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A MULTI – SPEED EUROPE, AND THE PERIPHERALITY OF POLAND

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Abstract

In recent years, research on the synchronization of business cycles in economies has been undertaken more than once. This is a desirable phenomenon especially for the European Union. The aim of the article is to verify selected macroeconomic indicators that characterize the economies of countries belonging to the European Union in relation to Poland, thus presenting convergence of dynamic cycles of changes in socio-economic sphere indicators: inflation rate, unemployment rate, short-term interest rates, and GDP. For this purpose, a cross-spectral analysis was used which allows us to show the occurring fluctuations of different lengths, as well as to compare the strength of the relation of changes between selected indicators. According to the conducted analyses, it was noted that the Polish economy (in the perspective of long-term changes) is a determinant of changes for highly developed countries.

JEL classification: E60, F36
Keywords: European economy, multi-speed Europe, cross-spectral analysis, the peripherality of Poland

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Introduction

In recent years, research on the synchronization of business cycles in economies has been undertaken more than once. This is a desirable phenomenon especially for areas with one currency for different countries. An obvious example of such an area is the European Union. It is worth noting, however, that the very accession to the euro area (which is most closely associated with the single currency area) in some of the zone states has increased the correlation of the business cycle, but there were also countries with which it reduced this power. In addition, there are countries whose cycles are strongly synchronized with the euro area (among others Germany, Austria, France), but also those whose cycles are less correlated with the euro area (including Italy, Portugal, Greece) (Stafaski, 2008, p. 132). The degree of synchronization of business cycles is an indicator that allows us to determine whether the benefits of membership in the monetary union outweigh the costs of losing the tools of "absorbing" shocks such as independent monetary and exchange rate policy (Konopczak, 2009, p. 69). The lack of synchronization of the economic cycle of one of the countries within the EU structures may destabilize its economic situation, which is why it is extremely important for the policy to verify that all countries are in the same phase of the cycle, because (no matter how intense this phase is) all factors affect member states' economies in the same way (Stafaski, 2008, p. 131). Due to the differences in phases for the security of each of the economies individually, it would be necessary to apply other monetary policy tools. According to Konopczak (2009, p. 68), there is a common factor that synchronizes the business cycle in Poland and the largest member states of the euro area. A public discussion on the idea of a "multi-speed Europe", including the most frequently mentioned concept of a two-speed Europe was launched, due to the economic crisis in the European Union and the euro area debt crisis. By assumption, the European Union countries would be divided according to the pace of development in two or more areas of similar economic situation. According to Górka and Łuszczyk strong arguments for changes in European Union policy may be uneven economic and social development, as well as lack of integration within the Economic and Monetary Union, the euro area itself, as well as an unsatisfactory state of public finances of some EU member states (Górka, 2017, p. 23). The aim of such a division would be, paradoxically, to maintain European integration, avoid economic problems, and at the same time to allow developing countries to integrate slowly as part of their development path - these countries were colloquially called peripheral countries. According to reports, Poland would be qualified among these countries, which for the above would not have its justification. The authors aimed at the verification of selected macroeconomic indicators that characterize the economies of countries belonging to the European Union in relation to Poland, thus examining the convergence of the dynamics of cycles of changes in socio-economic sphere indicators – inflation rate, unemployment rate, short-term interest rates, GDP. Based on the conducted analyses, an attempt was made to assess if changes in the Polish economy depend on economic changes in other European Union countries.

Methodology and subject of the analysis

The cross-spectral analysis was used to explain the dependence of relations between individual macroeconomic values, referring to the results of individual countries. It allows us to show the occurrence of variations with different lengths - seasonal or business fluctuations (Osińska, 2006, p. 156). This method is based on decomposing a time series into several sine and cosine functions with different periods, thus enabling the most important fluctuation frequencies, which have different (but significant) effects on the general dynamics and amplitude of the series (Łuczyński, 2015, p. 21). To determine the causality of variables (the impact of changes in the value of the selected indicator on changes in this indicator in Poland), the values of spectral density and the square of coherence were used to indicate significant fluctuations in the cyclical structure of changes in individual variables. Based on the results, for the indicated frequencies of cyclic fluctuations, the value of the delay of variables was calculated, which indicates the occurrence of causality of individual indicators of selected countries.

Spectrum estimation is based on a set of empirical observations for a time series $\{Y_t : t = 1, 2,\ldots, T\}$, on the basis of which the inference of the stochastic process Y_t is carried out. One of the methods to estimate the spectrum is to use a discrete Fourier transform, which for the series $\{Y_t: t = 0, 1, \ldots, T\text{-}1\}$ is defined (and for s = 0, 1, ..., T-1) as:

$$x_s = \sum_{T=0}^{T-1} y_t e^{-\frac{2\pi i s t}{T}} \quad (1)$$

After appropriate transformations[1], the periodiagram function of the studied process can be described by the following formula:

$$f(w_s) = \frac{1}{2\pi}(\gamma_0 + 2\sum_{j=1}^{T-1} \gamma_j \cos(jw_s)) \quad (2)$$

where consecutive γ_j (for j = 0, 1, ..., T-1) are values of autocorrelation coefficients in the sample.

In order to examine the relationship between two variables, it is necessary to conduct a stationary reciprocal spectrum analysis (i.e. cov $(x_s; y_{s+j})$ = cov $(x_t; y_{t+j})\forall(s,t,j)$) of the two-dimensional process $\begin{bmatrix} x_t \\ y_t \end{bmatrix}$, t∈N. The spectral function of such a process has the form (Łuczyński, 2015, pp. 21-23):

$$f(\omega) = \begin{bmatrix} f_{xx}(\omega) & f_{xy}(\omega) \\ f_{yx}(\omega) & f_{yy}(\omega) \end{bmatrix} = \frac{1}{2\pi}\sum_{j=-\infty}^{\infty} e^{-i\omega j}\Gamma(j) \quad (3)$$

is the function of autocovariance of the discussed process equal to $\begin{bmatrix} \gamma_{xx}(j) & \gamma_{xy}(j) \\ \gamma_{yx}(j) & \gamma_{yy}(j) \end{bmatrix}$, where:

$$\gamma_{xx}(j) = cov(x_t; x_{t-j}),$$
$$\gamma_{xy}(j) = cov(x_t; y_{t-j}),$$
$$\gamma_{yy}(j) = cov(y_t; y_{t-j}),$$
$$\gamma_{yx}(j) = cov(y_t; x_{t-j}).$$

The diagonals of the spectral functions of the discussed two-dimensional process are: the density of one-dimensional processes (x_t, y_t) which take values of $f_{xx}(w) = \frac{1}{2\pi}\sum_{j=-\infty}^{\infty}\gamma_{xx}(j)e^{-iwj}$, $f_{yy}(w) = \frac{1}{2\pi}\sum_{j=-\infty}^{\infty}\gamma_{yy}(j)e^{-iwj}$ and the functions of mutual spectral density $f_{xy}(w) = \frac{1}{2\pi}\sum_{j=-\infty}^{\infty}\gamma_{xy}(j)e^{-iwj}$, $f_{yx}(w) = \frac{1}{2\pi}\sum_{j=-\infty}^{\infty}\gamma_{yx}(j)e^{-iwj}$.

