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Multi-dimensional analysis of regional investment attractiveness in Poland

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Abstract

Research background: A given region's investment attractiveness is a set of conditions that depend primarily on the policy of the country that is the recipient of direct foreign investment, encouraging or discouraging foreign investors from making decisions about locating investments in a given area. These conditions include: the economic conditions, the infrastructure, the political and legal system, the business environment, and the socio-cultural environment. For a foreign investor, the motive for exporting capital abroad is the search for benefits that can be derived from the business activity conducted there, including easier entry into new markets.

Purpose of the article: The main aim of the paper is to distinguish groups of voivodeships (NUTS 2 level) that are relatively homogeneous in terms of investment attractiveness, which is conducive to the inflow of foreign capital and the implementation of investment projects involving foreign capital.

Methods: Distinguishing groups of voivodeships similar to each other in terms of the level of investment attractiveness is made by applying hierarchical cluster analysis. The dendrogram illustrates the hierarchical structure of clusters of similar objects according to the analysed set of variables. The quality of the clustering result is also assessed by determining the silhouette index. Comparative and descriptive analysis of CSO statistics are additional methods used that have

contributed to the achievement of the aim of the paper. The research period covers the years 2000–2018.

Findings & value added: The investment attractiveness of a voivodeship is closely related to the level of its economic development. Therefore, the following voivodeships are listed at the top of the investment attractiveness rankings: Mazowieckie, Dolnośląskie, Śląskie, Małopolskie, and Pomorskie. The conducted study has confirmed that the creation of special economic zones and the development of regional smart specialisations contribute to the inflow of foreign capital. It is worth noting that the assessment of investment attractiveness is relative. The comparison of the innovative attractiveness of voivodeships is based on the use of the average value, overestimated by cities, i.e. central hubs, attracting investors. The regional perspective on investment attractiveness using multi-dimensional statistical analysis methods is the added value of the article.

Introduction

In the literature, one can find different approaches to the issue of attractiveness — including investment attractiveness, differing in terms of their message and orientation towards sustainable development (Lee, 2016). In a relatively broad sense, investment attractiveness should be equated with a specific feature of regions or cities expressed as the ability to attract new residents, migrants and tourists, as well as new business services and investments. Investment attractiveness is also perceived from the perspective of the potential development of the local community (Russo *et al.*, 2013; Servillo *et al.*, 2012). Foreign capital inflow through international investment plays an important role in the structural changes of national economy and acts as a catalyst for international business development (Hobbs *et al.*, 2021; Škare *et al.*, 2020; Das, 2020; Roszko-Wójtowicz & Grzelak, 2020; Cieślík & Hien Tran, 2019; Paul & Singh, 2017; Bandelj, 2010). According to a study by the EY company, Poland is the undisputed leader in Central and Eastern Europe in terms of investment attractiveness. Out of 1,598 foreign direct investments (FDI) (there were 1,621 the year before) that flew into our region in 2018, 272 went to Poland. Hungary recorded 101 FDI and ranked 15th, while the Czech Republic with 65 FDI ranked 20th. On a European scale, Poland occupies a high 6th place (E&Y, 2019). In 2018, there were 6,356 new foreign direct investments recorded in Europe, an annual decrease of 4%. Nevertheless, this is still the second highest result recorded since 2000. The United Kingdom (1054 FDI) and France (1027 FDI), which for the first time since 2010 overtook Germany (973 FDI), pushing that country to the last position on the podium, are the leaders in attracting FDI. The above-presented data confirm Europe's investment attractiveness. Looking at the problem more globally, it can be said that Western Europe is once again considered the best location for new investments in the world. In addition, Central and Eastern Europe ranks second, just ahead of North America and China. Slightly less optimistic is

the situation of Poland from the perspective of assessments made under the 14th edition of the Polish-German Chamber of Commerce and Industry (AHK) Business Survey, conducted in cooperation with 14 other bilateral chambers in Poland affiliated to the International Group of Chambers of Commerce. The survey involved 205 foreign companies operating in Poland and about 1,400 foreign investors in Europe. In the 2019 survey, Poland fell to the third position in the ranking of investment attractiveness of the countries in the Central and Eastern Europe region and the Baltic States. It was preceded by Estonia and the Czech Republic. Poland ranked 2nd in the years 2016–2018, and it was the leader of the ranking from 2013 to 2015 (IGCC, 2019). In the overall assessment made in 2019, the leader of the ranking — Estonia — scored 4.2 points out of 6 possible, the Czech Republic — 4.16 points, and Poland — 4.05 pts. In the ranking, Poland is ahead of Slovakia (4.02 pts) and Slovenia (3.98 pts). The opinions expressed in the survey are certainly much more optimistic than those currently presented by entrepreneurs. Among Poland's strengths are its membership in the EU, its ease of access to sub-suppliers, and the qualifications of its employees, including IT professionals. There are approx. 250,000 programmers in Poland, which is 25% of the total European IT human resources.

On the other hand, in the opinion of foreign investors, Poland's obvious weakness is the regulatory and political sphere. Those surveyed were most likely to indicate: (a) a low level of predictability of economic policy, (b) a lack of political and social stability, (c) the shortcomings of the tax system and institutions, and (d) the amount as well as nature of the tax burden. In addition, the negative rating of the current government expressed by 61.3% of those surveyed is not encouraging. Still, the outlook for the future is hopeful. Firstly, because more than half (54.4%) of foreign investors surveyed in Poland rate the current state of our economy as good (in 2018, such an assessment of the Polish economy was expressed by 46.4% of those respondents). In addition, as much as 55.7% of those surveyed said that the situation in their industry would not change, and nearly one in four of those surveyed believed that it would improve. Secondly, and most importantly, 94.5% of foreign companies operating in the country would once again choose Poland as their place of investment; this represents an increase, as the figure was 90.1% in 2018. In particular, in the context of assessing the future investment climate, it should be stressed that the results of this survey have not yet been affected by the outbreak of the coronavirus pandemic and lockdown, the effects of which, although with varying intensity, have been seen in most EU countries. Current assessments of foreign investors regarding the further development prospects of their companies

and the possibility of an influx of new investment into the host country appear to depend on the effectiveness of government policy in combating the effects of the pandemic and the skilful introduction of effective measures to minimise the negative impact of the COVID-19 pandemic on the economy and society (Zinecker *et al.*, 2021; Grzelak & Roszko-Wójtowicz, 2020; Dias *et al.*, 2020; Pardal *et al.*, 2020; Kuc-Czarnecka, 2020; Kufel, 2020; Korzeb & Niedziółka, 2020).

