

RURAL OBSERVATORY

# Outlook and demographic perspectives for EU's rural regions

## A modelling-based exercise

JRC Working Papers on  
Territorial Modelling and Analysis

No 01/2025



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### Rural Observatory

<https://observatory.rural-vision.europa.eu>

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# Abstract

The European Union is experiencing profound demographic shifts. This paper presents an analysis of observed population trends encompassing observations for the period 2000–2022 and projections until 2040 at the NUTS3 level. The projections were obtained by regionalizing the 2021 Ageing Report’s demographic projections using the Demography-Economy-Land use interaction (DELi) model, which considers explicitly the interlinkages between demographic and economic dynamics. Results show that urban regions are expected to increase their populations primarily due to economic opportunities pulling migrants, while intermediate and rural regions are projected to face population decline, with remote rural regions being the most affected. The natural change rate is trending downwards across all regional typologies, while the net migration rate, historically positive in all typologies, is projected to compensate for the natural change only in urban regions. The implications of these demographic changes are far-reaching, affecting labour markets, public service provision, and economic growth. The paper discusses the potential for regional convergence in GDP per capita, particularly in rural regions close to cities, and the challenges posed by changes in the demographic structure, affected by increasing old age dependency ratio and a shrinking working-age population, and the need for adaptation.

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## **AUTHORS**

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# Executive summary

The article aims to explore and project the demographic and economic changes across various regional typologies within the EU, focusing on urban, intermediate, and rural regions (remote and close to a city). The article has been promoted by DG AGRI and performed by DG JRC, unit B3, in the context of the Rural Observatory.

Motivated by the profound demographic shifts that are reshaping the socio-economic landscape of the EU, particularly affecting rural regions, this paper analyses demographic and economic trends from 2000 to 2022 and utilizes the innovative Demography-Economy-Land use interaction (DELi) model to offer projections until 2040 at the NUTS3 level. The study highlights significant trends such as urban population growth driven by economic opportunities pulling migrants and a marked decline in rural and intermediate regions, with the most severe impacts on remote rural areas.

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## KEY CONCLUSIONS

The projections underscore the need of adaptation strategies to address the demographic and economic challenges faced by different EU regions. By understanding the interplay between demographic changes and economic conditions, policymakers can better plan for sustainable development across the EU. The DELi model offers a comprehensive framework for anticipating these changes and formulating strategies that capitalize on the opportunities presented by demographic shifts.

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## MAIN FINDINGS

**Demographic Shifts:** The EU faces a general decline in natural population change, with urban areas expected to maintain population growth due to positive net migration rates. In contrast, rural areas, particularly those remote from urban centers, are projected to experience significant population declines.

**Economic Implications:** Economic opportunities in urban regions are likely to attract working-age individuals, contributing to GDP growth. Conversely, rural regions, while seeing some convergence in GDP per capita with urban areas, especially in regions close to cities, face challenges in sustaining economic vitality due to depopulation.

**Ageing Population:** The old age dependency ratio is set to rise sharply, particularly in remote rural regions, driven by increased longevity and declining birth rates. This demographic shift will have profound effects on economic performance and the demand for services.



**Policy Recommendations:** To mitigate these challenges, the article suggests adaptation strategies that include leveraging the knowledge and capital of older populations, enhancing healthcare services to meet changing needs, and ensuring that remote rural areas have the resources to adapt to demographic changes.

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## RELATED AND FUTURE JRC WORK

This work is part of the research within the Rural Observatory. The projections generated are based on the Demography-Economy-Land use interaction model (DELI), a methodology developed by the Territorial Development Unit, in collaboration with the Demography and Migration Unit.

## 1

# Introduction

Demographic change has recently become a hot topic in the European Union (EU), with increasing longevity and declining fertility rates as key drivers of an ageing population (European Commission, 2024; Goujon et al., 2021), which presents opportunities (Smith & Longland, 2010; Stoodley & Conroy, 2024; UNECE, 2007) but also challenges (European Commission, 2024; OECD, 2021). As people live longer, society can benefit from a higher human capital. The accumulated expertise, knowledge and experience of older persons not going on retirement can be further exploited to a greater extent compared to the past in both private and public sectors (UNECE, 2007). People going on retirement reduce pressure on transport services in commuting hours, and might spur new business opportunities, especially if receiving a lump sum payment. They might be interested in new business opportunities by starting their own business, or investing in local ones (Smith & Longland, 2010). On the other side, ageing could have a negative impact on productivity and service provision (European Commission, 2024; OECD, 2021) and threaten the sustainability of pensions schemes (Daniele et al., 2020; Feyrer, 2002; Lallemand & Rycx, 2009; Mahlberg et al., 2013). Nevertheless, its economic consequences could be minimal if older people contribute economically and healthcare services adapt to support changing health needs (Stoodley & Conroy, 2024).

Those trends are not affecting territories uniformly, and bear socio-economic consequences not only between but also within Member States (Aiyar et al., 2016; Crespo Cuaresma et al., 2016; Lindh & Malmberg, 2009). Rural regions are facing a faster aging and population decline, as they tend to have lower net migration and natural population change compared to urban regions. In response, policy makers have placed rural regions on top of their agenda. They are central to frameworks and policies of the European Commission such as the Long-Term Vision for Rural Areas, the Territorial Agenda 2030 and the Common Agricultural Policy (European Commission, 2022; European Commission, 2021).

Essential tools to allow policy makers anticipating those challenges, and implement effective regional policies, are the projections of the demographic changes and the associated socio-economic impacts on a spatially refined and longer time scale. Existing population and economic projections are based on models that simulate demographic or economic change separately, or which take one of the two domains as fixed, exogenous input, not allowing for the bi-directional interactions that take place in reality. In this paper, we provide a first projection for the EU based on a new model integrating demography and economy as interacting components at the NUTS-3 level (Curtale et al., 2024). The projections, generated until 2040, show that depopulation in the EU will accelerate in non-urban contexts, characterized by a higher old age dependency ratio and a lower share of population in working age. On the other side, Gross Domestic Product (GDP) per capita growth in rural regions close to cities is projected to continue to converge towards that of urban regions. Demographic changes will likely affect the economic structure and the needs of the population differently depending on the regional typologies, but they are not shocks that cannot be anticipated. The slow progression of these changes provides policymakers with sufficient time to implement adaptive strategies, which will be discussed in the article.

The article is structured as follows. Section 2 provides an overview of the literature regarding demographic change, including the consequences, territorial disparities and forecasted trends of demographic change in the EU. In Section 3, the research method is outlined and in Section 4 the results of the model are presented. Lastly, in Section 5 we discuss the results and provide the conclusions.

## 2

# Demographic change and its impacts

Demographic changes are affecting the global economy. Changes in age structure are expected to boost per capita economic growth in low and lower-middle income countries, while population ageing accelerates sharply in high and upper-medium ones (Mason & Lee, 2022). The ageing trend is particularly evident in the EU, driven by an increased longevity and decreasing fertility rates. In particular, the EU is affected by a population decline linked to negative natural growth, only partly offset by net migration, resulting in a rapid increase of older population and the old age dependency ratio, with consequences for the macro-economic performance (Aiyar et al., 2016; Crespo Cuaresma et al., 2016; European Commission, 2024; Goujon et al., 2021; Lindh & Malmberg, 2009).

