MACROECONOMIC IMPLICATIONS OF INCREASING DIVERSITY OF POPULATION: THE ETHNIC, LINGUISTIC, AND RELIGIOUS FRAGMENTATION OF THE POPULATION IN THE EU IN THE PAST TWO DECADES

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Abstract: The paper focuses on the relationship between population diversity and macroeconomic outcomes. The econometric analysis using fixed and random effect panel data models was conducted in 27 European Union countries in 2000-2023. Changes in the population´s diversity are measured using the decreasing transformation of the Herfindahl-Hirsch Index to express the ethnic, linguistic, and religious fragmentation of the population. To capture the overall effect of the changes in the diversity of the population in the European Union, the composite index based on principal component analysis is constructed. The first component with the highest eigenvalue is a regressor of selected macroeconomic outcomes – economic growth, public debt, and income disparities. Besides, the other public policy outcome - political instability, which affects the macroeconomic outcomes, is also considered. As expected, the increasing diversity of the population is observed. It has a statistically significant positive relationship with public debt, income disparities, and political instability, while in negative with economic growth.

Keywords: ethnic fragmentation, linguistic fragmentation, religious fragmentation, public debt, economic growth, income disparities, political instability.

1 Introduction

In the European Union (EU), we witness certain population movements for several reasons. The fall of communist regimes in the eastern part of Europe, the accession of many of these countries to the EU, the Global financial crisis, migration waves from other continents, and the war conflict affecting Europe in the last few years caused population migration. It brings certain changes inside the entire population of the countries when considering the diversity of the population. Increased diversity of the population contributes to higher heterogeneity of preferences which might have important implications for the macroeconomic and societal circumstances of the countries.

The literature focusing on diverse populations works with multiethnicity and multilingualism (e.g. Cassilde and Labart, 2020), and the increasing number of different religions in countries are considered, too (e.g. Okediji, 2005; Chakravarty et al., 2019). The ethnic, linguistic, and religious point of view deals with the implications on macroeconomic outcomes (Vigdor, 2002; Alesina and La Ferrara, 2002; Chakravarty et al., 2019) including the public policy outcomes (Alesina, Baqir, and Easterly, 1999; Vigdor, 2002; Bodman and Hodge, 2010; Mariani, 2017; Maličká and Križko, 2020). Besides, countries might suffer from social and political tensions, and uncertainty driven by diverse populations (e.g. Easterly and Levine,1997; Reilly, 2000; Vigdor, 2002; Bodman and Hodge, 2010; Chadha and Nandwani, 2018) and it worsens the countries´ conditions, too.

The paper aims to analyze the variability of the diversity of the EU population from ethnic, linguistic, and religious perspectives in the past two decades and its impact on several macroeconomic outputs, including public outcomes and political instability, too. The analysis is conducted on the sample of 27 EU countries in 2000-2023. Panel data estimation techniques are employed to examine the relationship between the population´s diversity and selected macroeconomic outcomes.

In this paper, to measure the diversity of the population we use the decreasing transformation of the Herfindahl-Hirsch Index to express a fragmentation (opposite to concentration, in a similar vein used e.g. in Easterly and Levine, 1997; Alesina, Baqir, and Easterly, 1999 and 2000; Vigdor, 2002; Alesina et al., 2003; Drazanova, 2019; Maličká and Križko, 2020; Marson, Migheli, and Saccone, 2021) and we focus on ethnic, linguistic and religious fragmentation of the population as proposed by related literature (e.g. Alesina and La Ferrara, 2002; Okediji, 2005; Bodman and Hodge, 2010; Bossert, D´Ambrosio, and La Ferrara, 2011; Bernhardsson, 2019; Chakravarty et al., 2019). To reduce the multidimensionality of the populations´ diversity measured by three indicators and to catch all the aspects of the diversity of the population, we compute a composite index using the principal component analysis. The component with the highest eigenvalue is then used as a regressor in an econometric analysis of the relationship between the population´s diversity and macroeconomic outcomes. The results when using the principal component covering all types of computed diversities are then compared to the results of estimations where ethnic, linguistic, and religious fragmentation indices are employed alternatively to the regression following the approach of Maličká and Križko (2020), who expressed the fragmentation of the population by the maximum value of ethnic and linguistic fragmentation indices.

The paper contributes to the literature on the effects of changes in the population´s diversity on economic outcomes. The paper's uniqueness lies in measuring the population´s diversity via the composite indicator created using the principal component analysis which covers ethnic, linguistic, and religious fragmentation of the population in EU countries in 2000-2023.

The paper is organized in the following way. After the Introduction, the section on State of the Art, which presents related literature contributions to the topic, is listed. In the section of Methods and Data, the research design and employed data are described. The main results of the paper are presented and discussed in the Results and Discussion section. The paper ends with the Conclusion.