Since Poland's accession to the EU, the country has been undergoing external convergence, consisting in the reduction of the income gap between Poland and the EU average (Roszko-Wójtowicz & Białek, 2019), and internal divergence, which is expressed in increasing discrepancies in the levels of GDP per capita between individual voivodeships. Disparities in the level of development of administrative units at both the NUTS 2 and NUTS 3 levels pose a serious threat to social cohesion, economic progress, and political stability in Europe (Kyriacou & Roca-Sagalés, 2012; Iammarino, 2019). From the perspective of the benefits brought by the inflow of foreign capital and the functioning of economic entities with this capital, the growing interest of foreign investors in the Polish market should be encouraging. Nevertheless, the inflow of foreign capital to Poland is characterised by a significant uneven distribution by voivodeship, which deepens the spatial disproportions in the country's development. As in many other countries, the vast majority of investments with foreign capital are located within the region's capital (Yegorova & Hasanoğlu 2016) and in large industrial centres, such as Śląsk and Wielkopolska or Trójmiasto (Tri-City) in Poland. Foreign investments are also often located around the main communication routes and along the western border of the country (Heller & Warżała 2005; Zagórska, 2016). Nevertheless, positive changes are visible. Dynamically developing cities attract foreign capital, and at the same time stimulate the development of their closer and more distant surroundings. It is on the outskirts of these large cities that currently new production plants, logistic centres and modern warehouse spaces are being located (Kaźmierski, 2012). Investment attractiveness, understood as a combination of location-related benefits resulting from the specific features of the area where the economic activity takes place which can be achieved in the course of running a business, is described in the article by means of a selected set of diagnostic features. The use of hierarchical clustering methods in the assessment of diversification of investment attractiveness at the voivodeship level (NUTS 2) is a response to the growing demand for analyses at the level of administrative units that the country is divided into.

The main aim of the paper is to distinguish groups of voivodeships that are relatively homogeneous in terms of investment attractiveness, which is conducive to the inflow of foreign capital and the implementation of investment projects involving foreign capital. The following research hypothesis is tested in the paper: Poland's investment attractiveness is increasing, but there is still a significant variation in this attractiveness between voivodeships.

The structure of the paper is subordinated to the adopted aim. The paper starts with the presentation of the investment attractiveness of Poland in the light of selected international rankings, in particular in comparison with other Central and Eastern European countries. The next section briefly reviews the literature on factors influencing investment attractiveness. The following section describes the research method — cluster analysis, which has made it possible to distinguish groups of voivodeships similar to each other. Comparative and descriptive analysis of CSO statistics are additional methods used that have contributed to the achievement of the aim of the paper. The research period covers the years 2000–2018. According to the international NUTS classification, the analysis is carried out at the NUTS 2 level, without taking into account the changes in the administrative breakdown that were introduced as a result of the fourth NUTS revision in 2016 (European Commission, 2016; European Parliament and Council of the European Union, 2005).

Literature review

The importance of foreign capital for the host country

The literature emphasises that the choice of the location for investments outside the country where the company is based is influenced by the motives driving foreign investors planning these investments as well as the investment climate created in countries seeking to have such investments located in their territories (Snieska *et al.*, 2019; Lee, 2016; Hlavacek, 2009; Gorynia *et al.*, 2007). For a foreign investor, from the point of view of implementing an investment in another country, the possibilities of gaining benefits from the business activity conducted there and their scale are important. Dunning equates investments made by companies abroad with the process of internationalisation. He presents a model of investments made by companies in foreign markets which is based on the specific advantages at their disposal: the advantages of ownership, location and internationalisation (Dunning & Lundan, 2008b; Dunning, 2006). In particular, the loca-

tion advantage enables companies to reap the benefits of lower production and transport costs, access to a larger market, and reduced investment risk. These benefits result from access to cheap and skilled labour, from gaining new sales markets and implementing new development strategies (Wawrzyniak, 2010; Dunning & Lundan 2008a; Dunning, 2006). In addition, Dunning (1993) has identified and specified four groups of factors influencing companies' decisions to make foreign investments: a. Resource-Seeking Foreign Direct Investment; b. Market-Seeking Foreign Direct Investment; c. Efficiency-Seeking Foreign Direct Investment; d. Strategic Asset-Seeking Foreign Direct Investment.

Investment attractiveness expresses the relative attractiveness of certain areas in terms of location quality and investment absorption based on the assets available there (the availability and quality of factors of production and raw materials, the size of the market, the wealth of the population, the qualifications and resources of employees, the quality of technical infrastructure, the availability of R&D centres, etc.) (Lee, 2016; Russo *et al.*, 2013). The literature distinguishes various factors of investment attractiveness and their different classifications. Among the universal factors determining the investment attractiveness of an area, the following are listed (Asongu *et al.*, 2018; Nazarczuk & Krajewska, 2018; Villaverde & Maza, 2015; Mottaleb & Kalirajan, 2010; Vijayakumar *et al.*, 2010; Faeth, 2009; Cheng & Kwan, 2000):

- transport access and availability,
- labour resources,
- market absorption,
- economic infrastructure,
- social infrastructure,
- level of economic development,
- level of general security,
- activities undertaken by voivodeships to attract investors,
- environmental situation,
- innovativeness,
- social capital.

The presented classification of determinants of investment attractiveness constitutes a 'universal' approach to investment attractiveness, i.e. based on aggregate factors for all sectors of economic activity, and determines approximate overall investment attractiveness. In view of the specificities of various business activities and manufacturing industries, the criteria considered in the location analyses may contribute to varying degrees to the actual location decision.

In many studies, the emphasis is on location factors, as regions that are relatively better equipped with these factors provide better business conditions (e.g. less investment expenditure is required, there are opportunities for greater profitability of investments), and thus are associated with less investment risk. Thus determined investment attractiveness is the result of an analysis of a number of factors potentially affecting the location of investments in a given area. However, actual investment attractiveness, which is the result of location decisions and the attractiveness of the areas in question as places to invest capital, is described by financial and physical flows in the form of investments.

Actual investment attractiveness is the ability of the region to absorb financial and physical capital in the form of investments, which is most often identified by analysing the value of investments in enterprises or the inflow of foreign direct investment. This means that actual investment attractiveness can be estimated *ex ante*, on the basis of investments made in the past.