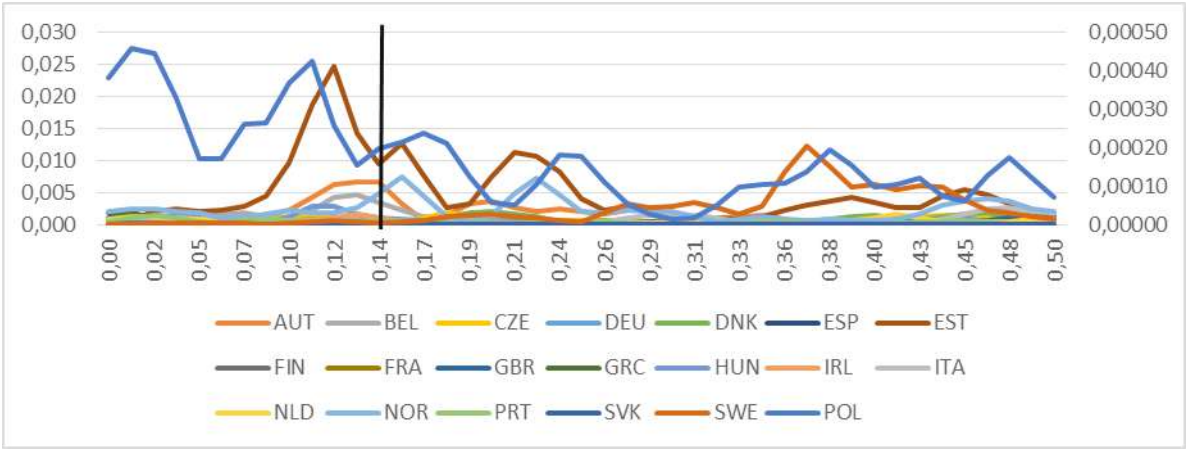
Subject of the analysis: The quantitative data for the period from January 2011 to December 2017 were used for the study. Time series collections were created for selected macroeconomic indicators corresponding to individual countries: inflation rate (monthly change), unemployment rate (monthly change), short-term interest rates (monthly change) and GDP (quarterly change). Each set of series consisted (as far as available) of the data of individual countries for which the designations were written in brackets: Austria (AUT), Belgium (BEL), Switzerland (CHE), Czech Republic (CZE), Germany (DEU), Denmark (DNK) , Spain (ESP), Estonia (EST), Finland (FIN), France (FRA), United Kingdom (GBR), Greece (GRC), Hungary (HUN), Ireland (IRL), Italy (ITA), Latvia (LTU)), Lithuania (LVA), the Netherlands (NLD), Norway (NOR), Poland (POL), Portugal (PRT), Slovakia (SVK), Slovenia (SVN) and Sweden (SWE). In order to verify the stationarity of the studied time series two diagnostic tests were used: Dickey-Fuller and Philips-Perron. The test results in all cases indicated the stationarity of the analyzed time series.

Cyclic dependencies of selected indicators between the Polish economy and the economies of selected European countries

Below are presented the results of the cross-spectral analysis referring to the subject of research – cyclical relationships of selected macroeconomic variables of Poland and other European countries. Due to the large

1 This refers to Fourier transform and demonstrating Parseval equality. More on this subject in: Talaga & Zieliński, 1986.

Chart 1: The density of spectral changes in unemployment for selected countries



Source: Own elaboration based on data from OECD, http://www.oecd.org/, download date: 03/25/2018

amount of data, the results of the study were interpreted in two fluctuations:

- short-term - fluctuations below one year, which for changes in the unemployment rate, inflation rate and interest rates means the frequency of cycles being below 0.14, while for GDP changes the frequency is below 0.13,
- long-term - fluctuations over a year, marked above the frequencies indicated earlier.

In the case of the square of the coherence of spectral densities, the results were divided according to the set frequencies.

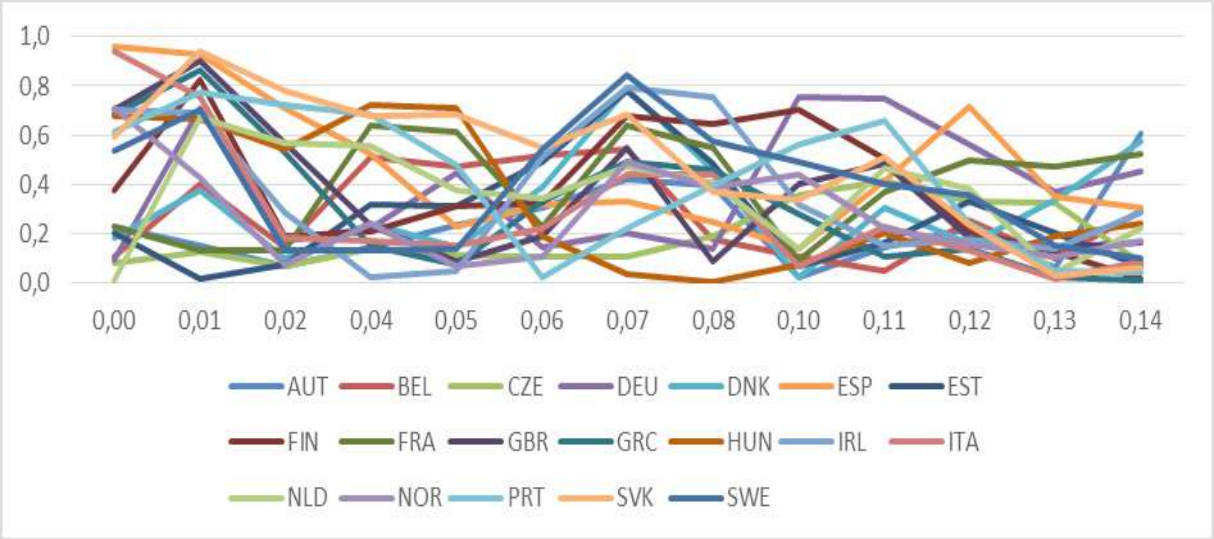
Chart 1. presents the value of the density of spectral changes in unemployment in Poland (auxiliary axis) and the same values for selected European countries. In the case of Poland, in the short term, there is a large contribution of variations of 0.01 and 0.11 corresponding to monthly and ten-month cycles in the dynamics of changes in the indicator. In the case of long-term fluctuations, fluctuations of 0.17 and 0.24, i.e. 15-month and 2-year cycles should be distinguished as significant. For selected countries, there is a minimal tendency to increase the role of the frequency of 0.11 in the short term. This points to the increased role of changes in the value of unemployment rates in 9-month cycles (which correspond to the frequency of 0.11) in shaping the overall dynamics of changes in the indicator.

Chart 2 shows the square of coherence of the spectral density of changes in the unemployment rates in Poland and selected European countries, which shows a clear tendency for strong dependencies in the ratio of Poland and other countries for the frequency of 0.01 (one month volatility) and 0.07 (six-month fluctuations). To determine the causality, frequencies for which the square of coherence was above 0.75 were used. In the case when two or more such values could be indicated for a given relation, the one that was more important in view of the contribution to the dynamics of the change in Poland was chosen.

