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DEPOPULATION AND LOCAL HETEROGENEITIES IN ITALY: A SPATIAL ANALYSIS

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Introduction (1)

- Territorial heterogeneity in population growth (and decline) **is a European phenomenon**:
  - **territories subject to depopulation** are realities that are gradually becoming **weaker and unsafe** [Lasanta et al. 2017]
  - other **territories that grow very quickly - typically large urban and metropolitan areas - clash with other problems** that arise from the processes of concentration [Kempen and Marcuse, 1997]
- European Commission affirms that a **territorial redistribution** of the population and a **balanced growth** of the territories are **necessary conditions for a significant, lasting and sustainable development of the various local realities** [European Commission, 1999; Vanolo,2003].

Introduction (2)

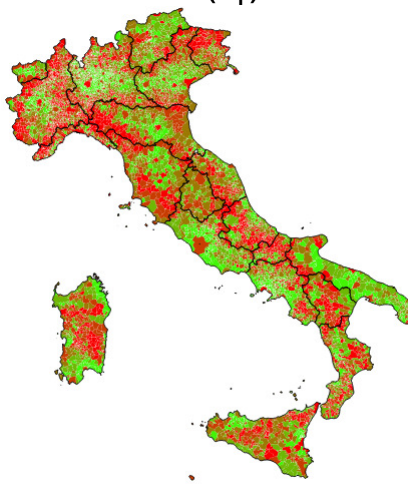
- At municipality (local) level in Italy there are some “more dynamic” contexts contrasted by others characterized by **demographic malaise** that tend to be *increasingly dusty in size and become peripheral in localization* [Golini, Mussino and Savioli, 2000].

- In Italy, the population trend is strongly territorially differentiated with some municipalities that show a **systematic loss of population** and others with an equally **continuous and significant demographic increase** [Benassi, Busetta, Gallo, Stranges, 2021].

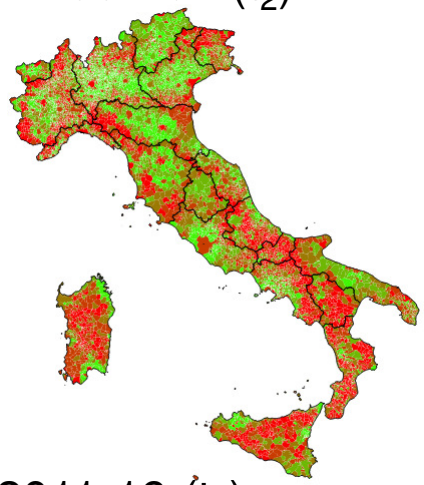
Population growth/decline over the last 40 years at local level

Average annual growth rates (‰)

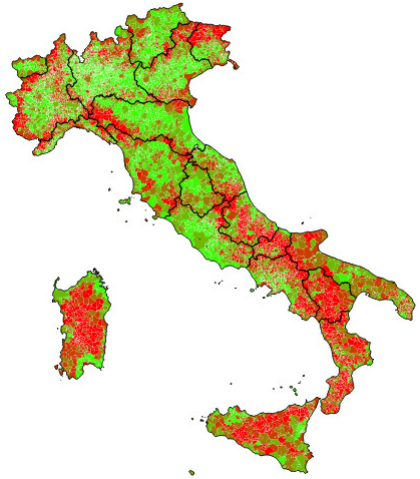
1981-91 (t_1)



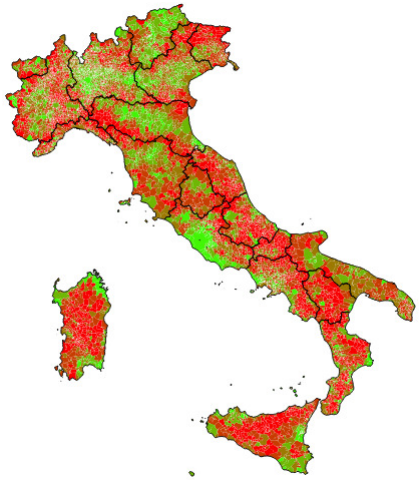
1991-01 (t_2)



