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Macroeconomic stability and the level of competitiveness in EU member states: a comparative dynamic approach

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Abstract

Research background: The choice of the issue of international competitive-ness of economies as the research problem addressed in this paper has been mainly dictated by the changes observed in the nature of the development of EU economies and the need to assess the competitiveness of the Polish economy. It is time to evaluate and learn from the largest enlargement in the history of the EU which took place in May 2004. An assessment of changes in the state of EU economies, including the Polish economy, is in the centre of research interest of many scientists. National competitiveness is the subject of a great deal of research and economic studies. Integration and globalisation processes in the world economy are the main reasons for the popularity of this topic. The efficient use of sources and factors determining the competitiveness of economies, sectors and enterprises is associated with prosperity over the long term. One of the methods based on the observation of selected basic indicators of economic competitiveness is the method of analysis called the macroeconomic stabilisation pentagon. The method illustrates the extent to which the government achieves five macroeconomic objectives. It is very difficult, if not impossible, to meet all these objectives at the same time. The difficulty of meeting all these goals concurrently is due to the fact that they are more or less competitive rather than complementary. The proposed

assessment of competitiveness based on the developed model of macroeconomic stabilisation pentagon is a unique approach in terms of discussion of country's competitiveness. This approach significantly distinguishes the current study in comparison with standard international reports on competitiveness such as the Global Competitiveness Index or the EU Regional Competitiveness Index.

Purpose of the article: The main aim of the paper is to assess the competitiveness of EU economies in the years 2005–2018, based on a selected set of diagnostic variables referring to the concept of macroeconomic stabilisation pentagon. The paper also formulates a detailed list of four research hypotheses.

Methods: In order to characterise the competitiveness of the European Union economies, including the EU–15 and EU–13 groups, as well as the Visegrad group, six diagnostic variables affecting the economic situation of individual EU countries were analysed. The variables for analysis were chosen so as to reliably describe the competitive position of a given country, at the same time referring in a substantive sense to the concept of macroeconomic stabilisation pentagon. The linear ordering of objects was made using the reference Hellwig method. The selected method enabled the development of competitiveness rankings of EU Member States in the years 2005, 2009, and 2018.

Findings & Value added: The comparative analysis of the main macroeconomic indicators conducted in the paper forms the basis for assessing the cur-rent state of the EU economy in relation to other countries. In the paper, the authors depart from the standard elaboration of 'magic pentagon.' Instead, they apply the variables used in the macroeconomic stabilisation pentagon analysis to develop competitiveness rankings of EU Member States. The con-ducted empirical study has confirmed that the 15th anniversary of EU member-ship had a decidedly positive impact on the level of economic development of the EU–13 countries.

Introduction

It has been 15 years since the largest enlargement in the history of the EU which took place on 1 May 2004. It is therefore time for the membership overview, encompassing an assessment of changes in the state of EU economies, including the Polish economy. By their accession to the EU, Poland and other new Member States agreed to the free movement of goods and services, and since 2011 also to the free movement of labour between the Member States. The abolition, as a result of European integration and progressing globalisation, of institutional barriers has forced economic entities to compete not only on the domestic market, but also on the single European market and the international market. Therefore, the subject of competitiveness of the economy and its determinants is often discussed in economic research (Gorynia, 2019). The issue of the country's international competitiveness has also been an important element of government economic policy in recent years.

Much has been written about competitiveness. It has been the subject of numerous studies and economic research (Laureti & Viviani, 2011; Krugman, 1996). Integration and globalisation processes in the world economy, which force one to search for sources and factors determining the competitiveness of economies, sectors and enterprises (Petricevic & Teece,

2019; Delgado *et al.*, 2012; Altomonte *et al*., 2012; Lanoie *et al.*, 2011; Burda & Dluhosch, 2002), are the main reason for the popularity of this subject (Kim & Kwon, 2017; Hämäläinen, 2003; Fagerberg, 2002; Obstfeld & Taylor, 2002). Extensive literature studies show that the approach to the assessment and measurement of competitiveness has varied over time, which indicates the need for further research to present the complexity of this economic phenomenon from various perspectives. The main problem of researchers is a lack of a single, universally accepted definition of economic competitiveness. Different approaches to competitiveness are mainly the result of applying numerous criteria that allow for capturing the multidimensionality of this phenomenon (Altomonte & Ottaviano, 2011). It should also be added that the concept of competitiveness is derived from at least three economic theories, i.e. the theory of international trade, the theory of economic growth, and the theory of microeconomics. Additionally, many researchers believe that competitiveness should be considered at various levels, i.e. micro-, meso-, macro- and mega, (Liu, 2017; Perényi, 2016; Delgado *et al.*, 2012; Daszkiewicz (Ed.), 2008) which are conceptually linked (Chikán, 2008). These levels of competitiveness are in constant interaction with each other (Cho & Moon, 2013) and are aimed at enhancing the level of productivity of a country (Schwab & Sala-i-Martin, 2013). Country (macro) level competitiveness is defined as a set of hard and soft factors influencing a country's productivity, and consequentially its ability to grow over time (Rusu & Roman, 2018; Schwab & Sala-i-Martin, 2013; DiRienzo *et al.* (2007). According to both Krugman (1994) and Porter (1990; 1998), productivity is one of the central concerns of competitiveness in a macro-economic approach. Further on, the Global Competitiveness Report defines competitiveness as "*the set of institutions, policies and factors that determine the level of productivity of an economy, which in turn determines the level of prosperity a country can achieve*" (The Global Competitiveness Report, 2017, p. 54). National competitiveness requires constant improvement across a broad range of policy spheres and is essential to embedding the economic recovery and prosperity over the long term (Keteles, 2016; Delgrado *et al.*, 2012).

Competitiveness has been the subject of economic research and analysis since the second half of the 20th century among scientists, economic politicians and representatives of business. It is widely believed to be a complex phenomenon, hence its discussion requires the use of various criteria and methods of measurement (Berger, 2011; Kołodko, 1994). A set of indicators known as the macroeconomic stabilization pentagon is used in competitiveness analysis (Pieloch-Babierz, 2020). The essence of macroeconomic stabilization analysis with the use of the pentagon method is based on ob-

serving the development over a given period of such basic indicators as: a) economic growth rate (GDP), b) registered unemployment rate c) inflation rate (CPI), d) state budget balance, e) current account balance. This method consists in an analysis of the most optimal use of resource streams and the development of a relatively stable growth rate (ΔGDP) with greater or lesser internal and external balance. The enormous number of definitions and concepts of competitiveness presented in the literature causes a semantic blur. In many cases, it is impossible to verify them empirically, which calls into question the very scientific value of theories created in this way. In the literature, there are many works devoted to the issues of competitiveness of countries that are uncritically based on competitiveness rankings developed by international institutions. There is a scarcity of studies that highlight the problems of measuring and comparing the competitiveness of countries at different levels of development. It is worth remembering that a stable macroeconomic environment is of key importance for the growth of competitiveness and, consequently, the economic development of countries, especially less developed ones. It is also difficult to find in the literature studies showing changes in the competitiveness of the Polish economy in the long term.