Similarly, for the fluctuation frequency between 0 and 0.14, in Chart 3 the shaping of the square of coherence for long-term fluctuations is presented, from which the frequencies above 0.75 were used to determine the causality of the variables. For this range of fluctuations, the characteristic frequency was not observed among the examined relationships.

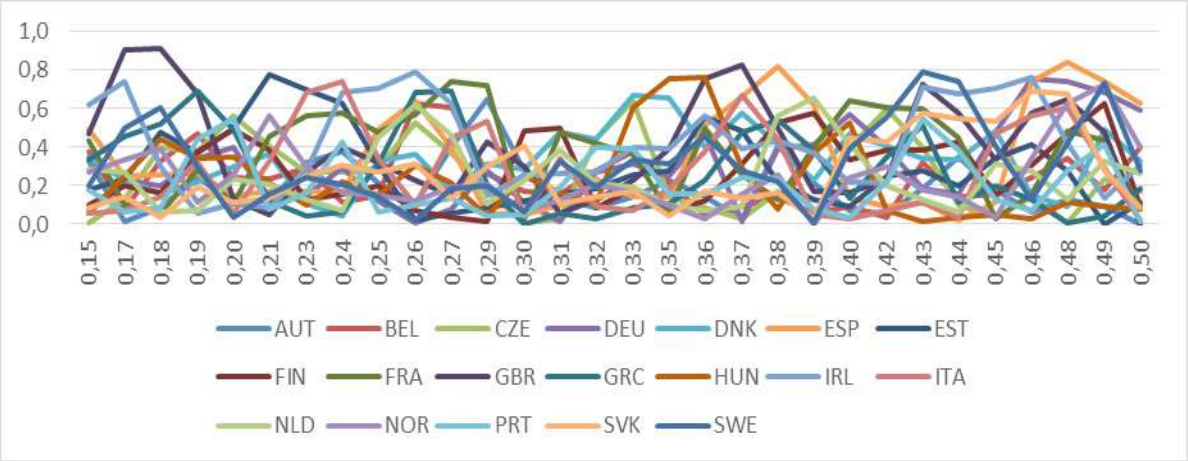
Chart 4. illustrates the evolution of the density of spectral inflation changes for the surveyed countries, which in the short term pointed to the trend of increasing the fluctuations in the frequency of 0.05 (4-month cycles) and 0.12 (10-month cycles). In the case of long-term fluctuations, no clear synchronization of cycles was noted. In the case of changes in the inflation rate for Poland (values marked on the auxiliary axis), a high contribution of fluctuations in the short-term, 0.07 and 0.12 cycles (six-month and 10-month variations) have been demonstrated for cycles. In the long-term, a high value can be indicated for cycles of 0.31, which means that for a long period it is possible to indicate a significant contribution of 26-month

Chart 2: The square of the coherence of the spectral density of changes in the unemployment of Poland and selected European countries for the frequency of fluctuations from 0 to 0.14



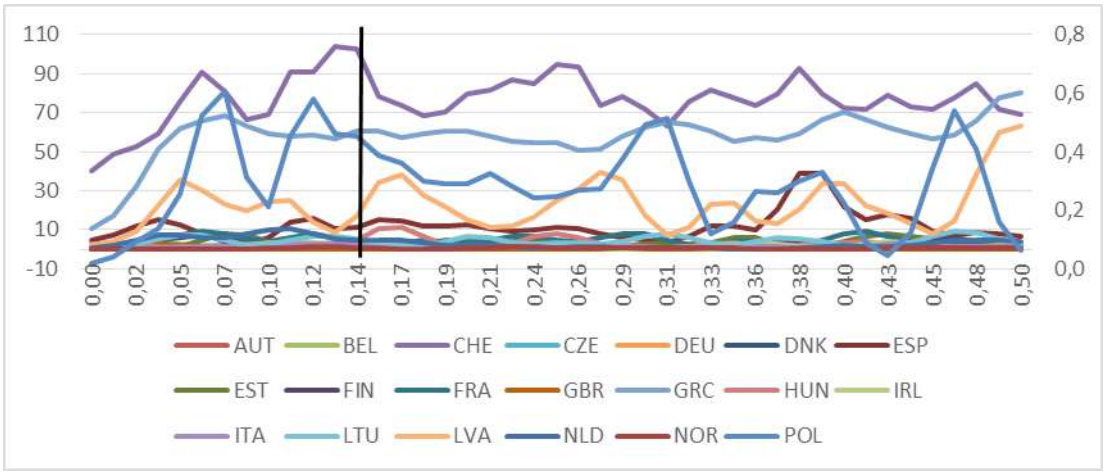
Source: Own elaboration based on data from OECD, http://www.oecd.org/, download date: 03/25/2018

Chart 3: The square of the coherence of the spectral density of changes in the unemployment of Poland and selected European countries for the frequency of fluctuations from 0.15 to 0.5



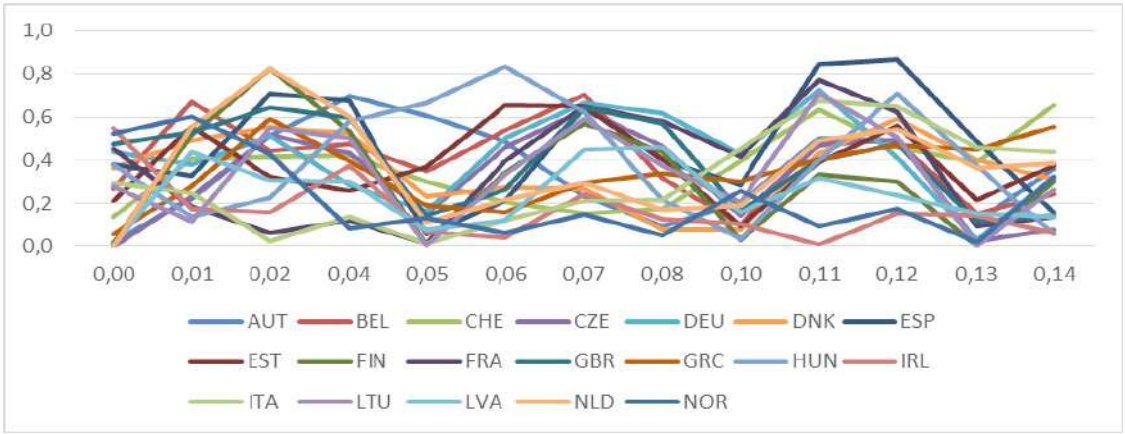
Source: Own elaboration based on data from OECD, http://www.oecd.org/, download date: 03/25/2018

Chart 4: Spectral density of inflation changes for selected countries



Source: Own elaboration based on data from OECD, http://www.oecd.org/, download date: 03/25/2018

Chart 5: The coherence of the spectral density of changes in inflation of Poland and selected European countries for the fluctuation frequency from 0 to 0.14



Source: Own elaboration based on data from OECD, http://www.oecd.org/, download date: 03/25/2018

changes to the dynamics of inflation changes.