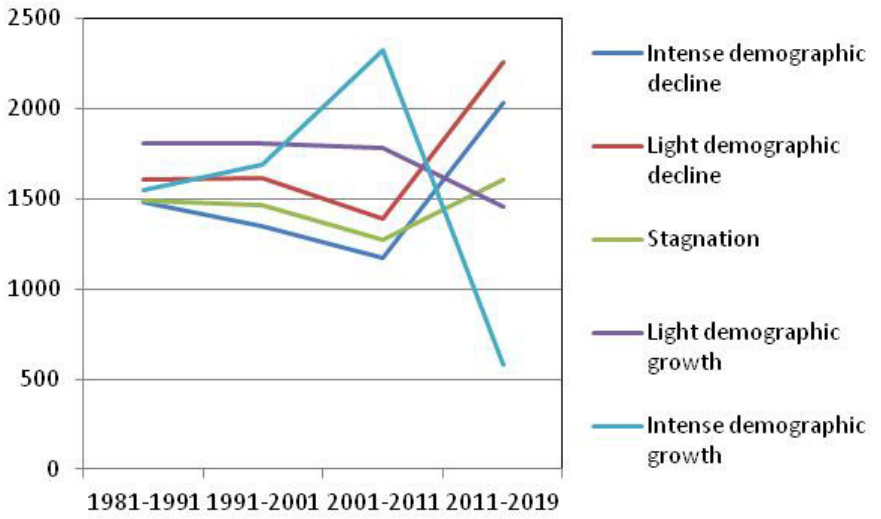
2001-11 (t_3)



2011-19 (t_4)



Number of municipalities by category of population growth/decline



Intense demographic decline (<- 8.0)
Light demographic decline (> = - 8.0 < = -2.00)
Stagnation (> -2.0 < = 2.0)
Light demographic growth (> 2.0 <= 8.0)
Intense demographic growth (> 8.0)

Aim of the study

In this contribution we try to answer two questions:

1. **Is the average annual growth rate affected by spatial auto-correlation?**

   [**global and local spatial autocorrelation analysis**]

2. How do different demo-socio-economic dimensions directly affect demographic growth and decline?

   [spatial regression model]

Question 1 - Data and methods

- **DATA for global and local spatial autocorrelation analysis**

  Resident population at municipality level from 1981 to 2019 (1981-2011 census; 2019 population register, pre census. Source: Istat).

  Shape file for municipalities at 2019 (Source: Istat)

- **STUDY VARIABLE**

  Annual demographic growth rates at local level (t_1-t_4)

- **SPATIAL AUTOCORRELATION ANALYSIS (t1-t4)**

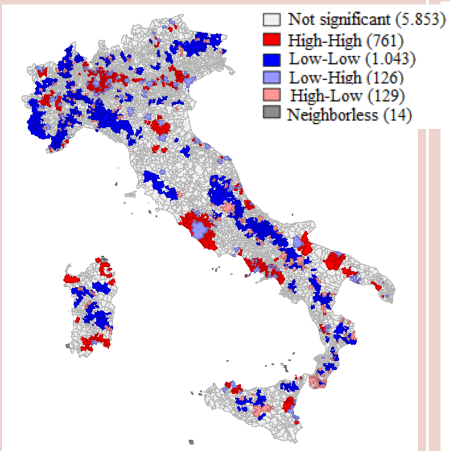
  Moran global index of spatial autocorrelation I (Moran 1948)

  Univariate local version of Moran global index of spatial autocorrelation (Anselin 1995)