This paper attempts to fill the gap in this respect. A multidimensional assessment of Poland's competitiveness against the background of EU countries was carried out using the methods of linear ordering of objects. The starting point in the selection of diagnostic variables was the concept of macroeconomic stabilization pentagon.

In view of the above-presented considerations and the usefulness of the method described in the multidimensional assessment of competitiveness of economiesthe authors have decided to formulate the following main aim of the paper: the assessment of the competitiveness of EU economies in the years 2005–2018 based on a selected set of diagnostic variables referring to the concept of macroeconomic stabilisation pentagon.

Specific objective 1: determination of groups of countries characterised by the strongest competitive position in the years covered by the analysis.

Specific objective 2: assessment of differences and similarities in the level of competitiveness of groups of countries included in the EU–15 and EU–13 groups as well as the Visegrad group (V4) in the analysed time units.

Specific objective 3: assessment of Poland's competitive position against the background of other EU countries in particular years.

Hypothesis 1: The top of the authors' own rankings of competitiveness presented in the paper remains unchanged over time and is dominated by the countries of the ‘old’ EU.

Hypothesis 2: Over time, the EU–13 countries, including members of the Visegrad Group, have become an increasingly homogeneous group in terms of their level of competitiveness.

Hypothesis 3: The EU–15 countries are characterised by weaker economic growth.

Hypothesis 4: The competitiveness of the Polish economy increased over the considered period.

The paper consists of five substantive sections, preceded by an introduction and crowned with a summary which presents formulated conclusions and refers to stated objectives and research hypotheses. Subsequent sections successively deepen the analysed issues related to the assessment and measurement of the competitiveness of EU Member States, with particular emphasis on the macroeconomic stabilisation pentagon. The literature review is included in section one. Section two discusses the research method that allows us to create a ranking of the competitiveness of EU Member States. Section three discusses diagnostic variables. The research results along with the competitiveness rankings are presented in section four. Section five is a discussion in which the authors compare the results of their own research with the achievements already presented in the literature.

Theoretical framework

Literature studies lead, among others, to the conclusion that the directions of development of research on competitiveness are related to the search for an answer to the question of what constitutes the source of the advantage of one economy over another. The first factor approach to competitiveness in the form of Diamond Model was proposed by Porter (1990). Also other researchers: Krugman (1992), Clyde and Prestowitz (1994), Thurow (1994), Cohen (1994), as well as Burda and Severgnini (2009) emphasised in their publications the dominant role of internal factors in shaping competitiveness and indicated productivity as the best method of its measurement (Dresch *et al.*, 2018; Liu, 2017; Gardiner *et al.,* 2006; van Hemert & Nijkamp, 2011; Porter, 2003). Porter's approach was further developed by Dunning (Ed.) (2000) as well as Cho and Hwy-Chang (2000). The thesis about an overly national approach to the factors of competitiveness in Porter's model was put forward, among others, Rugman and D'Cruz (1993) as well as Rugman and Verbeke (1993). In their opinion, the right model for the analysis of the competitiveness factors of smaller countries associated with larger economies is the Double Diamond Model, in which the economic environment is described by the national diamond and the diamond

describing the microeconomic environment of the main economic partner (Moon & Cho, 2000; Cho *et al.*, 2009).

In 2001, based on the results of many years of research, Porter (2001) presented his own concept of international competitiveness, recognising that a country's competitiveness depends primarily on the efficiency and effectiveness of using resources such as labour and capital. Porter believes that companies compete with one another, and whether an enterprise achieves high efficiency or not depends on the environment and economic conditions. According to Porter, sources of competitiveness change with the development of the economy.

The works of the above-mentioned authors, along with the achievements of research on competitiveness growth, formed the theoretical foundations for the development of currently very popular competitiveness rankings (The Global Competitiveness Report, 2020, The World Competitiveness Yearbook, 2020). Comparative analyses of national competitiveness are mainly based on very broad composite indices such as the Global Competitiveness Index published by the World Economic Forum (Schwab (Ed.), 2019) or the World Competitiveness Rankings developed by the Institute for Management Development World Competitiveness Centre (IMD, 2020). The methodologies used by these institutions are constructed in such a way that it is possible to assess the level of competitiveness of a given economy using one index calculated on the basis of a complex algorithm based on several hundred detailed factors. Aforementioned reports provide knowledge about how complex and difficult to measure competitiveness is as a phenomenon. In the mentioned indices, a large number of variables is combined to produce a single composite competitiveness measure (Huggins *et al.*, 2013). The analysis of the directions of research on competitiveness shows that we are still far from creating a uniform theory of competitiveness, i.e. one in which competitiveness will be the dependent variable. Therefore, there are consequent proposals in the literature of new approaches to the multidimensional assessment of competitiveness. For instance, at the regional level, the European Commission has introduced the EU Regional Competitiveness Index created by the DG for the Regional and Urban Policy (Annoni *et al.,* 2017).

As technology advances, the perception of a country's international competitiveness also evolves. More and more often, the theoretical context of competitiveness of the economy is supplemented with issues related to sustainable development, the standard of living of the population or the importance of the eco-economy. Maintaining constant economic growth depends on raising the level of technological advancement of the already existing branches of industry. At the same time, however, it is also depend-

ent on stimulating the development and strengthening the competitive advantage of promising new branches of the economy which have the best chance of generating high market profits (Martin *et al.,* 2006). An increase in labour productivity and reduction of the technological gap measured by Total Factor Productivity (TFP) may also constitute the basis for gaining a permanent competitive advantage (Roszko-Wójtowicz *et al.,* 2019; Castellani *et al.*, 2018, Castellani *et al.*, 2016; Machek & Hnilica, 2012). The literature also emphasises the structure of international trade as a factor stimulating the competitiveness of the economy (Gorynia, 2019; Nehme & Nehme, 2014; Dia & Abdelaziz, 2011). A characteristic feature of highly developed countries is the export of goods manufactured by more technologically advanced sectors of the economy, and the import of mainly those goods whose production is based on cheap labour and does not require the use of technologically advanced production factors (Borowski, 2015, p. 14; van Hemert & Nijkamp, 2011).