2 State of the Art

Ethnic fragmentation of the population (sometimes referred to as ethnic fractionalization, e.g. Bodman and Hodge, 2010; Bossert, D´Ambrosio, and La Ferrara, 2011; Bernhardsson, 2019) enjoys wide attention in empirical research. Vigdor (2002) mentions that higher ethnic fragmentation is linked to various undesired effects in the macroeconomic and social fields such as lower economic growth, public spending, trust, and higher corruption. Bernhardsson (2019) investigates the ethnic diversity and corruption. Alesina and La Ferrara (2002) mention that more ethnically fragmented populations face higher income disparities.

Bodman and Hodge (2010) mention that the perpetual state of uncertainty in a country might be driven by ethnic fragmentation. Similarly, Cassilde and Labart (2020) mention several implications of multiethnicity and multilingualism in countries, too. They consider the index of ethno-linguistic fragmentation the measure of the potential social and political tensions in the country. Earlier, Reilly (2000) mentioned that many countries faced uncertainty (civil wars and internal conflicts) within the country after the collapse of authoritarian regimes (e.g. CEE countries).

Alesina, Baqir, and Easterly (1999) refer to ethnic fragmentation and public spending – public goods. Bodman and Hodge (2010) connect the higher diversity of the population with the higher diversity in demand meaning the provisioning of public goods. It is in line with the findings of Panizza (1999) that the higher diversity of the population is related to the higher heterogeneity of the population in terms of their preferences. According to these authors, especially at the sub-national government levels (regional and local) fiscal decentralization is considered the means of integration of minorities (ethnic, linguistic, or religious). Diverse groups of the population might require more political powers to feel less excluded and, thus more

integrated into society. However, the Decentralization Theorem introduced by Oates (1972, 1999) responds to higher diversity in demand, too. The higher rates of fiscal decentralization are in line with lower central government spending (mentioned e.g. by Vigdor, 2002) and higher sub-national public spending (Maličká and Križko, 2020). Belmonte, Dell´Anno, and Teobaldelli, (2018) consider federalism a means to prevent ethnic conflicts in ethnically diverse countries such as Belgium, Germany or Spain). Khan (2022) unveils the positive relationship between ethnic fragmentation and public expenditure on education. Easterly and Levine (1997) explain the relationship between ethnic fragmentation and public policy outcomes pointing out that in countries with higher ethnic fragmentation low economic growth is associated with higher political instability or higher public deficits. In a similar vein proceeds e.g. Siddique (2021). Marson, Migheli, and Saccone (2021) investigate the relationship between ethnic fragmentation and economic freedom focusing on developed and developing countries. They conclude that higher ethnic fragmentation is not necessarily linked to lower economic freedom because the effect depends
on the countries´ development.

Drazanova (2019) provides the dataset on the historical index of ethnic fragmentation in the period 1945-2013. Drazanova (2019 and 2020) points to the observed dramatic changes in the population composition. However, the population´s diversity is mainly described using ethnic fragmentation or fractionalization. The ethnic fragmentation of the population is usually connected with linguistic fragmentation. Taylor and Hudson (1972) introduced the index of ethnolinguistic fragmentation, which was employed in a plethora of empirical studies (like Mauro, 1995; Labart, 2010; Maličká and Križko, 2020). Mauro (1995) investigates the relationship between corruption and economic growth, while the index of ethnolinguistic fragmentation is used as an instrument in this relationship. In a similar vein proceed Papyrakis and Mo (2014). According to Labart (2010), ethnolinguistic fragmentation is often analyzed concerning economic outcomes. However, Chadha and Nandwani (2018) clearly interlink the population´s diversity-driven worsening in social and political fields (as poor quality of institutions, corruption, trust, and internal conflicts) with the worsening of economic outcomes. Chakravarty et al. (2019) mention the negative relationship between social fragmentation and the economic performance of the country which is in line with the statement of Chadha and Nandwani (2018) and confirmed by a myriad of empirical studies (e.g. Easterly and Levine, 1999; Alesina et al., 2003).

Besides, Okediji (2005) proposes to employ religion as a factor to catch the population´s diversity in the literature on economic development, too. Chakravarty et al. (2019) deal with religious fragmentation and mention that socially homogenous societies tend to cooperate compared to fragmented societies. It corresponds with the findings of Bodman and Hodge (2010), and Cassilde and Labart (2020) that higher fragmentation refers to higher political and social tensions. Walsh-Dilley (2019) agrees that increases in religious fragmentation cause higher tensions and conflicts, thus have disintegrating effects on society. Khalid (2011) states that the socio-religious fragmentation of the population is a serious threat in terms of the integrity and security of the society, too.