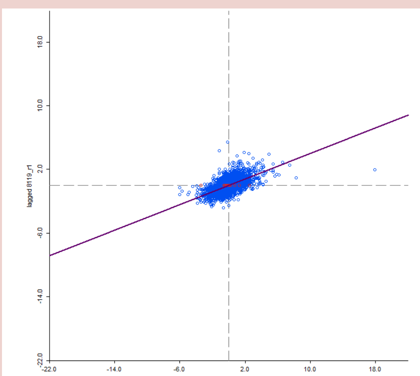
  Spatial weight matrix: Queen contiguity of first order

Global and local spatial autocorrelation analysis (p<0.05)

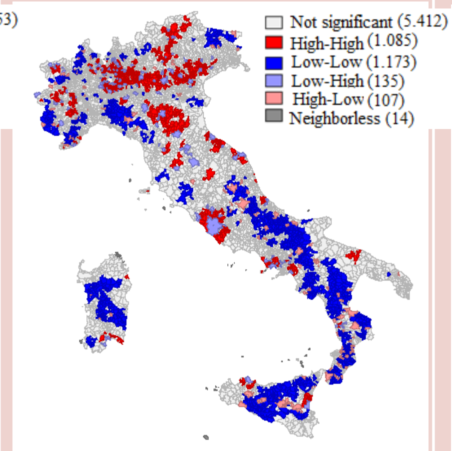
1981-1991



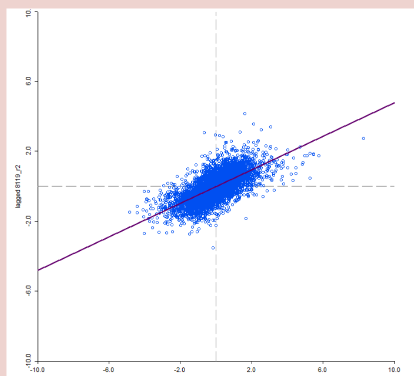
Global Moran's I: **0.401**



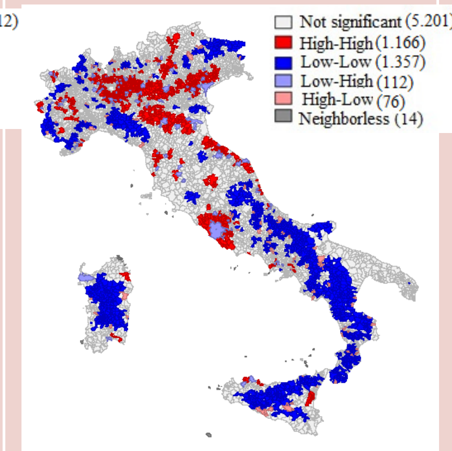
1991-2001



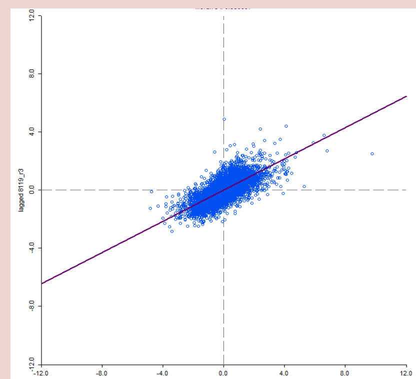
Global Moran's I: **0.436**



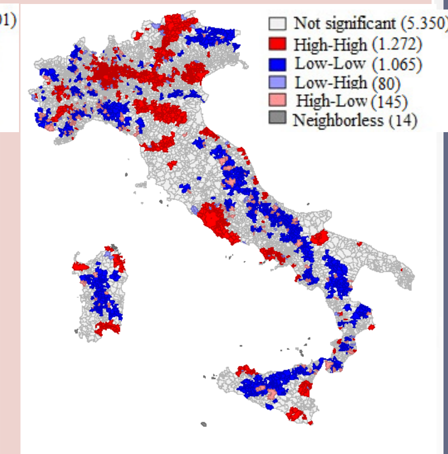
2001-2011



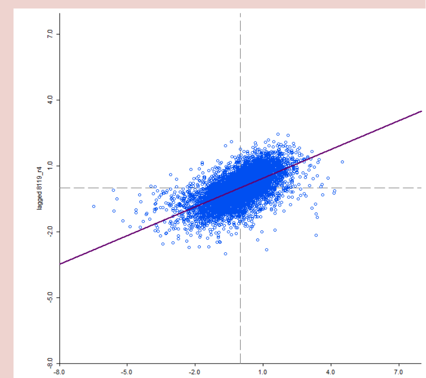
Global Moran's I: **0.536**



2011-2019



Global Moran's I: **0.436**



Aim of the study

- In this contribution we try to answer two questions:

1. Is the average annual growth rate affected by spatial auto-correlation?

   [global and local spatial autocorrelation analysis]

2. **How do different demo-socio-economic dimensions directly affect the demographic growth and decline?**

   [spatial regression model]

Question 2 - Data and methods

- **DATA for spatial regression model**
  - **For dependent variable (2011-2019):** resident population at municipality level (2011-2019; Source: Istat (2011 Census and 2019 Pop. Register pre Census)
  - **For independent variables (2011):** 2011 Census (source: Istat); Shape file for municipalities at 2019 (source: Istat)
- **STUDY VARIABLE**

  Annual demographic growth rates at local level (2011-2019) (t_4)
- **SPATIAL REGRESSION MODEL**

  Spatial Durbin Regression model (Elhorst 2014)

  (Spatial weight matrix: Queen contiguity of first order)

Analytical strategy

- Before individualize the final model, we have estimated 4 different ones:
  - OLS,
  - SEM (Spatial Error Model) ,
  - SAR (Spatial autoregressive models) ,
  - SDEM (Spatial Durbin Model)
- We opted, as a final model, for a Spatial Durbin Model (Elhorst 2014) which, as SAR models, examines how the dependent variable (y) is influenced by the value assumed by the same variable in adjacent spatial units (in our case, municipalities). The spatial lag parameter (ρ) refers to the estimate of how the average dependent variable in neighbouring spatial units (municipalities) is associated with the same variable for a focal spatial units (municipality).

The Spatial Durbin Model (1)

In this model the coefficients that cannot be interpreted as in an OLS model, but rather it is necessary to refer to direct and indirect (spatial spillovers) effects (Golgher and Voss, 2016).

The **direct effect**, *"represents the expected average change across all observations for the dependent variable in a particular region due to an increase of one unit for a specific explanatory variable in this region"* (Golgher and Voss, 2016: 185), while the **indirect effect**, *"represents the changes in the dependent variable of a particular region arising from a one-unit increase in an explanatory variable in another region"* (Golgher and Voss, 2016: 185).

The Spatial Durbin Model (2)

The spatial Durbin model (SDM) includes a spatial lagging of the dependent variable ($\rho \neq 0$) in addition to a **spatial lagging of all the independent variables** ($\theta \neq 0$). The spatial lagging of the dependent variable is included to capture effects as described for the spatial lag model.

The spatial lagging of the explanatory variables is added so that the characteristics of neighboring municipalities could have an influence on the annual growth rate of each municipality in the sample. In this way the spatial Durbin model allows for neighboring annual growth rate to determine the growth rate of a municipality, in addition to the structural characteristics of neighboring municipalities.

Our final model

DEPENDENT VARIABLE: the annual average growth rate of each municipality at **t4 (2011-2019)**

EXPLANATORY VARIABLES (at the 2011 Census) across 5 dimensions:

- the *demographic dimension* (percentage of preschool children and elderly over 75, percentage of foreign population);
- the *social dimension and mobility* (percentage of young people living alone, mobility for study and work reasons and long-distance mobility);
- *employment* (female activity rates, and employment rate of young people aged 15 to 29);
- the *economic-productive environment* (share of employees in the agricultural sector, and share of employees in the industrial sector).
- the *school infrastructure* (presence/absence of primary schools)

Table 1: Results of a Spatial Durbin Model on the average annual growth rate in the period 2011-2019

