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Demographic Transformation and Sustainable Workforce Challenges in the European Union

By Andrzej Skibiński[1]

ABSTRACT:
The aim of this publication is to assess the impact of dynamic demographic changes on the availability of labor in selected European Union countries: the Czech Republic, Denmark, France, Germany, Poland, and Italy. The aging of societies, declining fertility rates, and varying migration trends are leading to a systematic aging and shrinking of the potential labor force, thus posing a significant challenge to the economies of Member States. This study conducted a comparative analysis of key demographic indicators using harmonized statistical data (Eurostat and OECD). The results of the study indicate a clear relationship between the progressive aging of the population and the deteriorating balance in labor markets. The article emphasizes the need to implement coherent social and demographic policies, in particular migration policies, in order to adapt to the changing demographic structure. The conclusions point to the urgent need to respond to the impending labor shortages in order to maintain the EU's economic competitiveness.

Keywords: demographic change, labor force, migration policy, age structure

1. Introduction

Contemporary Europe is facing unprecedented demographic changes, which pose one of the most serious challenges to economic stability, social cohesion, and labor market competitiveness (European Commission, 2023). In recent decades, there has been a systematic increase in life expectancy, accompanied by a continuing decline in fertility rates in most European countries (Skibiński, 2017; Sobotka et al., 2019). This combination of factors leads to an inevitable deepening of the aging process and a shrinking of the potential labor supply, which fundamentally transforms the structure of the labor market and increases pressure on social security systems (Maciulyte-Sniukiene et al. 2023; Maestas, 2023; Chi, 2025). From a theoretical perspective, these demographic shifts necessitate a deeper integration of economic growth and labor productivity theories, such as endogenous growth models. As the absolute volume of the labor supply shrinks, sustaining economic momentum increasingly relies on capital deepening and technological adaptation. Consequently, demographic scarcity acts as a catalyst for structural transformation, shifting the economic focus from labor-intensive outputs to productivity-driven growth paradigms. The aging of the population also leads to a systematic increase in the demographic burden ratio, in which an increasingly smaller working-age population supports a growing senior population (Bodnar & Nerlich, 2022). It is worth noting that this process is not uniform, and its pace and consequences vary spatially depending on the economic, institutional, cultural, and migration context. Countries in North-Western

[1] Czestochowa University of Technology. Faculty of Management, Poland.

Europe, such as Germany, France, and Denmark, are in a better demographic situation thanks to positive net migration and stable family policies. On the other hand, the countries of Central and Eastern Europe and Southern Europe, including Poland and Italy, are facing a deeper decline in the working-age population, negative natural growth, and a lower compensatory effect of migration (European Commission, 2025; Mihajović & Miladinov, 2024). In some countries, this problem is exacerbated by job instability and economic uncertainty, which in turn determine decisions about having children and getting married. Studies show that in countries such as Italy, people who are temporarily employed or unemployed are less likely to decide to have children. On the other hand, in some northern European countries, flexible labor markets and high levels of social security can partially mitigate the effects of low fertility and labor shortages (Harper, 2023). In view of the above, demographic diversity within the European Union creates a clear division between regions with relatively stable population structures and those experiencing increasing population aging. These processes have far-reaching consequences not only for the economy, but also for social capital and the future organization of work (Bloom et al., 2011). Therefore, the aim of this paper is to analyze the demographic determinants of the labor market in selected European Union countries representing different models of social and demographic policies. The article focuses on identifying the factors shaping the labor force, analyzing interregional differences, and assessing the impact of migration processes on mitigating the effects of population aging and labor shortages in the labor market.

2. Conceptual and methodological information

The article uses comparative research methodology to quantitatively and qualitatively assess and analyze the impact of demographic changes on labor force availability in selected EU countries. The study uses secondary data from official statistical sources, including Eurostat and the OECD. The above analysis was carried out for six selected EU Member States. The choice of this research sample was justified by the need to capture the diversity of demographic trends and adaptation policies within the European Union. Table 1 presents the rationale for the selection of the group of EU countries.