As Drazanova (2019, 2020) mentions the increasing ethnic diversity over the world, Walsh-Dilley (2019) points out the increasing religious diversity, too. Even in Europe, after the collapse of authoritarian regimes the churches enjoyed freedom (Tēraudkalns, 2020), the modernity brought the decline in religion (Berger, 2012). According to Martin (2006) and Margry (2012), Europe faces religious fragmentation and secularization. However, as Mariani (2017) mentioned, religious demands are often converted into outcomes of public policies. Lane and Ersson stress that although it is expected that religious fragmentation has the same effect on society (democracy) as e.g. ethnic fragmentation, the final effect on democracy depends on the type of religion when a religiously homogenous country still might not be democratic.

3 Methods and Data

Measuring the diversity of the population from ethnic, linguistic, and religious perspectives is based on the Herfindahl concentration index (or Herfindahl-Hirsch Index, HHI, mentioned e.g. by Rhoades, 1993). Referring to the expression of the fragmentation of the population´s diversity (not concentration) we employ the decreasing transformation of the HHI, labeled as (1-HHI), like Easterly and Levine (1997), Alesina, Baqir, and Easterly (1999, 2000), Vigdor (2002), Alesina et al. (2003), Drazanova (2019), Maličká and Križko (2020), Marson, Migheli, and Saccone (2021). The homogenous population achieves the fragmentation index close to zero. The fragmentation of the population increases with its diversity and for the population with many small groups, the fragmentation index achieves values close to one.

Many authors use the index of ethnolinguistic fragmentation of the population (e.g. Labart, 2010; Bossert, D´Ambrosio, and La Ferrara, 2011; Maličká and Križko, 2020; Cassilde and Labart (2020). However, the literature on social fragmentation of the population recommends regard the religious fragmentation, too (e.g. Okediji, 2005).

We compute the fragmentation index (1-HHI) separately for ethnic (1-HHI E), linguistic (1-HHI L), and religious fragmentation (1-HHI R) in the period 2000-2023 for 27 EU countries. Data on ethnic, language, and religious groups of the population in 27 EU countries are collected from the World Factbooks published by the Central Intelligence Agency (CIA), which refer to the most populous groups in question usually with the percentage quantification. However, the index of linguistic fragmentation (1-HHI L) might be biased by the plurilingualism mentioned e.g. by Cassilde and Labart (2020).

To capture various forms of fragmentations, the Principal Component Analysis (PCA) was applied. PCA provides weights for input variables to ensure that the newly obtained variable best explains the deviations in the entire original dataset (Bro and Smilde, 2014). Although the values of these indices are in the same units, they have different ranges. Therefore, for data comparability, it is assumed that normalization is necessary to make them comparable. This adjustment can be done in several ways, such as z-scores and various types of data transformation or rescaling. In this case, since the indices are already standardized, such adjustment is not required (Blessing and Klaus, 2023). The result of the PCA is one principal component that will be used in further analysis.

The fixed effects model (FEM) assumes that individual effects are unobservable and not correlated with the explanatory variables. These effects remain constant over time for each cross-sectional group (e.g., countries). In a standard Ordinary Least Square (OLS) model, parameter estimates (beta) would be biased if these effects were not accounted for. The FEM is suitable when there is variability that could bias parameter estimates, as it captures individual heterogeneity across units that do not vary over time. However, it has a limited capacity to explain changes over time in the data (Novák, 2007). In the random effects model (REM) variables represent individual effects that influence observed values over time, with these effects varying across groups according to a specific distribution. These effects are assumed to be uncorrelated with the explanatory variables. Compared to the FEM, the REM is more flexible, as it allows for variability among groups and can estimate an average response for the entire dataset. However, it may be sensitive to fixed characteristics that cannot be captured by random effects alone (Gibbons, Serrato, and Urbancic, 2014).

For FEM we use equation (1) and for REM equation (2):

$$Y_{it} = \alpha_i + \beta\ Diversity_{it} + \sum_{k=1}^{L} \gamma_k X_{kit} + \varepsilon_{it} \quad (1)$$

$$Y_{it} = \alpha + \beta\ Diversity_{it} + \sum_{k=1}^{L} \gamma_k X_{kit} + u_i + \varepsilon_{it} \quad (2)$$

where:
Y_{it} is a dependent variable for country *i* in time *t;* $Diversity_{it}$ is an explanatory variable for country *i* in time *t;* X_{kit} are *k* control variables for country *i* in time *t*, k=1, …, L; and ε_{it} and are error terms.

Labeling, technical definition of dependent, explanatory, and control variables, and sources of variables included in the research are shown in Table 1.