Measuring international competitiveness, as previously mentioned, is a very difficult issue which depends on many factors, not all of which can be described quantitatively. The literature lacks a clear description of methods of measuring international competitiveness and rules for selecting dependent and independent variables, but one of the main divisions is the classification into measures of competitive position and measures of competitive capacity (Weresa, 2008, p. 102).

Conducting international comparative research on the assessment of the competitive position of an economy is a major challenge. Despite extensive achievements presented in the literature, many issues, especially with regard to the set of diagnostic variables and determinants of competitiveness of economies, continue to arouse a great deal of controversy in scientific discourse (Cheba & Szopik-Depczyńska, 2017; Berger, 2008; Zanakis & Becerra-Fernandez, 2005). One of the main classifications is the division into competitive position measures and competitive capacity measures.

The concept of competitive position refers to the place of a given national economy in the world, among others, in terms of trade in goods and services as well as the technological and financial markets that determine the well-being of inhabitants (Weresa, 2008, p. 102). The competitive capacity of the country determines the ability of the entity, in this case a given national economy, to take effective and innovative actions to adapt to future precarious conditions, risks, and changing customer preferences in order to increase derived benefits (Roszko-Wójtowicz & Białek, 2019). This therefore also applies to the future alignment of the competition system and policy in such a way as to increase current benefits to a greater extent than will be the case in other economies (Momaya, 2019, p. 2).

One of the concepts of measuring and analysing competitiveness is that created by Aiginger (Aiginger, 1998; Misala, 2011, p. 134). International competitive capacity is, according to the author, the ability of the country to sell such a quantity of goods and services to maintain macroeconomic balance. Aiginger along with Landesmann (2002), have distinguished four levels of competitive capacity and international competitiveness with each successive level containing attributes of the levels preceding it: level 1 — competitiveness as the ability to raise incomes by increasing employee productivity and the number of employees; level 2 — extended to include the assessment of the process sustainability; level 3 — extended to include the introduction of a social and environmental protection system; level 4 — extended to include sustainable economic development, e.g. the level of satisfaction of citizens.

The method of macroeconomic stabilisation pentagon analysis is a method consisting in the observation of selected basic indicators. These indicators were developed in 1990 by the Foreign Trade Research Institute. This method, regardless of the time of its creation, continues to provide up-to-date measurements of the country's competitiveness. The concept of the pentagon of macroeconomic stabilization is derived from the method of economic analysis introduced by Kaldor, British Economist of post-keynesien current, the so-called magic square, showing each year's achievements in one of the four economic policy goals: fast growth, full employment, low inflation and external balance (Nehme, 2014). This magic square helps to define the main points of the economic policy of a country.

In this method, the basis for assessing (measuring, determining) the competitive position (of an economy) consists of indicators based on values of the main indicators of the size and structure of national income: Gross Domestic Product (GDP) and Gross National Product (GNP) (Esty & Porter, 2002). These indicators allow us to estimate the level of development of an economy, as well as the stage of development of its competitiveness. The first indicator is gross domestic product (GDP), which corresponds to the production generated in a given country, regardless of who owns the factors of production, which serves to assess the degree of economic development of individual countries and the stage of development of their competitiveness. The other indicator is a measure of the total income earned by nationals of the country concerned regardless of the place where it was generated. Assessments of global GDP and GNP figures, no matter how they are measured, make it possible to estimate the size of a given national economy. In order to determine the standard of living of the population (the level of prosperity of citizens) and the development of an economy, GDP and GNP should be applied to the population, thus receiving indicators of

the level of national income per capita. In comparative practice, GDP and GDP per capita are most commonly used in current prices measured by purchasing power parity (PPP) (Castles & Henderson, 2005; Vachris, 1999). Comparative analysis of the main macroeconomic indicators is the basis for assessing the current state of a given economy in relation to other countries (Santos *et al.*, 2017; Martínez & Sanchez-Robles, 2012; Montiel & Servén, 2006; Misala, 2011). The measures proposed by the Institute included (Misala, 2011, p. 138; Matkowski *et al.*, 2016, p. 21):

- GDP growth rate – a picture of a given country's economy and information on the wealth of the population;
- registered unemployment rate – measured as the number of registered unemployed persons in relation to the economically active population;
- inflation rate – regarded as an indicator of internal balance;
- state budget balance – measured in relation to the GDP;
- current account balance – measured in relation to the GDP.

This method uses the analysis, both in static terms (referring to the year in question) and in dynamic terms, of the categories described above.

The tool most commonly used in the analysis of these macroeconomic indicators is the graphic method of the so-called macroeconomic stabilisation pentagon. It illustrates the extent to which the government achieves the following five macroeconomic objectives:

- economic growth rate;
- internal balance (lack of inflation);
- full employment (no unemployment);
- government budget balance;
- current account balance.

At the same time, it is very difficult, and indeed impossible, to meet all these goals concurrently, that is why the set of these macroeconomic indicators is called the "magic pentagon". The difficulty of meeting all these objectives at the same time is due to the fact that they are more or less competitive rather than complementary (Santos *et al.*, 2017; Martínez & Sanchez-Robles, 2012; Montiel & Servén, 2006; Misala, 2011).

Another important component affecting the country's competitive position is its economic openness, i.e. the share of the economy in the international economic exchange (Frieden & Rogowski, 1996). The classic methods for assessing this phenomenon are: current account balance (export and import balance) measured in relation to GDP, changes in terms of trade (Eichengreen, 2006), and the influx of foreign direct investment (Petricevic & Teece, 2019; Altomonte & Ottaviano, 2011; Martin *et al.*, 2006). It is widely believed that the effective and competitive economy has no problems balancing the foreign trade balance in the long term.

Another measure of economic openness, i.e. terms of trade, allows us to assess benefits of foreign exchange and the market success of a given economy. Price (nominal) terms of trade, i.e. the ratio of relative prices of goods and services exported to relative prices of goods and services imported for the country concerned during the analysed period, is the most commonly considered. This indicator shows changes in the purchasing power of exports to imports.

The last of the above-mentioned measures, i.e. the value of the influx of foreign direct investment (FDI), shows the attractiveness of individual countries to foreign direct investors. Foreign direct investment is considered beneficial for host countries as it makes up for the capital shortfall resulting from insufficient national savings. It influences technological modernisation of an economy, and introduces or disseminates modern management systems. FDI is also seen as a way to stimulate the economic growth of underdeveloped regions, e.g.: through the creation of new jobs by foreign investors (Petricevic & Teece, 2019; Su *et al.*, 2018; Altomonte & Ottaviano, 2011).

