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Demographic Trends in European Union Countries During the COVID-19 Pandemic

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Abstract:

Purpose: *The main aim of this study is analyse the impact of the pandemic on the demographic situation in the European Union countries between 2015 and 2023. The situation before the pandemic and its impact in 2020–2021 and 2022–2023 will be presented.*
Design/Methodology/Approach: *Eurostat is the source of the analysed data. This study employed taxonomic analysis, a non-model method. Four key variables were analysed across the period considered: population density per 1 km^2, total dependency ratio, net migration rate per 1,000 people and natural increase rate per 1,000 people.*
Findings: *The analysis revealed a decline in demographic development in the period considered and a statistically significant decrease in the demographic development change dynamics index during the pandemic.*
Practical Implications: *The results of the study can be used as recommendations for regional development policies.*
Originality/Value: A comparison of the demographic development of EU countries shows a decline during the period under examination.

Keywords: *Development, socio-economic development, taxonomic analysis.*

JEL Codes: *J10, C00.*

Paper type: *Research article.*

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1. Introduction

European countries and their economies, as well as the world economy, are facing various crises. This has been the case for at least a decade. This trend can be traced back to the global economic crisis that affected the financial markets. The crisis reached its peak between 2008 and 2009. Another crisis recorded in Europe in 2016 affected the banking sector.

The outbreak of the COVID-19 pandemic and Brexit were also significant blows to the economy. Both events took place in 2020. The armed conflict in Ukraine, initiated in 2022 (Kluth, 2023), also contributed significantly to the deepening economic crisis.

2. Literature Review

The European Union has struggled with population ageing for several decades, and the birth rate is clearly declining. At the same time, migration plays an increasingly important role as a counterbalance to demographic change. Between 2015 and 2019, even before the outbreak of the COVID-19 pandemic, most EU countries were struggling with declining birth rates and an increasing proportion of older adults in the population.

This is a long-term trend that started in Europe several decades ago. Predictions strongly suggest this trend will not change in the coming decades (Bak and Szczecinska, 2021).

Many researchers point to three "great revolutions" in human history since the 18th century. The first is industrialisation, the second is related to the internationalisation and subsequent globalisation of business, and the third is defined by radical changes in demographics. In terms of the latter, these changes were initially perceived as dynamic population growth, implying a threat of limited living space, population impoverishment, depletion of natural resources and environmental degradation (Gajowiak, 2021).

The demographic mechanism involves a dynamic feedback loop between fertility, the birth rate and the population's age structure. Declining birth rates reduce the proportion of young people in the population, accelerating change and, as a result, population ageing. In turn, the older the age structure, the lower the birth rate. In the long term, these forces can cause very profound changes in the population, resulting in a negative population growth rate, i.e., a permanent decline in the number of people due to their age or a decline in the number of people due to their age structure (Sobolewska-Poniedzialek, 2024).

In 2020, a global pandemic emerged, significantly impacting and changing the demographic situation in Europe. The consequences were manifold, ranging from a significant increase in the number of deaths to a reduction in life expectancy. Restrictions and limitations on the movement of people have led to significant migration barriers. There have even been changes in parenting decisions. The examples presented are only some of the many consequences. One significant, albeit temporary, consequence of the pandemic has been the disruption of healthcare systems. This also had a certain impact on the demographic situation.

It can be said that social policy has focused on demographic developments and related changes for many years. This topic has also become popular among social scientists. This is because the developments and trends in this area often have a direct impact on national policies. They also determine decisions made not only by local authorities and communities but also at the state level. Looking at the different aspects of population ageing, this problem undoubtedly affects many, if not all, areas of economic and social life, such as public spending, social welfare, healthcare and the labour market (Abramowska-Kmon, 2011; Bloom and Luca, 2016; Filas-Przybył, 2017; Józefowicz, 2019; Spilbergs *et al.*, 2023).

The hypothesis of 'global convergence and local divergence' was confirmed by J.A. Duro, among others. His research shows that until the mid-1980s, income disparities between member states represented half of the inequalities observed between regions. In contrast, inequalities between regions within each country accounted for the other half. Since then, disparities between countries have decreased, while regional disparities within each country have increased.

Consequently, the vast majority of regional disparities in Europe are currently attributed to disparities within countries. The convergence of European regions is primarily driven by external factors (between countries) (Sawicz, 2013; Martin, 2005, as cited in Krawczyk, 2017).

Analysing the relationship between global convergence and local divergence, demographic differences are gradually becoming less noticeable globally. The opposite trend can be observed locally, i.e., they can become more pronounced. This is particularly the case when analysing demographic differences between urban and rural areas or between richer and poorer regions. Trends with global characteristics, such as the declining birth rate, can have a different impact locally. While such a situation induces relative stability in some countries, it can contribute to drastic changes in demography in others.

Economists identify four factors that may explain convergence between European Union countries (Gierczycka-Bednarek, 2007, as cited in Krawczyk, 2017):

- Convergence resulting from neoclassical growth theory. Poorer countries have a higher marginal productivity of capital (due to weaker initial endowment of this factor of production) and thus grow faster than capital-rich countries. The situation is similar when it comes to human capital. The new growth theory suggests that the fundamental sources of long-term GDP per capita growth are closely linked to human and intellectual capital development, as it supersedes the law of diminishing marginal returns.

- Technological catch-up, a theory based on endogenous models. Convergence happens because less developed countries catch up technologically. This may stem from the fact that importing know-how or copying solutions is cheaper than investing in research.

- Profits from commerce – rich countries were more economically integrated from the beginning, and poorer countries joining the common market had relatively greater increases in benefits from international trade, which caused convergence.

- Structural transformation – growth is driven by the reallocation of resources from less productive sectors to more productive ones.

There are convergence clubs in the European Union. This conclusion is based on the growing imbalance between regions within individual countries and the simultaneous reduction in the imbalance between countries. In each country, the richer regions develop faster than the poorer ones, and the richer regions in relatively poorer countries grow faster than the rich regions in wealthier countries (Sawicz, 2013; Boldrin and Canova, 2002 as cited in Krawczyk, 2017).

Demographic convergence can be said to exist once a gradual and long-term alignment of demographic indicators has been observed. For example, it can be a coefficient relating to the age structure of the population, life expectancy or fertility rates in different countries or smaller areas such as regions. This relationship is caused by global socio-economic changes, medical and technological progress, and urbanisation.

As a result, the dominant manifestations of demographic convergence can be seen in the decline in fertility, population ageing, increased life expectancy, urbanisation and significant changes in the structure of households.

As developing countries experience demographic convergence, their age structure begins to resemble that of developed countries. Such a process is intrinsically linked to population ageing.