An ageing population typically leads to a smaller working age population and lower GDPpc and productivity growth (Daniele et al., 2020; Feyrer, 2002; Lallemand & Rycx, 2009; Mahlberg et al., 2013). It alters consumption patterns and shift a country's comparative advantage towards industries with age-appreciating skills (Aiyar et al., 2016; Boersch-Supan, 2001; Cai & Stoyanov, 2016). Due to the link between demographic change and macro-economic performance, the process of economic and social convergence between the Member States of the EU is expected to be impacted (Crespo Cuaresma et al., 2016). The economic and social convergence has been occurring across the EU since the introduction of the European Single Market and the Cohesion Policy, but it has been characterized by different rates of convergence depending on the spatial and temporal dimension. Territorial disparities in demographic change exist between and within Member States.

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## 2.1 TERRITORIAL DISPARITIES

Rural regions in the EU tend to have lower net migration and natural population change in comparison to urban regions. However, differences exist between rural regions close to a city and remote rural regions, with the former often benefitting from proximity to agglomeration effects and the latter facing an increased risk of economic stagnation or decline. This leads to lower economic and employment growth rates and less demand and resources to improve or maintain basic services and amenities, further diminishing their attractiveness (European Commission, 2024; OECD, 2021; Veneri & Ruiz, 2016).

The current migration inflow of younger age cohorts into urban regions benefits the GDP growth, while rural regions tend to experience an in-migration of older age groups (**Figure A1** in the Appendix). Changes in the age structure are likely to have different economic consequences in the regions. On one side, they exacerbate the effects of ageing at the local level (Goujon et al., 2021; Jacobs-Crisioni et al., 2020), which potentially threatens the socioeconomic resilience due to lower adaptation of older populations (Giannakis & Bruggeman, 2020). On the other, they can spur new

business opportunities due to additional capital brought to the regions and an increasing demand for local services (Smith & Longland, 2010; UNECE, 2007).

Nevertheless, rural regions demonstrate varying degrees of macro-economic performance, depending on the participation rates and productivity levels between genders, different age cohorts and educational levels, with for example highly educated human capital having an important role for income convergence dynamics on different geographical scales (Crespo Cuaresma et al., 2016).

The trends of employment and population in working age (i.e. 20-64 years old) show that at the EU level employment increased by 0.67% per year between 2011 and 2021, despite a decrease of 0.25% of population in working age (**Table A1** in the Appendix). Employment grew more slowly in rural regions, but because working age population was shrinking more rapidly, the end result is slightly higher growth of the employment to population ratio in rural regions. This is clearly the case in northern and western Member States, but not in eastern. The south has been characterized by reduction of employment in rural regions, but highest growth in employment over population in urban and remote rural regions (**Table A1** in the Appendix). There have been changes in employment by sector, with clear patterns between typologies showing a convergence trend in the economic structure between typologies (**Table A2** and **Figure A2** in the Appendix). Public services, information, communication, culture and sports recorded an increase of employment in all typologies. The rural regions recorded the fastest reduction of employment in the agricultural sector and the highest increase in construction, trade, transport and accommodation sectors. As result, the employment composition by sectors between typologies is becoming more similar over time.

Finally, local economic conditions contribute significantly to demographic change, and growth rates between rural and urban regions demonstrate greater divergence in lower income countries in the EU than high-income countries (Alamá-Sabater et al., 2021; Meloni et al., 2024). The specific characteristics, conditions and adaptability of rural regions therefore influence their potential, as demonstrated by the higher GDP per capita growth levels in several rural regions of the EU15 countries compared to urban regions due to the spread of agglomeration advantages (Dijkstra & Gáková, 2010).

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## 2.2 EXPECTED FUTURE TRENDS

Available regional level projections for Europe (European Commission, 2021; Eurostat, 2019) have been designed assuming long run convergence of birth, mortality and net migration rates across EU regions. This is a reasonable assumption for highly uncertain long-term projections until 2100, but leaves out the possibility of persisting divergence, which seems to be realistic in the short term. For example, research on urban-rural issues indicates that the differences between urban and rural regions in the EU are likely to increase (Perpiña Castillo et al., 2021) in coherence with the vicious cycle of rural depopulation and demographic ageing. The repercussions of this divergence are profound, influencing macroeconomic stability, transportation needs, and healthcare accessibility (Alonso et al., 2023; Perucca et al., 2019; Urbanek et al., 2023) and may further increase emigration of specific age groups and fuel political discontent among the remaining population in the short term (Dijkstra et al., 2020; Ghio et al., 2023).

Moreover, much of the current studies generating socioeconomic projections tends to operate in silos, investigating either population or GDP trends (Jacobs-Crisioni et al., 2020; Perpiña Castillo et al., 2021) using fixed scenarios of one of the two variables (Crespo Cuaresma et al., 2016;

Leimbach et al., 2017; Wolfgang et al., 2018), which fails to capture the interplay between the two. This compartmentalized approach overlooks the complex feedback mechanisms between demographic changes and economic conditions, a gap that no study to date has adequately bridged to the best of our knowledge.

To fill this gap, this paper introduces the Demography, Economy, Land use interaction (DELi) model, a modular and integrated approach to regionalize socio-economic projections (Curtale et al., 2024) through iterative and interactive projections of population, employment, GDP and land use, using a specification that allows to explain the drivers of migration rates by age groups.

## 3

## Research material

## 3.1 METHODOLOGY: THE DELI MODEL

The regional projections have been generated using the Demography-Economy-Land use interaction (DELi) model (Curtale et al., 2024). DELi is a framework designed to regionalize exogenous demographic and economic projections from the national to the NUTS3 level. It is a technical tool that supports policy-making by providing sub-national projections of population, employment, GDP, and land use. The DELi model operates through a set of linked equations that integrate assumptions regarding future regional growth and estimate regional levels of the aforementioned variables in a dynamic, recursive, and integrated manner. This allows the model to capture feedbacks between demography and economy as well as processes of divergence and convergence across regions.

The DELi model is modular and flexible, allowing for the expansion or substitution of its components with alternative methodological approaches or assumptions. It can be configured to generate different regionalization scenarios based on the same or different input country-level projections. The model is particularly useful for exploring scenarios of regional convergence or divergence, demographic change, land use policies, and their territorial implications at the NUTS3 level.

For the specific projections of population in the present paper, we used the DELi model structure, where the demographic changes are estimated through a cohort component model. Net migration is estimated econometrically, based on an improved specification. The improved equation (**eq. 1**) allows for a better control of the impact of population density on the net migration rate, by age group, and is specified as follows:

**Equation 1.** Econometric specification of net migration rate.

$$nmr_r^{5yag} = \beta_0 + \beta_1 \ln\left(\frac{GDPpc_r}{GDPpc_c}\right) + \beta_2 \frac{Pop_r}{Area_r} + A + \epsilon_r$$

Where:

$nmr_r$ : Net migration rate for specific age groups

$5yag$ : 5 years age group

$\ln\left(\frac{GDPpc_r}{GDPpc_c}\right)$ : Log of NUTS3 region average GDP per capita divided by country average GDP per capita

$\frac{Pop_r}{Area_r}$ : Mean population divided by area of NUTS3 region (population density)

$A$ : Set of Fixed Effects (Country, Metro, Capital)

$r$ : NUTS3 region

The main estimated coefficients (Appendix A1) show a positive impact of higher GDP per capita on net migration and a negative impact of population density, *ceteris paribus*. The effect is



heterogeneous across age groups: higher GDP per capita has a stronger impact on population in the 20-35 years old age group, while for the other age groups the impact of population density is stronger in slowing down the migration rate. Metropolitan regions are attractive for population in the 20-35 years old age group, while repulsive for the population in the 60-75 years old.