The authors' proposal constitutes a synthetic examination of selected basic economic indicators that illustrate the condition of EU economies in the analysed period. Taking into account the changes in the assessment of competitiveness of economies and based on the concept of macroeconomic stabilisation pentagon, the authors propose an extended version of the pentagon supplemented with the living standards of the population expressed in terms of GDP per capita.

Research methodology

Linear ordering methods allow us to create an ordered list of objects based on a specific criterion (e.g. variable values) (Marsh *et al.* (eds.), 2017; Chen *et al.* (eds.), 2018). In turn, nonlinear ordering methods return a graph of connections of similar objects due to the variables describing them.

In a multidimensional variable space, linear ordering of objects consists in the projection onto a straight line of points that represent the objects subjected to ordering. This operation allows us to determine the hierarchy of objects. The features of the linear ordering of objects will be presented below along with their mathematical interpretation. Linearly ordered objects are characterised by the fact that:

- each object has at least one neighbour and no more than two neighbours,
- if the neighbour of the i-th object is the k-th object, then at the same time the neighbour of the k-th object is the i-th object,

– two objects have only one neighbour (Grabiński *et al.*, 1989).

The above-mentioned features are the result of possessing only a finite number of objects that have undergone ordering.

Linear ordering methods can be divided into diagram methods, procedures based on a synthetic variable and iterative procedures based on the function of the goodness-of-fit criterion.

Reference point methods assume the existence of reference point $P_0 = [n_{0j}]$, j = 1,2, ..., m (Marsh *et al.* (Eds.), 2017; Chen *et al.* (Eds.), 2018). The variables of this point are normalised. They assume optimal values which are determined on the basis of generally accepted standards, subjective opinions about the observed object, or expert opinions. Then objects are ordered based on their distance from the reference point. Individual methods may differ in the manner of determining the reference point, the distance and the synthetic measure on the basis of which the ordering is carried out.

To carry out linear ordering of objects from the observation matrix, there is a need to unify the nature of variables in accordance with the postulate for normalisation and uniformisation of attribute scores (Balcerzak, 2020). Therefore, it is necessary to transform diagnostic variables in such a way that the direction of their impact on the aggregate (synthetic) variable is consistent with the direction of the aggregate (Młodak, 2006). It should be noted, however, that in linear ordering methods that use synthetic measures based on a reference point, it is not always necessary to unify the nature of variables (Walesiak, 2011). In this paper, we assume that variables describing objects should be stimulants (Rogalska, 2018a). However, the Hellwig method chosen for analysis does not require prior transformation of destimulant variables into stimulants. Therefore, a normalisation transformation was carried out as the next step of the statistical procedure. The basic condition for ordering objects linearly is their measurability on the ordinal scale. If variables are measured on an interval or quotient scale, they are normalised (Walesiak, 2004). This operation makes it possible to unify attribute scores of variable values and their order of magnitude in order to make them comparable (Walesiak, 2004; Panek, 2009). There are several types of normalisation transformations, but standardisation is most commonly used for the Hellwig method. Standardisation aims to obtain variables with an average value of zero and a standard deviation of one (Grabiński *et al.*, 1982). Classic standardisation is performed according to the following formula (Panek, 2009):

$$z_{ij} = \frac{x_{ij} - \bar{x}_j}{S(x_j)}, \tag{1}$$

where:
i = 1, 2, …, n; j= 1, 2, …, m.
x_{ij} – observation of the *j*-th variable for the *i*-th object,
$\bar{x}_j$ – arithmetic mean of observations of the *j*-th variable,
S_j – standard variation of the *j*-th variable (Bąk, 2016).

The Hellwig method is one of the oldest reference point methods. In this method, the reference point is determined based on standardised input variables. The coordinates of the reference point are assigned a maximum when the input variables are stimulants or a minimum when the variables are destimulants (Rogalska, 2018b; 2018c). The coordinates of the reference point are calculated based on the following formula:

$$z_{0j} = \begin{Bmatrix} max_i\{z_{ij}\}\ dla\ z_j^S \\ min_i\{z_{ij}\}\ dla\ z_j^D \end{Bmatrix} \tag{2}$$

where:
j = 1, 2, …,m; i= 1, 2, …,n (Panek, 2009).

Next, we will determine the synthetic measure by performing the following steps.

Objects are ordered based on the distance from the reference point using the Euclidean distance. For ordering, however, a synthetic measure in the following form is used:

$$s_i = 1 - \frac{d_{i0}}{d_0}, \qquad i = 1, 2, \ldots, m. \tag{3}$$

where:
d_{i0} – the distance of the *i*-th object from the reference point,
d_0 – the value that is the sum of the average distance from the reference point and double the standard deviation.

Distance measures in multivariate comparative analysis are used to determine similarity between analysed objects. An increase in their value indicates an increase in the degree of object diversity. There are many methods for calculating distance measures, but the Hellwig method most often uses the Euclidean metric (Panek, 2009).

For each object, the distance to the reference point is determined according to the following formula:

$$d_{i0} = \sqrt{\sum_{j=1}^{m}(z_{ij} - z_{0j})^2} \tag{4}$$

where:
z_{ij} – standardised variables,
z_{0j} – coordinates of the reference point (Bąk, 2016).

The Euclidean distance is equal to the length of the line segment connecting points in a multidimensional space (Panek, 2009). The lower the obtained value of the coefficient d_{i0}, the higher the development level of a given object (Zeliaś, 2004).

For each object, the distance to the reference point is determined according to the following formula:

$$\bar{d}_0 = \frac{1}{n}\sum_{i=1}^{n} d_{i0} \tag{5}$$

In the next step, we determine the standard deviation using the following formula:

$$S(d_0) = \sqrt{\frac{1}{n}\sum_{i=1}^{n}(d_{i0} - \bar{d}_0)^2} \tag{6}$$

Having the above, we can determine the value of d_0 as the sum of the average distance and doubled value of the standard deviation:

$$d_0 = \bar{d}_0 + 2S\,(d_0) \tag{7}$$

The variable s_i usually takes values from the range<0,1>. However, negative values may appear when the level of development of a given object is significantly lower than others, or if the number of ordered objects is high (Zeliaś 2004). The higher the s_i values, the closer the object O_i is to the reference point O_0. Thus, the value of the measure s_i allows for ordering objects from the best to the worst in terms of the studied phenomenon (Zeliaś, 2004).