Variable	Coefficient	Std. Error	z-values	Probability	Effects		
					DE	IE	TE
Intercept	-2.0537	0.7736	-2.6549	0.0079			
% less than 6 years old	0.7226	0.0775	9.3266	0.0000	0.7601	0.8882	1.6483
% over 75 years old	-0.6376	0.0244	-26.1392	0.0000	-0.6449	-0.1730	-0.8179
% foreigners	0.0035	0.0026	1.3582	0.1744	0.0043	0.0196	0.0239
% youth living alone	0.1265	0.0192	6.5897	0.0000	0.1238	-0.0655	0.0582
Study work mobility	-0.0418	0.0089	-4.7216	0.0000	-0.0416	0.0052	-0.0364
Female activity rate	0.1745	0.0142	12.2543	0.0000	0.1754	0.0196	0.1950
Youth (15-29) employment rate	0.0385	0.0112	3.4296	0.0006	0.0375	-0.0243	0.0132
% workers in agricolture sector	-0.1169	0.0136	-8.5719	0.0000	-0.1201	-0.0743	-0.1944
% workers in industry	-0.0895	0.0123	-7.2808	0.0000	-0.0937	-0.0995	-0.1933
Primary school	0.8612	0.2407	3.5775	0.0003	0.8113	-1.1821	-0.3707
Lag % less than 6 years old	0.4306	0.1244	3.4616	0.0005			
Lag % over 75 years old	0.0654	0.0381	1.7152	0.0863			
Lag % foreign people	0.0132	0.0034	3.8670	0.0001			
Lag % youth living alone	-0.0858	0.0314	-2.7363	0.0062			
Lag Study work mobility	0.0163	0.0126	1.2945	0.1955			
Lag Female activity rate	-0.0381	0.0227	-1.6825	0.0925			
Lag Youth (15-29) employment rate	-0.0293	0.0164	-1.7872	0.0739			
Lag % workers in agricolture sector	-0.0191	0.0182	-1.0467	0.2952			
Lag % workers in industry	-0.0457	0.0164	-2.7821	0.0054			
Lag Primary school	-1.1206	0.4520	-2.4795	0.0132			
Lag. coefficient (Rho)	0.3004			0.0000			
Log likelihood	-25395.6						
Akaike info criterion	50837.0						
LM test for residual autocorrelation							
test value: 18.781, p-value: 1.4658e-05							

All effects are statistically significant at p<0.05 (in red are not stat.sig.)

Policy suggestions

- The demographic composition of the population confirmed to have a determinant effect of the dynamics of the next years. Also relevant the contribution of the socio-economic dimension lived by individuals whose faster - or at least less slow - transition to adulthood give a crucial contribution of the next growth.
- As far, the latter the recent experience of Covid-19 has shown the limits of the distance learning for schools of different levels and particularly for pupils. Starting from our analysis and from the elements that emerged in this health crisis, it is evident that the maintenance of the primary school cannot be neglected if we want to introduce policy to stem the depopulation of the most remote and isolated. On the contrary, for the restart of the social elevator also for those who live in internal areas or remote areas it is crucial to invest in a high quality and full time school that lay the cultural foundations to new generations.

Conclusions and further developments

- The study done proved that space matters in defining population growth and decline underlying the importance of the spatial demography approach in studying such kind of processes [Voss 2007].
- The analysis of the determinants/predictors of the average annual growth rate in the last ten years at municipality level showed a strong effect of the spatial dimension too.
- A further development of this work may be to estimate a spatial regression model in which the dependent variable is the average annual growth rate of the total population of the *i-th* municipality and the explanatory variables are **the growth rates for the same municipality of the foreign and Italian population plus a spatial lag effect**. The results will allow us to evaluate the net effects that changes in the rates of Italians and foreigners have on the total rate of change while keeping in check the spatial effect of *y* on itself (which will still be measured to see if there remains an element of spatial influence of *y* on itself).

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Thank you

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