Developed countries have long struggled with population ageing, whereas in developing countries, this process is rapidly accelerating due to declining fertility rates and longer life spans. In conclusion, population ageing is a global trend resulting from demographic convergence. This process has a significant impact on social policy, pension schemes and the labour market.

The existence of convergence clubs proves that the world is not developing uniformly. Individual countries are organised into clubs that reflect different demographic and economic models.

Focusing on the determinants of population ageing is a crucial step in analysing this trend. Several variables should be considered when analysing it. When considering the definition of population ageing, it can be concluded that it is an increase in the proportion of older persons in a population relative to the proportion of younger persons (Sytuacja demograficzna osób starszych... 2014, p. 2).

Hence, it is possible to identify various factors influencing urban ageing. These will undoubtedly include natural population change, changing family models and gradually increasing life expectancy and the mortality rate of a given community (Kurek, 2008). Nevertheless, when analysing the factors influencing a country's ageing process, it is important to consider the significant influence of population migration, especially emigration. It is precisely emigration that causes disturbances in the structure and age distribution of the population of a given city (Janiszewska and Dmochowska-Dudek, 2017).

Emigration, the subject of this research, involves the outflow of citizens of a particular country and refers largely to adults but most often to young people. Emigration has serious consequences and causes significant changes. By changing their place of residence, these young people contribute to a significant loss affecting two important social groups. The first group is young people of working age or in their prime, often also parents. The second group consists of their children, who are of pre-working age.

The fact that children move with their parents modifies the population structure of a particular country. As a result, the percentage of older people of post-working age increases (Józefowicz, 2019). The causes of demographic convergence include globalisation, knowledge transfer, economic development and medical advances.

In conclusion, demographic convergence can be seen as a process in which countries at different stages of development begin to exhibit similar demographic characteristics. Analysis of global trends suggests that demographic indicators will continue to converge in the future, although the pace of change varies between regions.

This article hypothesises that the level of demographic development of EU countries declined between 2015 and 2023. The following research questions were considered:

- Does the demographic development in countries lead to a levelling out of their development in spatial systems?

- Has the COVID-19 pandemic altered the trends in the scope of change in demographic development dynamics?

- Does a country's size correlate with its demographic development change dynamics index?

- Does the level of demographic development affect the demographic development change dynamics index?

3. Research Methodology

The analysis covers nine years (2015-2023), focusing on 27 EU countries. Indicators were then used to describe the demographic development of the countries. All indicators used meet the formal requirements relating to quantitative analyses. Their diagnosticity was analysed and then transformed into intensity indicators (Kosiedowski, 2001).

Assuming that the *m*-element set represents the countries under study at year-end (*m* = 243 = 27 cities × 9 years) and *n* expresses the development features, we can calculate the following two-dimensional data matrix (Ponikowski, 2004).

$$X_c = \begin{bmatrix} x_{11} & x_{12} & \dots & x_{1n} \\ x_{21} & x_{22} & \dots & x_{2n} \\ \dots & \dots & \dots & \dots \\ x_{m1} & x_{m2} & \dots & x_{mn} \end{bmatrix} \quad (1)$$

where:
X_c – matrix of diagnostic features for component *c* (*c* = 1…3), x_{ik} – elements of matrix X_c denote the value of examined features for the *i*-th (*i* = *1,2,...,m*) object (country) in a given year and *k*-th (*k* = *1,2,...,n*) development features.

The variables used from the set X_c should indicate a significant level of potential differentiation. Coefficients of variation can be used to determine how strongly the selected measures condition country development differentiation. These, in turn, can be calculated as the quotient of the standard deviation of the values in the set of analytical variables and their arithmetic mean. The higher the coefficient of variation, the more objective the choice of the corresponding variable that determines potential (Niedźwiecki, 2002a).

The coefficient of variation is calculated as (Ponikowski 2004):

$$V_k = \frac{S_k}{\bar{x}_k} 100 \ , \quad (2)$$

where:
$\overline{x}_k$ – the arithmetic mean of the *k*-th development feature calculated according to the formula:

$$\overline{x}_k = \frac{1}{m}\sum_{i=1}^{m} x_{ik} \ , \tag{3}$$

while S_{x_k} is the standard deviation calculated as:

$$S_k = \sqrt{\frac{1}{m} \quad \sum_{i=1}^{m}(x_{ik} - \overline{x}_k)^2} \ . \tag{4}$$

The next step is to standardise variables. This is done by converting destimulant metrics into stimulant metrics, respectively (Niedźwiecki, 2002a; Roeske-Słomka, 2003):

for stimulants

$$x'_{jk} = x_{jk} \ , \tag{5}$$

for destimulants

$$x'_{jk} = \max_{j} x_{jk} - x_{jk} \ , \tag{6}$$

resulting in an adjusted matrix X_c' of partial indicators of demographic potential as follows (Niedźwiecki, 2002a; Roeske-Słomka, 2003):

$$X_c' = \begin{bmatrix} x'_{11} & x_{12} & \dots & x'_{1n} \\ x'_{21} & x_{22} & \dots & x'_{2n} \\ \dots & \dots & \dots & \dots \\ x'_{m1} & x'_{m2} & \dots & x'_{mn} \end{bmatrix} . \tag{7}$$

Destimulants are diagnostic features whose increasing values negatively impact the examined process or phenomenon.

In the second stage, the correlations between the individual partial indicators of demographic potential are determined. As a result, strongly correlated variables are eliminated from the analysis. Therefore, it is possible that if the correlation level is exceeded, a specific sub-measure will be omitted from further analyses. This is an expert method.

The third stage involves using various non-additive measures to express diagnostic characteristics. Standardisation is necessary to achieve comparability of the investigated characteristics. Standardised statistical data, on the other hand, are presented as pure numbers. Therefore, the adjusted observation matrix X_c' is transformed into a matrix of standardised observations of partial potential indicators (Niedźwiecki, 2002a; Ponikowski, 2004):

$$Z_c = \begin{bmatrix} z_{11} & z_{12} & \cdots & z_{1n} \\ z_{21} & z_{22} & \cdots & z_{2n} \\ \cdots & \cdots & \cdots & \cdots \\ z_{m1} & z_{m2} & \cdots & z_{mn} \end{bmatrix}, \tag{8}$$

whereas:

$$z_{ik} = \frac{x'_{ik} - \bar{x}_k}{S_k} \quad , \tag{9}$$

where:
z_{ik} – standardised k-th feature for the i-tk object (country), x_{ik} – initial value of the k-th feature of the i-th object, $\bar{x}_k$ and S_k – arithmetic mean and standard deviation of the k-th potential feature.