Table 1 Research variables

Variable	Characteristic	Source
(1-HHI E)	Ethnic fragmentation of the population. Decreasing transformation of the Herfindahl-Hirsch Index.	CIA World Factbooks
(1-HHI L)	Linguistic fragmentation of the population. Decreasing transformation of the Herfindahl-Hirsch Index.	CIA World Factbooks
(1-HHI R)	Religious fragmentation of the population. Decreasing transformation of the Herfindahl-Hirsch Index.	CIA World Factbooks
Diversity PC1	PCA component with the highest eigenvalue and covering the highest proportion of the variability computed from (1-HHI E), (1-HHI L), and (1-HHI R).	Own
Public Debt	General government gross consolidated debt as % of GDP.	Eurostat
Economic growth	Growth of the Gross Domestic Product at market prices per capita.	Eurostat
Income inequalities (disparities)	Gini index - the extent to which the distribution of income among individuals or households within an economy deviates from a perfectly equal distribution. A Gini index of 0 represents perfect equality, while an index of 100 implies perfect inequality.	The World Bank
Political instability	Negative Political Stability Index which is a composite measure reflecting the likelihood of a disorderly transfer of government power, armed conflict, violent demonstrations, social unrest, international tensions, terrorism, as well as ethnic, religious, or regional conflicts.	The World Bank
Unemployment rate	Unemployment. Percentage of population in the labor force.	Eurostat
Crises	The dummy variable became 1 in 2009 referring to the beginning of the Global financial crisis and in 2021 referring to the beginning of the multi-crisis (COVID-19, energy crisis, and war conflict).	Own
Inflation rate	All items HICP. Annual average rate of change.	Eurostat
Population growth	Population on 1 January. Number of persons. First differences.	Eurostat
Government Expenditure	General government expenditure as % of GDP.	Eurostat

Source: Own processing

As a dependent variable, we employ alternatively:

- Economic growth (inspired by e.g. Vigdor, 2002; Alesina and La Ferrara, 2002; Labart, 2010; Chadha and Nandwani, 2018; Chakravarty et al., 2019).
- Public debt (inspired by Easterly and Levine, 1997; Siddique, 2021; for other public policy outcomes see e.g. Alesina, Baqir, and Easterly, 1999; Vigdor, 2002; Bodman and Hodge, 2010; Mariani, 2017; Maličká and Križko, 2020).
- Income inequalities (inspired by Alesina and La Ferrara, 2002).
- Political Instability (inspired by e.g. Easterly and Levine,1997; Reilly, 2000; Vigdor, 2002; Bodman and Hodge, 2010; Khalid, 2011; Walsh-Dilley, 2019; Chadha and Nandwani, 2018; Cassilde and Labart, 2020)

As the main explanatory variable, we employ the variable of the diversity of the population. It is a composite index computed using the PCA based on the indices of ethnic, linguistic and religious fragmentation of the population expressed through the decreasing transformation of the Herfindahl-Hirsch Index (used e.g. in Easterly and Levine, 1997; Alesina, Baqir, and Easterly, 1999 and 2000; Vigdor, 2002; Alesina et al., 2003; Drazanova, 2019; Maličká and Križko, 2020; Marson, Migheli, and Saccone, 2021). The component with the highest eigenvalue is then used as a regressor in an econometric analysis of the relationship between the population´s diversity and macroeconomic outcomes.

As control variables, we employ a set of variables determining hereinbefore mentioned dependent variables. They include:

- Crises (e.g. Paulus, Figari, and Sutherland, 2017; Ingham, 2023).
- Unemployment rate (e.g. Horváthová et al., 2012; Galiński, 2015).
- Inflation rate (e.g. Šuliková et al, 2015; Shaukat, Zhu, and Ijaz Khan, 2019).
- Population resp. Population growth (e.g. Šuliková et al., 2015).
- Public expenditure (e.g. Parui, 2020; Arawatari, Hori, and Mino, 2023).

We compute the estimations using PC1 and then we alternatively employ (1-HHI E), (1-HHI L), and (1-HHI R) into the estimations to compare the results with those of PC1. The comparison of models is provided based on the approach of Maličká and Križko (2020), who expressed the fragmentation of the population by the maximum value of ethnic and linguistic fragmentation indices.

Table 2 displays the descriptive statistics of all variables included in the research.

Table 2 Descriptive statistics

Variable	Mean	Median	S.D.	Min	Max
(1-HHI E)	0.242	0.230	0.168	0.000	0.658
(1-HHI L)	0.199	0.167	0.177	0.000	0.630
(1-HHI R)	0.381	0.362	0.200	0.020	0.938
Public Debt	60.10	53.50	35.50	3.800	207.0
Economic growth	0.053	0.045	0.065	-0.201	0.346
Income disparities	31.20	31.20	3.71	23.20	41.30
Political instability	-8.770	-7.600	4.660	-31.40	0.000
Unemployment rate	8.360	7.300	4.280	2.000	27.50
Crises	0.083	0.000	0.277	0.000	1.00
Inflation rate	3.040	2.300	3.740	-1.700	45.70
Population growth	3.3e+004	9.7e+003	1.7e+005	-1e+006	1.1e+006
Government Expenditure	45.00	44.80	6.810	20.70	64.90