Data sources

In order to characterise the competitiveness of the European Union economies, including the EU–15 and EU–13 groups as well as the Visegrad group, six diagnostic variables affecting the economic situation of individual EU countries were analysed. When choosing variables, the authors were guided by the literature, their own research experience and the availability of data in Eurostat databases (data collection — January — February 2020). Regardless of the subject of the research, in statistical analyses focusing on making comparisons at the level of countries or groups of countries (EU–15, EU–13, V–4), the authors most often refer to international databases, i.e. Eurostat or the World Bank (Roszko-Wójtowicz & Białek, 2019, Balcerzak, 2016).The variables for analysis were chosen so as to reliably describe the competitive position of a given country, while at the same time referring in a substantive sense to the concept of Macroeconomic Stabilisation Pentagon. The following diagnostic variables were used for multivariate analysis:

- Gross Domestic Product per capita (GDP at current prices, Euro per capita) – X1 — stimulant;
- real GDP growth rate – X1 – stimulant;
- inflation rate expressed using the HICP – X1 — destimulant;
- unemployment rate – X1 — destimulant;
- public sector debt rate – measured as the ratio of the public finance balance to GDP – X1 — destimulant;
- foreign debt rate — measured as the ratio of the current account balance to GDP – X1 — destimulant.

In order to assess the competitiveness of EU economies according to the multidimensional approach, data from three selected years were analysed: 2005, 2009 and 2018. This choice was dictated by events in the global and European economy and the availability of data.

The year 2005 — is the first full year of membership in the EU structures for ten countries: Lithuania, Malta, Poland, Slovakia, and Slovenia. There have been six enlargements in the history of the EU, the largest of which took place on 1st May, 2004.

The year 2009 — is the year of coming out of the global economic crisis in financial and banking markets which was initiated by the collapse in the high-risk mortgage market in the United States.

The year 2018 — the availability and completeness of the most current data in the Eurostat database allowing for the preparation of a preliminary assessment and summary of the 15th anniversary of the EU membership of Poland and other countries that joined the EU in May 2004.

Conducting the multivariate analysis was preceded by making the variables expressed in monetary units comparable (conversion from current to constant prices).

Results

In the analysed years: 2005, 2009 and 2018, Luxembourg, the Netherlands and Denmark remained at the top of the competitiveness rankings presented in the paper, although their positions in these rankings changed. For example, Luxembourg, from its top position in 2005 and 2009, moved to the 2nd position in 2018, and Ireland became the leader of the ranking. In the entire considered period, countries of the so-called 'old' EU are classified in the highest positions in the innovation rankings. In 2005, top-ranking countries were: Ireland, Denmark, Sweden, and the Netherlands. Similarly, in 2009, apart from Luxembourg, the leaders were also: Denmark and the Netherlands. Countries characterised by a high competitive position also included: Austria and Sweden. The most numerous changes are evident in the ranking prepared for 2018, in which — apart from Ireland and Luxembourg — Malta also appeared at the very top. The next positions in the ranking, which is not surprising, are occupied to Denmark and the Netherlands (see Figure 1, Table 2).

In the ongoing scientific discussion, it is also worth examining the positions of EU–13 countries in the competitiveness rankings in subsequent analysed units of time. In 2005, Slovenia and the Czech Republic occupied the highest positions, 7th and 8th, respectively. In 2009, EU–13 representatives moved down the ranking, Cyprus (10th position), the Czech Republic (11th position) and Slovenia (12th position) ranked the highest. As mentioned above, 2018 brought the largest shake-up in the ranking. Malta appeared among the leaders (3rd position). A quite high, 6th position belonged to Slovenia. Poland making the top ten is also an optimistic sign. Especially since Poland's competitive position in 2005 among the countries of the Community was very low. Poland occupied the 24th position, ahead of only Greece, Bulgaria, Portugal, and Romania. Poland also recorded the lowest position among the V–4 countries (the Czech Republic — 8th position, Hungary — 19th, Slovakia — 23rd). In 2009, compared to 2005, Poland advanced in the competitiveness ranking, moving up by 4 positions, finally reaching the 20th position. Among the V–4 countries, Poland is behind the Czech Republic (11th position) and Slovakia (17th position), but ahead of Hungary (23rd position). For the V–4 countries, 2018 was a year of progress. Hungary was classified 7 positions higher in relation to the

2009 ranking, ranking 16th. Nevertheless, the greatest advancement was recorded for Poland, which ranked 10th. The other two representatives of the Visegrad Group, the Czech Republic (11th position) and Slovakia (17th position), maintained their positions in the ranking (see Figure 1, Table 2).

On the opposite side of the ranking were the weakest countries in terms of competitiveness. From period to period, different EU representatives appeared at the bottom of the ranking. In 2005, Bulgaria, Portugal and Romania closed the ranking. In 2009, the countries with the weakest competitive position included: Greece, Lithuania and Latvia. Greece, for which the synthetic measure of Hellwig's economic development was negative, was definitely the country with the weakest competitive position in 2018. Right next to it, at the bottom of the ranking, the following countries were found: Spain, Italy and Romania. It is worth emphasising that while the EU–15 countries dominate the top of competitiveness rankings, irrespective of the unit of time under consideration, representatives of the so-called 'old' EU, especially from the southern part of the continent, started to appear there more frequently.

In the context of the conducted comparative analysis, two more issues deserve attention: (1) minimum and maximum values of the synthetic measure in individual years (see Table 1), (2) differences between the values of the synthetic measure for individual EU countries in selected time units (see Figure 2).

As the saturation level increases, the dynamics of changes within the analysed measure decreases, which can be observed in the values of statistical indicators presented in the table above. The rate of growth of economic as well as social indicators, after reaching a certain threshold value, begins to slow down. Economic indicators are subject to cyclical amplitude. Therefore, maintaining a growth trajectory often means the need to reduce the growth rate within a given indicator (Jones, 2016, pp. 3–69). This is also reflected in the results presented in the paper. Namely, the dynamics of changes in the synthetic measure of competitiveness of the EU–28, and especially the EU–15, is definitely lower than the dynamics of changes in the EU–13 and the V4 countries. Consequently, a comparison of the values of individual measures indicates the existence of significant differences between EU–13 representatives (countries) and EU–15 representatives (countries). Therefore, in the EU–13 countries, as well as in the Visegrad group countries, there is still scope to generate a high rate of change within individual indicators (see Table 1).