In the final step, the synthetic measures are constructed. After a thorough examination and synthesis of all partial indicators considered diagnostic (Kosiedowski 2001), the relative development indicator W_i was created, which only takes values in the range of <0.1>. The higher its value, the higher the potential of the country studied (Niedźwiecki, 2002b).

$$W_i = \frac{\sum_{k=1}^{n} z_{ik}^{*}}{\sum_{k=1}^{n} \max_i \left[z_{ik}^{*} \right]} \ , \tag{10}$$

where:

$$z_{ik}^{*} = z_{ik} + \left| \min_i \left[z_{ik} \right] \right| . \tag{11}$$

Each country’s relative synthetic development indicator for 2015–2023 was determined. A specific map of the countries' demographic development was created, which categorises the examined objects in time and space.

4. Research Results and Discusion

Table 1 presents a selection of indicators for the analysis of demographic development in EU countries. They include three stimulants and one destimulant. The selection of indicators was limited due to data availability concerning the 2015-2023 study period. Ultimately, four indicators were selected for the study period.

These are indicators used in regional statistics to describe the demographic development of different territorial units. Unfortunately, Eurostat does not yet have a forecast for some of the 2023 data. Table 1 also presents the coefficients of variation of the examined indicators. The dependency ratio is calculated by dividing the total population aged 0–19 and the population aged 59 and over by the population aged 20–59. This ratio is a destimulant. Table 2 shows the correlations between the studied indicators.

Table 1. *Features used to measure the level of demographic development of countries in 2015–2023*

Features	Feature symbol	Specification	Coefficient of variation	S/D*
Social	S1	Population density per 1 km^2	165	S
	S2	Total dependency ratio	44	D
	S3	Net migration rate per 1,000 people	306	S
	S4	Natural increase rate per 1,000 people	-274	S

Note: **S/D – stimulant/destimulant.*
Source: *Own elaboration based on Jerczyński 1971; Swianiewicz 1989; Ziółkowski 1997, Pociecha, Podolec, Sokołowski 1998; Ratajczak 2000; Wiatrak 2000; Kosiedowski 2001; Rakowski, Pakulska 2001; Madras-Kobus 2001; Ponikowski 2002; Roeske-Słomka 2003; Wysoki, Łuczak 2004; Ponikowski 2004; Kapusta 2004; Brol 2004; Tokarski, Stepień, Wojnarowski 2006, Malina, Malina 2005; Młodak 2005, 2006; Roszkowska 2005; Lira, Wysocki 2004; Rosner 2007; Rosner, Stany 2007a; Rosner, Stany 2007b; Rosner, Stany 2007c; Czornik 2008; Ziemniańczyk 2010; Głuszczuk 2011; Kocura-Bera 2011; Szubska-Włodarczyk 2014; Kołodziejczyk 2014; Kiniorska 2014; Ludwiczak 2014; Adamowicz, Janulewicz 2016; Chądzyńska 2016; Krawczyk 2017; Konecka-Szydłowska, Maćkowiak 2016; Parysek 2018; Malina 2020; Kozubek, Konecka-Szydłowska 2022; Krawczyk 2023, 2024; Krawczyk, Marzec 2024; Eurostat 2025; Statistics Poland 2025.*

Table 2. *Correlations between demographic development features*

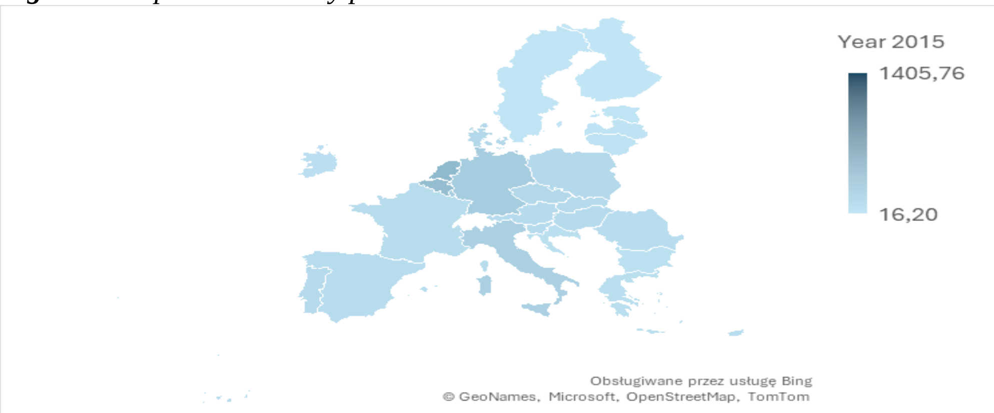
Description	S1	S2	S3	S4
S1	X			
S2	-326.0**	X		
S3	0.19	0.281	X	
S4	0.23	-0.002	-0.306**	X

Note: ***Significant correlation at 0.01, *Significant correlation at 0.05*
Source: *Own elaboration based on Eurostat data.*

An expert method determines the degree of interdependence, and if it is exceeded, the partial indicator in question is excluded from further analysis. After analysing the correlation (Table 2) and coefficient of variation (Table 1), it was concluded that none of the studied features needs to be excluded.

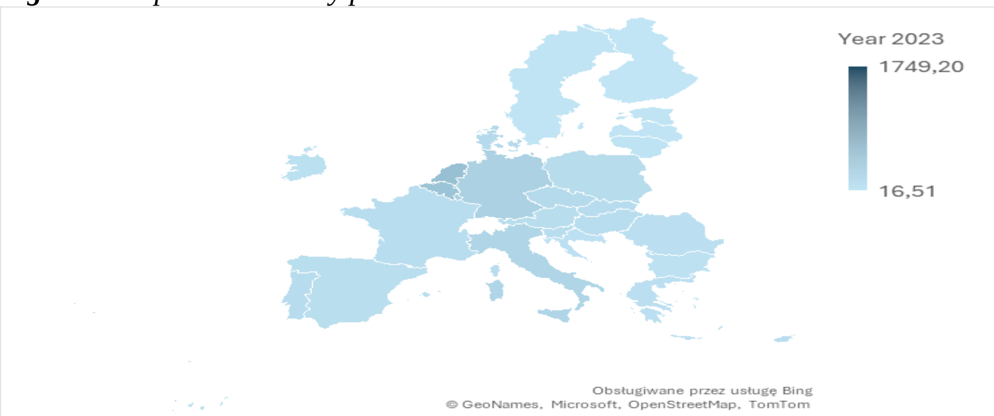
Figures 1 and 2 show the population per 1 km^2 in 2015 and 2023. Population density is increasing in 18 countries and decreasing in nine. Figures 3 and 4 show the dependency ratio in 2015 and 2023. An increase in dependency ratio is observed in 25 countries, while a decrease is observed in two (Luxembourg and Malta). Figures 5 and 6 present net migration in 2015 and 2023. A net migration increase is observed in 16 countries, while a decrease is observed in 11. Figures 7 and 8 present population dynamics in 2015 and 2023. Malta has the highest values on the maps (Figures 1 and 2), but it is not visible on the maps due to their scale.