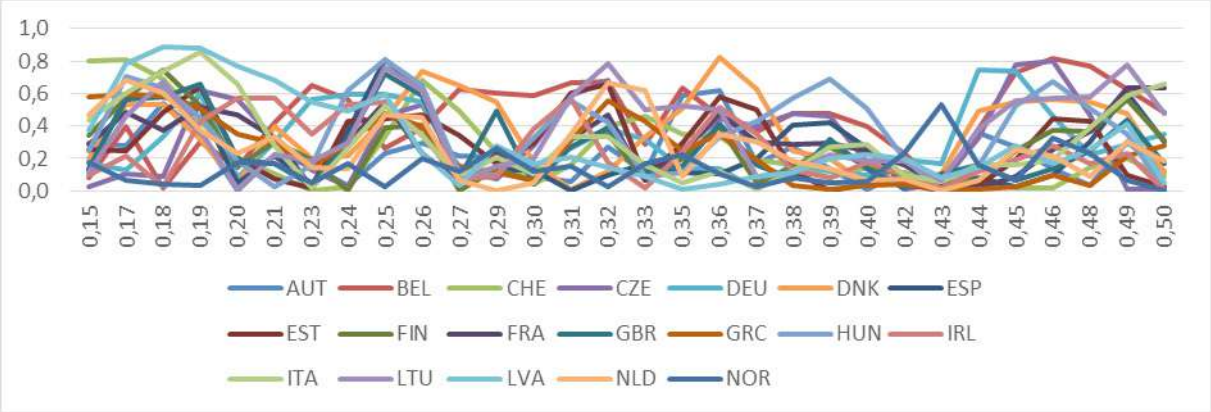
As illustrated in Chart 5, three distinct frequencies can be noted in the short term, characterized by an increase in the ratio in inflation rate in Poland: 0.02, 0.07 and 0.12. In the shaping of the indicator of changes in Poland, the two highest frequencies for this length of fluctuations (0.07 and 0.12) have a relatively large contribution. Thus, the indicated lengths of inflation fluctuations have the greatest contribution to shaping the changes in the total indicator (in comparison to other frequencies), and for this reason the frequency has been used to study causality in international relations.

The values of the square of the coherence of the spectral density of inflation changes for a long period showed a high level of diversity of significant frequencies (above 0.75), which was depicted in Chart 6. For this reason, for the study of causality for this period, those frequencies that showed the significance of the relationship (the value of the coherence square above 0.75) were used at the same time as a lower frequency level (lower than other results relevant for a given country in relation to Poland).

The values of the spectral density of interest rate changes in Poland, presented in Chart 7, indicate that quarterly cycles have a significant contribution to the change. In the long run, these are cycles with a length of 15 months. These values correspond to the tendencies of all surveyed countries, which increase the values of spectral densities for frequencies of 0.04 and 0.18.

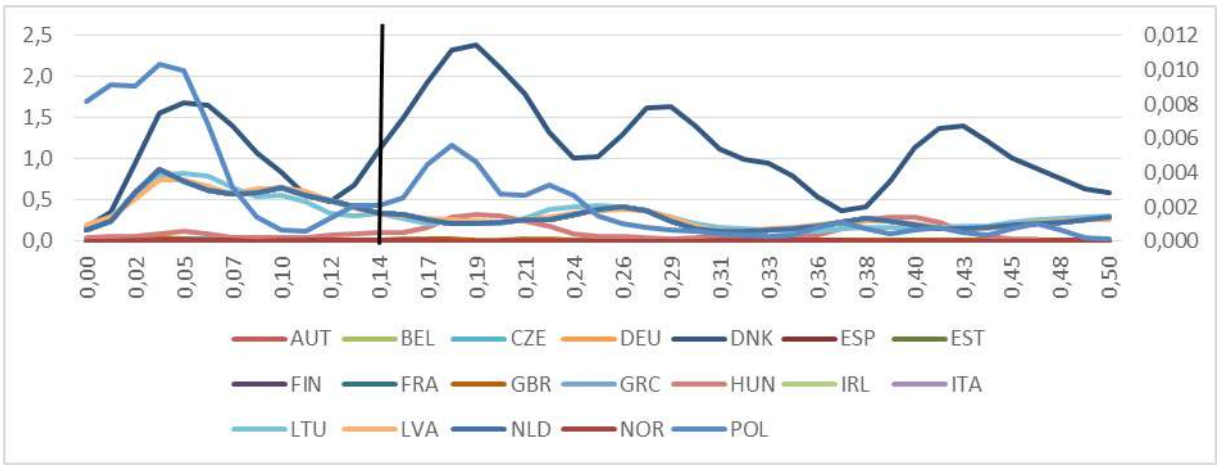
The value of the coherence square of the analyzed relationship does not explicitly indicate the selection of the selected frequency in the short term (Chart 8). Therefore, these frequencies in the short period were used to determine causality, which showed a significant

Chart 6:



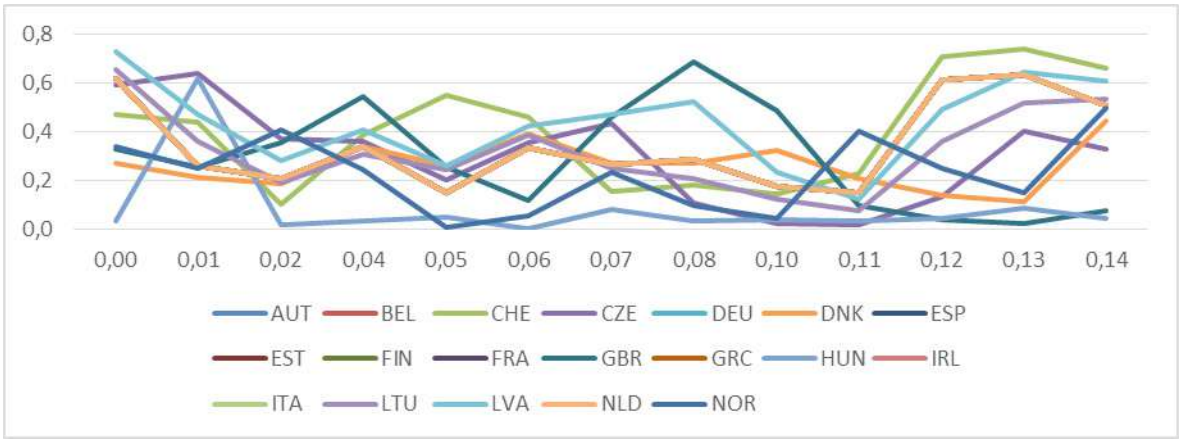
Source: Own elaboration based on data from OECD, http://www.oecd.org/, download date: 03/25/2018