For any given projected year, DELi starts by estimating regional population, which is the sum of natural growth (expected births minus expected deaths) with net migration is modelled according to the description above. Subsequently, regional GDP per capita growth is determined by an equation which includes a non-linear GDP per capita converge term, plus factors relating to human capital, quality of institutions, urban agglomeration effects and demographic parameters such as the old age dependency ratio (OADR) and the share of working age population (WAP). The demographic parameters in the equation of GDP per capita growth closes the loop between demography and economy interactions. All coefficients were estimated econometrically for the period 2000-2019 (Curtale et al., 2024).

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## 3.2 DATA

Input data refer to a historical time-series at the NUTS3 and projections at NUTS0 level. Historical data are primarily sourced from the ARDECO dataset (AUTERI et al., 2024) and Eurostat, which provide a set of long time-series variables and indicators for EU27 regions. For land use data, the sources include the LUISA Base Map (Pigaiani & Batista e Silva, 2021) and the Global Human Settlement Layer (GHSL) (Pesaresi et al, 2016). For the projections, the DELi model's 2023 release, used for this specific study, rely on national-level demographic and socioeconomic projections published in the 2021 Ageing Report (European Commission, 2021). Specifically, this includes GDP growth and population projections by age groups. Additionally, assumptions on fertility and mortality rates were taken directly from the NUTS3 level version of Eurostat's EUROPOP 2019 population projection (Eurostat, 2019).

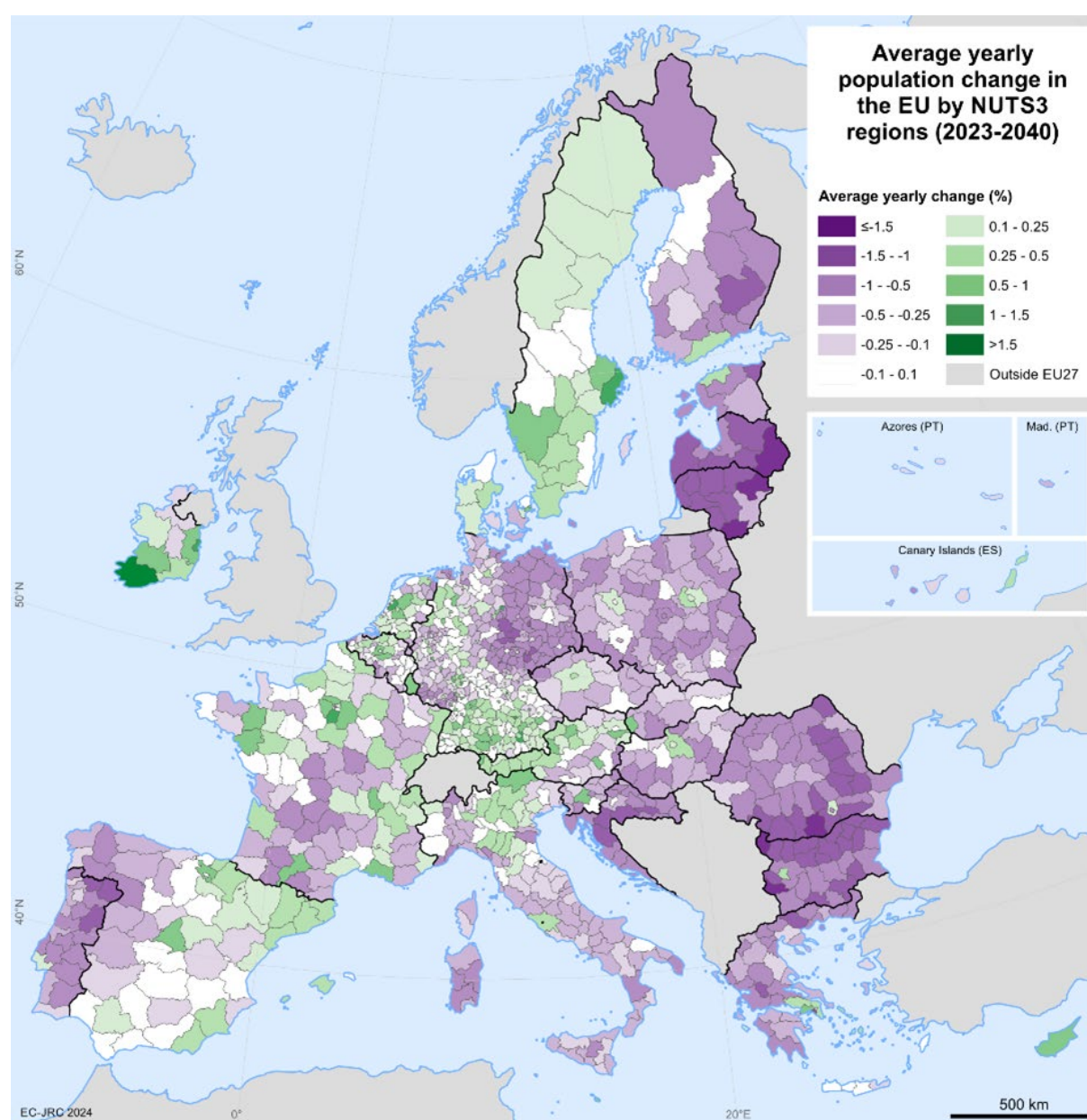
## 4

# Results

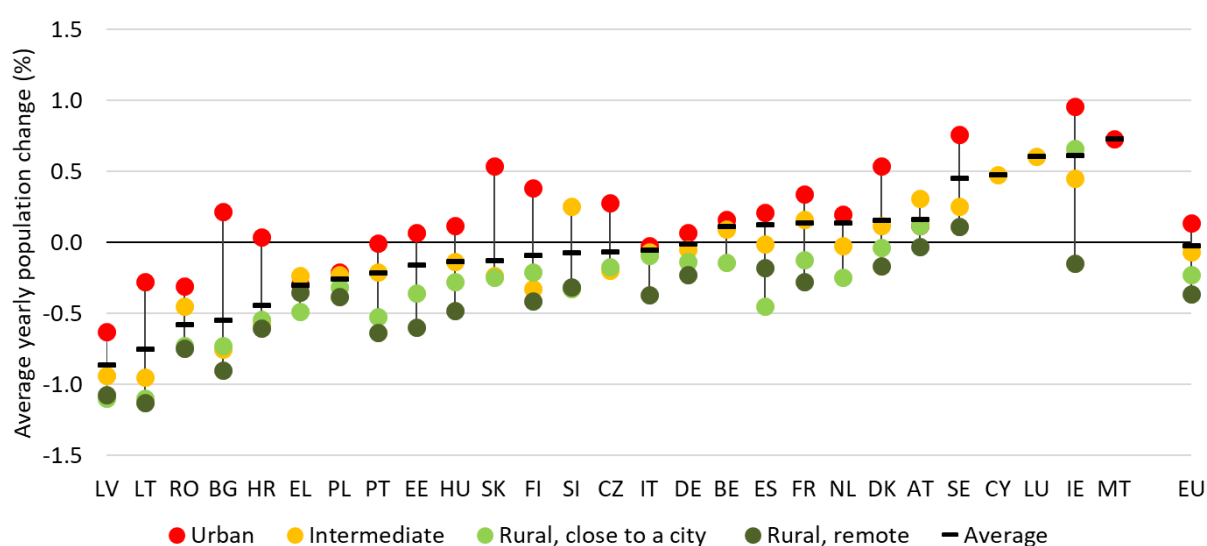
Demographic projections by Eurostat at the national level indicate the ageing and the slight contraction of the overall population in the EU in the coming years. This trend is the combination of heterogeneous demographic dynamics that are expected to unfold at the regional level. The DELi model provides a nuanced lens through which to examine these dynamics, offering insights into the divergent trends across different regional typologies, including urban, intermediate, and rural regions. The latest is further split between 'close to a city' and 'remote' rural regions, which are classified as remote if less than half of its residents can drive to the centre of a city of at least 50 000 inhabitants within 45 minutes, as defined by Eurostat (Dijkstra & Poelman, 2018).