Figure 1. *Population density per 1 km^2 in 2015*



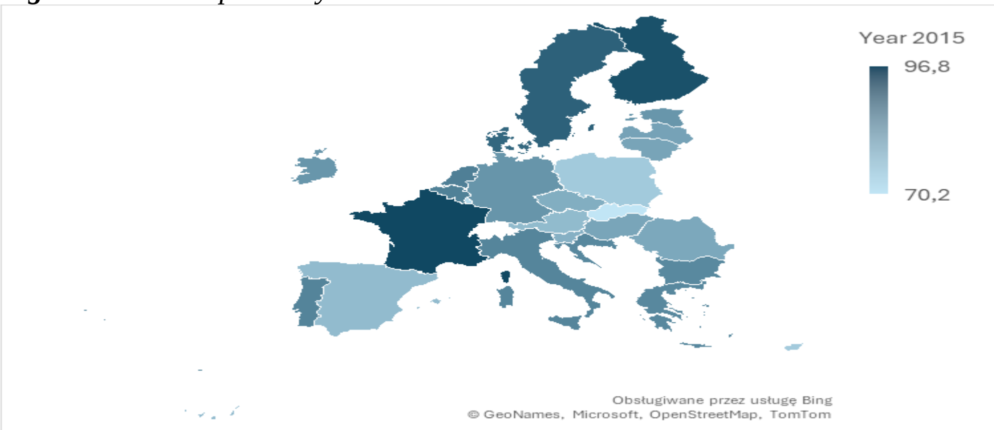
Source: *Own elaboration based on Eurostat data.*

Figure 2. *Population density per 1 km^2 in 2023*



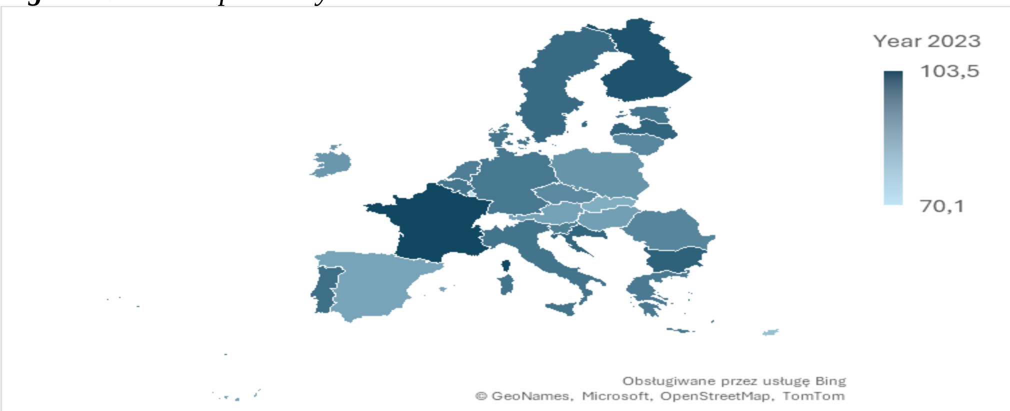
Source: *Own elaboration based on Eurostat data.*

Figure 3. *Total dependency ratio in 2015*



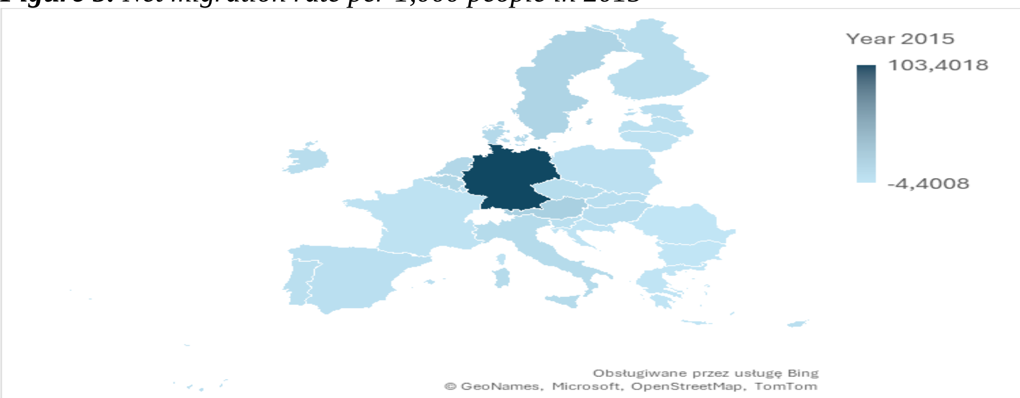
Source: *Own elaboration based on Eurostat data.*

Figure 4. *Total dependency ratio in 2023*



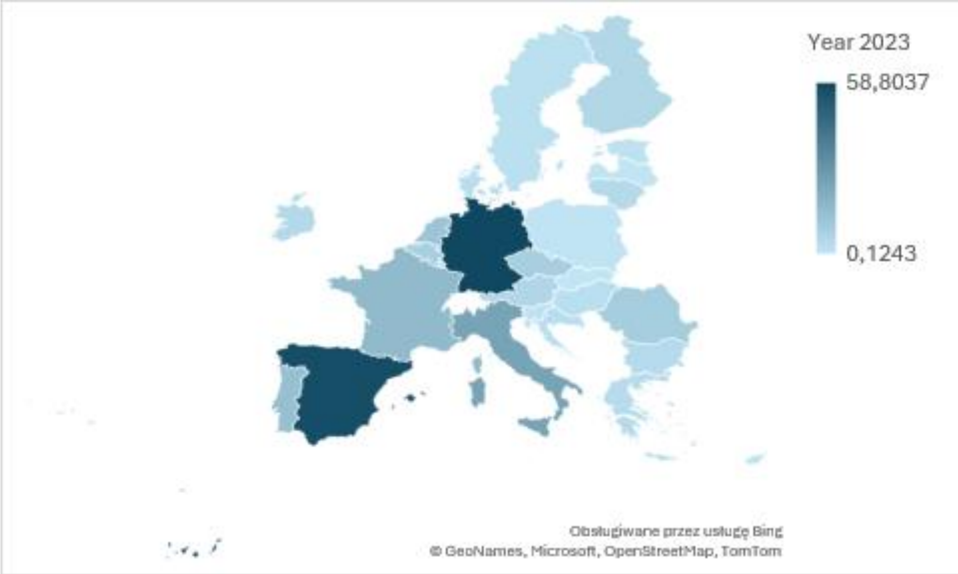
Source: *Own elaboration based on Eurostat data.*