Chart 7: Spectral density of interest rate changes for selected countries



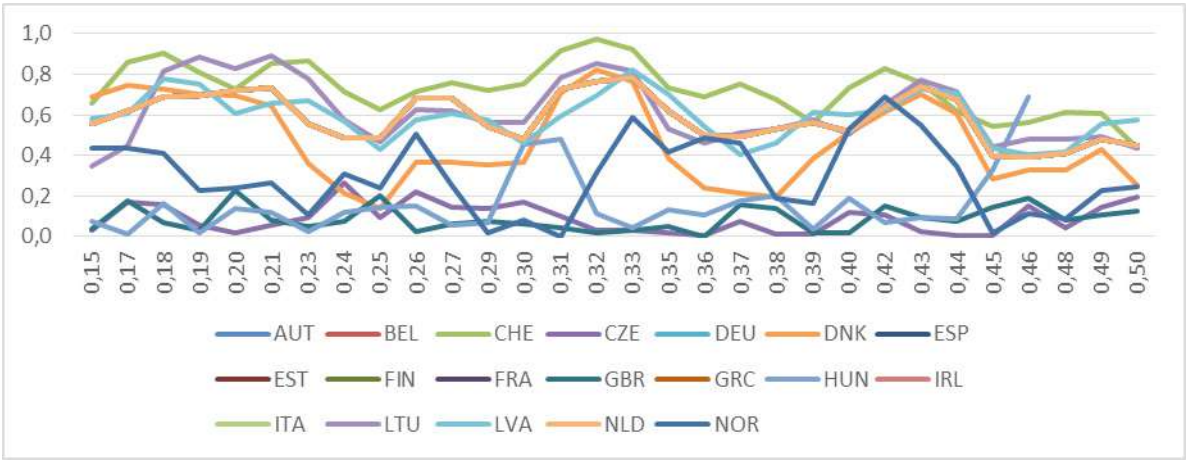
Source: Own elaboration based on data from OECD, http://www.oecd.org/, download date: 03/25/2018

Chart 8: The square of coherence of spectral density of interest rate changes in Poland and selected European countries for fluctuations frequency from 0 to 0.14



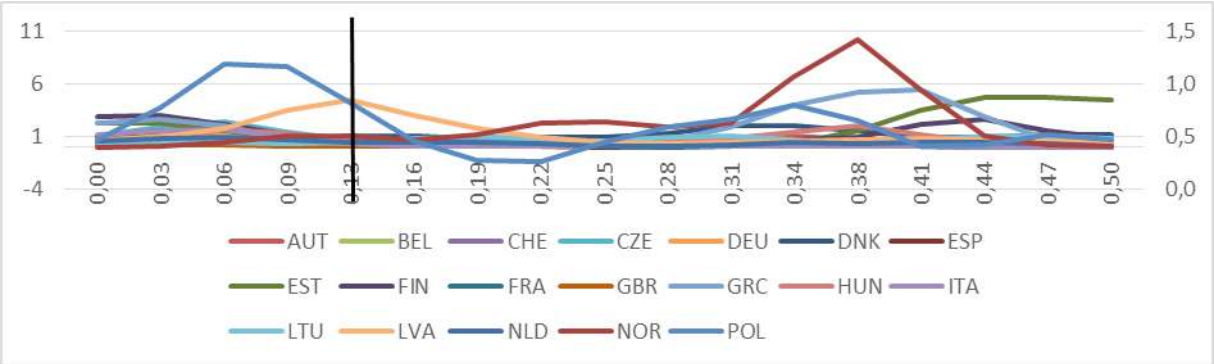
Source: Own elaboration based on data from OECD, http://www.oecd.org/, download date: 03/25/2018

Chart 9: The square of coherence of spectral density of interest rate changes in Poland and selected European countries for the frequency of fluctuations from 0.15 to 0.5



Source: Own elaboration based on data from OECD, http://www.oecd.org/, download date: 03/25/2018

Chart 10: Spectral density of GDP changes for selected countries



Source: Own elaboration based on data from OECD, http://www.oecd.org/, download date: 03/25/2018

level of the presented value.

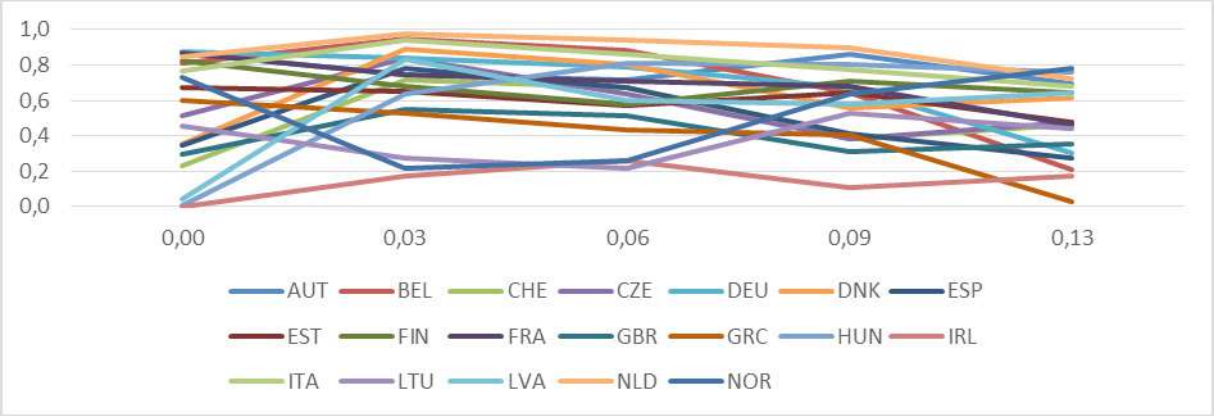
Similarly, as in short-term fluctuations, long-term cycles depicted in Chart 9 do not indicate the occurrence of variations characteristic for these lengths. The determination of causality was based on the use of these frequencies, which indicated a high level of significance of the studied relationship.

Chart 10 presents the shaping of spectral density values for the surveyed countries, which indicate the significance of frequencies of 0.06 and 0.38 in the shaping of the examined variable. They correspond respectively to six-month and four-year fluctuations. In the case of a short period for Poland, the same frequency of 0.06 may be indicated as significant for the cyclical structure of Polish GDP. In the case of long-term fluctuations, this frequency is similar for other countries and amounts to 0.34, which is less than four years (3.75 years).

The short-term values of the coherence square, depicted in Chart 11, indicate the occurrence of the relation between changes in the GDP of Poland in relation to changes in the GDP of other countries, mainly for two frequencies: 0.03 and 0.09. These fluctuations correspond to quarterly and nine-month cycles. In order to analyze the causality of changes in Polish GDP in response to changes in this indicator in other countries, the frequency with a higher value of the square of coherence was used.

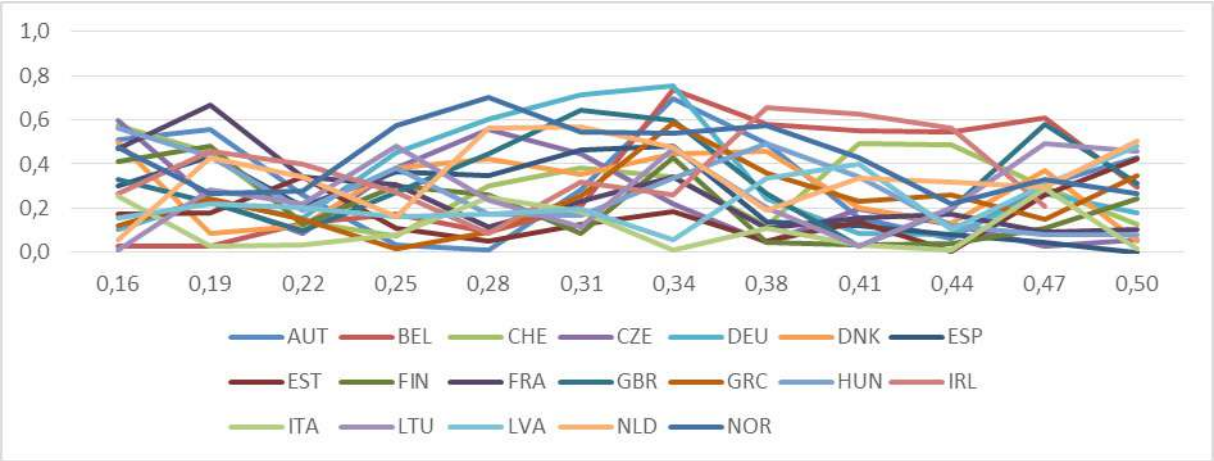
Diagram 12 illustrates the shaping of the square values of the coherence of GDP changes in the long run, which does not explicitly indicate the existence of dependence between Poland's GDP and other countries in more than one-year cycles. As shown in the chart, you can only indicate a few ratios in which this ratio approaches