The activities of foreign-capital companies should be assessed positively from the perspective of the labour market and the reduction of unemployment (Beenstock *et al.*, 2017; Moraru, 2013; Mucuk & Demirsel, 2013). The inflow of foreign capital into Poland has contributed significantly to the creation of jobs in the national economy. The number of people employed in companies with foreign capital increased from more than 100,000 in 1991 to more than 960,000 in 2000. In 2018, employment in companies with foreign capital exceeded 2 million people. The benefits derived from the inflow of foreign capital should also be seen in terms of labour productivity, which in companies with foreign investors is several times greater than in companies with exclusively Polish capital (Baranwal, 2019; Shuyan & Fabuš, 2019; Li & Tanna, 2019; Przychodzeń, 2012; Bellak *et al.*, 2008). However, foreign capital flowing into the host country should not be equated only with the creation of new jobs. The expenditure incurred by companies with foreign capital on training local employees is a tangible benefit to the national labour market. It translates into more skilled human resources for the economy that in the future can also be hired by national companies. In addition, the knowledge transfer accompanying foreign investments contributes to technological upgrades in the host country (Sala & Silva 2013; Gentile-Lüdecke & Giroud, 2012; Kemeny, 2010). The social and economic consequences of the influx of foreign investment can also be assessed from the perspective of the positive impact of foreign companies on the competitiveness of Polish exports (Jakšić *et al.*, 2019; Antwi *et al.*, 2013). Cooperation between foreign investors and Polish suppliers should lead to increased availability of services and products produced with the participation of Polish sub-suppliers also outside the country. This indirect-

ly stimulates the export potential of domestic producers and facilitates their entry into other outlets (Mahmoodi & Mahmoodi, 2016). In the long term, it is important to ensure that the influx of FDI is conducive to the transfer of modern technologies and managerial knowledge and skills (Feng *et al.*, 2019, Jin *et al.*, 2019). The inflow of foreign capital also contributes to the improvement of the host country's macroeconomic indicators, which is in particular expressed by GDP growth (Moraru, 2013; Nosheen, 2013).

Inflow of foreign capital to Poland

The systemic changes initiated in the late 1980s of the previous century created the conditions for foreign investors to establish business activity in Poland (Przychodzeń, 2012; Bandelj, 2010; Bandelj, 2002). The need to rebuild and modernise an economy characterised by a structurally low level of internal accumulation led to an uninterrupted increase in direct investment streams in the years 1991–2000 (Przychodzeń, 2012; Siemiątkowski, 2011; GUS, 2001). The inflow of capital in the form of direct investments was therefore increasingly dynamic. The trend was supported by the good economic situation and the increasing revenues from the privatisation of state-owned enterprises. The situation changed rapidly between 2000 and 2002, when the inhibition of privatisation and the economic downturn in Poland and worldwide contributed to the decline of FDI (NBP 2018, 2015; Przychodzeń, 2012, PAIiZ 2004, 2003; GUS, 2001). It is worth noting, however, that in the context of the variables in question and from the perspective of the Polish market, that was not a clear downward trend, but merely a deceleration of the growth rate.

The data shown in Figure 1 confirm the positive impact of Poland's accession to the EU and the accompanying faster pace of economic growth on the level of inflows of foreign direct investment. During the whole period considered, in the years 2002–2008, there was the most dynamic increase in the number of entities with foreign capital operating in the Polish market, the medium-term rate of change in this period of time was 6.5%. It was also accompanied by an average annual increase in employment and an increase in share capital involved in entities with foreign capital. According to public statistics, the global financial crisis, in the case of the Polish economy, started to be felt in particular in 2008 and 2009. At that time, the growth rate of all the variables in question decreased significantly. The effects of the crisis were also felt between 2010 and 2013, but their market impact was not as strong as in the earlier period. The year 2017 brought a renewed strong increase in the inflow of foreign direct investment, linked to the

good macroeconomic performance of the Polish economy and, consequently, to a favourable investment climate (Figure 1).

The volume of share capital involved in foreign capital companies has increased significantly in recent years and was nearly 150% (2.5 times) higher in 2018 than in 2000. This phenomenon was also accompanied by less stable, but nevertheless upward, trend both in terms of the number of entities with foreign capital operating in Poland ($\uparrow$ by 88%) and employment ($\uparrow$ by 110%) in those entities. However, between 2014 and 2017, the number of entities with foreign capital operating in the Polish market decreased quite significantly, as much as by 16.5%. This is tantamount to more than 4,300 entities with foreign capital exiting the market. In fact, the downward trend in the number of foreign capital entities started as early as 2011, which can be seen as a result of the negative effects of the global financial crisis. It was not until 2018 that the number of entities with foreign capital reached again a level similar to that recorded in 2014. There was a significant increase in the number of entities between 2017 and 2018. Year-over-year change amounted to 21% (Figure 2).

The territorial distribution of foreign capital is of significant importance for the host country. It is assumed that its impact is the more beneficial, the greater the degree of mitigation of disparities in the development of individual regions. The spatial distribution of foreign capital is determined by a number of interrelated and time-varying location factors, which results in different trends in the inflow of foreign capital to individual regions, characterised by specific and often unique features. The increase in the inflow of foreign capital to Polish voivodeships between 2000 and 2018, measured by the number of companies with foreign capital, was characterised by a strong concentration. Analysing the available data, it was observed that the Mazowieckie Voivodeship (10,814) was at the top of the ranking in 2018 in terms of the number of companies with foreign capital, with more than 40% of all foreign capital entrepreneurs operating in Poland. Another 35% were located in only four voivodeships: Śląskie (2,369), Dolnośląskie (2,312), Wielkopolskie (2,217), and Małopolskie (2,209). Enterprises with foreign capital operating in the aforementioned voivodeships accounted for nearly 75% of the group of entities analysed. A similar situation occurred in the earlier periods analysed. The share of entities with foreign capital registered in the Mazowieckie, Śląskie, Dolnośląskie, Wielkopolskie, and Małopolskie Voivodeships was more than 70% in previous years of analysis; it was 71.3% in 2010 and 72.3% in 2015, respectively. In general, it should be concluded that over the years the share of the five voivodeships in the total number of entities with foreign capital operating in Poland increased.

In 2000, less than 63% of the total number of entities with foreign capital could be found in the aforementioned voivodeships.

The distribution of foreign capital indicates its concentration in the most economically developed regions. The concentration of the majority of economic operators in the presented voivodeships may be a consequence of their relatively high level of development and socio-economic potential compared to the rest of the country. The voivodeships are distinguished not only by their high level of GDP per capita but also by the high absorption of the regional market and access to a skilled workforce. The smallest number of foreign-capital enterprises operated in the analysed years in the following five voivodeships: Podlaskie, Świętokrzyskie, Warmińsko-Mazurskie, Opolskie, and Lubelskie. The voivodeships are characterised, among others, by the lowest level of GDP per capita in the country, relatively low labour productivity, as well as underdeveloped social and technical infrastructure. Comparing the situation existing in 2018 with that of 2000, it is worth adding that the voivodeships where the number of entities with foreign capital increased the most included: the Podkarpackie Voivodeship (↑199.2%), which ranked first, followed by the Mazowieckie Voivodeship (↑185.3%), the Podlaskie Voivodeship (↑167.4%), and the Małopolskie Voivodeship (↑144.9%). During the period considered, there was a growing interest among foreign investors in the placement of their companies in particular in the Mazowieckie and Małopolskie Voivodeships. However, their interest in the Pomorskie and Zachodniopomorskie Voivodeships declined. The share of foreign-capital entities operating in those voivodeships in the total value gradually decreased.