Figure 5. *Net migration rate per 1,000 people in 2015*



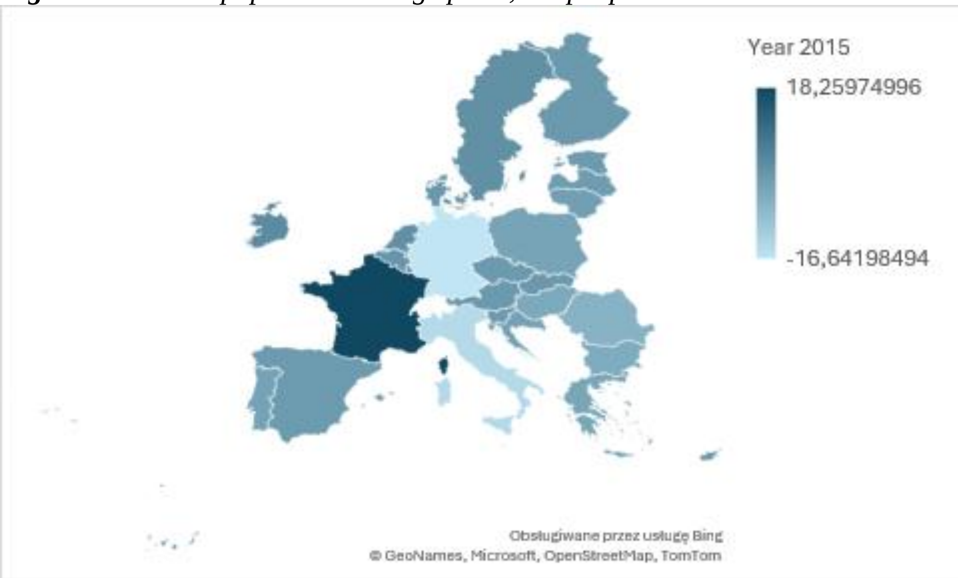
Source: *Own elaboration based on Eurostat data.*

Figure 6. *Net migration rate per 1,000 people in 2023*



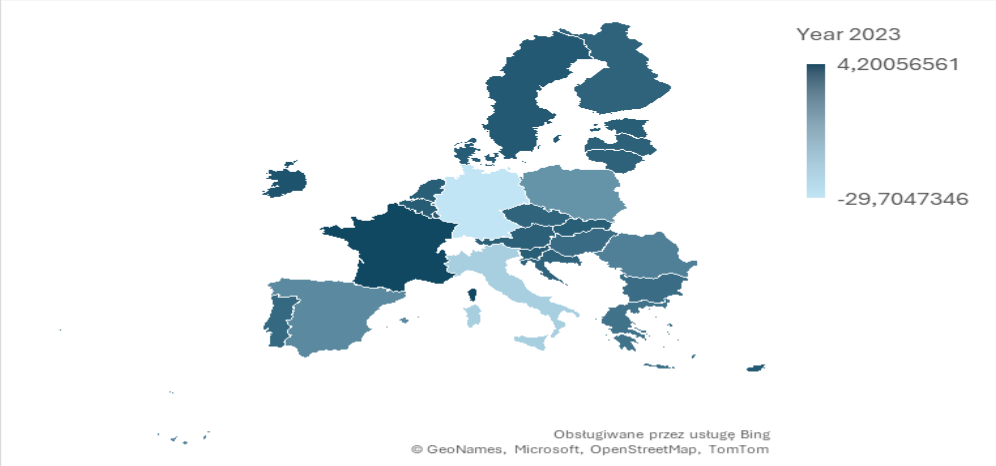
Source: *Own elaboration based on Eurostat data.*

Figure 7. *Natural population change per 1,000 people in 2015*



Source: *Own elaboration based on Eurostat data.*

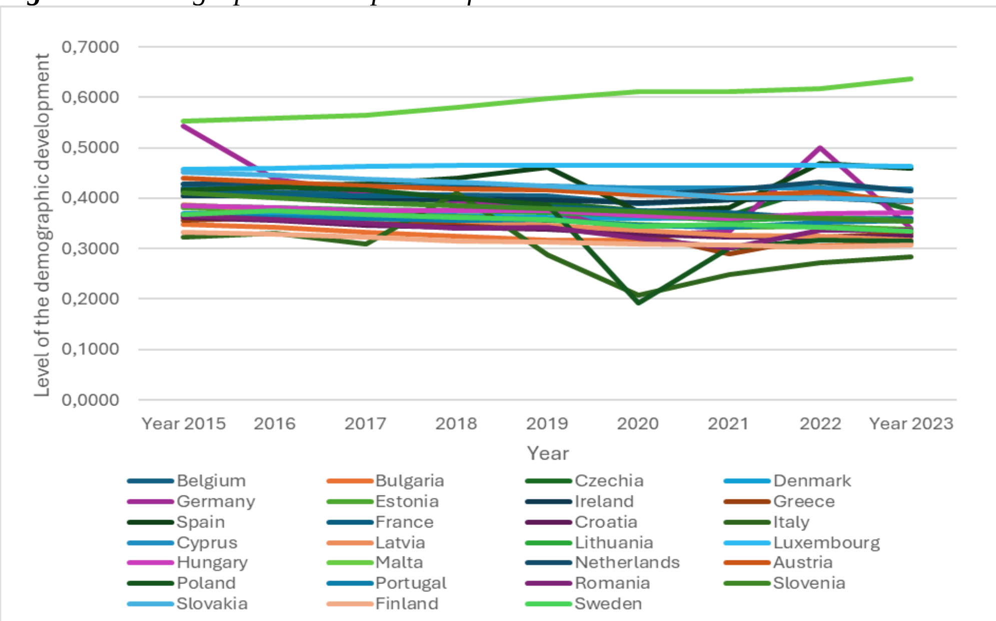
Figure 8. *Natural population change per 1,000 people in 2023*



Source: *Own elaboration based on Eurostat data.*

Figure 9 presents the level of demographic development between 2015 and 2023. In most EU countries, it is in decline. The countries that show an increase in 2015–2023 are Malta, Luxembourg and Cyprus (Table 3). Table 3 presents the ranking of EU countries and the dynamics of demographic development before, during and after the pandemic.