Table 1: Justification for the selection of the research sample

Country	Demographic characteristics	Justification for inclusion in the analysis
Poland, Italy	Countries with a strong negative feedback loop	They represent countries with the lowest fertility rates in the EU and a progressively aging population. Although Poland is no longer a country dominated by emigration, it still experiences a deficit in its working-age population. Italy, on the other hand, combines low fertility with one of the highest rates of demographic aging.
Germany	A country compensating through migration	Despite its low fertility rate, Germany maintains population stability due to a positive migration balance. It serves as an example of a country where migration helps stabilize the demographic structure.
France, Denmark	Countries with relative stability	France and Denmark maintain relatively higher fertility rates due to effective family policies (France) and

		flexicurity combined with support for work family balance (Denmark). These findings enable a comparison of different welfare state models in terms of their moderate resilience to fertility decline.
Czech Republic	CEE country with variable dynamics	This country provides a basis for comparison with Poland, as it exhibits fertility fluctuations alongside a positive net migration balance, making it an interesting case of adaptation in the CEE region. It also allows for an assessment of how social and migration policies contribute to the modest improvement in fertility despite the pan-European downward trend in TFR.

Source: own work.based on: Eurostat database, OECD, Kreiner, C. T., & Svarer, M. (2022). Danish Flexicurity: Rights and Duties. *Journal of Economic Perspectives*, *36*(4), 81-102. https://doi.org/10.1257/jep.36.4.81

The time frame of the analyses covers the years 2000–2024, taking into account long-term demographic projections available in official Eurostat statistics. In order to more fully assess the impact of demographic changes on the availability of labor resources, the Ke migration balancing efficiency index was also used, defined as the quotient of the crude net migration rate (Sm) and the absolute value of the crude rate of natural change (Pn) **(Ke = Sm/|Pn|).** This indicator is a synthetic measure of the ability of migration to compensate for population losses resulting from negative natural growth and allows for an assessment of the relative impact of migration in conditions of depopulation. It should be emphasized that the interpretation of the Ke indicator is only valid in the case of negative natural growth values (**Pn < 0).** In situations where the growth rate is positive or close to zero, the indicator loses its compensatory character and may lead to overestimated values that are not subject to demographic interpretation. The values of the Ke indicator were interpreted as follows:

- Ke > 1 – migration fully compensates for natural population decline,
- 0< Ke < 1 – migration partially compensates for natural population decline,
- Ke = 0 – migration has no impact on balancing natural decline,
- Ke < 0 – migration exacerbates the process of depopulation.

For the purposes of this study, the Ke index was calculated only for countries with negative natural growth, which ensures its comparability and interpretative accuracy. The structure of the index is consistent with the classic component approach in demography, in which population change is a function of natural increase and migration, as well as with the current of research on the role of migration as a factor balancing the decline in fertility (Rowland, 2003; Coleman, 2006; Okólski&Fihel, 2012). While this study relies primarily on secondary quantitative indicators from Eurostat and the OECD, it attempts to complement these trends by considering national institutional frameworks and contextual policy rationales. However, a fully integrated qualitative evaluation of specific policy implementation outcomes remains beyond the scope of this paper and represents an important limitation. Acknowledging this, future research would benefit from incorporating mixed-methods approaches to provide a deeper understanding of how different EU states manage the transition toward demographic sustainability.

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3. Result and discussion

3.1. Analysis and assessment of demographic indicators for selected EU countries

At the beginning of the analysis of selected demographic indicators, it is useful to present a graphical representation of the demographic structure of European society, illustrating the distribution of the population by age group and gender. Figure 1 presents the population pyramid of the EU, including demographic projections.

