeconomic determinants studied and the pace and value of payments made. The conducted analyses have shown a positive influence of the payments made in Poland within the framework of Regional Operational Programmes on selected macroeconomic indicators, i.e., regional economic and social-institutional capitals. The research results obtained may have a practical decision-making aspect for regional and national authorities responsible for the disbursement of EU funds.



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## 1. Introduction

The weakening position of the European Union as the dominant global economy, including the deteriorating social, economic [1], and demographic situation [2] in Europe, forces the application of a new approach to programming activities whose basic goal is to strengthen the EU competitiveness. It is necessary that the concentration of intervention covered correctly diagnosed areas of development, which will result in the macroeconomic development of the European Union as a whole, as well as its individual member states and regions [3]. Economic growth is highly influenced by certain macroeconomic indicators [4]. Thus, the sustainable development of the EU, a country, or a region is a complex process influenced by numerous internal and external factors [5]. The shaping of development policy requires a thorough analysis of the factors as well as great courage, willingness, and readiness to actively and effectively minimise the negative impact of unfavourable trends [6].

In the national dimension, the Polish economy is an integral part of the global economic system; thus, it should be remembered that one of the key factors affecting Poland's economic development is the global economic situation [7,8]. The dynamics of the Polish economy and its dependence on cycles and development trends of the global system are influenced both by direct economic relations and global markets conditions, including the consequences of participation in the common market of the European Union and in multilateral free trade agreements [6]. It should also be borne in mind that the development of the country as a whole is a component of the development of its individual regions, whose growth potential has been and continues to be stimulated thanks to the support of the European Union structural funds. In Poland, this support has been in place since 1999 and significantly increased after accession in 2004. At the moment, the third perspective of the EU funds spending is coming to an end; these are the years 2004–2006, 2007–2013, and 2014–2020. Poland is the largest recipient of the EU assistance among all EU member states. In 2004, the Polish GDP per capita equalled 51% of the EU's average, and over a period of 15 years, it has grown by 15%, i.e., to 73% in 2019 [9]. Between 2014 and 2020, the amount reached over 87 billion euros. Over 35.9% of this allocation, i.e., 31.3 million euros, is assigned for 16 Polish regions under regional operational programmes. These funds are managed by regional authorities and are earmarked for increasing socio-economic competitiveness, including sustainable development [9].

Taking the above into account, the aim of the subject research is to analyse the relationship between the public intervention under Regional Operational Programmes (ROP) and macroeconomic variables, crucial for the development of the regions, i.e.,

- The labour market, with particular reference to the unemployment rate and the employment level;
- Average monthly remuneration;
- The residential construction market, with particular attention to the number of construction permits and the number of apartments under construction.

The research, and the analyses carried out on its basis, will indicate the relations between the studied development determinants and the EU funds spending in the 16 Polish provinces. In the research, the following hypotheses were made:

**Hypothesis 1.** *There is observed a seasonality in the payments made in relation to the analysed variables.*

**Hypothesis 2.** *The correlation between the payment and macroeconomic variables depends on the amount of financial support.*

**Hypothesis 3.** *There is a time correlation between the payments and the analysed macroeconomic areas.*

**Hypothesis 4.** *The analysed macroeconomic variables are characterized by a different flexibility with relation to the payments made.*

The implementation of the research process was performed in several key stages. The first provides an in-depth analysis of strategic development planning from a transnational, national, and regional perspective. The second one is the literature analysis of the studied issue, and the third one contains calculations showing the influence, expressed quantitatively, between the EU funds spending and selected determinants of regional development. The conducted research will show the relationship caused by spending EU funds on selected regional macroeconomic variables. As a result of the literature analysis, the selection of variables for the analysis was narrowed down to the identification of the correlation between the EU spending and regional economic, social and institutional capitals of sustainable development. The selected capitals are very important economic and social components of sustainable development. It should also be strongly emphasised

that the conducted research is based on created simulation models, the aim of which is to show—in a simplified and generalised way—the researched interdependencies.

Undoubtedly, EU project-related payments are significant for the variables under study. This article focuses only on the regional dimension of EU funds. At the same time, it should be noted that in Poland, EU funds are also allocated within the framework of national programmes. Thus, the macroeconomic variables under study are influenced by other public funds and private capital on the market. It should also be noted that the effectiveness and structure of the obtained funds within the ROP programme in relation to the total value of implemented projects is usually only 30–40%. This creates problems in obtaining the remaining funds for the implementation of projects [10]. ROP programmes are sometimes criticized for supporting urban regions or rich regions that have their own sources of funding to implement projects. This, instead of balanced development of the regions, may cause even greater polarisation and increased economic disparities between regions [11]. An important issue is also the analysis of differences in the amount of funds absorbed by individual countries and regions [12].

## 2. Cascading Strategy of Development Planning—Established Assumptions

While presenting a cascading strategy description for economic and social development planning, first, the adopted assumptions for development at the transnational level were described, i.e., first, the European Union; then, the national level, i.e., Poland; and finally, the regional level, i.e., Polish provinces. Planning documents are shaped at the EU, national, and regional levels and are the basis for negotiations on structural funds for specific years.

The crisis has wiped out the results of many years of economic and social progress and exposed structural weaknesses in the European economy. At the same time, the world has been changing rapidly, and long-term issues, such as globalisation, increasing demands on limited resources, and ageing populations, are becoming more and more pressing. Europe must take care of its future. Europe can succeed if it acts together as a Union. Appropriate strategic planning is needed, including planning documents. The main one is the Strategy for smart, sustainable, and inclusive growth—Europe 2020 (hereinafter Europe 2020), which will make the EU economy smart, sustainable, and inclusive, with high rates of employment, productivity, and social cohesion. Europe 2020 is a vision of a social market economy for Europe in the 21st century. It comprises three interrelated priorities:

- Smart growth: economy development based on knowledge and innovation;
- Sustainable development: promotion of a more resource-efficient, greener, and more competitive economy;
- Inclusive growth: fostering of a high-employment economy delivering social and territorial cohesion.

The European Union had to define where it wanted to be at the end of the described planning periods. To this end, several overarching and measurable targets have been proposed, relating to the following: the employment rates for people aged of 20–64 years (should be 75%); 3% of the Union's GDP should be invested in research and development; the "20/20/20" climate and energy targets should be met (including a reduction in carbon emissions of up to 30%, if conditions allow); the number of early school leavers should be reduced to 10%, and at least 40% of the younger generation should pursue higher education; the number of people at risk of poverty should be reduced by 20 million [13].