Research methodology

Cluster analysis in an intuitive sense means both the activity of grouping objects and methods of analysis of a set of objects. As a rule, it is the grouping of a set of objects in such a way that objects in the same group (i.e. a cluster) are more similar (in some sense) to each other than to those in other groups (clusters) (Wierzbicka, 2020; Gavurova *et al.*, 2020; Rogalska, 2018; Roszko-Wójtowicz 2014; Everitt *et al.*, 2001). The issue of grouping objects can be considered according to a static approach, i.e. at one point in time (short-time interval) or dynamically at several time points, i.e. comparing changes in the belonging of objects to groups.

The overall scheme of the cluster analysis method in static and dynamic terms can be described in eight consecutive stages (Milligan & Cooper, 1987; Gordon, 1987; Gordon, 1999):

- Stage 1 – Selection of units for cluster analysis — a descriptive or stochastic approach (a random sample taken from the population); selection — selection of important diagnostic indicators allowing us to group objects, weighing diagnostic indicators adopted for analysis. Database creation.
- Stage 2 – Visualisation of objects (or diagnostic indicators) and distance matrix.
- Stage 3 – Weighting and normalisation of diagnostic indicators — selection of procedures for weighing and normalising or making a decision not to incorporate this stage of analysis.
- Stage 4 – Selection of measure of dissimilarity, distance between objects, or measure of object similarity — neighbourhood measures.
- Stage 5 – Choosing the right cluster analysis methods for a given issue, defining the cluster — individual methods have the ability to seek out clusters with the right structure for a given method.
- Stage 6 – Preliminary determination of the number of classes sought.
- Stage 7 – Object classification — the actual stage of cluster analysis: a) Evaluation of the result in terms of the number of distinguished classes; b) Comparing in pairs results obtained by different methods of analysis; c) Testing, replication (repeating the analysis); d) Assessment of the quality of the clustering result; e) Interpretation, description of the result of grouping (clusters).
- Stage 8 – Analysis of the compatibility of clustering results over time.

The question of the choice of units for analysis is not a problem in the conducted analysis of the investment attractiveness of voivodeships in Poland. The “selection” of administrative units results from the administrative division of the country. According to the international NUTS classification, the analysis will be carried out at the NUTS 2 level. This classification was formally introduced in Poland on 26 November 2005, at the time of the entry into force of the Regulation of the European Parliament and of the Council amending the Regulation on the establishment of a common classification of Territorial Units for Statistics (NUTS) (European Parliament and Council of the European Union, 2005). At that time, 6 NUTS 1 non-administrative units (regions), 16 NUTS 2 administrative units (voivodeships) and 45 NUTS 3 non-administrative units (sub-regions) were introduced. As a result of the fourth revision, NUTS 2016 (European Commission, 2016), the division of Poland at all NUTS levels changed — one new unit was introduced at each level. At the NUTS 2 level, the Mazowieckie Voivodeship was divided into two units — the Mazowieckie Region and

the Warsaw Capital City. Due to the time horizon selected for the analysis covering the period 2000–2018, the analysis in the paper was conducted at the level of voivodeships, i.e. according to the breakdown in force throughout the period considered. Cluster analysis based on the static approach was carried out for the year 2018.

As with linear ordering methods for objects, it is difficult to identify the ‘best’ methods for the selection of diagnostic indicators (or variables) (Balcerzak, 2000; Pietrzak, 2019; Roszko-Wójtowicz, 2014; Steinley & Brusco, 2008; Milligan, 1996). It is worth noting, however, that the two methods of multivariate analysis require a selection of indicators (variables) that would be as little correlated as possible, and this type of analysis lacks a dependent variable. The stage of the graphical presentation of data is intended to determine the number of clusters sought, to discover their structure and, in particular, to help with choosing the right clustering algorithms taking into account their attributes. The next step in the cluster analysis scheme — the choice of weighing and normalisation procedures of diagnostic indicators or the decision not to weigh and normalise variables is controversial both in the context of weighing and normalising variables and in the context of their legitimacy in the cluster analysis. In the area of weighing diagnostic indicators, an approach based on equal treatment of all indicators (variables) used for the analysis of clusters appears to be objective, in particular when there are no substantive premises for weighing variables or there is an absence of strong arguments in favour of simple, well-known methods (Gnanadesikan *et al.*, 1995). In cluster analysis, the normalisation of variables is an individual matter (Milligan, 1996; Cormack, 1971), and not a routine transformation, and it is unreasonable to claim that standardisation may hinder or hide the structure of clusters present in the data, if there is any.

Moving on to the issues of cluster analysis as such, the primary issue is the choice of the neighbourhood measure, including measures of dissimilarity, distance between objects, and of similarity, proximity of objects. In the literature, many measures of distance are known. However, in practice, the use of a specific distance measure is quite simple due to the fact that the application of a particular measure of distance depends on, among others, the scales of measurement of diagnostic indicators (variables) adopted for analysis and their possible normalisation, as well as the attributes of the distance measure and its interpretation. Due to the best-recognised attributes and useful geometric interpretation, commonly used as the distance measure $d(i, s)$ in cluster analysis is the *Euclidean distance* (metric) or the *Squared Euclidean distance*:

$$d(i, s) = \sqrt{\sum_{j=1}^m (x_{ij} - x_{sj})^2} \quad (1)$$

$$d(i, s) = \sum_{j=1}^m (x_{ij} - x_{sj})^2, \quad (2)$$

where:

n – number of objects $(i, s = 1, \dots, n)$,

m – number of attributes $(j = 1, \dots, m)$,

x_{ij}, x_{sj} – the value of attribute x_j for the objects i, s .

The next step is to select a cluster analysis method specific to a given issue and to define the cluster in a given analysis — individual groups of methods have the ability to seek out clusters with the right structure for these methods. This choice is important as it determines the application of counting procedures at other (further) stages of the analysis. Agglomerative or divisive methods are used for socio-economic analyses. Agglomerative methods which have been used in the paper are hierarchical methods, operating according to a single central agglomerative procedure, in which, as a result of multiple individual steps of analysis of the matrix of distances between objects, a nested, hierarchical structure of objects or clusters of similar objects is obtained. The result obtained in this way is most often presented in the form of a tree also called a dendrogram. Among the most popular are the following algorithms: single linkage, complete linkage, group average, weighted group average, average dissimilarity, median, and Ward's method, on the basis of which the authors distinguished the cluster of voivodeships similar to each other due to investment attractiveness.