Figure 9. *Demographic development of UE countries between 2015 and 2023*



Source: *Own elaboration based on Eurostat data.*

Table 3. *Ranking of the demographic development level of EU countries and dynamics of demographic change (in the level of demographic development)*

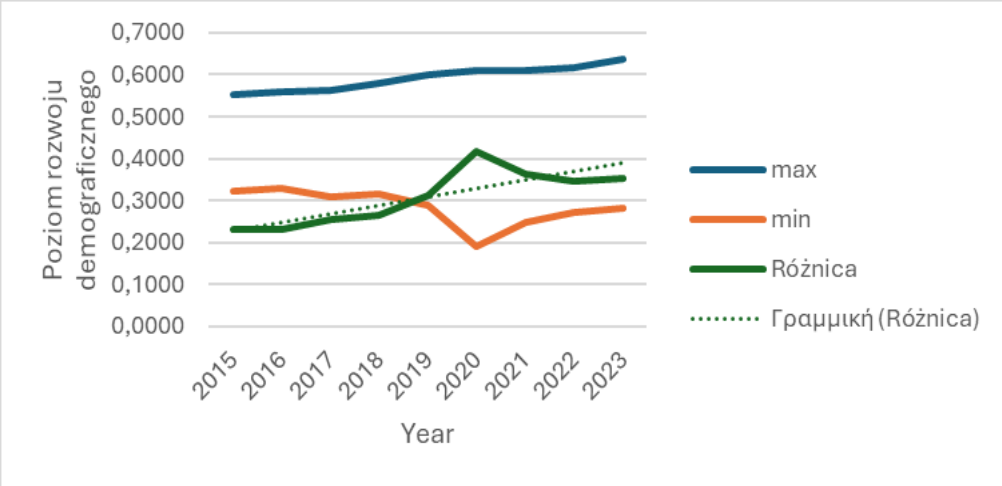
Description*	Ranking				Dynamics index			
	2015	2019	2021	2023	2015–2019 2015=100%	2020–2021 2019=100%	2022–2023 2021=100%	2015–2023 2015=100%
Malta	1	1	1	1	1.0837	1.0207	1.0426	1.1533
Luxembourg	3	2	2	2	1.0166	0.9995	0.9941	1.0100
Spain	11	3	9	3	1.1106	0.8281	1.2043	1.1075
Cyprus	6	6	3	4	0.9875	0.9927	0.9946	0.9750
Netherlands	7	4	4	5	0.9908	0.9809	0.9943	0.9662
Slovakia	4	5	6	6	0.9415	0.9433	0.9877	0.8772
Belgium	8	8	8	7	0.9609	0.9821	0.9929	0.9369
Austria	5	7	5	8	0.9463	0.9735	0.9724	0.8958
Ireland	14	9	7	9	0.9809	1.0021	0.9882	0.9714
Czechia	12	10	11	10	0.9454	0.9372	1.0289	0.9116
Hungary	17	15	14	11	0.9733	0.9593	1.0319	0.9635
France	9	12	10	12	0.9167	0.9710	0.9639	0.8580
Portugal	21	18	18	13	0.9771	0.9527	1.0433	0.9711
Denmark	19	17	13	14	0.9813	0.9953	0.9871	0.9640
Lithuania	16	16	15	15	0.9654	0.9596	0.9982	0.9247
Slovenia	13	13	12	16	0.9269	0.9635	0.9677	0.8643
Germany	2	14	19	17	0.6932	0.8877	1.0204	0.6279
Estonia	18	20	17	18	0.9344	0.9593	0.9904	0.8878
Romania	22	22	24	19	0.9385	0.8819	1.1160	0.9237
Sweden	20	19	16	20	0.9699	0.9761	0.9596	0.9085
Greece	24	23	26	21	0.9631	0.8430	1.1428	0.9278
Croatia	23	24	21	22	0.9305	0.9581	1.0045	0.8955
Latvia	15	21	20	23	0.8980	0.9396	0.9718	0.8199
Poland	10	11	25	24	0.9312	0.7741	1.0518	0.7582
Bulgaria	25	25	23	25	0.9124	0.9593	1.0236	0.8959
Finland	26	26	22	26	0.9372	0.9864	0.9978	0.9225
Italy	27	27	27	27	0.8923	0.8651	1.1371	0.8778

Note: **Order according to the 2023 ranking*
Source: *Own elaboration based on Eurostat data.*

We sought to answer whether the demographic development of EU countries led to a levelling of development in a spatial system based on the adopted features. It has been proved that the differentiation of the demographic development level of the EU countries in a spatial system is increasing despite the declared and pursued policy of levelling development differences (Figure 10).

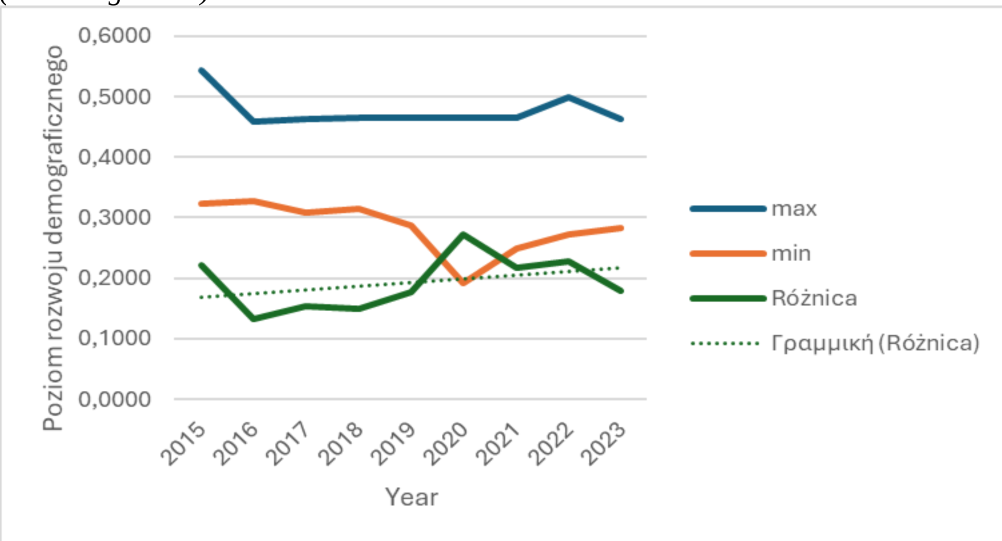
This is due to Malta's increasing level of development. Our analyses show that, apart from Malta, the demographic development of EU countries has been levelling off at an increasingly slower rate since 2020 (Figure 11).