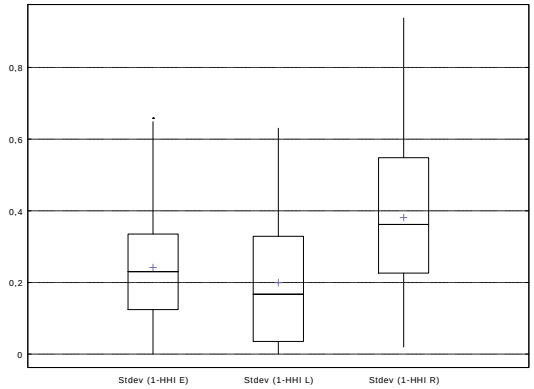
Source: Own processing

4 Results and Discussion

In the first step of the empirical analysis, we focus on computing the ethnic, linguistic, and religious fragmentation of the population using the decreasing transformation of the Herfindahl-Hirsch Index (labeled as (1-HHI E), (1-HHI L), and (1-HHI R)).

Figure 1 shows a comparison of evidenced variability of (1-HHI E), (1-HHI L), and (1-HHI R) measured by standard deviation. The highest average and variability in the EU 27 countries in 2000-2023, thus the largest changes, are observed in the case of religious fragmentation of the population.

Figure 1. Boxplots of (1-HHI E), (1-HHI L), and (1-HHI R)

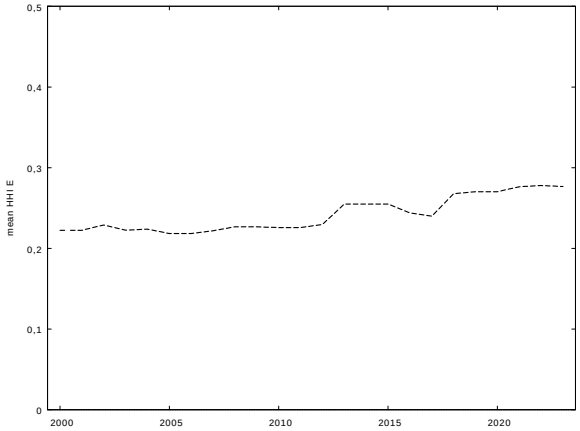


Source: Own processing

4.1 Ethnic fragmentation in the EU

Ethnic fragmentation of the EU population measured as (1-HHI E) increases in the period 2000-2023 with a mean value of 0.242 (see Table 2). Figure 2 shows the group means of (1-HHI E) in EU 27 countries in 2000-2023.

Figure 2 Mean (1-HHI E)



Source: Own processing

The highest variability of the ethnic fragmentation of the population in EU 27 countries in 2000-2023 expressed by the standard deviation of the (1-HHI E) is observed in the Czech Republic (see Figure 3), then in Sweden and Spain. Visible changes in the ethnic fragmentation of the population are obvious also in Ireland, Netherlands, Belgium, Austria, Croatia, and Bulgaria. For the Czech Republic, the continuous evident increase in foreigners since the change of the regime in 1989 is observed. Besides the re-opening of the borders, which influenced the homogeneity of the Czech population (Czech Statistical Office, 2024), in the past two decades, several reasons caused the increase in the population´s heterogeneity e.g. economic (migration waves from Africa and Asia), political (migration of population from Eastern Europe, Russia, Ukraine) and related to the integration (EU accession). The most heterogeneous population is evidenced in the capital city.

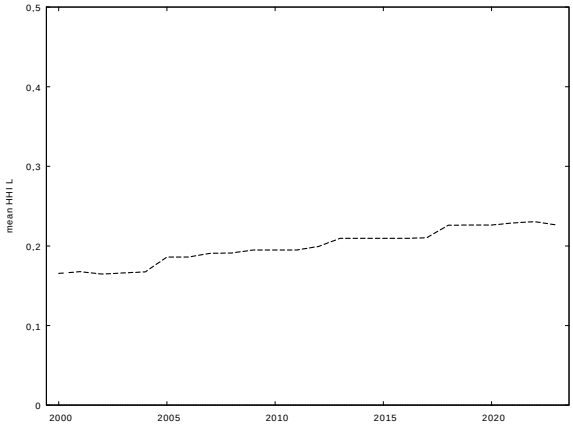
Figure 3. Variability of (1-HHI E)

Source: Own processing

4.2 Linguistic fragmentation in the EU

Linguistic fragmentation of the population in EU 27 countries is measured as (1-HHI L). We can observe an increase in linguistic fragmentation in the EU with a mean value of 0.199 (Table 2). Figure 4 shows the group means of (1-HHI L) in EU 27 countries in 2000-2023.