An important step in the cluster analysis is the assessment of the quality of the clustering result and the selection of the correct clustering result. For reasons of universality, usually the Silhouette Index $SI(u)$, called the Global Silhouette Index (GSI), which can be used for both agglomerative and divisive methods, is used. The silhouette index values are determined successively on the basis of: partial assessments of the belonging of each object to a cluster, aggregated in the subsequent step for each cluster of value $S(q)$ (3) and value $SI(u)$ (4) providing the total assessment of the whole clustering:

$$S(q) = \frac{1}{n_q} \sum_{i=1}^{n_q} s(i), \quad \text{where } s(i) = \frac{b(i) - a(i)}{\max\{a(i); b(i)\}}, \quad (3)$$

$$GSI = SI(u) = \frac{1}{u} \sum_{q=1}^u S(q). \quad (4)$$

where:

$a(i)$ – average distance of the i – th object from all other objects

in the cluster K_q ,

$b(i)$ – minimum average distance of the i – th object in the cluster K_q .

The structure of partial index $s(i)$ shows that $s(i) \in \langle -1, 1 \rangle$, whereas: if the i – th object is incorrectly classified, then $s(i) \in \langle -1, 0 \rangle$; in the case of the i – th object that creates a single-element cluster $s(i) = 0$; and with an increase in the degree to which the i – th object belongs to the cluster $s(i) \in \langle 0, 1 \rangle$, therefore ultimately $GSI \in \langle 0, 1 \rangle$. The value of $GSI \geq 0.71$ indicates a strong structure of the resulting clusters; $GSI \in \langle 0.51; 0.70 \rangle$ confirms a meaningful cluster structure; $GSI \in \langle 0.26; 0.50 \rangle$ says that the obtained structure is weak and that the result of the cluster analysis may be artificial (another method of analysis may need to be used); while the result $GSI \leq 0.25$ requires that the solutions obtained should be rejected – indicating a lack of clusters in the data set (Kaufman & Rousseeuw, 1990, p. 88).

Results

The literature indicates various factors determining the investment attractiveness of regions. Most often, a distinction is made between factors belonging to the social infrastructure or factors belonging to the economic infrastructure (Stimson *et al.*, 2006). In terms of economic factors, the ones most frequently mentioned are, among others, transport infrastructure, the use of structural funds, the economic condition of the existing economic entities, water and sewage infrastructure, purchasing power of the population, etc. From the perspective of investment attractiveness, social infra-

structure is equally important, which includes the scientific community, cultural infrastructure, workforce resources and their quality, as well as entertainment and recreational infrastructure (Miśkiewicz, 2018). In this context, the authors have proposed their own set of diagnostic variables in which economic aspects intertwine with the social potential (Table 1).

The correct selection of diagnostic variables has a significant impact on the final results of the conducted study (see the list of variables in Table 1). 14 variables were extracted from the initial set of diagnostic variables, 13 of which are stimulants and one is a destimulant. Stimulants are variables whose higher values are desirable from the point of view of the studied phenomenon, which in the article is the assessment of investment attractiveness of NUTS 2 administrative units (voivodeships) from the perspective of a foreign investor. It was therefore assumed that the variable of average monthly gross earnings in the enterprise sector was a destimulant, as higher wages in the business sector mean higher costs, which from the point of view of a potential investor may be a factor limiting interest in locating investments in the area. The investor's perspective was the main determinant of the direction in which diagnostic variables impacted the phenomenon considered. Therefore, the registered unemployment rate was defined as a stimulant. A higher unemployment rate means for an employer easier access to the economy's human resources, often also at a lower unit price. In order to determine the final set, basic measures of descriptive statistics were determined and, based on the level of variability of variables, their pre-selection was made (Table 2). It is assumed that quasi-permanent and non-useful information on the phenomenon under analysis should be eliminated. In general, variables that have a coefficient of variation of $|V_s| < 10\%$ are eliminated (Roszko-Wójtowicz, 2014). Based on this criterion, variables x3 and x5 should be eliminated out of the set of diagnostic characteristics. However, other information criteria should also be followed during the variables pre-selection phase. Diagnostic variables should be generally considered important in analysis. Although variable x5 — household disposable income — has variability of less than 10%, due to its importance and high substantive usefulness, it remains in the set of diagnostic characteristics. Only X3 was eliminated at this stage.

The next step was to build a matrix representing the correlation between variables and to calculate the critical value of the correlation coefficient. On the basis of the literature and for further dimensionality reduction, the correlation coefficient value $r^* = 0.85$ was used as a reference. The elimination of variables was guided by the substantive premises and usefulness of variables from the perspective of a multidimensional assessment of the investment attractiveness of voivodeships in Poland. As a result of the sta-

tistical analyses carried out, a final set of diagnostic variables was created, from which the variables X3 and X10 were excluded. In the final set of variables, two variables are distinguished by the highest level of variability, i.e. X7 — internal expenditure on R&D activities in PLN per capita and X9 — bed-places per 1000 inhabitants. A moderate level of variability was recorded for variable X1 — expressways and motorways in km per 1000 inhabitants and X14 — financing and co-financing of EU programmes and projects in PLN per capita (Table 2).

As a result of the application of Ward's algorithm, on the basis of the analysis of the dendrogram, two single-element clusters were distinguished, formed by the Mazowieckie and Zachodniopomorskie Voivodeships, respectively. The remaining four clusters are multi-element. Cluster one is the most numerous, including five voivodeships (Figure 3).

As a result of the conducted analyses, six clusters were distinguished. First, the basic measures of descriptive statistics for multi-element clusters will be presented (Table 3). Then, the values of individual diagnostic variables will be shown, registered for two statistical units, each of which constitutes a separate single-element cluster (Table 4). Additionally, in the case of the Zachodniopomorskie and Mazowieckie Voivodeships, the relation of the values of individual variables registered in these voivodeships to the national average will be presented.

- Cluster 1 – Dolnośląskie, Lubuskie, Opolskie, Wielkopolskie and Łódzkie Voivodeships.
- Cluster 2 – Kujawsko-Pomorskie and Warmińsko-Mazurskie Voivodeships.
- Cluster 3 – Lubelskie, Podkarpackie, Podlaskie and Świętokrzyskie Voivodeships.
- Cluster 4 – Małopolskie, Pomorskie and Śląskie Voivodeships.

The descriptive statistics of the variables in the distinguished groups of voivodeships are presented in Table 3. The voivodeships forming the cluster number one are characterised by the highest average value in terms of the length of motorways, expressways and railway lines per 1000 inhabitants. The values of the remaining indicators are at an average level. The voivodeships classified in the cluster number two show, on average, the lowest values of almost all diagnostic variables, except for the variables related to the length of motorways, expressways and railroads per 1000 inhabitants. The cluster number three consists of the voivodeships with the worst road and rail infrastructure (low values of X1 and X2 variables) and the highest values in terms of expenditure on fixed assets for environmental protection, average gross earnings in the enterprise sector, as well as a high co-financing rate of programs and projects from EU funds per capita.

