Does migration affect aging? A spatiotemporal analysis in Italy

Roberto Basile (roberto.basile@univaq.it); Cinzia Castagnaro (cicastag@istat.it); Francesca Centofanti (francesca.centofanti@students.uniroma2.eu); Francesca Licari (licari@istat.it)

Population aging results from an increasing life expectancy and a declining fertility and birth rate. Due to socioeconomic progress that improves the quality of life and healthy survival, the rising life expectancy has increased the number of elderly people (WHO, 2020). In addition, the decline in fertility rates and changes in age structures have caused a reduction in births and, over time, in the number of younger people. The drop in birth rates is also the effect of a smaller number of younger generations, those born in the Nineties, which, in turn, will result in fewer births in the absence of changes in reproductive behavior. All these factors have caused an unprecedented increase in the elderly population in most Western European countries, with a fundamental overturning of the age pyramid. Population aging raises concerns about the sustainability of social and economic developments (Bloom et al. 2015; Feldstein 2006), pension systems (Ediev 2013; Gruber and Wise 2009), and social and health care (Mahon and Millar 2014). Migration may be a key factor affecting population counter-aging because of the younger age structure of the migrants. Therefore, net migration becomes a topic of great interest when investigating the impact on the age structure of the resident population (Pritchett, 2023, Ghio et al., 2022).

The old-age dependency ratio measures the unbalance between people 65+ over people 15-64 years; the high ratio between the elderly population and those of working age identifies a situation of intergenerational imbalance, which can be interpreted as the social and economic burden of the elderly population, which weighs on the working-age population (Lee and Mason 2010). According to Eurostat (2023), the old-age dependency ratio in the European Union was 27.1% in 2012 and raised to 33% in 2022. The case of Italy is particularly significant because the phenomenon has been more rapid and intense than in other countries (between 1.1.2002 and 1.1.2022, the old-age dependency ratio in Italy increased from 27.9% to 37.5%), confirming it as the country with the largest elderly population in Europe and the second largest in the world, after Japan.

The sharp increase in aging in Italy over the past 20 years has also been accompanied by strong spatial heterogeneity (Basile et al., 2022). This heterogeneity is a peculiar feature of the aging phenomenon, as it is affected by typically socio-economic factors (such as the availability of public and social services, the presence of the tertiary sector, and others) and exogenous characteristics of the territory (altitude, proximity to the sea, accessibility and so on) (De Castro 2007; Thiede and Monnat 2016). Therefore, studying the spatiotemporal distribution of Italy's aging and its influencing factors is essential (Reynaud et al. 2018). Looking at the macro-regional level, the old-age dependency ratio in the North was 29.6% as of 1.1.2002 and 38.7% as of 1.1.2022. In the Center, it was 30.4% at the beginning of the period and 38.8% at the end; in the *Mezzogiorno* (Southern Italy and Island) was 24.3% *versus* 35.1%. The heterogeneity increases by using spatial units at the regional level (NUTS-2), at the provincial level (NUTS-3), and at the municipal level (LAU).

By using municipality data on population stock and flows (births, deaths, migrations) by the main demographic characteristics over the past twenty years, we explore the spatiotemporal heterogeneity of population aging and its driving forces, focusing on the role of migration. In addition to birth and death, migration is an essential factor determining population aging, especially in Italy's current context of low fertility and low mortality. We examine how large-scale internal and international migration relates to spatial differences and the changes of aging.

We measure population aging as indirect measure through the decrease in the ratio of the working-age population to the elderly population. In particular, we use the Potential Support Ratio (PSR, UN Population Division 2002), defined as the ratio of the working-age (15-64) to the old-age population (over 65). Since it is the reciprocal of the old-age dependence ratio, a lower PSR indicates that the economically active population faces a greater burden to support the social services needed by older persons.

The municipal-level also allow us to explore the aging dynamics in particularly fragile areas of the country, the so-called Inner Areas, according to the National Strategy of Inner Areas (NSIA) classification. This innovative taxonomy identifies three types of municipal aggregations of Inner areas (intermediate, peripheral, and ultra-peripheral) that are particularly exposed to the risk of depopulation with respect to the other three categories classified as Centres (poles, intermediate poles, and belts). Despite the different structural characteristics of the Inner Areas compared to the Centers, the PSR is declining rapidly throughout the period considered in all areas of the NSIA classification, with some convergence across the latest years (Figure 1). This convergence also emerges from the results of the estimated density of municipality-level values of the PSR for each year between 2002 and 2021 (Figure 2).