While presenting the adopted strategic planning process in the national perspective, it should be noted that for the financial perspective 2014–2020, European funds for Poland have been recognised as the main, although not the only, source of funding for investments ensuring dynamic, sustainable, and balanced development. Thus, the programming logic was based on the correlation of European expectations as regards the concentration on the objectives of Europe 2020 with the national objectives indicated in the medium-term national development strategy, i.e., the National Development Strategy 2020—Active society, competitive economy, efficient state, and operationalised in the integrated strategies. This

makes it necessary to look at Poland's development more broadly than just in the context of using the EU funds [14]. It contains recommendations for public policies, providing a basis for changes in the development management system, including the existing strategic documents with a long- and medium-term perspective (strategies, policies, and programmes); however, it also requires verification of other implementation instruments [14]. This means that the assumptions at the level of regions with regard to the implementation of the EU funds had their basis in it. While presenting specific measures, it should be reminded that in 2017 the Polish Government adopted the Responsible Development Strategy by 2020 (with the perspective by 2030). The main objective of the development measures designed in the Strategy is the creation of conditions for growth of income of the inhabitants of Poland with a simultaneous increase of cohesion in the social, economic, environmental, and territorial dimension. The strategy is geared towards inclusive socio-economic development. The document assumes that social cohesion is the main driver of development and a public priority. The strategy subordinates the activities in the economic sphere to achieving objectives related to the standard and the quality of life of the Polish citizens and puts emphasis on making the citizens, and the areas so far neglected in the development policy, benefit from the economic development to the extent greater than so far. The strategy presents a new development model—responsible development, i.e., the development that, while building competitive strength using new development factors, ensures participation and benefits to all social groups living in different parts of our country. This will be done by focusing legal, institutional, and investment actions on three objectives, i.e., sustainable economic growth based increasingly on knowledge; data and organisational excellence; socially responsive and territorially balanced development; effective state and institutions for growth and social and economic inclusion [15].

### 3. Research Evolution and Development: Region, Development, Sustainable and Smart Growth, and Smart Specialisations

Poland's accession to the European Union structures gave rise to intensified academic discussion on development, regions and regional development, sustainable and intelligent development, and the methods for their evaluation. There are many publications in Poland and Europe which describe these issues directly or indirectly. The following theoretical analysis of the issue has been carried out according to the procedure shown in Figure 1.



**Figure 1.** Diagram of relationship between EU Structural Funds and competitiveness of economy.

The notion of development should be understood as any change in the economic, social, and environmental system; however, the attribute of such a change is its irre-

versibility [16]. Development refers to the desired positive transformations of quantitative, qualitative, and structural properties of a given system [17]. Thus, spatial and temporal irreversibility is not a single attribute of development. It is worth adding another property to it, i.e., a positive evaluation of the changes taking place from the point of view of a particular system.

In the context of social and economic development, a region should be considered in terms of the relationship between the changes occurring at the local and global level [18] (p. 4). In the global economy, which is dominated by the process of globalisation, the area can become competitive only when it takes advantage of its individual characteristics while adapting to the conditions and requirements of the global environment [19]. Currently, the region is classified mainly in terms of economy, where it is possible to identify areas coherent by the role of a particular branch of services or industry [20]. Thus, the events and processes occurring in the region most often determine whether the region is developing or not. The region is identified as an element of developmental policy in terms of economic, institutional, demographic, natural, infrastructural, spatial, potential, and living conditions of inhabitants [21]. In the economic aspect, the region can be considered in relation to the functioning and mutual interaction of the private and the public sectors. In turn, taking into account the logic of market economy, regions treated as public sector entities function in a multi-level system. In this aspect, the national and transnational levels are most significant since the regions which receive financial support from central authorities and transnational institutions, and in which high-level institutions and infrastructure are located, have a chance to strengthen their competitiveness [5].

In this context, the concept of regional development should be investigated. It is more and more frequently defined as a holistic, structural, and strategic process by which a region's resources and conditions, its technological and cultural potential, and the opportunities identified in regional, national, and global markets are exploited by companies [5]. Regional development is influenced by both internal (endogenous) and external (exogenous) factors. At the same time, regional development models, which define a comprehensive and coherent way of explaining the mechanisms of regional development, are concerned with identifying only the key (priority) potentials that are important for development; they mainly revolve around economic growth [5,22]. Regional development can be considered to be a systematic improvement of competitiveness of entities and living standards of inhabitants as well as an increase in the economic potential of regions, contributing to the social and economic development of the country [23].

Among researchers, there is no coherent approach to the concept of regional development because, due to the changing environment, it is subject to constant modification. Sustainable development is one of the concepts of regional development. It is defined as a process of changes in the states of dynamic balance among local economic, social, as well as ecological and spatial development. On the basis of respect for natural resources, the ultimate goal of this process is to improve the quality of life in a broad sense [24]. The development policy objectives formulated by public authorities are characterised by certain principles which make it possible to operationalise them [25]. Sustainable development paradigm in regional development policy contains some conceptual features and operating principles; these are the development maintenance and sustainability [26]. Sustainable development as a concept of development policy defines the process of changing the states of dynamic balance between regional social, economic, as well as environmental and spatial development. There are two integrated pillars of this concept, i.e., balancing social (including political), economic, and environmental governance as well as the sustainability of development capitals achieved through the creation and diffusion of innovations [27]. Capitals are identified by, *inter alia*, human capital [28], social and institutional capital [29], and by physical and natural (ecological) capital [30].

Sustainable development should be viewed very broadly, including the way companies operate in the global economy. Currently, research is carried out in sustainable production [31]. Research is carried out to evaluate the progress in the implementation



of the concept of sustainable development in the social aspect of the European Union between 2014 and 2018, with particular emphasis on Poland [32]. It is posited that increased emphasis on knowledge and economy factors increases country's competitiveness, which contributes to its sustainable development [33]. Sustainable development is also influenced by fiscal issues [34], climate protection [35], sustainable product life-cycle management, big databases and the use of artificial intelligence in businesses [36,37], networked and integrated urban technologies and sustainable smart energy systems, as well as sensor-based big data applications and computational urban network in a smart energy management system [38,39].