Figure 4 Mean (1-HHI L)



Source: Own processing

The highest variability of the linguistic fragmentation of the population in EU 27 countries in 2000-2023 expressed by the standard deviation of the (1-HHI L) is observed in Luxembourg and Lithuania (see Figure 5), in the Czech Republic, Slovakia, Austria, and Bulgaria. A lot of countries have evidenced a low variation of the (1-HHI L) in the past two decades, while Sayers and Láncos (2017) mention that regional and minority languages become less appealing in the EU.

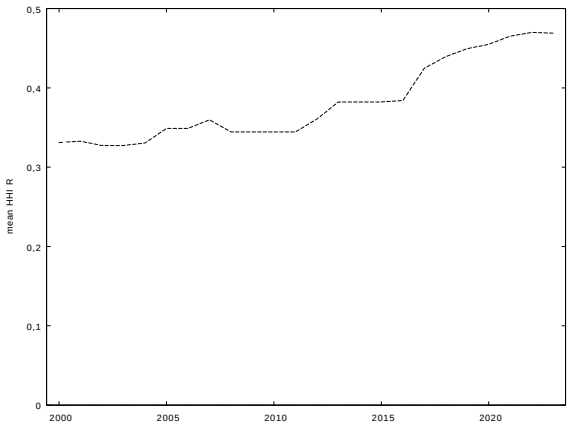
Figure 5. Variability of (1-HHI L)

Source: Own processing

4.3 Religious fragmentation in the EU

Religious fragmentation of the EU population measured as (1-HHI R) increases in the period 2000-2023 more significantly as ethnic and linguistic fragmentation. It ranges between 0.3 and 0.5 with a mean value of 0.381 (as shown in Table 2). Figure 6 shows the group means of (1-HHI R) in EU 27 countries in 2000-2023.

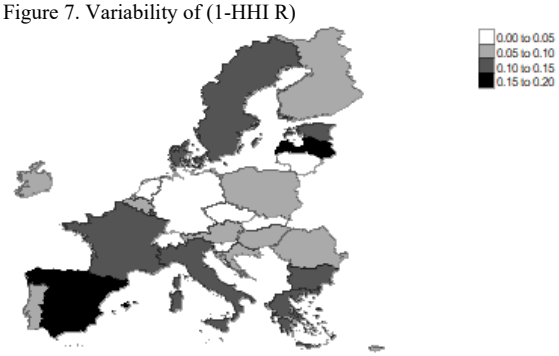
Figure 6 Mean (1-HHI R)



Source: Own processing

In the case of the religious fragmentation of the EU´s population, a visible increase in religious diversity is evidenced in line with the findings of Arnaiz et al. (2013), who mentioned that all EU countries guarantee by their Constitutions the freedom of religion to be the fundamental right. The highest variability of religious fragmentation is observed in Spain and Latvia. Vicente Torrado and Urrutia Asua (2023) mention obvious secularism and religious pluralism observed in Spain in the last two decades. As mentioned in Tēraudkalns (2020), in Latvia very high index of religious diversity is observed due to the fragmentation of religious groups. Many other EU countries evidence higher changes in the diversity expressed by the declared religion, e.g. Sweden, France, Italy, Bulgaria, and Greece. A lower variability of religious fragmentation is observed in Finland, Belgium, Ireland, Portugal, Poland, Austria, Hungary, Croatia, Romania, and Cyprus. Figure 7 shows the variability of (1-HHI R) in EU 27 countries in 2000-2023 expressed by the standard deviation of the (1-HHI R).

Figure 7. Variability of (1-HHI R)



Source: Own processing

4.4 Index of population diversity

In the next step of the conducted research, we created a composite index of population diversity using PCA. This index presents a linear combination of (1-HHI E), (1-HHI L), and (1-HHI R). The PCA created three principal components (PC1, PC2, and PC3) that cumulatively cover 100% of the fragmentation variability. The first principal component, PC1, covers 59,37% of the variability, the second, PC2 covers 29,28%, and the third covers 11,35% of the variability (see Table 3). As the PC1 has the highest eigenvalue (its eigenvalue is higher than the mean) in further analysis we decided to use this component as the regressor determining the selected macroeconomic variables.

The eigenanalysis of the correlation matrix is shown in Table 3.

Table 3 Eigenanalysis of the correlation matrix

Component	Eigenvalue	Proportion	Cumulative
PC1	1.7811	0.5937	0.5937
PC2	0.8785	0.2928	0.8865
PC3	0.3404	0.1135	1.0000
Eigenvectors (component loadings)			
	PC1	PC2	PC3
(1-HHI E)	0.677	0.002	0.736
(1-HHI L)	0.522	0.704	-0.482
(1-HHI R)	0.519	-0.710	-0.475

Source: Own processing

4.5 Macroeconomic implications of population diversity

In the last step of investigating, we employ the Index of population diversity (labeled as Diversity) as a main explanatory variable in the regression analysis to examine the relationship between population diversity and selected macroeconomic outcomes. We run the FEM and REM. Based on the Hausman test we decide whether FEM or REM is adequate. To compare the observed results with each of the parts of the composite index, in a similar vein we conduct regression analysis where the main explanatory variables (1-HHI E), (1-HHI L), and (1-HHI R) are alternatively employed.