- Cluster 5 – Zachodniopomorskie Voivodeship.
- Cluster 6 – Mazowieckie Voivodeship.

Although it may seem quite surprising, the Mazowieckie Voivodeship is characterised by relatively low values of the following variables: X9 — bed-places per 1000 inhabitants, X11 — percentage of people with tertiary education in the group of active people, and X14 — financing and co-financing of EU programmes and projects in PLN per capita (Table 4). On the other hand, internal expenditure on R&D per capita in the Mazowieckie Voivodeship is nearly 3.5 times higher than the national average. Also here, the total average monthly household expenditure per capita is higher by 23.1% than the national average. The Zachodniopomorskie Voivodeship is also quite unique compared to other administrative units (Table 3). Due to its location, direct access to the sea and the presence of numerous tourist destinations, the Zachodniopomorskie Voivodeship is distinguished by the value of the variable X9 — bed-places per 1000 inhabitants — which is over 3.5 times higher than the national average.

Statistical data confirm significant disproportions between individual voivodeships, which is undoubtedly important also in the context of assessing their investment attractiveness. For example, the average area of a voivodeship for Poland is 19.5 thousand km². The voivodeships also differ in terms of the number of inhabitants — the average for Poland is 2.4 million, and in terms of share in GDP — the average for Poland is 6.3% of GDP. With regard to these measures, first of all, the differences are visible in the assessment of the largest voivodeship — the Mazowieckie Voivodeship — and the smallest voivodeship — the Opolskie Voivodeship. The Mazowieckie Voivodeship has five times more inhabitants than the Opolskie Voivodeship. At the same time, it has a 10 times higher share in Poland's GDP than the Opolskie Voivodeship. However, it should be remembered that we cannot look at the Mazowieckie Voivodeship only through the prism of the capital city. There are many poorer communes in the entire voivodeship, which is confirmed by statistical data collected as part of the periodically carried out “Household Budget Survey” (“Badania budżetów gospodarstw domowych”). Monthly disposable income in PLN per capita, similarly to the average expenditure in PLN per capita, differs significantly between Warsaw and the Mazowieckie Voivodeship without Warsaw. In the case of the average monthly disposable income, the values are respectively 183% (Warsaw) and 97% (the Mazowieckie Voivodeship without Warsaw) of the average value for Poland, and for expenditure respectively 178% (Warsaw) and 98% (the Mazowieckie Voivodeship without Warsaw). The observed and demonstrated disproportions in the Mazowieckie Voivodeship are also present in other voivodeships of the country. In the

context of assessing investment attractiveness and benefits resulting from the inflow of foreign capital, and especially the pursuit of a balanced economic development of the country, it should be emphasised that local authorities play an important role. An appropriate policy, including the creation of solutions favouring the development of peripheral communes, distant from the capital of the voivodeship, is of particular importance. Actions fostering an even distribution of companies with foreign capital in individual voivodeships will multiply the benefits of foreign investments in our country and will enable stable and long-term development not only for large cities, but also for smaller municipalities.

The advantage of agglomerative methods is that they do not require the determination of the number of sought clusters of similar objects before starting the analysis. The choice of the result, i.e. the division of a set of objects, and thus the number of clusters, is made on the basis of the tree diagram, by applying appropriate methods of assessing the results of grouping — that is, *post factum*, using the obtained clustering result, which does not complicate the entire analysis scheme. The aim of the authors of the paper was to distinguish relatively homogeneous groups of voivodeships from the perspective of their investment attractiveness, but at the same time to divide the population into the smallest, substantively justified number of clusters. Bearing that in mind, it was assumed that the first solution for which the silhouette index value exceeded the value of 0.5 would be satisfactory and should be accepted as substantively justified and acceptable. Such a result of the silhouette index $GSI = 0.504$ was obtained when the population was divided into six clusters, where two of these clusters were single-element and formed by the Mazowieckie Voivodeship and the Zachodniopomorskie Voivodeship, respectively.

Discussion

The primary role of investment attractiveness in generating development at the regional level is to stimulate investments which create important effects for the economy of the whole region (Mabillard & Vuignier, 2020; Hlaváček & Bal-Domańska, 2016). The conducted analysis is consistent with the position presented in the literature, and the results of the analysis confirm that the inflow of foreign capital is highly diversified at the regional level and depends on many unique characteristics of a given area, e.g. its location on a transport route, access to the sea, etc. (Hoang *et al.*, 2021). Proper promotion undertaken by specialised agencies operating in a given area also seems to be of key importance in this respect (Acaravci & Ozturk,

2012). It is essential to emphasise local attributes in conjunction with national solutions in the field of: tax benefits, qualified human capital in the host country, regulations of financial markets, the financial system, and the quality of infrastructure (Mitic & Ivić, 2016; Hintošová *et al.*, 2021).

In the case of Poland, the region that has benefited to the largest extent from an intensive promotional campaign is certainly the Dolnośląskie Voivodeship, in particular Wrocław and the neighbouring poviats. The benefits generated at the level of NUTS2 units translate into the development of administrative units distinguished at a lower level of aggregation (NUTS 3) (Butkus *et al.*, 2020). Foreign investments create opportunities to boost employment by raising the number of jobs (Bayar *et al.*, 2020) and give positive impetus to increased labour productivity (Li & Tanna, 2019), which in turn translates into an increase in wages. The variation in wages between regions changes the patterns (directions) of labour flow between regions, and this in turn changes the patterns of demand for services and the industry structure of investments made in the region. Investment attractiveness also implies in part the amount of budgetary revenues of local government units derived from corporate taxes.

The research conducted by Godlewska-Majkowska shows that the attractiveness of regions in Europe is strongly dependent on the level of economic development, including urbanisation and industrialization (Godlewska-Majkowska, 2013). Regions develop according to logical patterns delineated by their past, type of economy and socio-economic potential. Large cities and their agglomerations are usually development drivers (Turok & McGranahan, 2013) i.e. places characterised by universal investment values. The investment attractiveness of these regions has a stable spatial arrangement and is subject to evolution, strengthening the existing diversity. This is due to the inertia of spatial structures, especially in terms of creating a settlement system and infrastructure. However, the development paths of regions become unstable due to the instability of space (changes in the centre-periphery system) and the penetration of the European space by development waves moving at different speeds. Development difficulties of once well-developed regions serve as an example of this trend (Godlewska-Majkowska, 2013). The investment attractiveness of a voivodeship is closely related to the level of its economic development. Therefore, the following voivodeships are listed at the top of the investment attractiveness rankings: Mazowieckie, Dolnośląskie, Śląskie, Małopolskie, and Pomorskie. Hence, it is worth emphasising that as a result of the analysis of clusters, three of the above-mentioned voivodeships, i.e. Pomorskie, Śląskie and Małopolskie, form one cluster. Therefore, the results of the cluster analysis carried out are consistent with the report commissioned by

the PAIH (Godlewska-Majkowska *et al.*, 2017). As already emphasised in the previous part of the paper, all voivodeships have development drivers in the form of large cities or former voivodeship cities. Due to this, the assessment of investment attractiveness is relative. When comparing the investment attractiveness of voivodeships, we use the average value, overestimated by cities, i.e. central hubs, attracting investors. The Mazowieckie Voivodeship is a special case. Warsaw is surrounded by many poor villages whose development is due to their location and proximity to the capital. Investment attractiveness is a factor that directly influences the actions of investors.