Figure 10. *Disparity in the level of demographic development of cities in 2015–2023*



Source: *Own elaboration based on Eurostat data.*

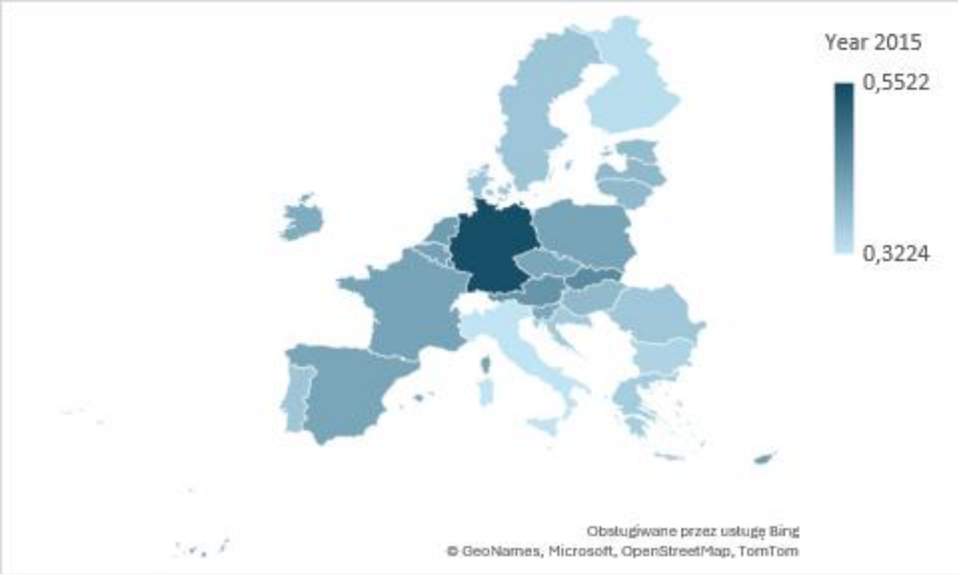
Figure 11. *Disparity in the level of demographic development of cities in 2015–2023 (excluding Malta)*



Source: *Own elaboration based on Eurostat data.*

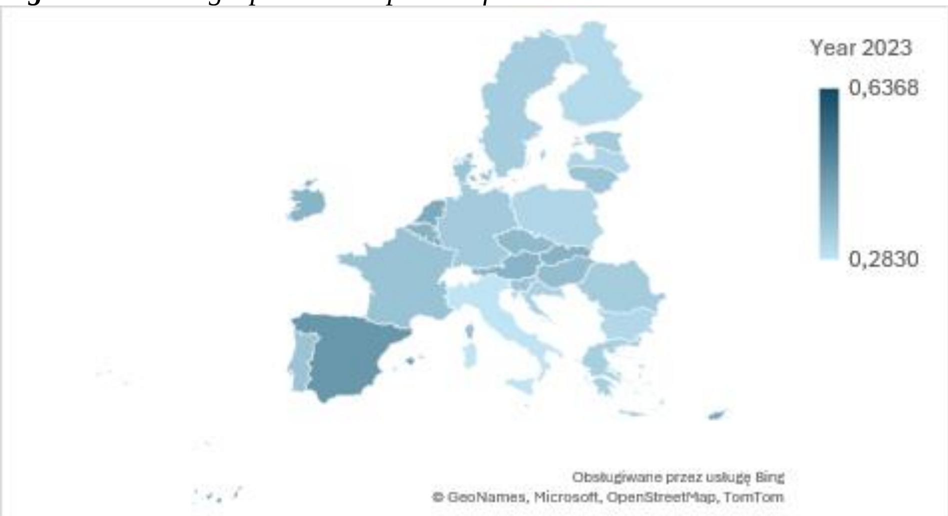
The maps (Figures 12 and 13) show the level of demographic development in 2015-2023.

Figure 12. *Demographic development of EU countries in 2015*



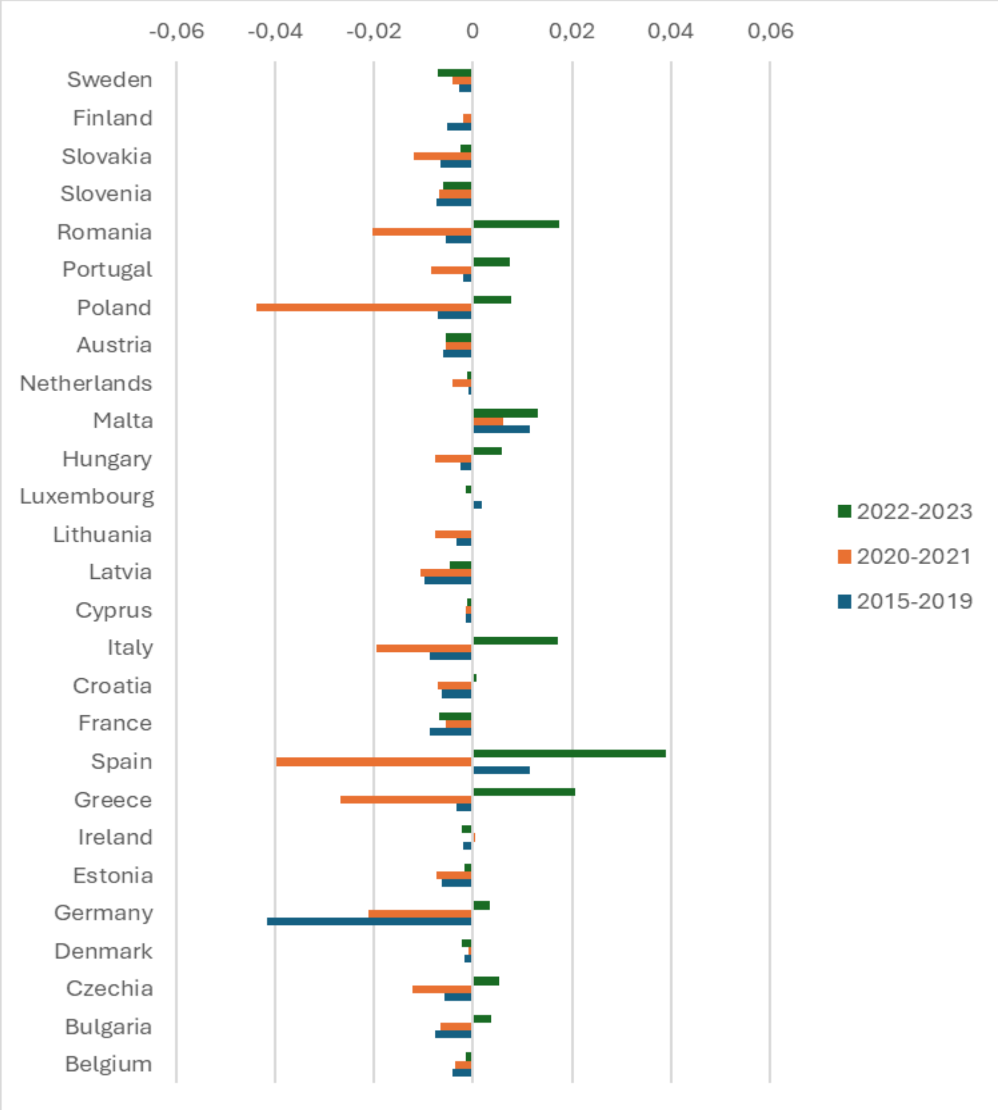
Source: *Own elaboration based on Eurostat data.*