## 4.1 POPULATION CHANGE ACROSS REGIONAL TYPOLOGIES

Overall, the EU population is expected to decline by a 0.04% yearly average between 2023 and 2040. The decline is determined by a reduction of population in intermediate (-0.11%) and rural (-0.35% close to a city, -0.46% remote) regions higher than the growth in urban regions (+0.18%). Urban regions are expected to experience continued population growth, albeit at a decelerated rate compared to historical levels. Despite the slowdown, urban regions remain the engines of demographic expansion within the EU, driven by their economic opportunities that will likely continue to attract individuals in working age and families. In contrast, intermediate and rural regions are projected to face population decline in the next decades, with a more pronounced reduction in remote rural regions (**Figure 1** and **2**). The results of our projections show that, by considering the interactions between economic and demographic dynamics as driver of net migration, we predict a faster growth of population in urban regions compared to Eurostat (+0.18% vs 0.16%, **Table A4** in the Appendix), and a faster decline in intermediate (-0.11% vs -0.10%), rural close to a city (-0.35% vs -0.33%), and especially rural remote (-0.46% vs -0.37%) regions.

**Figure 1.** Average yearly population change by NUTS 3.

The population decline is expected from Eurostat in 15 EU countries (see **Figure 2**), with the most pronounced decline in eastern countries, where in extreme cases such as Latvia and Lithuania, the yearly average reduction of population will be close to 1%. On the opposite, the highest population growth is expected in Malta, Ireland, Luxembourg, Cyprus and Sweden, with a country average increase of population close to 0.5% and higher. With few exceptions, the differences across typologies are expected in most EU countries, where urban regions are more likely to be growing while the rural regions are typically shrinking, and especially the remote ones.

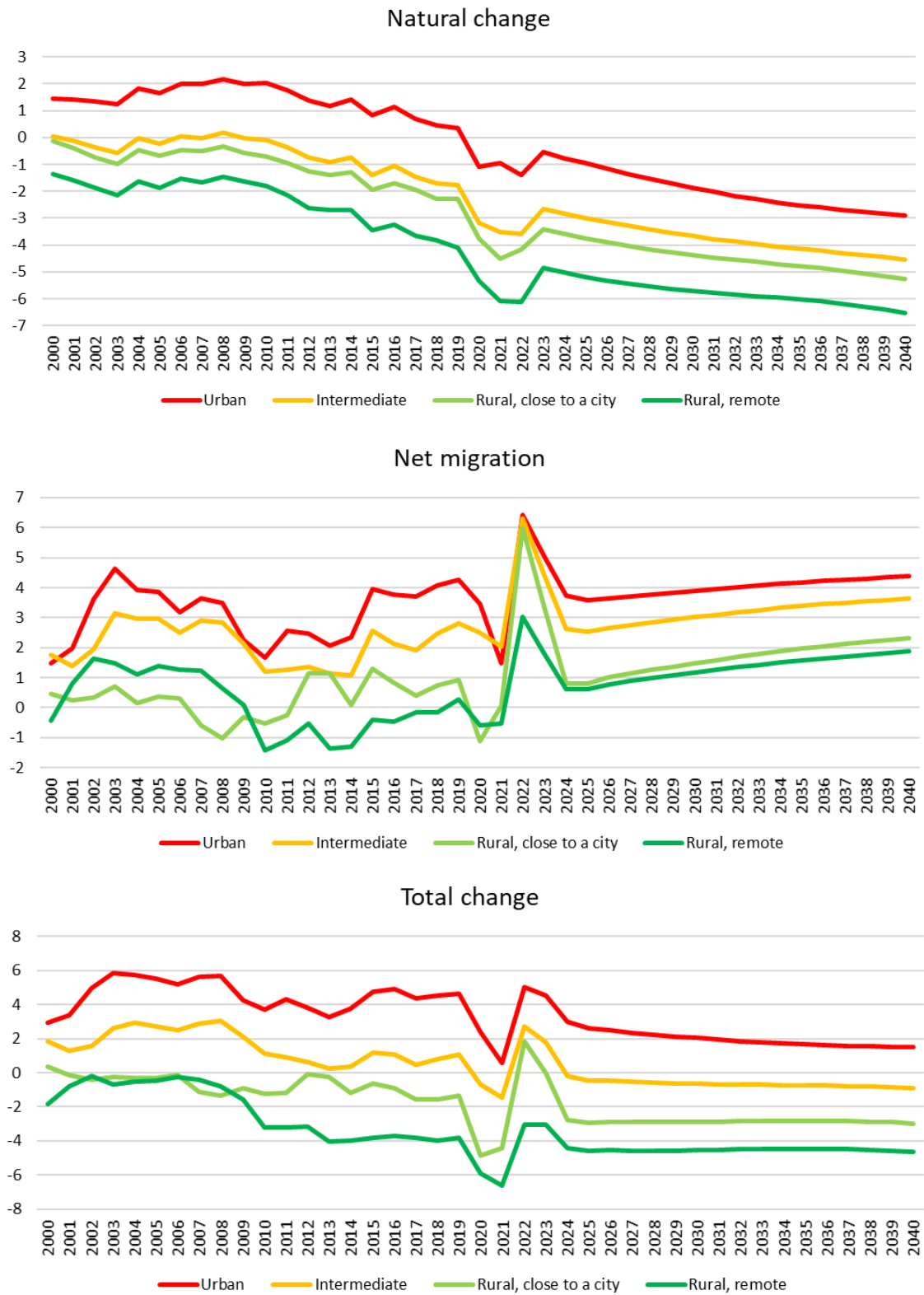
**Figure 2.** Average yearly population change 2023-2040, by Member State and regional typology.

## 4.2 NATURAL CHANGE AND MIGRATION FLOWS

Changes in population are driven by two main factors: the natural change, given by the difference between births and deaths, and net migration (**Figure 3**). The natural change rate has been trending downwards in all the regional typologies since 2008. It has been negative in intermediate and rural regions since the beginning of the century, while in urban regions it turned negative after 2019. Future projections of natural change expect a continuous decline, indicating that the new births will not counterbalance the deaths.

Excluding the exceptional circumstances of the COVID-19 outbreak, the net migration rate has been historically positive in all the typologies, apart from remote rural regions in the years between 2009 and 2018 and rural close to a city between 2007 and 2011. From the beginning of the century until 2019, the net migration rate was always higher in urban regions, followed by intermediate and rural. The COVID-19 outbreak temporarily halted the migration inflows towards urban regions, when it has been lower compared to intermediate regions. In 2022, the pre-pandemic pattern was restored, with urban regions recording the highest net migration rate since the beginning of the century, followed by an exceptionally high rate in intermediate regions and rural close to a city, mainly due to the increased migratory movements post-COVID-19 and the consequences of the Russia-Ukraine crisis (Eurostat, 2023). Future projections, in line with the historical values, expect a higher migration rate towards urban regions that will compensate for the reduction of population due to a negative natural change. Intermediate and rural regions, albeit having a positive net migration, will likely see a decline in population as the inflow of migrants will not offset the decline of natural change.