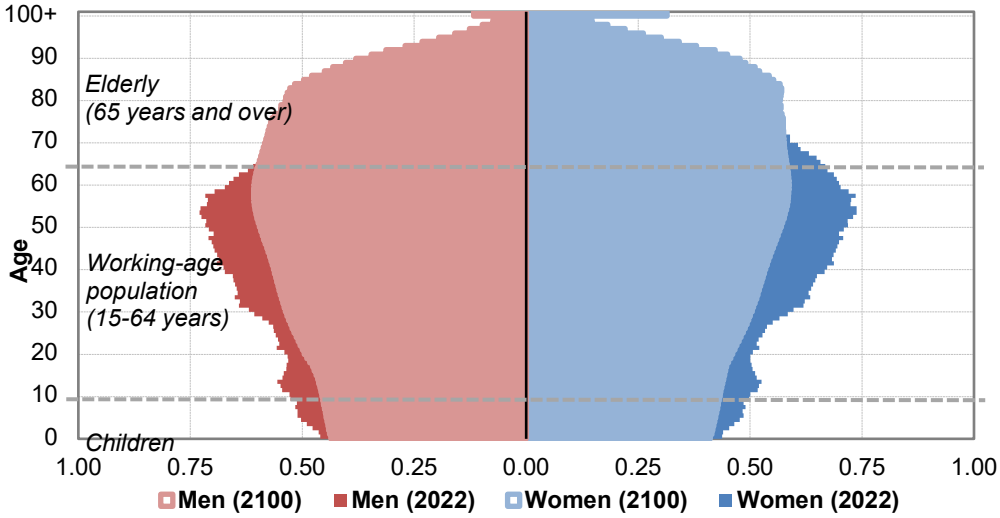

Figure 1: Population pyramids, EU, 2022 and 2100 (% of total population).
Source: EUROPOP 2023 population projections.

The data in Figure 1 illustrate the transformation of the population structure from a regressive type in 2022 to an extremely regressive type in 2100. Although the forecast data should be treated with some caution, the shape of the pyramid is narrowing at the base as a result of the fertility rate remaining below the simple replacement level, which heralds a long-term decline in population. At the same time, advanced population aging is observed, with a simultaneous further increase in life expectancy and a growing share of cohorts aged 65+. As a consequence, a decline in the working-age population is projected, which poses a serious challenge to the stability of social security systems, healthcare, and, above all, the labor market. The above analysis shows the progress of population aging at the EU level. But what is the demographic situation in a selected group of EU countries? To answer this question, we need to take a closer look at selected demographic indicators. Let's start by presenting changes in the total population.

Table 2: Population size in selected European countries

Country	Total population [in milion]			Trend and notes
	2000	2024	2100*	
Poland	38.2	37.5	29.5	**Long-term population decline**
Czech Rep.	10.2	10.4	10.6	**Demographic stability with slight long-term growth**
Germany	82.2	83.6	84.1	**Stable population level in the long term**

France	60.9	68.6	68.1	**Population growth followed by stabilization**
Italy	56.9	58.9	50.1	**Pronounced long – term population decline**
Denmark	5.3	5.9	6.1	**Moderate and stable population growth**

*population projection Eurostat EUROPOP
Source: own work based on: Eurostat database, OECD.

The above table shows clear differences in population change in the countries analyzed between 2000 and 2100. Poland is experiencing a steady decline in population throughout the entire period. The Czech Republic shows a slight increase in population after 2024, leading to a stable level in the long term. In Germany, on the other hand, the population is growing slightly during the analyzed period, reaching a level close to stabilization. France recorded population growth until 2024, followed by stabilization with a slight decline until 2100. Italy is experiencing a marked decline in population after 2024, while Denmark shows moderate but steady population growth throughout the analyzed period. Another indicator that has a significant impact on changes in the age structure of the population is the TFR. A shorter time horizon relating to the demographic forecast was taken into account for the analysis of this indicator.

Table 3: Total Fertility Rate in selected European Countries

Country	Total Fertility Rate (TFR)			Trend and notes
	2000	2024	2050*	
Poland	1.28	1.19	1.20	**Persistently very low fertility**
Czech Rep.	1.30	1.46	1.50	**Moderate increase in fertility levels**
Germany	1.38	1.36	1.40	**Stable but low fertility**
France	1.90	1.66	1.70	**Decline followed by partial stabilization at a relatively high level**
Italy	1.33	1.20	1.30	**Persistently low fertility with slight recovery**
Denmark	1.78	1.55	1.60	**Declining fertility from a relatively high level**

*population projection Eurostat
Source: own work based on: Eurostat database, OECD

