Service Provision and Demographic Change in Functional Rural Areas

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1. Motivation and Background

Demographic change in rural areas is a pressing challenge for Europe. Many rural territories experience population decline, ageing, and outmigration. Beyond the natural rate of change driven by fertility and longevity, migration decisions—both the choice to stay and incentives to attract new residents—are often influenced by the provision and accessibility of amenities and services (EC/JRC et al., 2025). Access to services is seen central to understanding rural well-being and prosperity. Yet which services are the most critical for demographic resilience, and how they interact with each other in a spatial context, remains only partially understood for the total population and much less so when disaggregated by gender and age group.

Empirical research on local services and amenities provision is growing (OECD/EC-JRC, 2021), although a solid relation between service provision and population change are evasive. Service provision is associated with population growth in midsize and smaller settlements (Veneri, Burgalassi, & Weingarden, 2025), while broadband connectivity is associated with both firm growth and household well-being, with effects that are spatially uneven across European territories (OECD, 2025). Concurrently, tourism and a greater potential for remote work can reinforce divergent spatial trajectories across rural areas, with implications for service demand and long-term demographic outcomes (Barranco, 2021). These divergent trajectories are not spatially random but follow patterns shaped by proximity to urban centres, transport networks, and the inherited distribution of public infrastructure. Despite these advances, the literature has not systematically decomposed the relative contribution of different types of services to local demographic change while accounting for the spatial structure of rural territories and the heterogeneity across the urban–rural gradient.

This paper responds to this gap by systematically analysing how access to public and private services is associated with demographic change within functional rural areas (FRAs) – a new classification of rural areas based on rural centric spatial patterns – and comparing these contributions to those observed in functional urban areas (FUAs). The spatial dimension is central to the analysis: outcomes and explanatory variables are inherently geographic, the analytical unit is defined by functional spatial boundaries, and proximity to urban agglomerations is a key dimension of heterogeneity. The paper connects to the EU agenda on the "right to stay," the ongoing demographic transition, and growing territorial inequalities within countries, while providing evidence for policy relevant to the EU's Long-term Vision for Rural Areas and the broader debate on territorial cohesion.

2. Research Questions

The paper addresses three interrelated research questions. First, do services contribute to demographic change. If so, how much do public services—as compared to tourism, amenities, and demographic composition—contribute to demographic change in rural areas? This question aims to quantify the relative importance of service provision versus other local factors using decomposition methods that isolate the contribution of each variable category. Second, does the contribution of services vary across the spatial distribution of rural areas, in particular by proximity to urban agglomerations or by other local measures of economic and social well-being? This question speaks directly to the spatial heterogeneity of service effects and the accessibility gradients that characterise European territories. Third, are there certain minimum conditions for service provision for demographic growth, or relatively slower decline, to be possible in rural settlements? This question seeks to *identify thresholds and combinations of services* that are necessary or sufficient for positive demographic outcomes.

3. Data and Analytical Framework

The analytical unit is the functional rural area (FRA) and functional urban area (FUA), spatial units that capture the geographic extent of local labour markets and commuting zones. These functionally defined geographies are better suited to modelling service accessibility and demographic dynamics than purely administrative boundaries, as they abstract from country-specific criteria and reflect actual patterns of spatial development and interactions. This paper is one of the first to use these new classifications of rural areas and contributes to building evidence for a spatial approach to national or regional disaggregated accounts.

The dataset draws on 2011 and 2021 European Census data at the level of local administrative units, aggregated to functional areas, capturing demographic change by gender and age. The dependent variables include changes in total population change, change in working-age population, net migration flows, youth population change, and elderly population share. The explanatory variables are organised into four domains: (i) population levels and economy, including employment rates, and income levels; (ii) access to and existence of public and private services, measured as average travel times and number of facilities for education, healthcare, retail, banking; (iii) local amenities, including natural assets, climate conditions, and environmental quality; and (iv) tourism services, including accommodation capacity and restaurant provision. All service access variables are inherently spatial, measuring per capita provision, travel time or distance to the nearest facility, which captures the geographic structure of service provision across territories. The cross-sectional variation across more than one thousand functional areas in the EU provides substantial power for identifying heterogeneous effects across different parts of the territorial distribution.

4. Empirical Strategy

The empirical strategy proceeds in three stages, each building on the previous to provide an increasingly nuanced understanding of the relationship between service provision and demographic change across space.

Stage 1: Relative importance and decomposition. The first stage employs OLS regressions to establish the baseline relationship between services and demographic change outcomes, comparing rural to non-rural functional areas. A Gelbach decomposition (Gelbach, 2016) is applied to quantify the relative contribution of each variable category to the explained variation in demographic outcomes. This approach isolates how much of the rural–urban gap in demographic change is attributable to differences in service access versus tourism endowments, amenities, and economic conditions. The decomposition is conducted separately for total population change and for age- and gender-specific outcomes, providing a disaggregated picture of where services matter most.