Sustainable development in all EU Member States is regarded as an integral factor in the economic and social policy of the state [40]. At the same time, this approach promotes the growth model proposed in Europe 2020, which is based on three priorities: smart growth, sustainable growth, and inclusive growth [14]. Smart growth means increasing the role of knowledge and innovation as drivers of our future development. This involves raising the quality of education, improving research performance, promoting innovation and knowledge transfer throughout the Union, making full use of information and communication technologies, and ensuring that innovative ideas can be turned into new products and services that create growth, jobs, and solutions for societal problems in Europe and globally. Entrepreneurship, financial resources, consideration of users' needs, and market opportunities are also necessary [14]. Inclusive growth is understood as a set of actions meant to promote a high-employment economy that ensures social and territorial cohesion. It is implemented through the Agenda for new skills and jobs and the European Platform against Poverty [41]. Research shows the effects of the implementation of the Europe 2020 from the point of view of the objectives on poverty and social exclusion [42].

A number of evaluation methods and tools are available in the literature that can be used to evaluate elements of regional development policy, including sustainable development. In the conducted research, attention is primarily paid to its usefulness within the framework of multidimensional processes of regional development, in which it is necessary to take into account the social, economic, and environmental dimensions of sustainable development [25]. The method of ratio analysis can be used to evaluate the effectiveness of sustainable development [43]. The same method should also be used to study the effectiveness of strategies and programmes based on the capitals as well as on the orders of sustainability and regional development (the so-called integrated strategic effectiveness) from the point of view of effectiveness, efficiency, and feasibility [44].

In the ratio analysis of integrated performance evaluation and in the analysis of effectiveness and efficiency of sustainable development for orders and capitals, static, dynamic, and criterion analyses are taken into account, including the integrating orders criteria, and in the capital—the spatial and temporal criteria [45]. The complexity of the category of sustainable development—in the concept of a set of features, objectives, principles, and integration of orders—entails attempts to operationalise this concept and the size of the cross-section of the ratio analyses. Criteria for the classification of indicators include, among others, the extent to which the characteristics, objectives and principles as well as governance of sustainable and balanced development have been achieved [43].

The new EU financial perspective for 2014–2020 and the closely related strategic vision of Europe 2020 clearly define the approach to the environment and its natural resources; it is clearly based on a strong principle of sustainable development [46]. The concept of smart specialisation is conducive to directing regions towards the creation of eco-innovations, which are understood as intentional activity, characterised by entrepreneurship and which encompasses a product design phase and its integrated management throughout its life cycle, that contributes to the pro-ecological modernisation of societies by taking into account environmental concerns in the development of products and related processes [47,48]. Eco-innovation reflects the concept of a clear focus on reducing environmental impacts, where such effects may or may not occur without limitations to product, process, marketing, or organisational innovation but also including innovation in social structures [49].

Intelligent and sustainable development is closely related. The process of arriving at smart specialisations in Regional Innovation Strategy of Podkarpackie Province was fully of an entrepreneurial discovery process. It basically covered two years, i.e., 2012 and 2013, although it used a number of documents and research findings. The methodology of creating of the Regional Innovation Strategy, including the methodology used for the evaluation of all stakeholders, as well as the criteria for the selection of smart specialisations, was of a uniform nature, showing the continuity and cohesion of individual stages. While preparing the document, a triangulation of methods was made, so that the final result was not derived from only one method used but was adopted when all methods used gave the same or similar result. The basic methods used in the process of creating the Strategy were the following: the analysis of strategic documents and other available sources of knowledge; the analysis of foresight projects carried out for the region; SWOT analysis in terms of social and economic potential of Podkarpackie; the analysis of stakeholders—also performed to identify the most important stakeholders; various forms of meetings and discussions, practiced on a continuous basis; the analysis of the potential and opportunities for development of clusters; and performing primary research with a very wide economic spectrum [50].

In Poland, in the Opolskie province, there has been developed an original model for the selection of regional smart specialisations and the creation of the Regional Innovation Strategy by 2020. It was based on the following methods and tools: content analysis; industry analysis; desk research; time series/trend forecasting; stakeholder consultation; Delphi method; creative imaging; impact assessment; PEST (Political, Economic, Socio-cultural, Technological); logic diagram; environmental scan; visioning; and workshops on future occurrences [51,52]). At the same time, it broadly describes the monitoring process of the Strategy on the basis of the Action Plan and selected indicators, which—to a lesser extent—is visible in the works carried out for Podkarpackie Province.

Another interesting example of research in this area is the analysis of higher education institutions from the point of view of their role as innovation brokers in the context of smart specialisations [53], or analyses of the whole regional innovation system in the context of the backwardness of European regions [54].

#### **4. Analysis of the Correlation between the Regional Operational Programme and Selected Macroeconomic Determinants of Development—Research Perspective for Poland**

When analysing the correlation between payments made under the ROP for Poland and the selected macroeconomic determinants, three selected areas of the economy were described. In terms of macroeconomic theory, these areas are crucial for the country's and regions' sustainable development. The first is the area of the labour market (employment); the second is the average monthly remuneration, while the third area of analysis is the housing market, which was described by two dimensions, i.e., the number of building permits issued and the number of current construction projects in the housing market. The choice of the indicated areas of analysis results from the analysis of issues concerning capitals and governance described by the authors of that publication in Chapter 2. It should be reminded that the selected areas of analysis belong to economic, social, and institutional capitals and their analysis is aimed at showing the relationship between public intervention under regional operational programmes and the creation and consolidation of these capitals.