**Figure 3.** Rates (persons per 1000) of natural change (above), net migration (centre) and total change (below), by regional typology with remoteness. The vertical grey line indicates the beginning of the projection period.



## 4.3 CHANGES IN AGE STRUCTURE AND IMPACTS

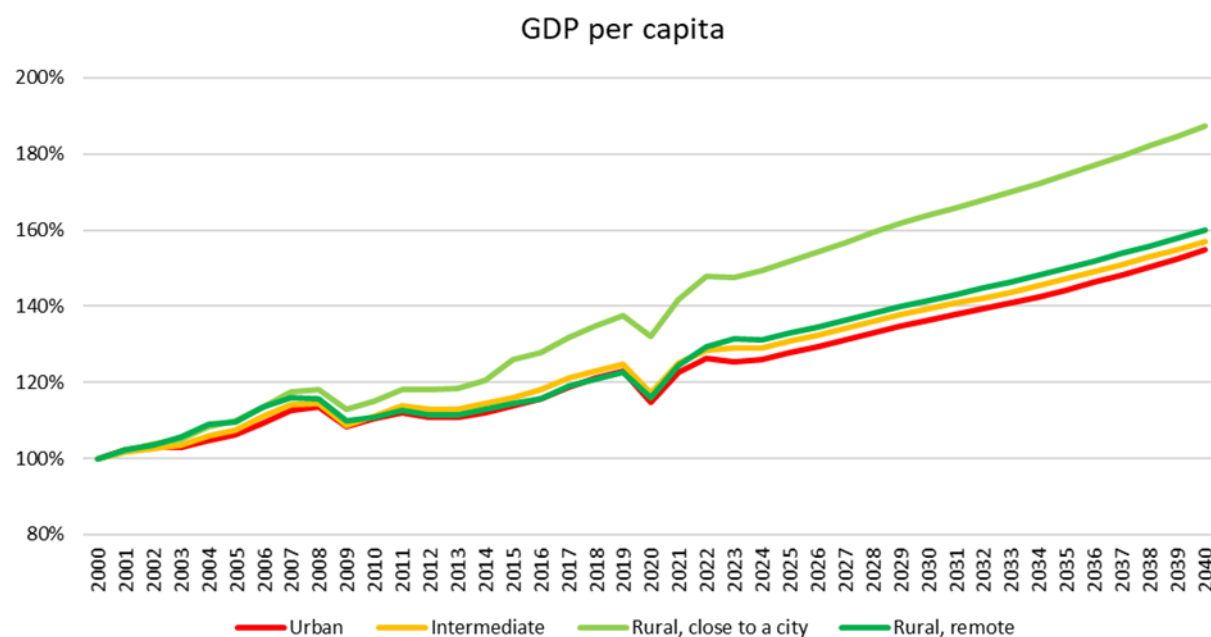
Changes in total population are coupled with changes in the age structure, and consequent impacts on future economic and social dynamics. Two key demographic indicators that offer a quick snapshot on the age structure are the old age dependency ratio (OADR), which measures the ratio of individuals aged 65 over those in working age (20-64), and the share of population in working age (WAP), which measures the ratio of individuals between 20-64 over the total population (**Table 1**).

**Table 1.** Old age dependency ratio and share of population in working age, by regional typology with remoteness.

|                               | OLD AGE DEPENDENCY RATIO (OADR) |       |       | SHARE OF POPULATION IN WORKING AGE (WAP) |       |       |
|-------------------------------|---------------------------------|-------|-------|------------------------------------------|-------|-------|
|                               | 2000                            | 2023  | 2040  | 2000                                     | 2023  | 2040  |
| <b>PREDOMINANTLY URBAN</b>    | 25.3%                           | 32.3% | 48.6% | 67.5%                                    | 64.6% | 57.8% |
| <b>INTERMEDIATE</b>           | 26.7%                           | 35.7% | 54.3% | 66.6%                                    | 63.3% | 55.9% |
| <b>RURAL, CLOSE TO A CITY</b> | 27.4%                           | 35.9% | 55.9% | 65.9%                                    | 63.0% | 55.3% |
| <b>RURAL, REMOTE</b>          | 29.9%                           | 41.1% | 61.0% | 64.9%                                    | 61.2% | 54.0% |
| <b>EU AVERAGE</b>             | 27.0%                           | 35.7% | 54.3% | 66.4%                                    | 63.2% | 55.9% |

The old age dependency ratio is expected to experience a marked increase in all regions, with the most pronounced acceleration in rural remote regions. This trend can be attributed to a combination of increased longevity, declining birth rates, and the outflow of younger individuals towards urban centres, combined with the inflow of older generations close to retirement age. Concurrently, the share of population in the working age is predicted to slightly diminish across all regional typologies and more acute in rural remote regions. The heterogeneity of the share of working age population across regional typologies is less pronounced than the OADR, indicating that the main difference in age structure would be in the weight of population above 65. The economic growth, measured in terms of GDP per capita (**Figure 4**) is expected to follow a convergence path, where the GDP per capita in rural regions close to city will likely record the highest growth.

**Figure 4.** Projections of gross domestic product (GDP) per capita growth indexed to base year 2000. The vertical grey line indicates the beginning of the projection period.





## 5

# Discussion

The demographic and economic landscape of the European Union is undergoing a significant transformation due to the decline in natural change and increased longevity that will lead to a generalized population ageing, which will be stronger in rural regions. An informed policy-making to address challenges rising from those dynamics calls for a deeper understanding of regional trends, and how they are likely to develop in the future. We used the DELi model to regionalize national level demographic projections considering the economic and demographic interactions, to understand how such projections unfold at regional level until 2040. In particular, we used a model specification that allows to identify drivers of net migration rate, which shows that GDP per capita and population density have significant and heterogeneous impact across age groups. The analysis suggest that economic incentives and quality of life considerations are not uniformly influential across the demographic spectrum, and indicate different migration flows depending on people's life stage. Younger generations are typically more attracted to urban regions with higher GDP per capita and greater economic and social opportunities, while older age groups are less attracted by metropolitan regions and may prioritize lower congestion, which can be found in less densely populated regions. The use of the DELi model provides additional insights compared to standard demographic projections designed assuming long run convergence of birth, mortality and net migration rates across EU regions, such as those from Eurostat's EUROPOP19 (European Commission, 2021; Eurostat, 2019). We show that by considering explicitly the interaction between economy and demography, a more pronounced pattern can be identified between regional typologies, with urban regions projected to attract more population compared to projections assuming long run convergence.

## 5.1 THE PROJECTION OF TERRITORIAL DIFFERENCES

The key results of our projections underscore the ongoing population increase in urban regions, while the population in rural and intermediate regions is likely to shrink. A declining natural change rate has been affecting all the regional typologies since 2008. It was positive in urban regions before 2019, but from 2020 onwards, the births have been failing to compensate for the deaths in all typologies, with future projections expecting this decline to persist. The natural change, marked by the widening gap between births and deaths, will be compensated by net migration in urban regions. The same is unlikely to be the case in intermediate and rural regions. The young people leaving the rural regions are more than offset by other age groups arriving, but the positive net migration fails to compensate the reduction from a declining natural change.