Strong industrial centres and tourist centres are also attractive to investors (Song, 2020; Attila, 2016; Lee, 2016). The functioning of special economic zones is another incentive for foreign capital (Klimek, 2018; Siudak, 2014; Wang, 2013). They contribute to shaping the real investment attractiveness on a local scale (McCann & Ortega-Argilés, 2014; Namyślak, 2004). However, in order for their potential to be fully exploited, their existence must be accompanied by other forms of support for entrepreneurship.

According to the analysis carried out in the article, one of the factors significantly differentiating voivodeships in Poland is financing and co-financing of EU programmes and projects per capita. The inflow of funds from the EU budget to individual Member States, including Poland, has served to reduce the distance between the new Member States and the old Member States (Butkus *et al.*, 2020). Despite the benefits resulting from the inflow of funds from the EU budget, evening out of disparities at the level of individual administrative units of the country, including the NUTS2 level, depends on many social and economic factors of a given area. Thus, in many voivodeships, the pace of change, including the GDP per capita growth rate, significantly differs from the national average. This translates into many other characteristics important from the point of view of the inflow of foreign capital, such as the development of local entrepreneurship, the presence of skilled personnel, access to appropriate infrastructure, or the level of remuneration in the enterprise sector in a given area. It is also worth emphasising that EU funds favour the creation of special economic zones and contribute to the development of smart specialisations (McCann & Ortega-Argilés, 2014) which in turn attract foreign capital (Bartlet *et al.*, 2019; Radosevic & Stancova, 2018).

Conclusions

Determinants of investment attractiveness undergo constant transformations influenced, among others, by the development of manufacturing techniques and technology, the availability and price of raw materials and semi-finished products, transformations in the price structure in the economy, changes in the individual system of investor preferences (e.g. attention is increasingly paid to the impact of soft factors), the development of communication, transport, and delivery systems, management methods, and products themselves. It seems that the assumption of equal influence of all variables (especially with a large number of variables) describing this multidimensional phenomenon brings the calculated indicators closer to the identification of the level of development in a spatial system, which, incidentally, is significantly related to the scale of investments, both domestic and foreign. Nevertheless, the results of the analysis carried out with the use of multidimensional methods show that the obtained groups of voivodeships are consistent with their general level of development measured by the value of GDP per capita. Capital absorption capacity is expressed as the real investment attractiveness of administrative units at the NUTS 2 levels (voivodeships) (Godlewska-Majewska, 2008). An effective model of Poland's regional development, which would enable catching up in terms of development with richer EU countries, is related to increasing the competitiveness of the growth poles of the Polish economy and creating conditions conducive to the diffusion of development impulses into less developed areas. In the long-term development strategy of Poland, territorial balancing of development is postulated, the essence of which is diffusion, i.e. spreading the benefits of the growth poles with the simultaneous development of the ability to absorb pro-growth impulses by areas currently characterised by worse parameters. The diffusion of development impulses from strong industrial centres to the economy may help to avoid a situation in which the low level of competitiveness of a considerable group of the country's regions will indirectly lead to disruption of high dynamics of development processes and to a lack of exploitation of opportunities offered by the regional component in macroeconomic development.

Analyses of the investment attractiveness of regions most often focus on presenting rankings of selected areas. In this paper, methods of multivariate static analysis are also applied. However, in line with the aim set out in the introduction, the authors have not built a ranking, but instead distinguished clusters of objects similar to each other in terms of the level of investment attractiveness. Nevertheless, the obtained results have turned out to be consistent with the rankings of investment attractiveness presented in the litera-

ture. This means that the use of cluster analysis allows for the formulation of conclusions valuable for economic practice. The search for similarities with other areas may constitute a point of reference for policy makers when creating a policy fostering the inflow of foreign capital.

The assessment of investment attractiveness, especially at the level of NUTS 2 and NUTS 3 units, still requires in-depth analyses, particularly in the area of unique attributes, important from the perspective of foreign entities. However, it should be borne in mind that changes in the economic and social environment mean that the expectations of potential investors are also subject to constant changes. These changes must be followed by official statistics along with the offer of indicators that will adequately describe the potential of regions to attract foreign capital.

The conducted analysis constitutes a valuable contribution to further research. In particular, the authors would like to take a closer look at individual regions, performing the analyses at the level of administrative units distinguished at the NUTS 3 level. Statistical data confirm that the discrepancies between voivodeships are large, but the potential for generating stable economic growth at the national level should be seen in the still unexploited opportunities of individual communes and poviats.

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Annex

Table 1. Diagnostic variables

Item	Variable	Nature of variable
x1	expressways and motorways in km per 1000 inhabitants	stimulant
x2	railway lines in km per 1000 inhabitants	stimulant
x3	labour force participation rate	stimulant
x4	registered unemployment rate	stimulant
x5	household disposable income in PLN	stimulant
x6	total average monthly household expenditure per capita in PLN	stimulant
x7	internal expenditure on R&D activity in PLN per capita	stimulant
x8	number of restaurants per 1000 inhabitants	stimulant
x9	number of bed-places per 1000 inhabitants	stimulant
x10	GDP in PLN per capita	stimulant
x11	percentage of people with tertiary education in the group of active people	stimulant
x12	expenditure on fixed assets used for environmental protection and water management in PLN per capita	stimulant
x13	average monthly gross earnings in the enterprise sector in PLN	destimulant
x14	financing and co-financing of EU programmes and projects in PLN per capita	stimulant

Table 2. Basic descriptive statistics measures for the distinguished set of diagnostic variables

	x1	x2	x3	x4	x5	x6	x7
$\bar{X}$	0.11	0.56	0.56	0.07	1557.13	1154.49	0.51
S _x	0.05	0.16	0.02	0.02	137.53	125.89	0.39
V _s	50.5%	27.9%	3.4%	29.5%	8.8%	10.9%	77.1%
K	2.384	-0.165	0.568	-0.765	2.440	-0.585	5.657
A _s	1.550	0.416	0.798	0.219	0.386	0.323	2.287
	x8	x9	x10	x11	x12	x13	x14
$\bar{X}$	12.28	22.36	46682.06	6.26	326.09	4482.27	144.40
S _x	3.30	18.21	11743.98	1.41	66.34	473.36	75.80
V _s	26.9%	81.4%	25.2%	22.6%	20.3%	10.6%	52.5%
K	-0.260	6.321	4.787	-0.988	0.317	2.152	-0.943
A _s	0.904	2.446	1.924	-0.171	-0.530	1.387	0.621

Source: own elaboration based on CSO data, calculations were made in SPSS.