Chart 11: The coherence of the spectral density of changes in the GDP of Poland and selected European countries for the frequency of fluctuations from 0 to 0.13



Source: Own elaboration based on data from OECD, http://www.oecd.org/, download date: 03/25/2018

Chart 12: The coherence of the spectral density of changes in the GDP of Poland and selected European countries for the frequency of fluctuations from 0.13 to 0.5



Source: Own elaboration based on data from OECD, http://www.oecd.org/, download date: 03/25/2018

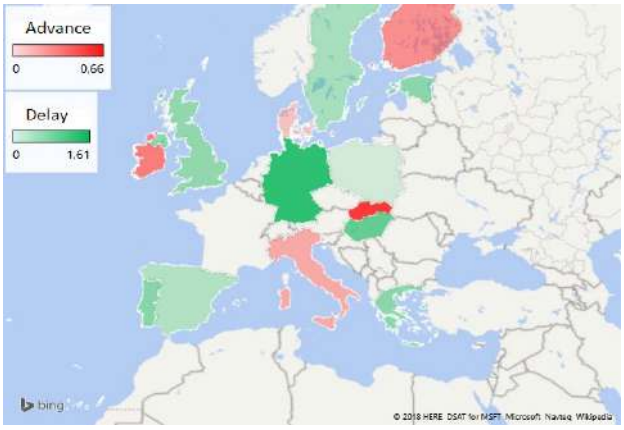
0.7. In the assessment of delays, in the further part of the work, the values for these relations and the length of the cycles were used.

Time shifts in the cycles of changes of selected macroeconomic indicators

Delays as well as predictions of variables between countries for previously selected frequencies have been presented in relation to Poland using maps. Countries for which there was no significant relationship between indicators characterizing the economies of these countries and the Polish economy for a given frequency in the selected range of fluctuation length (short-term and long-term) were not marked on the maps. In addition, the results of transfers have been included in the charts, where in addition to the names of countries, the cycle lengths for which the given time difference corresponds are marked with reference to Poland. It should be remembered that for each indicator, the contribution of a given frequency to the dynamics of the indicator in Poland should be considered - despite the existence of a frequency relationship, it may not be significant in the perspective of other fluctuations, hence should not be interpreted.

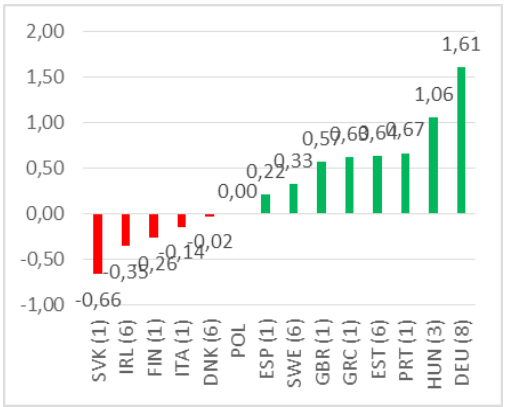
The results of dependence for the cycles of changes in the unemployment rate (Figures 1 and 2) indicate that the change in this indicator in Poland precedes the changes in a large part of the highly developed countries of Europe – i.e. Germany, England, France and Sweden. This means that in the case of changes in trends (both

Figure 1: Delays between short-term cycles of changes in the unemployment rate of selected countries in relation to changes in the unemployment rate in Poland



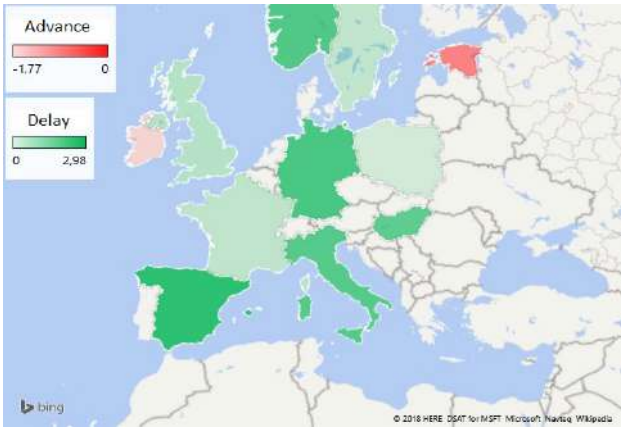
Source: Own elaboration based on data from OECD, http://www.oecd.org/, download date: 03/25/2018

Chart 13: Delays between short-term cycles of changes in the unemployment rate of selected countries in relation to changes in the unemployment rate in Poland



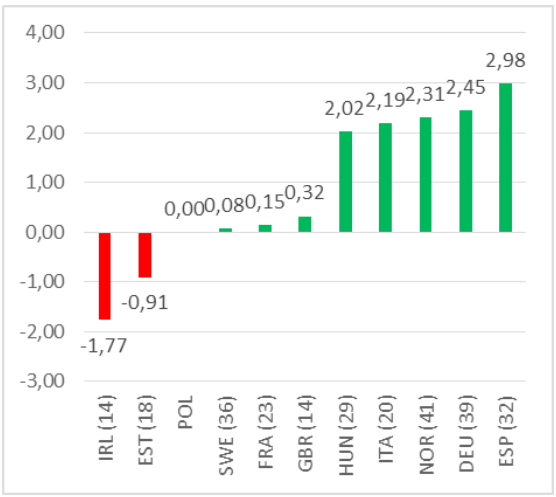
Source: Own elaboration based on data from OECD, http://www.oecd.org/, download date: 03/25/2018

Figure 2: Delays between long-term cycles of changes in the unemployment rate of selected countries in relation to changes in the unemployment rate in Poland



Source: Own elaboration based on data from OECD, http://www.oecd.org/, download date: 03/25/2018

Chart 14: Delays between long-term cycles of changes in the unemployment rate of selected countries in relation to changes in the unemployment rate in Poland

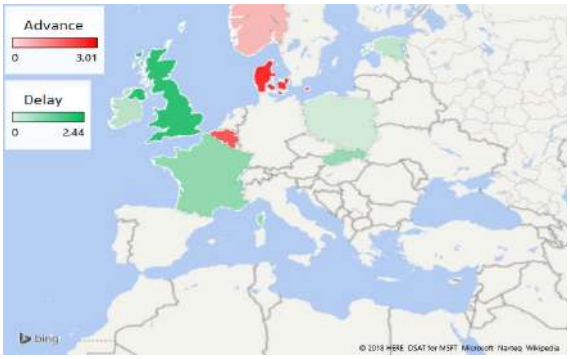


Source: Own elaboration based on data from OECD, http://www.oecd.org/, download date: 03/25/2018

long-term and short-term fluctuations) of this indicator, Poland will be the first to experience the effects of this change, which in theory will allow adjusting the policies of individual countries in response to the existing situation based on the experience of Poland. In the perspective of the subject discussed in the article, it is worth noting that the significance of the dependence (and therefore synchronization) of this indicator was recorded in relation to as many as 12 countries out of the 24 analyzed. It was also noted that in the short period of fluctuations, one can find countries in which changes in the unemployment rate are preceded by changes in this rate in Poland (e.g. Slovakia, Italy or Ireland). In the short-term, high significance in shaping the dynamics of fluctuations was indicated by cycles of 0.01 and 0.11, and in the long-term by cycles of 0.17 and 0.24, which indicates a stronger synchronization of Polish cycles with eight of the surveyed countries that indicated the occurrence of high level of dependence for this frequency (Charts 13 and 14).