Each of the described areas was scrutinised according to the methodological scheme taking into account the following:

- The analysis of the time variability of the examined determinants against the background of the payments made under ROP for Poland in general. The variability analysis was performed by assessing the nature of developmental trends for the relationships studied.
- The correlation (and cross-correlation) analysis between the examined determinants and payments made within ROP for Poland in total. The correlation analysis was performed using Pearson's linear correlation, assuming that  $x$  and  $y$  are the random

variables analysed with discrete distributions.  $x_i$  and  $y_i$  denote random sample values of these variables ( $i = 1, 2, \dots, n$ ), while  $\bar{x}$  and  $\bar{y}$  are the mean values of these samples. Then, the estimator of the linear correlation coefficient was determined according to Equation (1).

$$r_{xy} = \frac{\sum_{i=1}^n (x_i - \bar{x})(y_i - \bar{y})}{\sqrt{\sum_{i=1}^n (x_i - \bar{x})^2} \sqrt{\sum_{i=1}^n (y_i - \bar{y})^2}} \quad (1)$$

- The functional multiple regression analysis based on the estimation of structural parameters of the analysed models. The estimation was made according to Equation (2).

$$\begin{bmatrix} y_1 \\ y_2 \\ \dots \\ y_n \end{bmatrix} = \begin{bmatrix} 1 & x_{11} & x_{12} & \dots & x_{1k} \\ 1 & x_{21} & x_{22} & \dots & x_{2k} \\ \dots & \dots & \dots & \dots & \dots \\ 1 & x_{n1} & x_{n2} & \dots & x_{nk} \end{bmatrix} \begin{bmatrix} a_0 \\ a_1 \\ \dots \\ a_k \end{bmatrix} + \begin{bmatrix} \varepsilon_1 \\ \varepsilon_2 \\ \dots \\ \varepsilon_n \end{bmatrix} \quad (2)$$

where vectors  $y = \begin{bmatrix} y_1 \\ y_2 \\ \dots \\ y_n \end{bmatrix}$ ,  $a = \begin{bmatrix} a_0 \\ a_1 \\ \dots \\ a_k \end{bmatrix}$ ,  $\varepsilon = \begin{bmatrix} \varepsilon_1 \\ \varepsilon_2 \\ \dots \\ \varepsilon_n \end{bmatrix}$

and matrix  $X = \begin{bmatrix} 1 & x_{11} & x_{12} & \dots & x_{1k} \\ 1 & x_{21} & x_{22} & \dots & x_{2k} \\ \dots & \dots & \dots & \dots & \dots \\ 1 & x_{n1} & x_{n2} & \dots & x_{nk} \end{bmatrix}$

contain the following values:

$y$ —dependent variable,  $a$ —model parameters,  $\varepsilon$ —residual value,  $X$ —independent variable.

For each correlation under analysis, there were estimated parameters of two functional correlations, i.e., linear (cf. 3) and logarithmic (cf. 4)

$$y = ax + b \quad (3)$$

$$y = a * e^{\frac{-x}{b}} + c \quad (4)$$

It should also be added that the extent to which the model fits the data, i.e., quality of the developed model was assessed based on the coefficient of determination  $R^2$  (Formula (5)).

$$R^2 = \frac{\sum_{i=1}^n (\hat{y}_i - \bar{y})^2}{\sum_{i=1}^n (y_i - \bar{y})^2} \quad (5)$$

where:

$y_i$ —real value of variable  $Y$  in moment/period  $i$ .

$\hat{y}_i$ —model-based value in moment/period  $i$ .

$\bar{y}$ — arithmetic average of empirical values of the dependent variable.

The data was obtained from the databases of the Central Statistical Office and from the databases of individual Marshal Offices. It was collected with a time interval of one month. The data used for analysis was collected from January 2015 to July 2020 (in aggregate, 66 values for each studied variable were collected). The collected data include:

$x_1$ —independent variable—total payments under the ROP (data acquired from the Marshal Office of Opolskie Voivodship).

$y_1$ —dependent variable—employment rate (data obtained from the Main Office of Statistics).

$y_2$ —dependent variable—average employment rate (data obtained from the Main Office of Statistics).

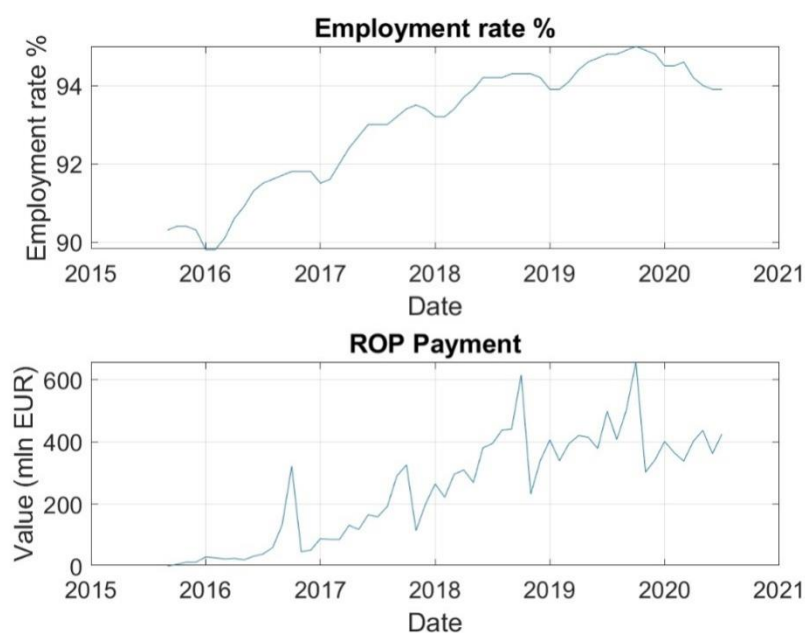
$y_3$ —dependent variable—number of apartment construction permits (data obtained from the Main Office of Statistics).



$y_4$ —dependent variable—number of apartments under construction (data obtained from the Main Office of Statistics).

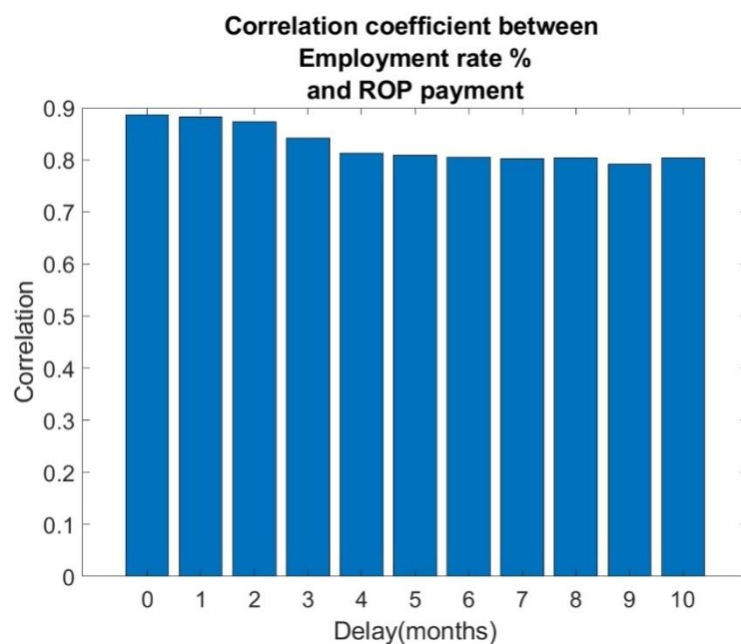
On the basis of the data presented above, a total of 4 groups of models have calculated (for each  $y_i$ ) for which the cross-correlation, functional correlation relationship and parameters of the regression function have been described in detail. By computing 4 different models, knowledge was gained about the relationship between each dependent variable ( $y_i$ ) analysed and payments made. It should also be noted that another approach in the conducted analyses may also be the simultaneous inclusion in the model of multiple dependent variables and conducting multiple regression analysis.