In terms of economic growth, our results anticipate a convergence path in GDP per capita for rural regions in proximity to cities and intermediate regions, indicating that the spread of economic benefits is not strictly limited to urban centres. This could be attributed to the diffusion of agglomeration advantages and the strategic positioning of these regions, which allows them to capitalize on their proximity to urban economies (European Commission, 2024; OECD, 2021;



Veneri & Ruiz, 2016). However, the convergence effect is not strong enough to counterbalance the demographic trends, which lead to a more pronounced concentration of GDP in predominantly urban regions. This finding aligns with the global phenomenon of urbanization and the centralization of economic activities in cities (United Nations, 2018). In summary, those trends highlight that despite the gap between urban and non-urban regions in terms of total production will increase, the average wealth level of people in rural regions close to a city is catching-up with those in the urban ones.

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## 5.2 A FOCUS ON REMOTE RURAL REGIONS

Remote rural regions seems to be particularly vulnerable to being left behind, with few exceptions that can be attributed to unique local factors, such as the presence of specialized industries, tourism, or natural resources, which can provide alternative sources of income and employment. A context of population decline, coupled with an increasing old age dependency ratio and decreasing population in working age, predicts a dual economic challenge in rural remote regions: a reduction in GDP per capita growth due to a smaller productive population and a simultaneous escalation in the demand for pensions and healthcare services (Aiyar et al., 2016; Crespo Cuaresma et al., 2016; European Commission, 2024; Goujon et al., 2021; Lindh & Malmberg, 2009). Nevertheless, the changing demographic structure does not bring only challenges but also opportunities. Indeed, an older population is likely to be associated with higher knowledge, experience and capital, which have the potential to spur business opportunities (Smith & Longland, 2010; UNECE, 2007).

Finally, the process of ageing is expected to affect all the regional typologies, with rural remote regions leading this process. These regions may gain a potential economic edge by pioneering the adaptation to evolving needs of their populations. This early adaptation might allow them to experiment diverse strategies and, upon identifying successful approaches, share these innovations with other types of regions, effectively exporting their proven adaptation models. Priorities for policymaker is to ensure that rural remote regions, more than others, have the capability to adapt to a new age structure with different needs and demand for services, in particular healthcare services to support changing health needs (Stoodley & Conroy, 2024).

## 6

# Conclusions

The ongoing demographic shifts in the EU, driven by lower fertility and increasing longevity are leading towards an overall ageing, whose potential consequences are longstanding and difficult to invert. The elephant in the room of an ageing society is that, as the balance between contributors and beneficiaries becomes skewed, the sustainability of social support systems, such as the pension schemes, is threatened (Daniele et al., 2020; Feyrer, 2002; Lallemand & Rycx, 2009; Mahlberg et al., 2013). Suggested strategies to tackle this issue include measures to boost fertility rates or employing migrants to counterbalance a diminishing workforce that cannot sustain the older generations. Each of these strategies is accompanied by its own set of challenges.

Low fertility is due to economic, structural, institutional and socio-cultural domains (Wilkins, 2019) and linked to fundamental societal trends, such as higher time-preference of modern society (Hoppe, 2018). Mitigating the problem with policies aiming to promote higher fertility to recover positive natural growth might be politically accepted and desirable in the long run, but are highly costly and uniformly failed to tackle demographic inertia and overall decline in fertile women (Dijkstra, 2024). Using migration to mitigate overall population decline has been often proposed, but should be used with precaution, respecting the capacity of countries and regions to properly integrate newcomers, and considering the needs of the labour market, skills and likelihood for socio-cultural integration in Europe.

Given the complexities and potential inefficacies associated with these solutions aiming at a mitigation of the ageing process, adaptation strategies should be prioritized. Increasing productivity, participation rate, and optimizing the territorial allocation of public services to ensure high coverage of essential services for all age groups at contained costs are all relevant strategies (Crespo Cuaresma et al., 2016; Lindh & Malmberg, 2009) but the differing time horizons for the issues caused by depopulation and ageing between the Member States make it challenging to find a uniform solution. Thus, it is important to understand the different projected ageing patterns across regions, and exploit the potential resources that an ageing population can bring, in terms of expertise and capital.

Our projections and analysis at the regional level show that although urban-rural differences exist, the main difference between regional performances does not seem to be connected to the typology of the regions, but rather to the proximity to cities. Rural regions are expected to lose population, to increase their GDP per capita, and their employment over population in working age ratio is catching-up those of urban regions. Among those, rural regions close to a city are expected to record the highest GDP per capita growth across all typologies and their sectoral employment composition is increasingly resembling that of urban regions in terms of economic structure. Instead, remote rural regions are experiencing the fastest depopulation and ageing.

Adaptation policies should be tailored to the unique circumstances of each region and passing through the involvement of regional actors that could leverage the local strengths. Policy-makers should allow all regions to have the necessary conditions to thrive, and to exploit the advantages of the changing demographic structure, with a particular attention towards the remote rural regions.

Remote rural regions can potentially become laboratories for adaptation strategies which will eventually share with urban regions the best practices and their expertise in service provision to an ageing population. Nevertheless, those regions are often characterized by lower economic diversification and limited access to services, which should be guaranteed.