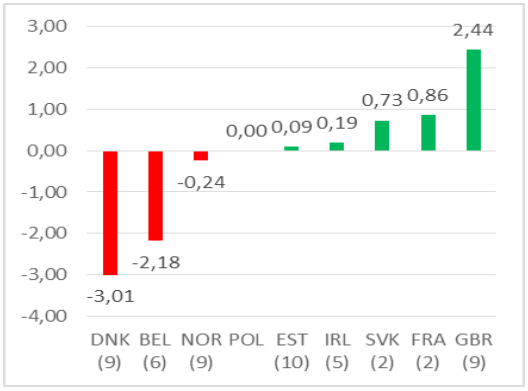
In the case of changes in the inflation rate in the short-term, there aren't such numerous dependencies as in the case of changes in the unemployment rate (Figure 3) - the significance of the relation was demonstrated for eight countries. In this length of fluctuations, it can be noticed that the role of Poland as an indicator of short-term trends can be noted for five of the surveyed countries (Estonia, Ireland, Slovakia, France and the United Kingdom). A high contribution to the dynamics of the Polish series of inflation fluctuations in the group of short-term fluctuations was recorded for the frequencies of 0.07 and 0.12, which indicates the possibility of

Figure 3: Delays between short-term cycles of changes in the inflation rate of selected countries in relation to changes in inflation in Poland



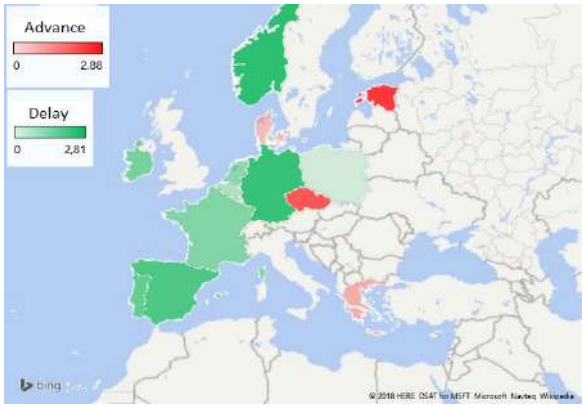
Source: Own elaboration based on data from OECD, http://www.oecd.org/, download date: 03/25/2018

Chart 15: Delays between short-term cycles of changes in the inflation rate of selected countries in relation to changes in inflation in Poland



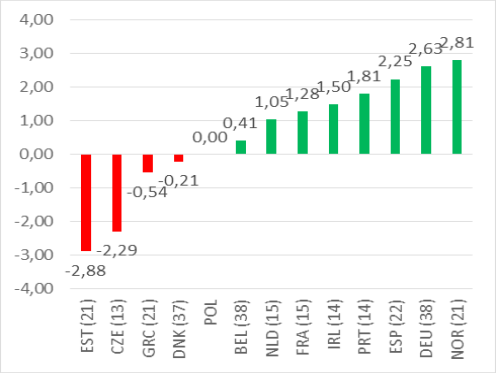
Source: Own elaboration based on data from OECD, http://www.oecd.org/, download date: 03/25/2018

Figure 4: Delays between long-term cycles of changes in the inflation rate of selected countries in relation to changes in inflation in Poland



Source: Own elaboration based on data from OECD, http://www.oecd.org/, download date: 03/25/2018

Chart 16: Delays between long-term cycles of changes in the inflation rate of selected countries in relation to changes in inflation in Poland



Source: Own elaboration based on data from OECD, http://www.oecd.org/, download date: 03/25/2018

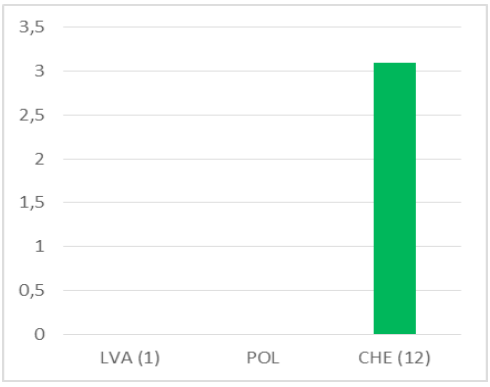
indicating the synchronization of the indicator between the analyzed countries, but not for frequencies with the largest contribution for short fluctuations (Chart 15).

The study of dependence on long-term fluctuations, however, indicated the repetition of Poland's position in the perspective of synchronization with other European countries. It can be noted that for long-term changes, Poland plays the role of a determinant of changes for highly developed countries, including Germany and Great Britain. The number of countries for which the results indicated the relevance of the relationship indicates the

Figure 5: Delays between short-term cycles of changes in interest rates of selected countries regarding interest rate changes in Poland

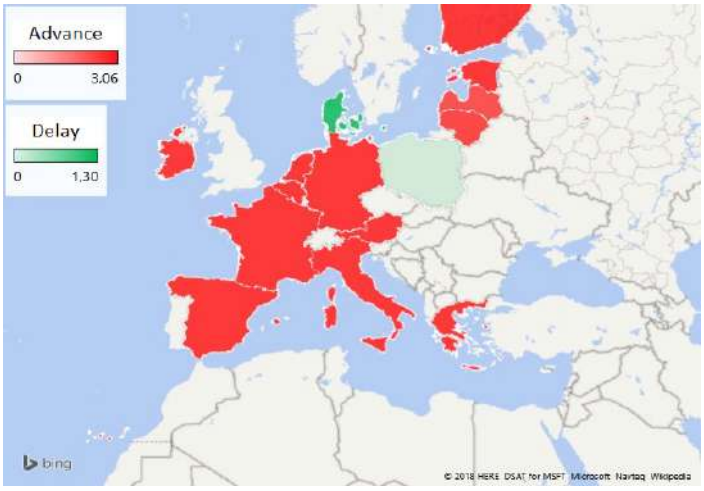
Source: Own elaboration based on data from OECD, http://www.oecd.org/, download date: 03/25/2018

Chart 17: Delays between short-term cycles of changes in interest rates of selected countries regarding interest rate changes in Poland