Table 3. Basic measures of descriptive statistics for distinguished clusters

Variable	Cluster	Mean	Sx	V _{sx}	Min	Max	Q25	Me	Q75
X1	cluster 1 - 5 voivodeships	0.16	0.06	39.4%	0.09	0.25	0.12	0.15	0.18
X2		0.65	0.19	29.2%	0.44	0.90	0.54	0.58	0.79
X4		0.05	0.01	23.6%	0.03	0.06	0.05	0.06	0.06
X6		1180.08	88.29	7.5%	1051.66	1282.80	1143.84	1189.77	1232.33
X7		0.42	0.18	42.0%	0.22	0.66	0.28	0.44	0.49
X8		12.33	3.29	26.7%	8.88	16.54	10.13	11.06	15.05
X9		15.02	6.06	40.3%	9.46	24.12	11.27	12.04	18.23
X11		7.58	0.85	11.2%	6.20	8.40	7.40	7.90	8.00
X12		327.47	49.69	15.2%	263.04	390.12	293.85	340.43	349.89
X13		4485.22	293.23	6.5%	4221.48	4987.55	4361.48	4419.28	4436.31
X14		118.38	67.63	57.1%	60.38	234.43	86.10	98.76	112.22
X1	cluster 2 - 2 voivodeships	0.13	0.16	123.7%	0.13	0.14	0.14	0.13	0.14
X2		0.67	0.76	113.5%	0.67	0.71	0.71	0.69	0.71
X4		0.10	0.10	108.3%	0.10	0.10	0.10	0.10	0.10
X6		1065.84	981.86	92.1%	1065.84	1023.85	1023.85	1044.85	1023.85

Table 3. Continued

Variable	Cluster	Mean	Sx	V _{Sx}	Min	Max	Q25	Me	Q75
X7	cluster 2 - 2 voivodeships	0.25	0.21	84.2%	0.25	0.23	0.23	0.24	0.23
X8		10.85	11.86	109.3%	10.85	11.35	11.35	11.10	11.35
X9		22.01	28.51	129.5%	22.01	25.26	25.26	23.64	25.26
X11		6.70	7.00	104.5%	6.70	6.85	6.85	6.78	6.85
X12		204.51	170.79	83.5%	204.51	187.65	187.65	196.08	187.65
X13		4025.90	3916.71	97.3%	4025.90	3971.30	3971.30	3998.60	3971.30
X14		97.24	98.01	100.8%	97.24	97.62	97.62	97.43	97.62
X1	cluster 3 - 4 voivodeships	0.07	0.02	22.9%	0.05	0.09	0.07	0.08	0.08
X2		0.54	0.08	15.2%	0.46	0.64	0.48	0.54	0.59
X4		0.08	0.00	5.2%	0.08	0.09	0.08	0.08	0.08
X6		1046.77	58.25	5.6%	960.22	1085.66	1039.63	1070.61	1077.75
X7		0.33	0.09	28.1%	0.23	0.43	0.27	0.33	0.39
X8		9.52	1.02	10.8%	8.61	10.99	9.07	9.24	9.70
X9		13.88	1.84	13.3%	12.38	16.32	12.49	13.41	14.80
X11		6.03	1.62	26.9%	4.60	8.00	4.75	5.75	7.03
X12		345.30	47.30	13.7%	289.83	401.32	319.40	345.02	370.92
X13		4097.84	54.61	1.3%	4025.33	4150.54	4072.93	4107.74	4132.64
X14		223.56	73.14	32.7%	121.65	295.25	205.02	238.66	257.20
X1	cluster 4 - 3 voivodeships	0.06	0.01	16.6%	0.05	0.07	0.06	0.07	0.07
X2		0.42	0.10	23.0%	0.32	0.51	0.37	0.43	0.47
X4		0.05	0.00	6.6%	0.04	0.05	0.05	0.05	0.05
X6		1198.35	156.69	13.1%	1017.42	1288.99	1153.03	1288.63	1288.81
X7		0.75	0.34	44.9%	0.41	1.09	0.58	0.75	0.92
X8		13.80	3.70	26.8%	10.18	17.57	11.91	13.64	15.61
X9		30.12	19.49	64.7%	10.81	49.78	20.29	29.76	39.77
X11		5.10	0.10	2.0%	5.00	5.20	5.05	5.10	5.15
X12		342.44	69.49	20.3%	286.98	420.39	303.46	319.94	370.17
X13		4861.33	145.15	3.0%	4696.66	4970.73	4806.63	4916.59	4943.66
X14		118.60	40.26	33.9%	72.27	145.00	105.40	138.54	141.77

Source: own elaboration based on CSO data, calculations were made in SPSS.

Table 4. Values of individual diagnostic variables registered for single-element clusters

Items	X1	X2	X4	X6	X7	X8	X9	X11	X12	X13	X14
Cluster 5 –											
Zachodniopomorskie Voivodeship	0.09	0.68	0.07	1236.53	0.25	14.01	81.09	6.00	425.77	4466.57	235.33
Relation to the national average	89.1%	121.4%	113.1%	107.1%	49.5%	114.1%	362.7%	95.8%	6798.7%	1369.7%	5.3%
Cluster 6 –											
Mazowieckie Voivodeship	0.07	0.32	0.05	1421.13	1.76	19.65	11.64	3.50	336.80	5796.51	38.64
Relation to the national average	62.1%	56.6%	74.9%	123.1%	344.3%	160.0%	52.1%	55.9%	103.3%	129.3%	26.8%
National average	0.11	0.56	0.07	1154.49	0.51	12.28	22.36	6.26	326.09	4482.27	144.40

Source: own elaboration based on CSO data, calculations were made in SPSS.

Figure 1. Dynamics of year-over-year changes of selected characteristics of entities with foreign capital in Poland in the years 2000–2018 (previous year=100)

Source: own elaboration based on GUS, Działalność gospodarcza podmiotów z kapitałem zagranicznym, (relevant years), Warszawa

Figure 2. Dynamics of changes of selected characteristics of entities with foreign capital in Poland in the years 2000–2018 (2000=100)

Source: own elaboration based on GUS, Działalność gospodarcza podmiotów z kapitałem zagranicznym, (relevant years), Warszawa.

Figure 3. Final cluster analysis results – dendrogram

Source: own elaboration based on CSO data, calculations were made in SPSS.