The data presented in Table 3 indicate that the low level of population reproduction persists in all the countries analyzed throughout the entire period of analysis, i.e., 2000–2050. Poland and Italy are characterized by very low TFR values and no signs of approaching the level of simple generational replacement (2.1). The Czech Republic, on the other hand, stands out with a moderate increase in fertility after 2000, leading to the relatively highest TFR among Central and Eastern European countries. Germany, in turn, maintains a stable but low fertility rate during the analyzed period. France and Denmark, despite a decline in TFR after 2000, maintain relatively higher fertility rates compared to other countries, although they also remain well below the replacement level. From the point of view of the labor market, it is also important to assess changes in the working-age population, which is a potential source of labor resources.

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Table 4: Share of Working- Age – Population (Approximate %of Total Population) in selected European Countries

Country	Working -Age Population (15-64) [in %]			Trend and notes
	2000	2024	2050*	
Poland	68.3	64.8	53.0	**One of the sharpest declines (15,3 %), signaling a major labor supply crisis and rising dependency ratio.**
Czech Rep.	69.8	63.7	55.0	**Significant yet slightly milder decline, stabilizing at 55% by 2050.**
Germany	67.9	63.5	52.0	**The steepest drop in the group (15,9 %), resulting in the lowest projected share (52%).**
France	65.0	61.6	58.0	**Shows the most stable trend, maintaining the highest projected share (58%) in 2050.**
Italy	67.4	63.4	53.0	**A significant decline, reaching a low share (53%), confirming advanced population aging.**
Denmark	66.7	63.6	58.0	**A relatively stable decline, projecting the highest share (58%) in 2050, similar to France.**

*population projection Eurostat
Source: own work based on: Eurostat database, OECD

The above data show a clear decline in the working-age population in all six European countries between 2000 and 2050, which is a key indicator of the progressive aging of the population. The most rapid decline in this population group is in Germany and Poland, which signals the greatest challenges for maintaining the labor force. On the other hand, France and Denmark show a relatively milder rate of decline in this population, maintaining its highest projected share (58%) in 2050. This demographic trend points to an inevitable deterioration in the old-age dependency ratio across Europe and requires urgent adaptation of economies to the changing working-age population. In evaluating these long-term projections, technological progress may play a key role in offsetting future labor shortages. The growing use of automation, robotics, and artificial intelligence (AI) is likely to reshape the labor market by changing the types of jobs people perform and increasing productivity per worker. As a result, even though the working-age population is expected to decline significantly—especially in Germany and Poland—faster digitalization and productivity growth could help reduce the direct impact of demographic decline on overall economic performance.

3.2. Analysis of the migration compensation index – empirical application for selected EU countries

The progressive ageing of the population and the persistence of negative natural growth in many EU countries mean that migration can increasingly serve as a factor

mitigating the effects of depopulation in a given country or region. To quantitatively assess this relationship, this study employs the migration compensation index described in the conceptual and methodological section. The analysis covers a selected group of EU countries that experienced negative natural growth in 2020 (the COVID-19 pandemic shock) and in 2024 (the post-pandemic period).

Table 5: Calculated values of the migration compensation index for a selected group of European countries.

Country	Migration compensation index (Ke)	
	2020	2024
Poland	-	+0.21
Czech Rep.	+1.39	+1.31
Germany	+0.92	+1.35
France	-	-
Italy	-	+0.85
Denmark	-	-

Note: (-) indicates years in which the birth rate was positive or very low.
Source: Own work based on: Eurostat database.

As emphasized, the immigration compensation index (Ke) reflects the contribution of migration to offsetting the population decline resulting from negative natural growth. Analysis of data from 2020 and 2024 shows the varying role of migration in European countries. In 2024, Poland achieved a low Ke value (+0.21), which suggests that migration plays a preliminary compensatory role in limiting population decline. The Czech Republic (+1.31) and Germany (+1.35) are characterized by high migration compensation, indicating effective demographic stabilization thanks to the influx of migrants. Italy (+0.85) showed a moderate level of compensation. In France and Denmark, on the other hand, the natural increase was positive or very low, so migration did not play a significant compensatory role. In view of the above, the variation in Ke values confirms that migration can mitigate the effects of adverse demographic processes, but its compensatory capacity remains strongly dependent on the scale and dynamics of population aging. However, it is important to remember that the Ke index shows only the numerical side of demographic balance. In reality, long-term demographic stability and labor market resilience also depend on several social and economic factors. These include how well foreign workers integrate into society, their level of education, whether their skills match labor market needs, and the overall level of social cohesion. Therefore, migration alone cannot fully solve labor shortages or maintain economic productivity without effective integration and supportive public policies.