# 7 Appendix

**Table A1.** Changes in population and employment.

|                              | Population 20-64 |             |                                     | Employment |         |                                     | Employment / pop20-64 |      |                                     |
|------------------------------|------------------|-------------|-------------------------------------|------------|---------|-------------------------------------|-----------------------|------|-------------------------------------|
|                              | 2011             | 2021        | Average (%) yearly change 2011-2021 | 2011       | 2021    | Average (%) yearly change 2011-2021 | 2011                  | 2021 | Average (%) yearly change 2011-2021 |
| EU27                         | 268,124,321      | 261,560,505 | -0.25                               | 195,388    | 208,902 | 0.67                                | 0.73                  | 0.80 | 0.92                                |
| Pred. urban                  | 107,608,666      | 108,131,886 | 0.05                                | 85,037     | 93,270  | 0.93                                | 0.79                  | 0.86 | 0.88                                |
| Intermediate                 | 103,803,046      | 100,384,745 | -0.33                               | 72,407     | 76,425  | 0.54                                | 0.70                  | 0.76 | 0.88                                |
| Pred. rural, close to a city | 40,968,412       | 38,602,007  | -0.59                               | 27,516     | 28,634  | 0.40                                | 0.67                  | 0.74 | 1.00                                |
| Pred. rural, remote          | 15,744,197       | 14,441,867  | -0.86                               | 10,430     | 10,573  | 0.14                                | 0.66                  | 0.73 | 1.00                                |
| NW                           | 122,850,189      | 124,253,423 | 0.11                                | 97,741     | 106,558 | 0.87                                | 0.80                  | 0.86 | 0.75                                |
| Pred. urban                  | 51,791,000       | 53,815,383  | 0.38                                | 44,682     | 49,701  | 1.07                                | 0.86                  | 0.92 | 0.68                                |
| Intermediate                 | 45,672,339       | 45,826,077  | 0.03                                | 34,998     | 37,713  | 0.75                                | 0.77                  | 0.82 | 0.72                                |
| Pred. rural, close to a city | 18,654,986       | 18,247,374  | -0.22                               | 13,236     | 14,093  | 0.63                                | 0.71                  | 0.77 | 0.85                                |
| Pred. rural, remote          | 6,731,864        | 6,364,589   | -0.56                               | 4,825      | 5,052   | 0.46                                | 0.72                  | 0.79 | 1.02                                |
| S                            | 79,079,619       | 76,933,128  | -0.27                               | 53,697     | 55,451  | 0.32                                | 0.68                  | 0.72 | 0.60                                |
| Pred. urban                  | 41,945,671       | 41,358,732  | -0.14                               | 28,851     | 30,445  | 0.54                                | 0.69                  | 0.74 | 0.68                                |
| Intermediate                 | 28,407,862       | 27,427,873  | -0.35                               | 18,907     | 19,125  | 0.11                                | 0.67                  | 0.70 | 0.47                                |
| Pred. rural, close to a city | 4,622,601        | 4,350,666   | -0.60                               | 3,168      | 3,139   | -0.09                               | 0.69                  | 0.72 | 0.51                                |
| Pred. rural, remote          | 4,103,485        | 3,795,857   | -0.78                               | 2,770      | 2,741   | -0.10                               | 0.68                  | 0.72 | 0.68                                |
| E                            | 66,194,513       | 60,373,954  | -0.92                               | 43,951     | 46,893  | 0.65                                | 0.66                  | 0.78 | 1.58                                |
| Pred. urban                  | 13,871,995       | 12,957,771  | -0.68                               | 11,504     | 13,124  | 1.33                                | 0.83                  | 1.01 | 2.02                                |
| Intermediate                 | 29,722,845       | 27,130,795  | -0.91                               | 18,501     | 19,588  | 0.57                                | 0.62                  | 0.72 | 1.49                                |
| Pred. rural, close to a city | 17,690,826       | 16,003,967  | -1.00                               | 11,111     | 11,402  | 0.26                                | 0.63                  | 0.71 | 1.27                                |
| Pred. rural, remote          | 4,908,847        | 4,281,421   | -1.36                               | 2,834      | 2,780   | -0.19                               | 0.58                  | 0.65 | 1.18                                |

**Table A2.** Employment share, by sector and regional typology with remoteness.

|            | URBAN |       |       | INTERMEDIATE |       |       | RURAL, CLOSE TO A CITY |       |        | RURAL, REMOTE |       |       |
|------------|-------|-------|-------|--------------|-------|-------|------------------------|-------|--------|---------------|-------|-------|
| SECTOR     | 2000  | 2022  | diff. | 2000         | 2022  | diff. | 2000                   | 2022  | diff.  | 2000          | 2022  | diff. |
| <b>A</b>   | 1.8%  | 1.1%  | -0.7% | 9.2%         | 4.7%  | -4.5% | 21.3%                  | 10.4% | -10.9% | 20.5%         | 11.8% | -8.7% |
| <b>B-E</b> | 17.2% | 11.5% | -5.7% | 22.5%        | 18.7% | -3.8% | 21.8%                  | 20.6% | -1.2%  | 19.0%         | 16.6% | -2.4% |
| <b>F</b>   | 6.6%  | 5.7%  | -0.8% | 7.3%         | 7.2%  | -0.1% | 6.6%                   | 8.0%  | 1.3%   | 7.2%          | 7.6%  | 0.4%  |
| <b>G-I</b> | 25.7% | 25.0% | -0.7% | 22.4%        | 24.0% | 1.5%  | 18.5%                  | 22.0% | 3.5%   | 19.8%         | 23.4% | 3.6%  |
| <b>J</b>   | 3.6%  | 5.0%  | 1.4%  | 1.7%         | 2.1%  | 0.4%  | 1.1%                   | 1.5%  | 0.4%   | 1.0%          | 1.1%  | 0.1%  |
| <b>K</b>   | 3.5%  | 3.1%  | -0.4% | 2.0%         | 1.7%  | -0.3% | 1.6%                   | 1.5%  | -0.1%  | 1.4%          | 1.3%  | -0.1% |
| <b>L</b>   | 1.2%  | 1.3%  | 0.1%  | 0.9%         | 0.9%  | 0.1%  | 0.6%                   | 0.7%  | 0.1%   | 0.6%          | 0.7%  | 0.2%  |
| <b>M-N</b> | 11.7% | 16.6% | 4.9%  | 7.0%         | 10.8% | 3.8%  | 4.9%                   | 7.9%  | 3.0%   | 4.4%          | 7.3%  | 2.9%  |
| <b>O-Q</b> | 22.1% | 23.9% | 1.8%  | 21.9%        | 24.2% | 2.3%  | 19.6%                  | 22.9% | 3.3%   | 22.1%         | 25.5% | 3.4%  |
| <b>R-U</b> | 6.5%  | 6.8%  | 0.3%  | 5.1%         | 5.6%  | 0.5%  | 3.9%                   | 4.5%  | 0.5%   | 3.9%          | 4.6%  | 0.7%  |

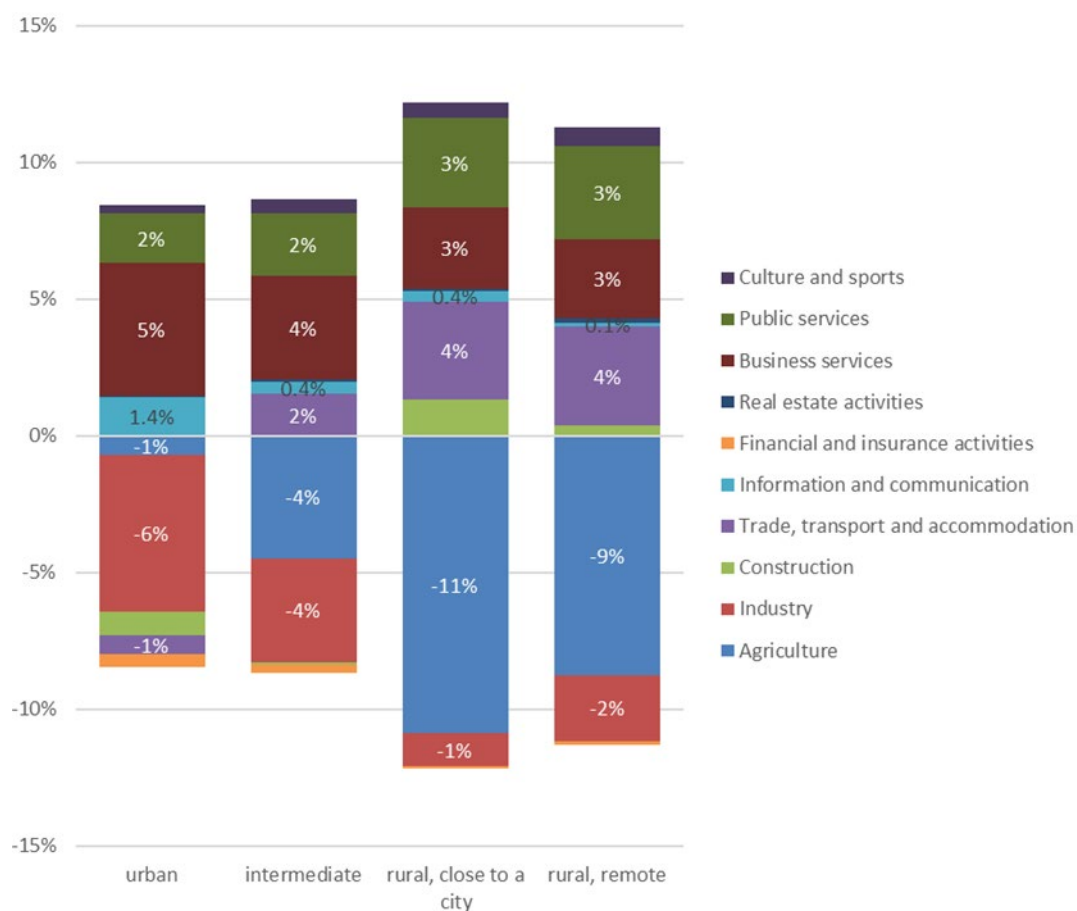
A=Agriculture, Forestry and Fishing, B=Mining and Quarrying, C=Manufacturing, D=Electricity, Gas, Steam and Air Conditioning Supply, E=Water Supply; Sewerage, Waste Management and Remediation Activities, F=Construction, G=Wholesale and Retail Trade; Repair of Motor Vehicles and Motorcycles, H=Transportation and Storage, I=Accommodation and Food Service Activities, J=Information and Communication, K=Financial and Insurance Activities, L=Real Estate Activities, M=Professional, Scientific and Technical Activities, N=Administrative and Support Service Activities, O=Public Administration and Defence; Compulsory Social Security, P=Education, Q=Human Health and Social Work Activities, R=Arts, Entertainment and Recreation, S=Other Service Activities, T=Activities of Households as Employers; Undifferentiated Goods and Services Producing Activities of Households for Own Use, U=Activities of Extraterritorial Organisations and Bodies.