We also analyze the spatiotemporal trend of the PSR across 7,904 Italian municipalities over the reference period (20 years from 2002 to 2021) by using a semiparametric model:

$$y_{it} = \alpha + f(s_{1i}, s_{2i}, \tau_t) + \epsilon_{it} \qquad (1)$$

where y_{it} is the PSR ratio observed for each municipality *i* in each year *t*; $f(s_{1i}, s_{2i}, \tau_t)$ is a smooth interaction between latitude, longitude, and year; α is a constant term; and ϵ_{it} is a random error component. This model allows us to represent the spatiotemporal dynamics of aging, when considering the observed population (Figure 3).

Figure 4 reports the maps of the estimated spatial trend evaluated for three different years (2002, 2011, and 2021). Generally speaking, these maps confirm that the spatial distribution of the ageing index remains persistently characterized by a strong coastal-inland divide as a result of the complex interaction between demographic dynamics and local socio-economic contexts. As for its spatial pattern, at the beginning of the period (1.1.2002), the PSR recorded low values in the municipalities of the North-West and the Centre, while it was much higher in some municipalities of the North-East and in the *Mezzogiorno* (the South and Island). Areas in the North-West, especially the Liguria and lower Piedmont regions, have always been those with a particularly low level of PSR. These are the areas with the lowest fertility since the 1970s.

Over time, however, many municipalities and areas in the Centre have also reached very low values of PSR: on 1.1.2012 the municipalities located along the Apennines in the Centre were among those with the lowest values. In 2012, the PSR ratio was also particularly low in some limited areas in the South of Italy, especially in Sardinia region. Finally, the map estimated for the last year of the sample period (2021) displays a more homogeneous picture with most of the territory affected by the aging process. Figure 4 also shows the estimated time trend for all municipalities.

In the second part of the paper, we use a beta regression approach to study the spatial convergence in the PSR across the Italian municipalities. We also apply a two-step decomposition to assess the contribution of the working-age and old-age population to the overall spatial convergence or divergence in PSR and explain which component of the working-age dynamics (cohort turnover, net migration, and deaths) mainly contribute to the overall dynamics and convergence in PSR.

The bottom line is that only net immigration can ensure population stability, slow its decline and be an indispensable resource for the resilience of social systems. This will happen only if we promote forward-looking immigration policies that allow larger numbers of immigrants and consider their long-run impact rather than focusing only on the short-term calculations of their (primarily political) costs.

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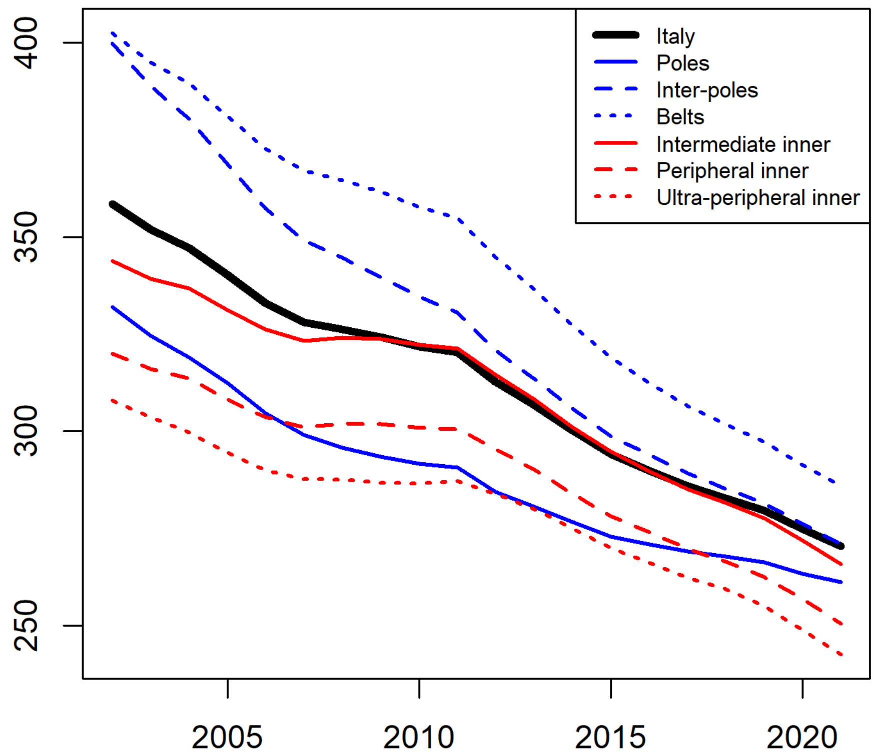