When analysing the first of the listed variables, i.e., payments made for Poland in total, it should be noted that the increased payments occurred annually at the end of each of the surveyed years. It should also be noted that there was an upward trend in the payments made during the period in question (see Figure 2). The seasonal character of the payments made under the ROP in the years covered by the study is caused, among other things, by the annual financial settlement of the programme-related activities. By subjecting to the analysis of the development of the employment rate in the studied period, we can also notice the tendency of its increase, especially visible in 2016–2018. Comparing the data in Figure 2 on the two horizontal diagrams on it, one can argue about the relationship between the payments made under ROP and the level of employment in Poland. It should also be noted that there are practically no time lags in the described variables in the relationships studied. This demonstrates the high elasticity of change between the studied variables.



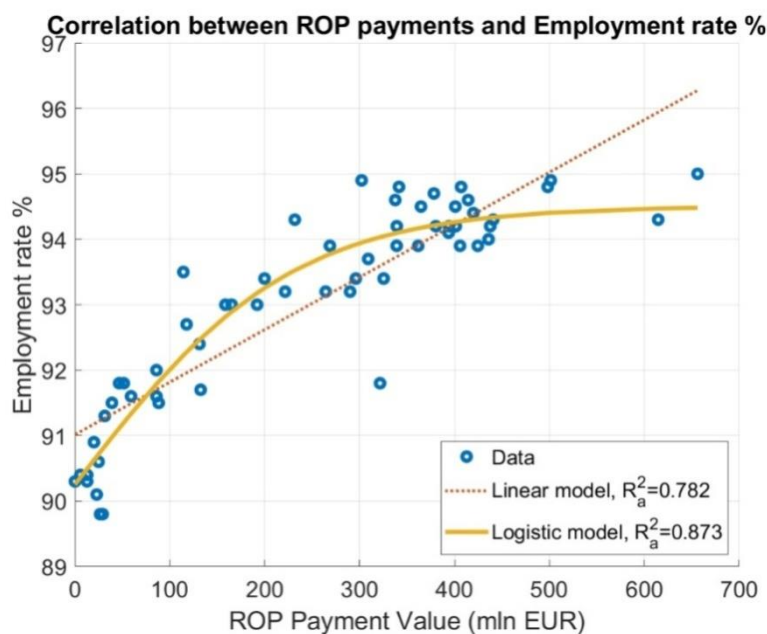
**Figure 2.** Employment and payments made under ROP—Poland.

In order to confirm the occurrence of significant elasticity of changes between the examined variables, cross-correlation diagrams were prepared for the variable employment to the ROP payments made. From the presented Figure 3, from the obtained decreasing correlation values over time, it can be concluded that the highest correlation relationship is for periods 0, 1, and 2. The results obtained for the calculated cross-correlation confirm the almost immediate effect of payments on employment. Of course, one should be aware that the described correlations illustrate a simplified case based on the cross-correlation model. It should be remembered that this correlation does not explain the cause-effect relationship, which should be the investigated into by experts dealing with sustainable development of regions.



**Figure 3.** Cross correlation between employment and made payments.

In the next step of the research, the relationship between the quantitative impact of the payments made on the labour market was analysed because the employment rate is one of key economic barometers. Figure 4 shows the graph of the estimated regression function along with the calculated value of determination coefficients. From the relationship obtained, it can be concluded that the nature of the relationships studied is in the form of a logarithmic function (higher value of the coefficient of determination). The obtained results of the research allow us to put forward a thesis that the effectiveness of the payments made and their impact on the labour market is high, up to payments of about 400 million euros. Above this value, employment growth is of a slowing nature.



**Figure 4.** Correlation function between ROP payments and employment—Poland.

The second variable analysed is remuneration. For this variable, in the first step, the course of its variability was checked, and its course was compared with the variability of made payments within ROP (Figure 5). The significance of lags between comparable variables was also examined (Figure 6) and, after functional estimation for the described relationships, their regression dependence was assessed (Figure 7).

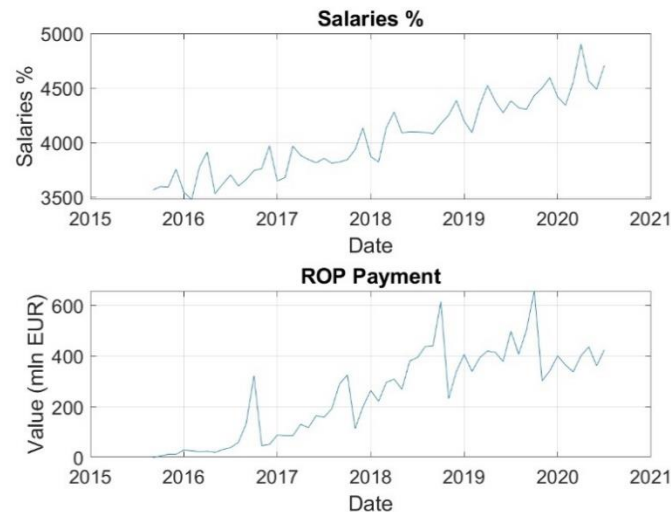


Figure 5. Salaries and payments made under ROP—Poland.