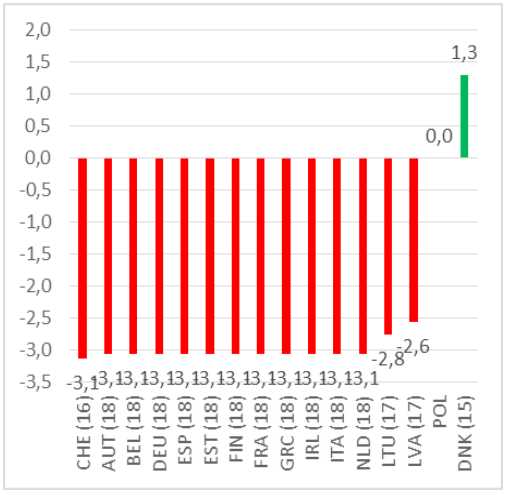
Source: Own elaboration based on data from OECD, http://www.oecd.org/, download date: 03/25/2018

Figure 6: Delays between long-term cycles of changes in interest rates of selected countries regarding interest rate changes in Poland



Source: Own elaboration based on data from OECD, http://www.oecd.org/, download date: 03/25/2018

Chart 18: Delays between long-term cycles of changes in interest rates of selected countries regarding interest rate changes in Poland



Source: Own elaboration based on data from OECD, http://www.oecd.org/, download date: 03/25/2018

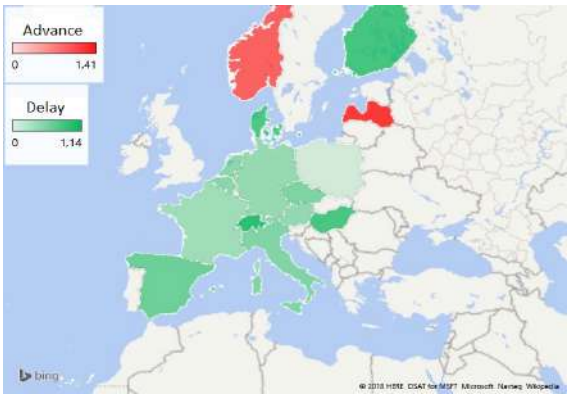
occurrence of synchronization of this indicator in Europe, in particular for long-term fluctuations.

As shown above (Figures 5 and 6, and Charts 17 and 18), in the short term, there aren't numerous relationships between changes in short-term interest rates in Poland and other European countries. This dependence is observable in the long-term, where it can be seen that there is significant advance of changes in these rates by changes in this ratio in other countries, both in Eastern Europe such as Lithuania, Latvia and Estonia, but also in Western Europe, such as Germany or France. Most frequencies indicate a dependence for one and a half year fluctuations. This situation may be dictated by the strong influence of the euro area on the shaping of monetary policy in Poland. The study, however, indicates that there is a strong synchronization of the surveyed countries in the long run.

The last analyzed indicator is quarterly GDP changes in selected European countries. In the case of this variable, in the short term, a number of dependencies can be observed between the economy of Poland and the economies of selected countries. A particular dependence can be pointed out in the case of highly developed countries, which indicate a delay in Poland's GDP changes in quarterly cycles.

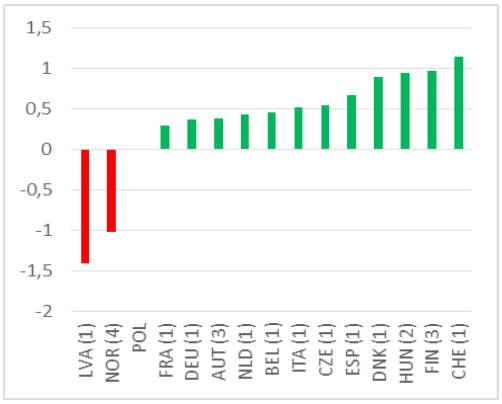
For long-term fluctuations, no such strong dependence of variables was observed. The only significant theoretical exception is the relation of long-

Figure 7: Delays between short-term cycles of GDP changes in selected countries in relation to GDP changes in Poland



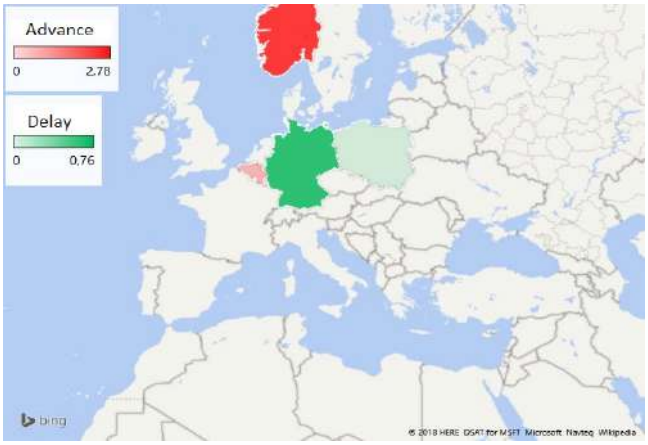
Source: Own elaboration based on data from OECD, http://www.oecd.org/, download date: 03/25/2018

Chart 19: Delays between short-term cycles of GDP changes in selected countries in relation to GDP changes in Poland



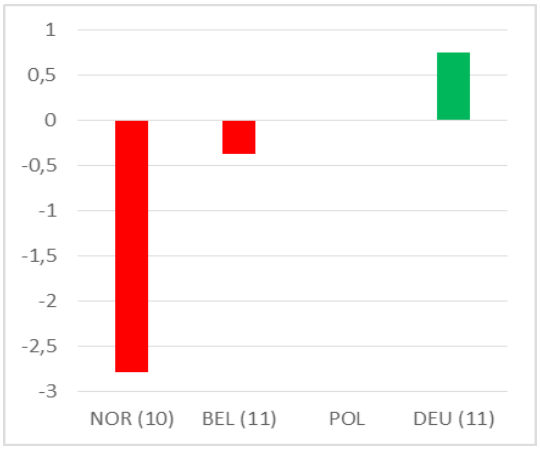
Source: Own elaboration based on data from OECD, http://www.oecd.org/, download date: 03/25/2018

Figure 8: Delays between long-term cycles of GDP changes in selected countries in relation to GDP changes in Poland



Source: Own elaboration based on data from OECD, http://www.oecd.org/, download date: 03/25/2018

Chart 20: Delays between long-term cycles of GDP changes in selected countries in relation to GDP changes in Poland



Source: Own elaboration based on data from OECD, http://www.oecd.org/, download date: 03/25/2018

term cycles of GDP of Poland and Germany, which indicates the economic relationship of these two countries, widely discussed in the literature.

Conclusions

The analysis presented in the study showed that there are significant relationships between the economies of European countries and the economy of Poland. Nevertheless, they were strongly diverse, both geographically and because of the significance of dependence. In conclusion, it should be pointed out, above all, that there is a strong dependence of changes in the unemployment rate in Europe. These changes are observable in the first place, among countries such as Ireland and Poland, and then in the highly developed countries of the European Union. In addition, there is a dependence of long-term changes in the level of inflation between countries, which may indicate a progressive synchronization of the economic development of the EU area. The conducted analyses also justify the fact that interest rate changes in Poland took place in response to changes in interest rates of other European countries in the long run, and in terms of GDP changes - in the short term it can be observed that Poland is a determinant of these changes for other EU countries. Therefore, it is reasonable to claim that changes in the Polish economy are reflected in changes in the European economy.

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