Figure 1 – Potential Support Ratio. Italy and subareas, from 1.1.2002 to 1.1.2021 (rates per 100)

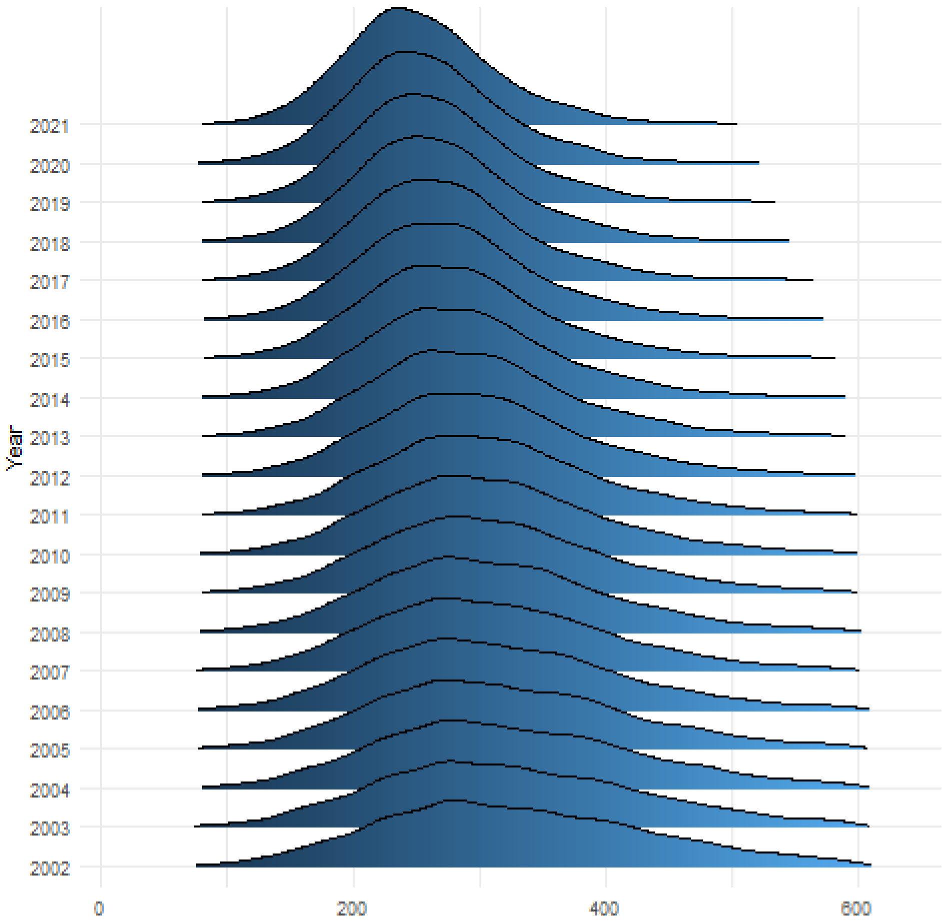

Figure 2 – Univariate density of municipality-level PSR, from 1.1.2002 to 1.1.2021 (rates per 100)