The lag effects and the slowing of the growth rate of economic indicators after reaching certain thresholds are of greater importance and can be more easily observed in shorter time intervals, up to a maximum of three or

four years. Therefore, in the case of analyses covering the entire period 2005–2018 examined, including the period 2009–2018, the dynamics of changes in the level of competitiveness will look better for countries representing primarily the EU–13. Nevertheless, it should be taken into account that in most EU countries, including those that are competitiveness leaders, there is still room for generating growth within individual indicators, even if the growth rate is slowing down. There is no doubt, however, that from the point of view of competitiveness of economies, the EU–13 countries are becoming a more homogeneous structure. At the same time, differences in the level of competitiveness of EU–15 countries are increasing.

Changes in the competitiveness rankings are illustrated in Table 2. The deterioration of the economic situation in 2009 can be seen in the decreasing values of synthetic measures in as many as 13 countries. In addition, there is a group of countries, and they are mostly representatives of the EU-15, where the values of synthetic measures even in 2018 are lower than those shown for 2005. An important element in the assessment of changes in the competitive position of EU countries over time are correlations between the rankings obtained for the years 2005, 2009, 2018 illustrated by scatter plot diagrams (Figure 3). The conducted analysis indicates the highest correlation of rankings for 2005 and 2009. Therefore, it can be assumed that the EU–15 countries benefited the most from the largest enlargement of the EU carried out in May 2004, gaining easy access to new markets. However, in the case of new countries, it was too short a period to eliminate the differences in the level of economic development between the EU-13 and the EU–15 (Figure 3).

Discussion

In the context of analyses concerning the level of competitiveness of EU economies, data aggregation should be borne in mind, as it makes difficult capturing relationships/regularities occurring at the level of an individual country.

First of all, in line with the objectives set out in the introduction to the paper, selected groups of countries, including the EU–28, EU–15, EU–13 and the Visegrad group (V–4), constitute the subject of the conducted analysis. Therefore, the situation of individual countries is not thoroughly discussed in the paper. Secondly, due to the multidimensional nature of the studied phenomenon and in accordance with the methodology adopted in the paper, the values of individual synthetic measures of competitiveness are the resultant of six individual indicators. Nevertheless, in discussing the

results obtained from the conducted analyses, it is worth pointing out some elements that explain their application value.

Based on the literature and referring to the results of their own research, the authors emphasise that the factors leading directly to the international competitive advantage of a given country are an increase in exports, an improvement in the current account balance, and a higher GDP growth rate (Weresa, 2016; Hurduzeu, & Lazar, 2015; Ahangari *et al.*, 2014; Eichengreen, 2006). The conducted empirical study indicates that in 2005 and 2018 the strongest positive correlation occurred between the level of competitiveness of countries expressed using the synthetic competitiveness measure proposed in the paper and the following two diagnostic variables: (a) observed values of the current account balance in relation to GDP (b) values of GDP per capita (PPS). It is also worth emphasising that the latter of the mentioned correlations weakened in strength in the subsequent time units examined. Thus, in the discussion on the results of their own research, the authors raise the issue that the current account balance is key to macroeconomic stability of the economy (Lyulyov & Shvindina, 2017; Żuchowska, 2013).

On the one hand, a permanent CA deficit and the consequent increase in the negative net international investment position (IIP) may be a source of low resistance of a given country to external shocks and may carry the risk of a rapid capital outflow. On the other hand, a permanent CA surplus can generate losses if it is recorded in relation to a country that is unable to pay its accumulated net foreign liabilities over the long term. The issue of the current account balance (CAB) which is in line with the fundamental economic parameters is, therefore, important for both a country with a CA deficit and a country with a CA surplus. The problem of undesirable effects of deficits and surpluses is important and cannot be left without a more thorough analysis, as this issue can inhibit international exchange and the development of economies, including a slowdown in the growth rate of the world economy (Blanchard & Milesi-Feretti, 2011; Eichengreen, 2006). The results of research on the global pattern of current account imbalances obtained by Gruber and Kamin (2007) indicate that financial crises, which lead to long-term imbalances, are largely responsible for the current account surplus. This is also confirmed by the results obtained by the authors. In 2009, which is the year of European economies recovering from the financial crisis, the relationship between the values of the current account balance in relation to GDP and the level of competitiveness of countries was much weaker than in 2005 and 2018. In addition, from 2009 to 2012, the diversity of EU countries due to the value of the current account balance (% of GDP) increased significantly. Another reason for this surplus is

a relatively high level of GDP per capita and the openness of the economy. On the other hand, current account deficits arise due to a high GDP growth rate, as well as the state budget and oil trade deficit.

The importance of the CA balance for the macroeconomic stability of individual European Union (EU) countries and the EU as a whole can be seen by the analysis of this indicator by the European Commission as part of the Macroeconomic Imbalance Procedure (MIP) (introduced following the crisis in 2011). The prudential thresholds adopted under the MIP for the CA balance (average of 3 years) are + 6/-4% of GDP (European Commission, 2019, p. 53). Available data, which were collected for the needs of the multivariate analysis presented in the paper, indicate a strong differentiation of the CA balance both between EU economies and over time.

As economic integration progresses, the current account deficit in the poorer countries increases, while the surplus in the richer countries of the group increases (Blanchard & Giavazzi, 2002). This regularity is primarily observable in countries that were at the top of the competitiveness rankings presented in the paper. Over the whole period considered, the surplus in current account balances was recorded by: Denmark, Germany, Luxembourg, the Netherlands, Austria, and Sweden. However, in the Netherlands, Germany and Denmark, the surplus recorded in 2018 increased compared to 2005 and 2009. In the remaining countries listed, the surplus decreased during the period considered. Only in four EU countries, i.e. in Greece, Romania and Great Britain, as well as in Cyprus, a negative balance was recorded throughout the entire analysed period. The countries from the EU–13 group which registered a current account deficit for a significant number of years in the 2005–2018 period were: Latvia, Poland and Slovakia.

Conclusions

The issue of international competitiveness has been frequently raised in recent years by both economists and politicians. The discussion concerns not only the way of defining, describing and choosing factors determining competitiveness but also the way of measuring this extremely complex and multifaceted phenomenon.

This paper is devoted to the assessment of EU countries' competitive position in the selected years of 2005–2018. The multidimensional analysis of EU countries' competitiveness goes beyond the simple result approach and takes into account also structural factors influencing Poland's competitiveness.