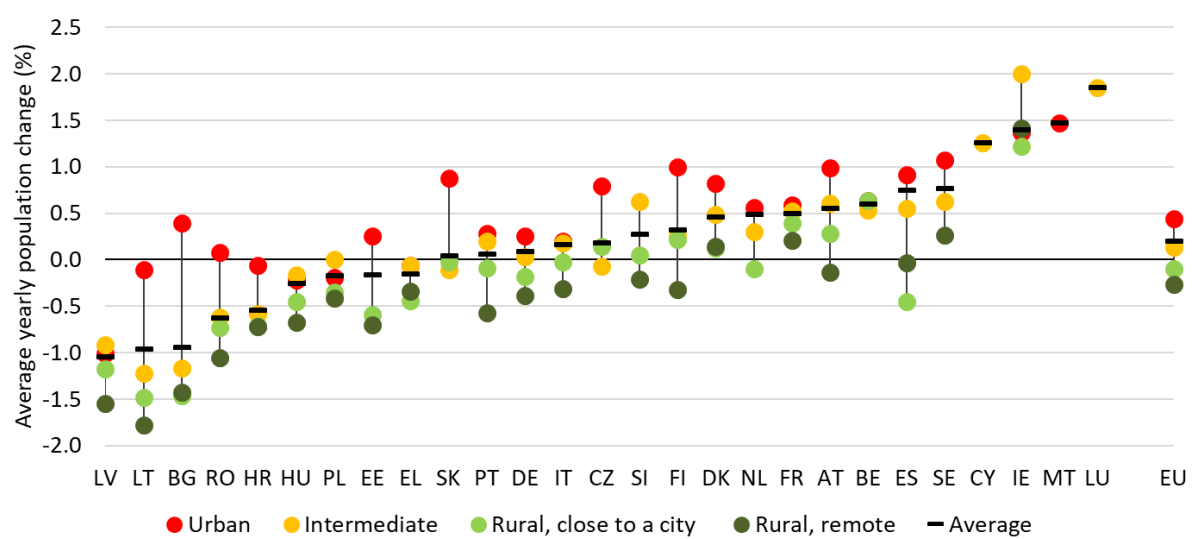
**Table A3.** Determinants of net migration rate, by age group (n=1126 NUTS3 regions).

| AGE GROUP | GDPPC    | POP. DENSITY | METRO    | COUNTRY, CAPITAL FE | R <sup>2</sup> |
|-----------|----------|--------------|----------|---------------------|----------------|
| AGE 0-4   | 0.032*** | 0.000        | 0.040*** | Yes                 | 0.632          |
| AGE 5-9   | 0.025*** | -0.001***    | 0.004    | Yes                 | 0.311          |
| AGE 10-14 | 0.035*** | -0.001***    | 0.003    | Yes                 | 0.258          |
| AGE 15-19 | 0.053*** | -0.000       | 0.011*   | Yes                 | 0.355          |
| AGE 20-24 | 0.171*** | 0.001        | 0.025**  | Yes                 | 0.395          |
| AGE 25-29 | 0.100*** | -0.000       | 0.003    | Yes                 | 0.409          |
| AGE 30-34 | 0.041*** | -0.002***    | 0.006    | Yes                 | 0.493          |
| AGE 35-39 | 0.024*** | -0.002***    | 0.006    | Yes                 | 0.424          |
| AGE 40-44 | 0.042*** | -0.001**     | 0.003    | Yes                 | 0.358          |
| AGE 45-49 | 0.039*** | -0.001*      | 0.002    | Yes                 | 0.281          |
| AGE 50-54 | 0.025*** | -0.001*      | -0.001   | Yes                 | 0.330          |
| AGE 55-59 | 0.017*** | -0.001*      | -0.007   | Yes                 | 0.303          |
| AGE 60-64 | 0.005    | -0.001**     | -0.010*  | Yes                 | 0.273          |
| AGE 65-69 | 0.007    | -0.001**     | -0.011*  | Yes                 | 0.384          |
| AGE 70-74 | 0.033*** | -0.001*      | 0.002    | Yes                 | 0.440          |
| AGE 75-79 | 0.029*** | -0.001*      | 0.001    | Yes                 | 0.463          |
| AGE >79   | 0.028**  | -0.001*      | 0.000    | YES                 | 0.240          |

**Table A4.** Average population change 2023-2040, by regional typology with remoteness. Comparison between our regional projections (DELi) and those from Eurostat (Eurostat, 2019).

| REGIONS                | AVERAGE (%) POPULATION CHANGE (EUROSTAT) | AVERAGE (%) POPULATION CHANGE (DELI) |
|------------------------|------------------------------------------|--------------------------------------|
| EU27                   | -0.04%                                   | -0.04%                               |
| URBAN                  | 0.16%                                    | 0.18%                                |
| INTERMEDIATE           | -0.10%                                   | -0.11%                               |
| RURAL, CLOSE TO A CITY | -0.33%                                   | -0.35%                               |
| RURAL, REMOTE          | -0.37%                                   | -0.46%                               |

**Figure A1.** Net migration rate 2011-2019, by broad age group and regional typology.**Figure A2.** Changes in employment share 2000-2022, by sector and urban-rural typology.

**Figure A3.** Average yearly population change 2000-2022, by Member State and regional typology.



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# List of abbreviations and definitions

| ABBREVIATIONS | DEFINITIONS                                         |
|---------------|-----------------------------------------------------|
| <b>ARDECO</b> | Annual Regional Database of the European Commission |
| <b>DELI</b>   | Demography-Economy-Land use interaction             |
| <b>EU</b>     | European Union                                      |
| <b>GDP</b>    | Gross Domestic Product                              |
| <b>NUTS</b>   | Nomenclature of territorial units for statistics    |
| <b>OADR</b>   | Old Age Dependency Ratio                            |
| <b>WAP</b>    | Working Age Population                              |

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