In the case of economic growth, the results show the expected negative effect of increasing diversity on the growth of the GDP per capita in line with the assumptions of Vigdor (2002), Alesina and La Ferrara (2002), Labart (2010), Chadha and Nandwani (2018), and Chakravarty et al. (2019) (see Table 4). However, the beta estimates are not statistically significant. Besides, none of the fragmentation individual indices are statistically significant even though their beta estimates have negative signs, too.

Table 4 Results of estimations on economic growth

	Diversity measured as			
	PC1	(1-HHI E)	(1-HHI L)	(1-HHI R)
Intercept	0.2842 (<0.0001) ***	0.2910 (<0.0001) ***	0.2891 (<0.0001) ***	0.2740 (<0.0001) ***
Diversity	−0.0008 (0.8753)	−0.0296 (0.3424)	−0.0438 (0.3909)	−0.0317 (0.2277)
Unemployment rate	−0.0023 (0.0150) **	−0.0023 (0.0158) **	−0.0024 (0.0137) **	−0.0021 (0.0238) **
Crises	−0.0355 (<0.0001) ***	−0.0355 (<0.0001) ***	−0.0356 (<0.0001) ***	−0.0358 (<0.0001) ***
Inflation	0.0060 (<0.0001) ***	0.0060 (<0.0001) ***	0.0060 (<0.0001) ***	0.0060 (<0.0001) ***
Population growth first diff	−5.4e-08 (0.0160) **	−5.4e-08 (0.0166) **	−5.4e-08 (0.0149) **	−5.1e-08 (0.0140) **
Government Expenditure	−0.0051 (<0.0001) ***	−0.0050 (<0.0001) ***	−0.0050 (<0.0001) ***	−0.0051 (<0.0001) ***
Hausman test p-value	6.1e-36 FEM	1.8e-26 FEM	4.5e-28 FEM	7.1e-24 FEM
adjR2	0.2921	0.2931	0.2940	0.2947

Note: p-values of beta estimates in parentheses, *** denotes significance level 0.01, ** 0.05, and * 0.1.
Source: Own processing

When examining the relationship between the population´s diversity and public debt, the results show the expected positive effect of increasing diversity on the public debt in line with expectations posed by Easterly and Levine (1997) when diverse populations create pressure on public policy outcomes

(see Table 5). The increasing diversity of the population is tied to the increase in public debt. Similar results are observed when employing the (1-HHI L), and (1-HHI R), while the beta estimate of (1-HHI E) is not statistically significant.

Table 5 Results of estimations on public debt

	Diversity measured as			
	PC1	(1-HHI E)	(1-HHI L)	(1-HHI R)
Intercept	−20.472 (0.1800)	−29.852 (0.0886) *	−27.493 (0.1228)	−37.224 (0.0199) **
Diversity	6.8799 (0.0836) *	27.082 (0.3892)	34.515 (0.0837) *	39.899 (0.0462) **
Unemployment rate	1.2566 (0.0425) **	1.1254 (0.0640) *	1.1784 (0.0507) *	1.2346 (0.0537) *
Crises	−0.3582 (0.8085)	−0.2379 (0.8789)	−0.1492 (0.9234)	−0.5109 (0.7131)
Inflation	−0.4482 (0.0178) **	−0.4325 (0.0145) **	−0.4255 (0.0144) **	−0.5073 (0.0143) **
Population growth first diff	−1.9e-05 (0.0485) **	−2.1e-05 (0.0543) *	−2.1e-05 (0.0621) *	−1.3e-05 (0.0541) *
Government Expenditure	1.6102 (0.0003) ***	1.6994 (0.0004) ***	1.6282 (0.0008) ***	1.6516 (0.0002) ***
Hausman test p-value	0.0003 FEM	0.0066 FEM	8.7e-05 FEM	0.0002 FEM
adjR2	0.3558	0.3206	0.3245	0.3657

Note: p-values of beta estimates in parentheses, *** denotes significance level 0.01, ** 0.05, and * 0.1.
Source: Own processing

Estimation results on the relationship between the population´s diversity and income disparities are shown in Table 6.