3.3. Consequences of observed demographic trends on labor market.

Based on the analysis of the migration compensation index, the role of migration in shaping labor resources can be assessed.

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Table 6: The importance of migration for the availability of labor resources in selected EU countries

Country	Migration inflow (2024)	Migration balance / impact on age structure	Ke (2024)	Migration intensity (2050)	Implications for population (2050)	Implications for labor market
Poland	Influx of people from Ukraine and Belarus for labor and humanitarian purposes	Positive balance, migration partially compensates for population losses, moderate impact on the age structure	+0.21	Moderate inflow of workers; dependent on labor market conditions and level of integration	Migration can maintain a near-balanced population; partial compensation for natural population decline.	Migration partially increases the number of working-age individuals and supplements losses in the labor force.
Czech Rep.	Stable regional inflow; Ukrainian refugees after 2022	Moderate positive balance; clear migration compensation	+1.31	Stable positive regional migration	Maintaining a positive balance, supporting the labor market, impact on population structure	Migration supplements labor shortages in heavy industry and service sectors
Germany	High migration inflow	High positive balance; impact on age structure	+1.35	High migration intensity	Migration partially mitigates the effects of population aging and acts compensatorily	Migration partially offsets the decline in the working-age population
France*	Stable inflow; work-family policies, post-colonial ties	Positive natural increase; migration supports population maintenance	-	Maintaining positive balance	Migration supports population size; relatively stable demographic structure	Migrants support the labor market, especially in services and care
Italy	Positive balance after 2020; labor and humanitarian migration	Moderate compensation; limited impact on population aging	+0.85	Positive balance; labor and humanitarian inflow	Migration partially offsets population losses	Migration partially mitigates the effects of labor shortages
Denmark*	Moderate inflow	Positive natural increase; migration supports	-	Stable inflow,	Positive migration balance supports	Migration supports the labor market

		population maintenance			population size	

*In the case of France and Denmark, the Ke index was not calculated due to positive natural growth; nevertheless, the inflow of working-age migrants may help mitigate potential future declines in labor resources. Source: own work based on: European Commission (2024), Scovil (2024), Dukić (2024), Wachter&Hornsta (2024), Ślęzak – Belowska &Kowalski (2025), May (2013), Eurostat (2024).

The table above shows that European countries differ in terms of the impact of migration on the age structure of their populations (Dukić, 2024). In Poland, the positive influx of working-age migrants, mainly from Ukraine and Belarus, contributes to an increase in the working-age population and may limit the rate of population decline resulting from negative natural growth, thus compensating for labor shortages, especially in heavy industry and services (Skibiński, 2017; Bagavos, 2022; Fihel & Okólski, 2019; Ślęzak – Belowska & Bielewska, 2025). Demographic forecasts indicate that if the above trends continue, positive net migration may partially offset population losses resulting from low fertility by 2050, although its effectiveness will depend, among other things, on integration policies and the geopolitical situation (European Commission, 2024, Kozak et al. 2025). In the Czech Republic, stable regional and external migration maintains a positive migration balance, which contributes to stability in the country's demographic development, especially in terms of filling vacancies in both skilled and low-skilled occupations. (European Parliament, 2025). Similarly, in Denmark, the influx of migrants of working age is associated with positive real growth and a relatively stable age structure of the population, which translates into stable access to labor resources. In the case of Germany and France, the high influx of working-age migrants translates into a high net migration gain, which mitigates the effects of population aging and thus limits the progressive decline in the working-age population (Dustman et al. 2005). It is worth noting that migration can partially slow down population decline and reduce pressure on changes in the age structure of the population, but it cannot completely reverse the negative demographic trends in terms of the progressive aging of the population and fertility (Wachter & Hornsta, 2024). Italy, in contrast, experiences a positive but limited impact of migration, which partially offsets population losses and labor shortages, particularly in the service and construction sectors (European Commission, 2025). In light of the above, maintaining a positive migration balance may slow the decline in the working-age population and mitigate the effects of negative natural growth, thereby reducing the consequences of adverse demographic trends (De Haas, 2010; May, 2013). Based on these considerations, it is also useful to present the key sectors currently facing labor shortages.