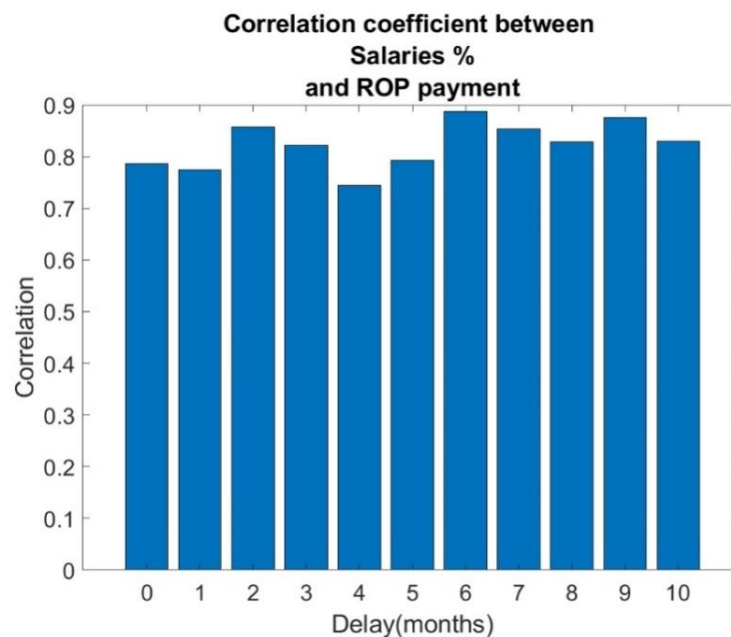
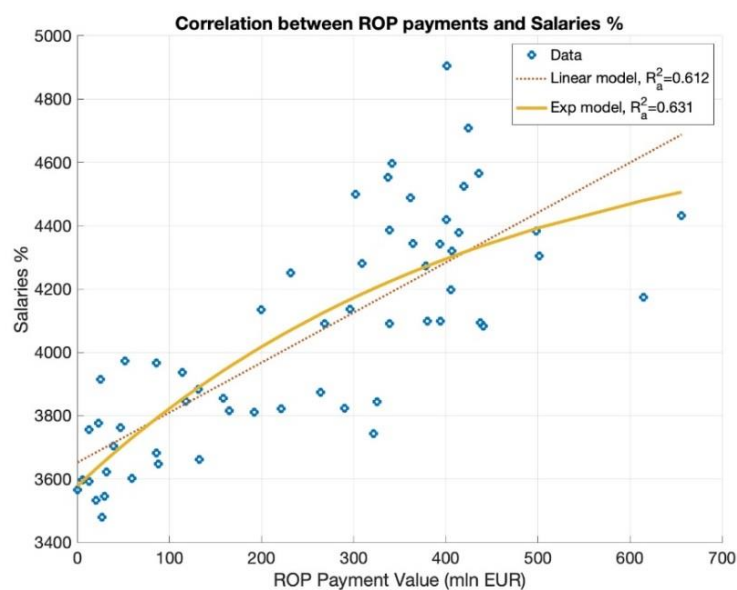


Figure 6. Cross correlation between employment and made payments.

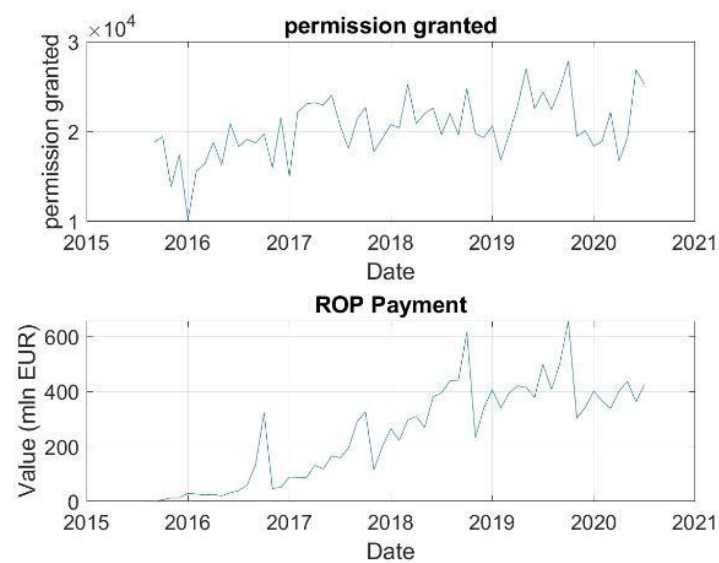


**Figure 7.** Correlation function between ROP payments and remuneration—Poland.

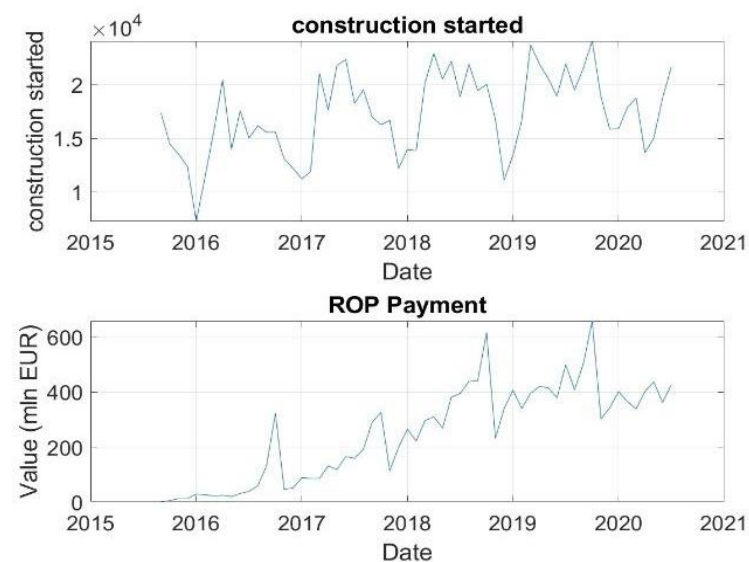
Comparing the time courses for the remuneration variable and made ROP payments, we can see an increasing trend for both variables studied. It should be noted that the remuneration variable is characterised by seasonality in the beginning/end of the year. This periodicity is due to the nature of the remuneration paid in Poland, where it is customary to pay additional remuneration at the end of the year, such as awards or annual bonuses. On the other hand, at the beginning of the year, in many companies, the so-called thirteenth salary is paid (see Figure 5). In the attempt to check the relationship between the remuneration variable and made payments, we can see (cf. Figure 6) that a six-month delay is the one with the highest value. This indicates that the time shift between the variables under study is characterised by a six-month period.