The method of selecting diagnostic variables referring to the concept of macroeconomic stabilisation pentagon and the use of multivariate statistical analysis allowed for the achievement of the main goal and specific objectives of the study. The compiled rankings of the EU countries' competitiveness enable the assessment of changes in competitiveness within the EU–15 and EU–13 groups as well as the Visegrad group (V–4) in the analysed time units.

The results of the presented empirical research allowed us to verify the research hypotheses. It has been confirmed that the countries of the so-called 'old' EU held top positions of competitiveness rankings throughout the entire analysed period, but there was also a noticeable increase in the competitiveness of the EU–13 countries. The greatest advancement of these countries was observed in 2018. At that time, Malta occupied a high 3rd position, and Slovenia was in the lead (6th position). Poland's 10th position in this ranking is also a cause for optimism, especially since Poland's competitive position in 2005 among the countries of the Community was very low, i.e. Poland ranked 24th, remaining ahead of only Greece, Bulgaria, Portugal, and Romania. Poland was also characterised by the lowest competitiveness among the V–4 countries (the Czech Republic — 8th position, Hungary — 19th, Slovakia — 23rd). For the Visegrad group countries, 2018 was also a year of significant advancement in the competitiveness ranking, with the Czech Republic ranking 11th, Hungary ranking 16th and Slovakia 17th. Nevertheless, the greatest progress was recorded in the case of Poland, which ranked 10th. Thus, the hypothesis that the competitiveness of the Polish economy was increasing in the analysed period has been confirmed.

In subsequent periods, various EU representatives appeared at the bottom of the competitiveness ranking. In 2005, the ranking was closed by: Bulgaria, Portugal, and Romania. In 2009, the countries with the weakest competitive position included: Greece, Lithuania and Latvia. Greece, for which the synthetic indicator of Hellwig's economic development was negative, was definitely the country with the weakest competitive position in 2018. Right next to it, at the bottom of the ranking, the following countries can be found: Spain, Italy and Romania. It is worth emphasising that while the EU–15 countries dominated the top of competitiveness rankings, irrespective of the unit of time under consideration, representatives of the so-called 'old' EU, especially from the southern part of the continent, started to appear there more frequently.

The research has proven that from the point of view of competitiveness of economies, the EU–13 countries are becoming a more homogeneous structure, while the differences in the level of competitiveness of the EU–15 countries are increasing.

The presented assessment of the competitive position of the EU–15 and EU–13 groups as well as the Visegrad group does not exhaust the complexity of the issue, and it is only one of its threads that make up the entire assessment system. The conducted research and formulated conclusions provide contribution to further research in this field, enrich the knowledge concerning the international competitiveness of EU countries presented in the literature, and constitute a valuable source of information about the international competitiveness of economies for political decision-makers.

The issues under consideration are particularly important in the context of less developed countries, including Poland, which face difficult development challenges resulting from the change in the competitive forces in the world and the turmoil caused by the pandemic. New factors for the modernisation of economies should be sought, using knowledge, innovation and human capital. It seems that the quality and uniqueness of products, the ability to identify and satisfy individual customer needs, as well as comprehensive promotional activities and the creation of national brands should be an important source of competitiveness.

In subsequent studies, it is worth focusing on assessing the competitiveness of the Visegrad group countries. Narrowing down the field of observation to this group of countries, with a simultaneous increase in the number of diagnostic variables with particular emphasis on the indicators characterising the competitiveness of enterprises, will allow for an in-depth analysis of the competitive capacity of the Visegrad group. It would also be interesting to use other methods of statistical multivariate analysis, such as the TOPSIS method or the Generalised Distance Measure (GDM) (Balcerzak & Pietrzak, 2017a, 2017b. Additionally, in further research, the authors intend to base the assessment of competitiveness to a greater extent on individual data (obtained from special studies), as aggregated data (published by the Central Statistical Office and Eurostat) do not take into account the specificity of a given economy.

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Annex

Table 1. Selected descriptive statistics of synthetic measures determined for selected time units

	TOTAL – EU					
	MIN		MAX		$\overline{x}$	Vs
	Value	**Country**	**Value**	**Country**		
2005	0.073	Romania	0.597	Luxembourg	0.281	49.1%
2009	0.014	Latvia	0.553	Luxembourg	0.147	49.1%
2018	-0.073	Greece	0.724	Ireland	0.145	49.1%
			UE-15			
2005	0.115	Portugal	0.597	Luxembourg	0.344	40.3%
2009	0.101	Greece	0.553	Luxembourg	0.378	33.0%
2018	-0.073	Greece	0.724	Ireland	0.300	**60.2%**
			UE-13			
2005	0.073	Romania	0.370	Slovenia	0.209	45.8%
2009	0.014	Latvia	0.372	Cyprus	0.207	54.6%
2018	0.122	Romania	0.508	Malta	0.290	**30.0%**
			V4			
2005	0.127	Poland	0.367	Czech Rep.	0.202	48.2%
2009	0.145	Hungary	0.357	Czech Rep.	0.248	30.9%
2018	0.258	Slovenia	0.344	Poland	0.298	**12.4%**

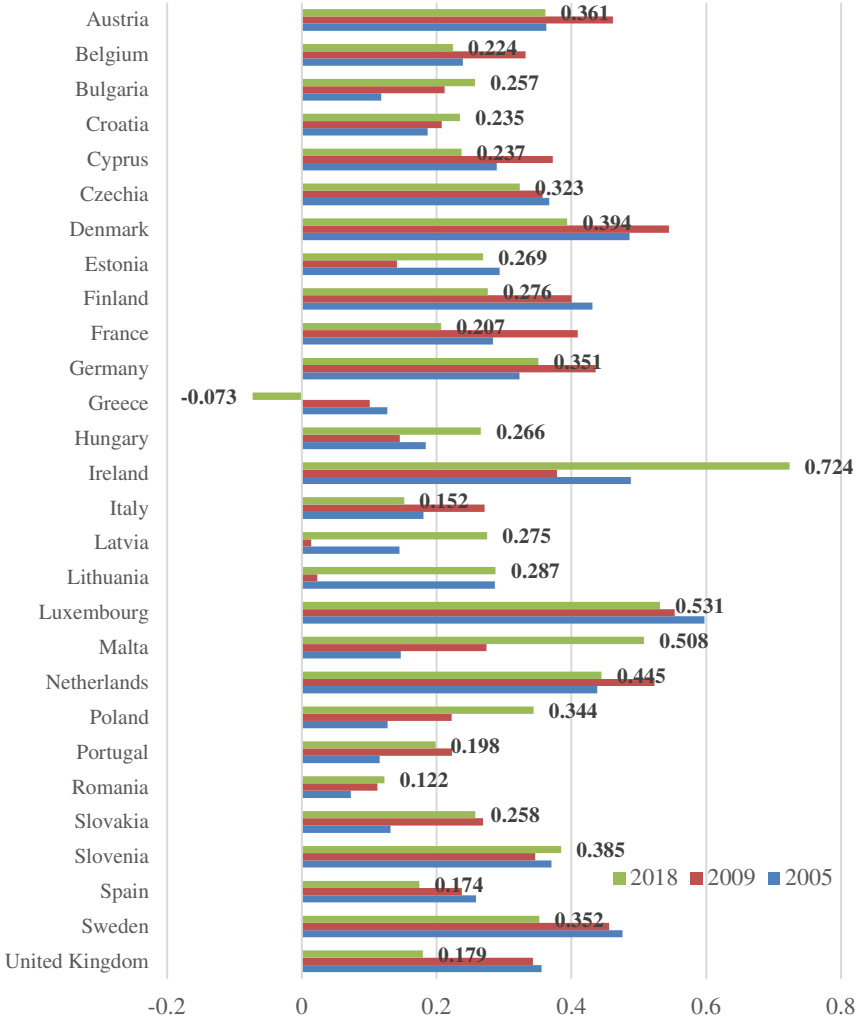
Source: own elaboration: calculations in the pllord package (R environment).