Figure 13. *Demographic development of EU countries in 2023*



Source: *Own elaboration based on Eurostat data*

Figure 14. *Average annual rate of change of the level of demographic development in 2015–2019, 2020–2021, 2021–2022*



Source: *Own elaboration based on Eurostat data.*

We sought to determine whether the pandemic has altered the trends in demographic differentiation of areas of development. The average annual rate of change during the pandemic (-0.0103) was lower than before the pandemic (-0.0049). Student's t-test for dependent samples revealed a statistically significant difference: t(26)=2.095; p=0.046. Cohen's D = 0.403 indicates a moderate effect, so there is a relationship between the pandemic and the decrease in change dynamics (Figure 14, Tables 4, 5, 6) (Bedyńska and Brzezicka, 2007).

We sought to determine whether the pandemic has altered the trends in demographic differentiation of areas of development. The average annual rate of change during the pandemic (-0.0103) was lower than after the pandemic (-0.0036). Student's t-test for dependent samples revealed a statistically significant difference: t(26)=-3.602; p=0.001. Cohen's D = - 0.693 indicates a moderate effect, so there is a relationship between the pandemic and the increase in change dynamics (Figure 14, Tables 4, 5, 6) (Bedyńska and Brzezicka, 2007).

Table 4. *Average annual rate of change*

Average annual rate of change	Mean	Standard deviation	N
(AARC) 2015–2019	-0.0049	0.00896	27
(AARC) 2020–2021	-0.0103	0.01162	27
(AARC) 2022–2023	0.0036	0.01032	27

Source: *Same as Table 2.*

Table 5. *Test for dependent samples*

Average annual rate of change	Mean	Standard deviation	Standard error of the mean	T	df	Significance one-tailed P	Significance two-tailed P
(AARC) 2015–2019 and (AARC) 2020–2021	0.00541	0.0134	0.0025	2.095	26	0.023	0.046
(AARC) 2020–2021 and (AARC) 2022–2023	-0.01388	0.0200	0.0038	-3.602	26	0.001	0.001

Source: *Same as Table 2.*

Table 6. *Effect for dependent samples*

Average annual rate of change	Cohen's D	Hadges' correction
(AARC) 2015–2019 and (AARC) 2020–2021	0.403	0.391
(AARC) 2020–2021 and (AARC) 2022–2023	-0.693	-0.673

Source: Same as Table 2.

Analysing the correlation between the population of each country and the change dynamics index (Table 7), we noted negative correlations, i.e. as the number of inhabitants increases, the dynamics of demographic development change decreases. The larger the country, the lower the dynamics of change.

Table 7. *Correlation between the dynamics index and the number of inhabitants*

Description	Change dynamics index in			
	2015–2019	2020–2021	2022–2023	2015–2023
Number of inhabitants in 2015	-0.481*	-0.552**	0.371	-0.460*
Number of inhabitants in 2023	-0.476*	-0.536**	0.360	-0.452*

Note: ***Significant correlation at 0.01, *Significant correlation at 0.05*
Source: *Own elaboration based on Eurostat data*

Table 8. *Correlation between the dynamics index and the level of demographic development.*

Description		Level of demographic development								
		2015	2016	2017	2018	2019	2020	2021	2022	2023
Dynamics index	2015–2019	-0.039	0.308	0.400*	0.431*	0.553**	0.505**	0.533**	0.288	0.625**
	2020–2021	0.150	0.194	0.235	0.169	0.2630	0.658**	0.565**	0.274	0.362
	2022–2023	-0.172	-0.115	-0.121	0.063	-0.025	-0.265	-0.261	-0.011	0.035
	2015–2023	0.008	0.299	0.382*	0.459*	0.554*	0.625**	0.595**	0.392*	0.696**

Note: ***Significant correlation at 0.01, *Significant correlation at 0.05*
Source: *Own elaboration based on Eurostat data*

Analysis of the correlation between the level of demographic development and the change dynamics index indicates that (Table 8):

- The dynamics index in 2015–2019 has a statistically significant positive correlation with the level of development in 2017–2023, implying that the higher the level of development, the higher the change dynamics index.
- The dynamics index in 2020–2021 has a statistically significant positive correlation with the level of development in 2020–2021, implying that the higher the level of development, the higher the change dynamics index.
- The dynamics index in 2022–2023 does not show a statistically significant correlation with the level of development in the period under review.
- The dynamics index in 2015–2023 has a statistically significant positive correlation with the level of development in 2017–2023, implying that the higher the level of development, the higher the change dynamics index.

In summary, countries with a higher level of demographic development show a higher change dynamics index of this level of development.

5. Conclusions, Propols, Recommendations

This article presents the demographic situation in EU countries between 2015 and 2023, including the COVID-19 pandemic period. The analysis of the indicated period revealed a decline in this area. The level of demographic development of the EU countries declined in the period studied except for three countries: Malta, Luxembourg and Spain. Finally, there are a few points to consider:

- We sought to answer whether the demographic development of EU countries led to a levelling of development in a spatial system based on the adopted features. It has been proved that the differentiation of the demographic development level of the EU countries in a spatial system is increasing despite the declared and pursued policy of levelling development differences. We observed a decrease in the level of demographic development in 24 countries, while it increased in three. Our analyses show that, apart from Malta, the demographic development of EU countries has been levelling off at an increasingly slower rate since 2020.
- We sought to determine whether the pandemic has altered the trends in demographic differentiation of areas of development. The average annual rate of change during the pandemic (-0.0103) was lower than before the pandemic (-0.0049). It was concluded that there is a link between the pandemic and the decline in the dynamics of change.
- We sought to determine whether the pandemic has altered the trends in demographic differentiation of areas of development. The average annual rate of change during the pandemic (-0.0103) was lower than after the pandemic (-0.0036). It was concluded that there is a link between the pandemic and the increase in the dynamics of change.
- We sought to answer whether there is a correlation between the population of individual countries and the change dynamics index.○ We noted negative correlations, i.e. as the number of inhabitants increases, the dynamics of demographic development change decreases. The larger the country, the lower the dynamics of change.
- We sought to answer whether the level of demographic development affects the demographic development change dynamics index. We found that countries with a higher level of demographic development show a higher change dynamics index of this level of development.

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