While interpreting the results obtained for the calculated autocorrelation functions (cf. Figure 7), we can see that the values of determination coefficients for the linear function and the logarithmic one are close to each other. Based on the results of the linear trend function, it can be noticed that the salaries grow along with the increased level of payments under the ROP in Poland. The average statistic increase in the average salary in relation to the increase amount of payments is expressed by formula  $y_t = 1.579t + 3651$ .

The last area examined is the residential construction market. The research examined the relationship between made payments and the first two stages of the housing construction process, which included the number of permits issued for the construction of new housing units and the number of units under construction. In Figures 8 and 9, we can see that for both examined variables there is a dynamic increase of values at the beginning of each examined year. It may also be noted that the execution of a construction project, as described by commenced construction, has a visible periodic component, which results from a strong dependence of the execution of construction projects on seasonal variability in the housing market. These phenomena result, among other things, from the differences between the climatic seasons in Poland.



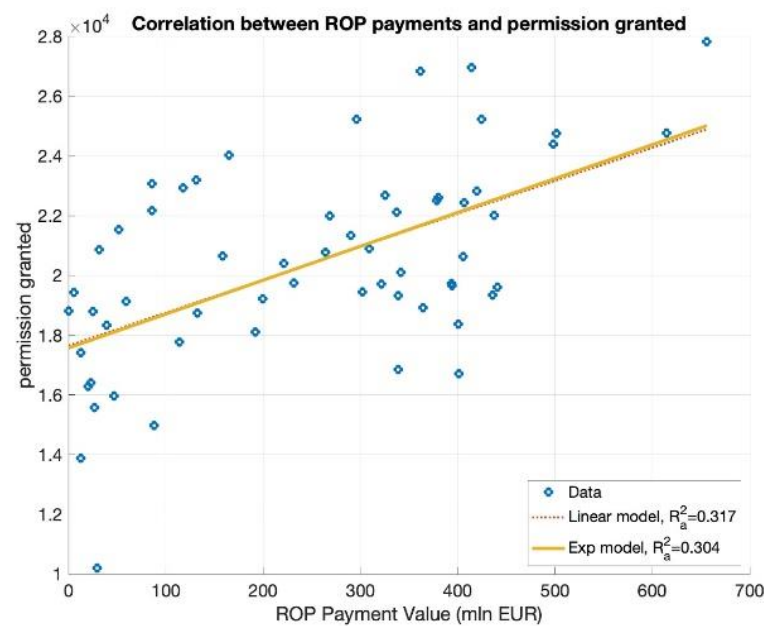
**Figure 8.** Permits issued for the construction of new apartments and payments made under ROP.



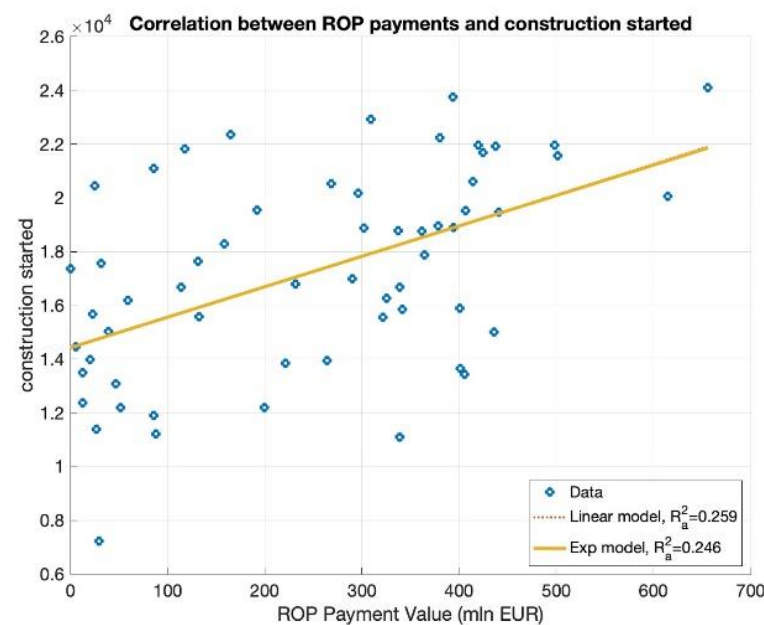
**Figure 9.** Apartments under construction and ROP payments made.

Making an attempt at a quantitative analysis of the examined dependencies, taking into account the linear regression models constructed, it may be noticed that if we increase the payments within the framework of ROP in Poland by 1 million euros, we will obtain an average increase of 110,500 building permits issued, while in the case of apartments under construction, an increase in payments by 1 million euros will result in an average increase of 114,300 units under construction. Comparable values of estimated parameters of regression functions for the analysed variables prove similar sensitivity of changes (cf. Figures 10 and 11).



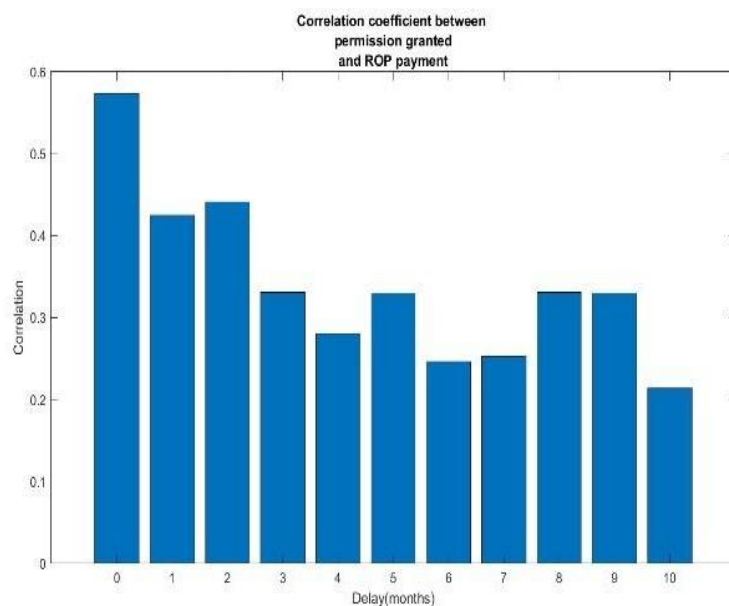


**Figure 10.** Correlation function between ROP Opolskie Province payments and permits issued for the construction of new apartments.