Table 7: Key sectors with labor shortages in selected EU countries

Country	Main sectors with labor shortages
Poland	**Construction (excluding electricians), metal and machinery workers, teachers, health and social care, education**
Czech Rep.	**Stationary machinery and equipment operators, construction workers (excluding electricians), healthcare workers. IT**
Germany	**Health care, construction, craft, professional drivers, educators, service sector, industry, retail and wholesale trade**
France	**Science and engineering specialists, construction workers (excluding electricians), metal and machinery workers, health and social care, education, hotel and catering, IT, transport and logistics, renewable energy.**

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Italy	**Stationary machinery and equipment operators, legal, social and cultural specialists, salespeople, ICT, teachers, agriculture, tourism**
Denmark	**Science and engineering specialists, science and technology specialists, business and administration specialists, healthcare and long-term care, ICT, hotel and restaurant industry**

Source: own work based on: Labor market reports of individual countries, OECD, Eurostat, WHO, Word Bank Data.

The data presented in Table 7 suggest that migration of the working-age population is likely to play an increasingly important role in mitigating the effects of demographic change, particularly in relation to emerging labor shortages. In many EU countries, migrants help to fill gaps in sectors experiencing labor shortages, including healthcare, construction, civil engineering, transport, services, tourism, and IT. These shortages result from both populations ageing and a declining native labor supply. In certain industries, the share of migrant workers is particularly significant, especially in sectors facing chronic staff shortages, such as healthcare, construction, and services, as confirmed by Eurostat statistics (European Labor Authority, 2025). Effective integration policies and the recognition of qualifications are crucial for migrants to contribute meaningfully to the labor market. (Andre, Gal & Schief, 2024, European Parliament, 2025). The analysis of migration and its impact on labor shortages in healthcare, construction, services, and industry adds practical value to the study. The findings show that the role of migration differs across countries depending on their economic structure and demographic situation. Future research could expand this approach by examining long-term labor market trends, productivity changes in different sectors, and migration integration policies to better understand how European Union member states adapt to demographic challenges over time.

4. Conclusions

Demographic changes are one of the key challenges facing labor markets in the European Union. Studies have confirmed that Poland, the Czech Republic, Germany, France, Italy, and Denmark are experiencing a decline in the working-age population accompanied by a progressive aging of the population. This trend is particularly evident in Central and Eastern Europe and Southern Europe, where negative natural growth is not fully offset by migration. In this context, international migration in particular is one of the key adjustment mechanisms of modern labor markets, while at the same time having a lasting impact on the demographic structures of sending and receiving countries. Its effects vary in time and space and depend on the skill structure of migrants, which justifies the need for an interdisciplinary assessment. The analysis of the data and the Ke values obtained made it possible to assess the extent to which migration can potentially fill labor shortages in key sectors of the economy, such as healthcare, construction, IT, and manufacturing. In response to these challenges, EU countries are implementing migration strategies to address issues related to the availability of workers with the various qualifications and skills sought after in the labor market. To manage these demographic changes successfully, European Union member states will need to introduce more practical and targeted policies. Education and vocational training systems should focus more on

lifelong learning and helping workers quickly adapt to new technologies and automation. Pension systems should also become more flexible and encourage people to stay in the workforce longer if they choose to. At the same time, closer cooperation between governments, businesses, and educational institutions will be important for managing migration effectively and maintaining a stable labor market in the long term. In addition, research findings indicate that long-term planning and a flexible approach appear to be essential to mitigate the effects of population aging and labor shortages in Europe, thereby ensuring relative stability in labor markets.

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