Stage 2: Spatial and distributional heterogeneity. The second stage investigates whether the relationship between services and demographic outcomes varies across the spatial distribution of rural areas. Using quantile analysis, the paper examines whether the contribution of services differs for functional rural areas at different points of the proximity-to-urban-centres distribution and for different demographic and economic profiles of regions. This stage addresses a key question in spatial economics: whether accessibility to services has heterogeneous effects depending on a territory's position within the broader spatial network, with remote rural areas potentially exhibiting stronger or qualitatively different responses to service provision than peri-urban territories.

Stage 3: Minimum conditions and configurational analysis. The third stage adopts a more holistic approach by investigating joint minimum conditions for service provision associated with demographic growth. This is pursued through three complementary methods. Necessary Condition Analysis (NCA) (Dul, 2016) identifies service thresholds that are necessary, though not sufficient, for positive demographic growth—for example, establishing that a maximum average travel time to the nearest hospital below a certain threshold is required for a rural area to exhibit population growth. Hansen threshold estimation (Hansen, 2000) identifies levels of service provision at which the relationship with demographic growth shifts in direction or magnitude, detecting non-linearities and tipping points in the service–demography nexus. Finally, rule-based machine learning methods, including decision trees and ensemble approaches, establish which combinations of services and other provisions are sufficient for, or best explain, demographic growth or relative demographic resilience. These configurational methods go beyond average marginal effects to characterise the joint conditions under which rural areas can sustain their populations, offering directly actionable insights for spatial planning and regional policy.

5. Spatial Dimensions and Relevance to the Workshop

The paper is fundamentally spatial in its research design, data, and policy implications. The use of functionally defined spatial units as the analytical framework ensures that the analysis captures real patterns of spatial interaction and accessibility rather than arbitrary administrative boundaries. This functional approach aligns with best practice in spatial econometrics and regional science, where the definition of spatial units can significantly affect estimated relationships. The dependent and explanatory variables are all geographically referenced, with service access measured through spatial

indicators such as travel time to the nearest facility. The distributional analysis in Stage 2 explicitly models heterogeneity along the urban–rural proximity gradient, a core dimension of European territorial structure that reflects the spatial decay of agglomeration externalities and network connectivity. The configurational analysis in Stage 3 identifies spatially differentiated policy thresholds, recognising that the minimum service conditions for demographic resilience may differ systematically between remote rural, intermediate, and peri-urban areas.

To further strengthen the robustness of our findings, future developments of this work will formally test for spatial dependence across our main variables. Should significant spatial correlation be detected, we intend to supplement our baseline results with appropriate spatial econometric frameworks – such as Spatial Lag (SLM) or Spatial Durbin (SDM) Models. This approach will enable a rigorous identification of spatial dependencies, allowing us to formally test and account for spillover effect and spatial heterogeneity across the studied areas.

The paper contributes to the workshop's themes of regional development and inequality by providing new evidence on how service accessibility shapes demographic trajectories across European territories. It also contributes to the theme of public policy evaluation by providing a framework for assessing whether service provision meets the minimum conditions for demographic sustainability, with direct implications for Cohesion Policy, rural development programmes, and the spatial allocation of public investment. The methodological combination of decomposition, distributional, and configurational methods offers a transferable toolkit for spatial analysis of place-based policy questions.

6. Expected Contributions

The paper makes three expected contributions. First, by decomposing the relative importance of service access compared to tourism, environmental amenities, and economic conditions, the paper provides new evidence on the extent to which services influence demographic resilience in rural areas. This addresses a gap in the empirical literature, where the contributions of different local characteristics are rarely isolated in a unified framework that accounts for their joint spatial structure. Second, by examining heterogeneity across the rural–urban proximity gradient and other regional economic measures, the paper reveals whether the role of services is conditional on a territory's position in the broader spatial structure. This has direct implications for place-sensitive policy design, as it may indicate that uniform service provision policies have different demographic payoffs depending on spatial context. Third, the minimum conditions analysis offers a novel and policy-actionable framework, moving beyond average effects to identify the thresholds and combinations of service provision that are necessary or sufficient for demographic growth. By combining econometric and machine learning approaches, this stage provides both statistically grounded thresholds and interpretable decision rules for policymakers. The results will help policymakers prioritise investments in service provision aiming to support demographic resilience, including policies for tourism-related activities in rural areas, contributing to the EU's Long-term Vision for Rural Areas and the broader debate on spatial equity and territorial cohesion.

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