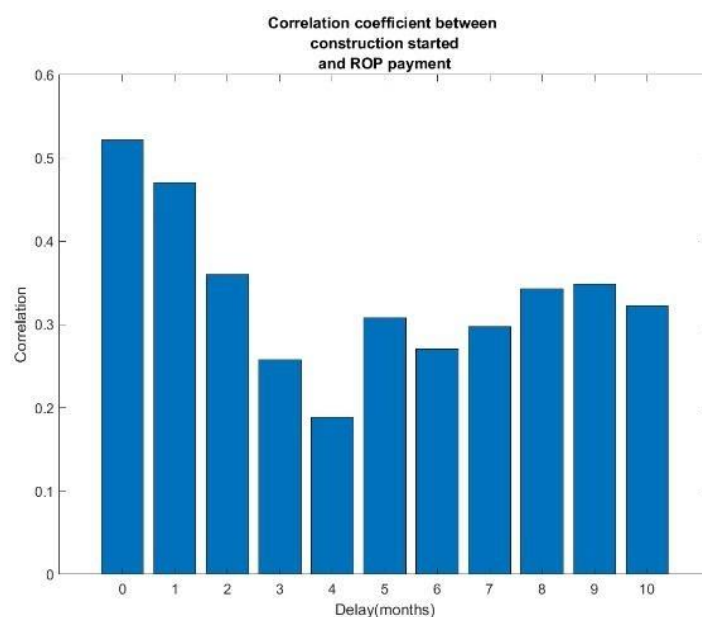


**Figure 11.** Correlation function between ROP Opolskie Province payments and housing units whose construction has begun.

Trying to assess significant time lags between the examined variables, it should be noted (cf. Figures 12 and 13) that no single significant time lag can be unambiguously identified for the examined relationships. This may testify to the fact of cyclical changes on the residential property market, and this study covered the analysis of seasonal fluctuations over a period of 10 months.



**Figure 12.** Cross correlation between completed payments and permits issued for new residential construction.



**Figure 13.** Cross correlation between payments made and dwellings started.

## 5. Results

The research carried out facilitated the identification and analysis of the relationship between the payments made throughout Poland under the regional operational programmes and selected macroeconomic variables. The analysis covered key macroeconomic aspects directly affecting, inter alia, the creation of the sustainable development potential of 16 Polish provinces and, consequently, the creation of Poland's competitive position in Europe and worldwide.

In order to perform a possibly systematic research inference, the literature analysis of the issue was conducted in the first stage. This analysis presents the validity of the cascading strategy planning process from the perspective of spending the European Union funds. It comprehensively describes the evolution of the perception of development of individual countries and regions, i.e., sustainable development, smart development, and

inclusive growth, including the importance of smart specialisations. It is important from the point of view of shaping the directions of spending structural funds in particular periods of European Union programming.

Discussing the utilitarian research dimension of the conducted analyses, it is stated as follows:

- During the period considered, there are annually increased payment values at the end of each calendar year, which evidences the seasonal fluctuations.
- Analysis of the development of the employment rate shows that over the period considered, there is a tendency for it to increase, which was particularly noticeable between 2016 and 2018.
- The effectiveness of the payments made and their impact on the labour market is high up to payments of around 400 million euros. Above this value, employment growth is of a slowing nature.
- When comparing the time courses for the variables employment and ROP payments made, there is an increasing tendency. The employment variable is characterised by seasonality in the beginning/end of the year. In this analysis, the six-month lag is the one with the largest value.
- In the relationship between the made payments and the first two stages of the housing construction process, i.e., the number of permits issued for the construction of new apartments and the number of apartments under construction, a dynamic increase of the value at the beginning of each analysed year for both variables is noticeable.
- When attempting a quantitative analysis of the examined dependencies, it can be seen that if we increase the payments under ROP in Poland by 1 million euros, we will obtain an average increase of 110,500 building permits issued, while in the case of dwellings units under construction, an increase in payments by 1 million euros will result in an average increase of 114,300 units under construction.
- When attempting to assess significant time lags between the researched variables, i.e., made payments and the first two stages of the housing construction process, it should be noted that no single significant time lag can be unambiguously identified for the examined relationships within a period of 10 months.

It is worth underlining that it is not easy to assess the impact of structural funds on the economy. The authors are aware that in practice, it is often difficult to indicate how much public intervention is a direct cause of a region's social and economic development, including its sustainable development. When interpreting the results described in this study, one should be aware of their model approach, i.e., an approach showing a simplified picture of the reality which, by rule, focuses only on correlative and regressive relationships, without allowing for the cause-and-effect relationships present in economy.

The analyses carried out showed a positive relationship between the payments made under ROP and the selected macroeconomic indicators. The results obtained from the research may have a practical aspect for decision-making for both regional and national authorities responsible for disbursement of the EU funds. Referring to the practical goal of the research, recommendations for authorities at all levels of the EU spending are as follows:

- Determining the principles for the implementation of regional operational programmes in individual provinces should be the subject of permanent discussions and meetings of regional authorities with programme stakeholders. This approach guarantees greater efficiency in the disbursement of funds in a given province.
- The assessment of the rate of disbursement of the EU funds, i.e., payments from the operational programme, should be continuously monitored by the regional authorities so that corrective measures can be introduced in due time. The remedial models used should be based on past experience. They should be discussed with programme stakeholders.
- At the level of implementers of project initiatives financed from the EU funds, information activities should be carried out to promote the fastest possible implementation of projects and, at the same time, the importance of this approach from the point of view

of macroeconomic indicators, important for the development of economy, including job creation, the level of wages, or the pace of housing construction.

In conclusion, the economic and social position of the European Union on the global stage is a determinant for coordinated actions by regional and national authorities in the twenty-eight individual Member States. For Poland, it is of particular importance because it was the largest recipient of the EU funds between 2014 and 2020 as well as in the new EU perspective for 2021–2027. Structural Funds are the main vehicle for project initiatives and have a positive impact on the country's macroeconomic indicators. This situation leads to the emergence of new barriers that need to be eliminated in the short term to achieve the best possible results in the disbursement of the EU funds.

The authors have analysed ROP payments and their correlation with the selected macroeconomic indicators. It should be emphasized that it is worthwhile to continue the research that would focus on the influence of other public funds on selected indicators.

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