Table 6 Results of estimations on income disparities

	Diversity measured as			
	PC1	(1-HHI E)	(1-HHI L)	(1-HHI R)
Intercept	31.517 (<0.0001) ***	30.851 (<0.0001) ***	30.958 (<0.0001) ***	30.924 (<0.0001) ***
Diversity	0.4569 (0.0922) *	2.5543 (0.1099)	3.5479 (0.0207) **	1.4254 (0.3831)
Unemployment rate	0.1867 (0.0057) ***	0.1826 (0.0067) ***	0.1819 (0.0068) ***	0.1816 (0.0068) ***
Crises	−0.0999 (0.6156)	−0.0682 (0.7323)	−0.0704 (0.7190)	−0.0812 (0.6745)
Inflation	0.0303 (0.6929)	0.0212 (0.7943)	0.0222 (0.7936)	0.0164 (0.8353)
Population growth first diff	4.6e-07 (0.4074)	3.6e-07 (0.5411)	3.0e-07 (0.6214)	4.6e-07 (0.4138)
Government Expenditure	−0.0422 (0.2277)	−0.0399 (0.2345)	−0.0443 (0.1836)	−0.0395 (0.2346)
Hausman test p-value	0.0005 FEM	0.0032 FEM	0.0081 FEM	0.0014 FEM
adjR2	0.1553	0.1441	0.1504	0.1396

Note: p-values of beta estimates in parentheses, *** denotes significance level 0.01, ** 0.05, and * 0.1.
Source: Own processing

When analyzing the relationship between the population´s diversity and income disparities, the results show the expected positive effect of increasing diversity on income disparities (see Table 6). The results are in line with the expectations of Alesina and La Ferrara (2002). The increasing diversity of the population is tied to the increase in income disparities. Similar results are observed when employing the (1-HHI L), while the beta estimates of (1-HHI E), and (1-HHI R) are not statistically significant.

In the case of political instability (see Table 7), the results show the expected positive effect of increasing diversity on political instability. The results are in line with statements of e.g. Easterly and Levine (1997), Reilly (2000), Vigdor (2002), Bodman and Hodge (2010), and Chadha and Nandwani (2018). The increasing diversity of the population contributes to political friction and tensions. Similar results are observed when employing the (1-HHI L), while the beta estimates of (1-HHI E), and (1-HHI R) are not statistically significant.

Table 7 Results of estimations on political instability

	Diversity measured as			
	PC1	(1-HHI E)	(1-HHI L)	(1-HHI R)
Intercept	−3.8697 (<0.0001) ***	−4.1000 (<0.0001) ***	−4.1408 (<0.0001) ***	−4.1965 (<0.0001) ***
Diversity	0.1850 (0.0257) **	0.7320 (0.2235)	1.696 (0.0006) ***	0.7002 (0.2079)
Unemployment rate	−0.9531 (<0.0001) ***	−0.9566 (<0.0001) ***	−0.9542 (<0.0001) ***	−0.9553 (<0.0001) ***
Crises	−0.1272 (0.0491) **	−0.1219 (0.0571) *	−0.1205 (0.0560) *	−0.1285 (0.0465) **
Inflation	−0.0044 (0.5172)	−0.0049 (0.4988)	−0.0048 (0.4842)	−0.0055 (0.3971)
Population growth first diff	−2.4e-07 (0.3694)	−2.9e-07 (0.3004)	−3.2e-07 (0.2894)	−2.3e-07 (0.3957)
Government Expenditure	0.0706 (<0.0001) ***	0.0725 (<0.0001) ***	0.0693 (<0.0001) ***	0.0724 (<0.0001) ***
Hausman test p-value	1.1e-15 FEM	1.4e-06 FEM	1.4e-13 FEM	1.5e-11 FEM
adjR2	0.9698	0.9691	0.9699	0.9693

Note: p-values of beta estimates in parentheses, *** denotes significance level 0.01, ** 0.05, and * 0.1.
Source: Own processing

5 Conclusion

In the past two decades, the EU´s population faced several changes when considering its heterogeneity. The relaxation of totalitarian regimes in Central and Eastern European countries, integration processes, external shocks, and migration waves influenced the diversity of the population. According to the related literature, the increasing heterogeneity of the population has several macroeconomic implications.

The paper focuses on the relationship between population diversity and selected macroeconomic outcomes – economic growth, public debt, and income disparities. Besides, the other public policy outcome - political instability, which affects the macroeconomic outcomes, is also considered.

The econometric analysis using fixed effect and random effect panel data models is conducted in 27 European Union countries in 2000-2023. Changes in the population´s diversity are measured using the decreasing transformation of the Herfindahl-Hirsch Index to express the ethnic, linguistic, and religious fragmentation of the population. To capture the overall effect of the changes in the diversity of the population in the EU, the composite index based on principal component analysis is constructed. The first component with the highest eigenvalue is a regressor of selected macroeconomic outcomes.

The results show the increasing diversity of the population. As expected, a diverse population is in a statistically significant positive relationship with public debt, income disparities, and political instability, while in negative with economic growth. However, the relationship between diversity and economic growth is not statistically significant.

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