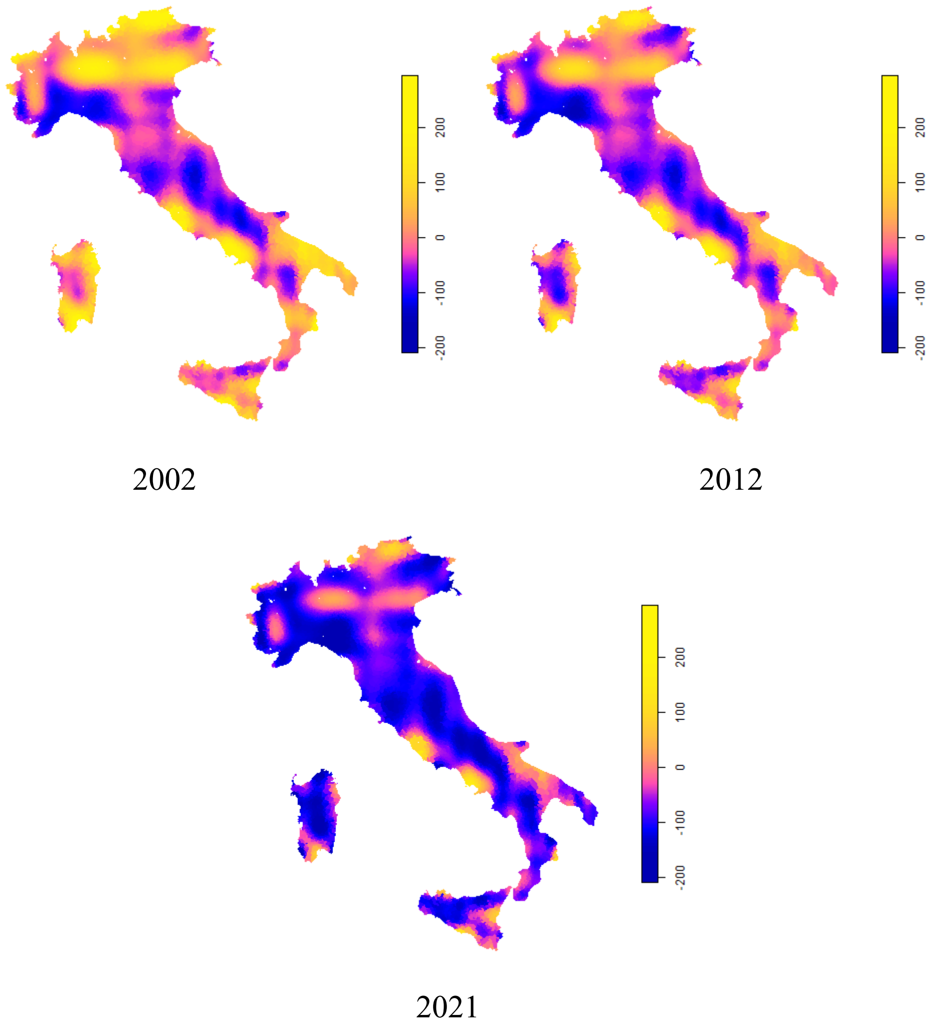

Figure 3 – Estimated spatial trends of municipality-level PSR. Italy, at 1.1.2002, 1.1.2012 and 1.1.2021

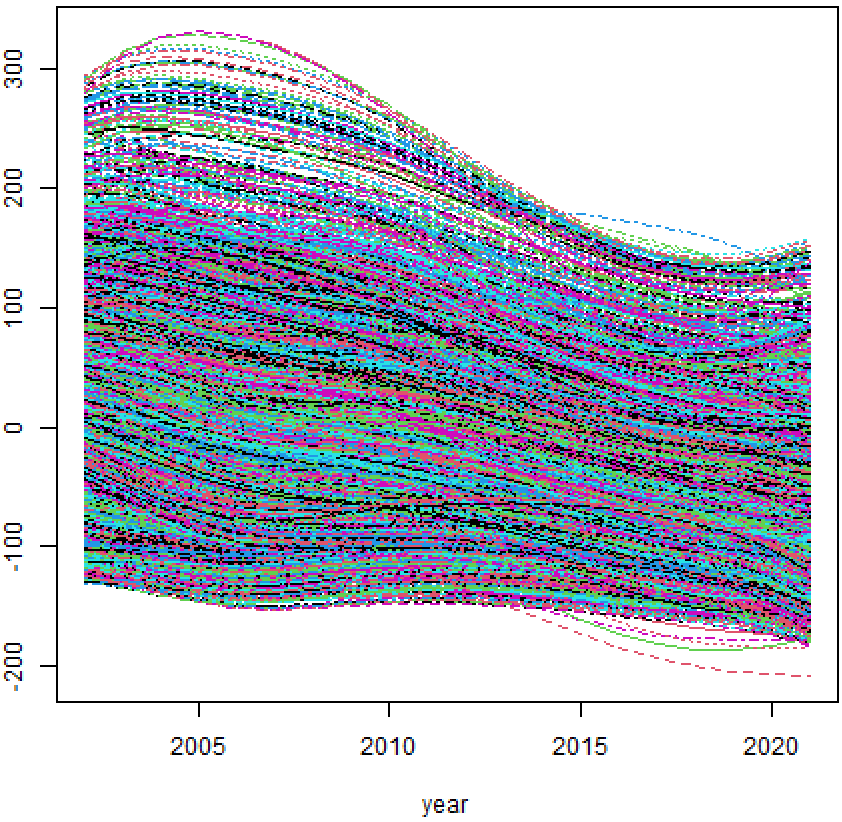

Figure 4 – Estimated time trends of municipality-level PSR. Italy, from 1.1.2002 to 1.1.2021