Table 2. Competitiveness rankings for EU countries in selected time units

Country	2005		2009		2018	
	Position	Synthetic measure value	Position	Synthetic measure value	Position	Synthetic measure value
Austria	9	0.363	4	0.461	7	0.361
Belgium	17	0.239	14	0.332	21	0.224
Bulgaria	26	0.118	21	0.212	18	0.257
Croatia	18	0.187	22	0.207	20	0.235
Cyprus	13	0.289	10	0.372	19	0.237
Czech Rep.	8	0.367	11	0.357	11	0.323
Denmark	3	0.486	2	0.545	5	0.394
Estonia	12	0.294	24	0.141	15	0.269
Finland	6	0.431	8	0.400	13	0.276
France	15	0.284	7	0.409	22	0.207
Greek	25	0.127	26	0.101	28	-0.073
Spain	16	0.258	18	0.238	25	0.174
Netherlands	5	0.438	3	0.523	4	0.445
Ireland	2	0.488	9	0.378	1	0.724
Lithuania	14	0.286	27	0.023	12	0.287
Luxembourg	**1**	**0.597**	**1**	**0.553**	**2**	**0.531**
Latvia	22	0.145	28	0.014	14	0.275
Malta	21	0.147	15	0.274	3	0.508
Germany	11	0.323	6	0.436	9	0.351
Poland	**24**	**0.127**	**20**	**0.222**	**10**	**0.344**
Portugal	27	0.115	19	0.222	23	0.198
Romania	28	0.073	25	0.112	27	0.122
Slovakia	23	0.132	17	0.269	17	0.258
Slovenia	7	0.370	12	0.346	6	0.385
Sweden	4	0.476	5	0.456	8	0.352
Hungary	19	0.184	23	0.145	16	0.266
UK	10	0.355	13	0.343	24	0.179
Italy	20	0.180	16	0.271	26	0.152

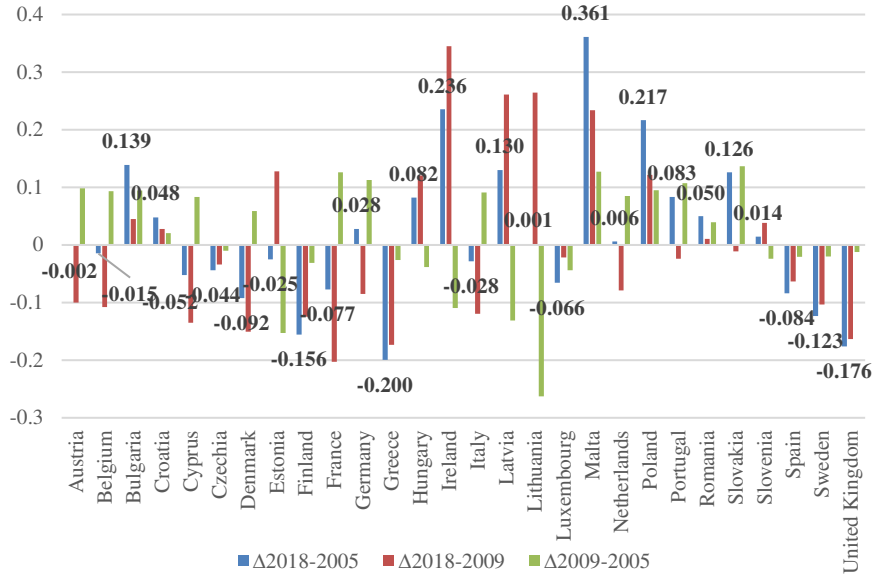
Source: own elaboration: calculations in the pllord package (R environment) and graphic visualisation in MS Excel.

Figure 1. Linear ordering results of EU countries in the analysed years – 2005, 2009 and 2018



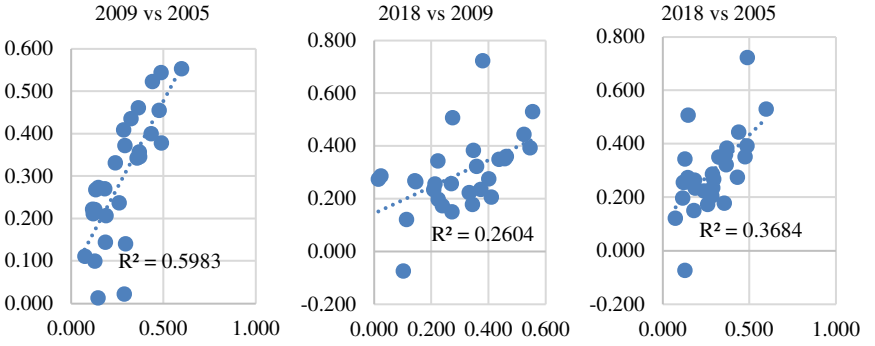
Source: own elaboration: calculations in the pllord package (R environment) and graphic visualisation in MS Excel.

Figure 2. Differences in the values of the synthetic measure for individual EU countries in selected years



Source: own elaboration: calculations in the pllord package (R environment) and graphic visualisation in MS Excel.

Figure 3. Correlation scatter diagrams for the values of synthetic measures determined in selected time units



Source: own elaboration: calculations in the pllord package (R environment).