THE CAUSES AND CONSEQUENCES OF DEPOPULATION
29 November – 1 December 2021

DEPOPULATION AND POPULATION AGEING:
AN UNSUSTAINABLE RELATIONSHIP?

Reynaud Cecilia*, Miccoli Sara**

* cecilia.reynaud@uniroma3.it; ** sara.miccoli@uniroma1.it
Introduction: demographic trend

Since the Second World War, Italy has experienced major demographic changes: increasing survival, decreasing fertility, and the change from a country of emigration to one of immigration.

Population at the census data. Italy, 1951-2019

Population growth (*1,000 inhabitants). Italy, 1951-2019

Source: Authors’ calculation from ISTAT data
Territorial level

Italy is divided into major socio-economic regions (NUTS 1), regions (NUTS 2), provinces (NUTS 3), and municipalities (LAU).

Population dynamics differ widely at different territorial levels.
Population ageing in Italy


The % of the population 65 years+ was 9.5% in 1961, 15.2% in 1991, 23.2% in 2019 (18.8 in Europe)
Population trend


<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>-0.59</td>
<td>0.07</td>
<td>-0.52</td>
</tr>
<tr>
<td>% municipalities &lt;0</td>
<td>65.4</td>
<td>46.1</td>
<td>70.1</td>
</tr>
</tbody>
</table>

Source: Authors’ calculation from ISTAT data
Aim

- To study the phenomena of depopulation and population ageing in Italian territories in the period 1961–2019
- to study the relationship between depopulation and population ageing
- to verify how depopulation contributed to population ageing in different time periods in Italian municipalities

To understand the sustainability of depopulation and the ageing population combined
Research questions

1) Is there a relationship between the level of population ageing at the beginning of a given period and the variation of population in the same period?

2) Is there a relationship between the variation of population in a given period and the level of population ageing at the end of the same period?
Data

8,092 Municipalities (LAU)
2011 borders

Census data of the population

Six inter-census periods
1961-1971
1971-1981
1981-1991
1991-2001
2001-2011
2011-2019

* Italian Population census → Italian «Permanent Census» of Population
Methods

Intercensal population growth rate

\[
    r_{i(t,t+10)} = \frac{\ln\left(\frac{P_i(t+10)}{P_i(t)}\right)}{10}
\]

\(i = \text{i-th municipality } 1,2,\ldots, 8092\)
\(t = \text{census data}\)
\(t+10 = \text{next census data}\)
\(P = \text{total resident population}\)

Proportion of the population over 65 years

\[
    \%P_{65+i(t)} = \frac{P_{65+i(t)}}{P_i(t)} \times 100
\]

\(i = \text{i-th municipality } 1,2,\ldots, 8092\)
\(P_{65+} = \text{Resident population over 65 years}\)
\(P = \text{total resident population}\)
Methods

- **Pearson’s correlation coefficient** and the test for association between two variables was applied using Pearson’s product moment correlation coefficients.

- **Regression linear model**

- **Moran’s index**

- **Spatial autoregressive model**
# Ageing and depopulation

\[ \rho \left( \%P_{65+}(t), r_{t,t+10} \right) \]

<table>
<thead>
<tr>
<th>( r(t,t+10) )</th>
<th>( P_{65+t} )</th>
<th>Signif.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1961-1971</td>
<td>-0.30</td>
<td>***</td>
</tr>
<tr>
<td>1971-1981</td>
<td>-0.50</td>
<td>***</td>
</tr>
<tr>
<td>1981-1991</td>
<td>-0.52</td>
<td>***</td>
</tr>
<tr>
<td>1991-2001</td>
<td>-0.46</td>
<td>***</td>
</tr>
<tr>
<td>2001-2011</td>
<td>-0.54</td>
<td>***</td>
</tr>
<tr>
<td>2011-2019</td>
<td>-0.54</td>
<td>***</td>
</tr>
</tbody>
</table>

Signif. codes: 0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05

Source: Authors’ calculation from ISTAT data
### Depopulation and ageing

$$\rho \left( r_{t,t+10}, \% P_{65+(t+10)} \right)$$

<table>
<thead>
<tr>
<th>Period</th>
<th>$r_{t,t+10}$</th>
<th>$P_{65+(t+10)}$</th>
<th>Signif.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1961-1971</td>
<td></td>
<td>-0.53</td>
<td>***</td>
</tr>
<tr>
<td>1971-1981</td>
<td></td>
<td>-0.64</td>
<td>***</td>
</tr>
<tr>
<td>1981-1991</td>
<td></td>
<td>-0.63</td>
<td>***</td>
</tr>
<tr>
<td>1991-2001</td>
<td></td>
<td>-0.62</td>
<td>***</td>
</tr>
<tr>
<td>2001-2011</td>
<td></td>
<td>-0.61</td>
<td>***</td>
</tr>
<tr>
<td>2011-2019</td>
<td></td>
<td>-0.67</td>
<td>***</td>
</tr>
</tbody>
</table>

Signif. codes: 0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05

Source: Authors’ calculation from ISTAT data
Depopulation and ageing

The Moran’s indexes of proportion of the population over 65 years are always positive and statically significant

Parameter estimates of spatial autoregressive model

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Interc.</td>
<td>13.01***</td>
<td>16.66***</td>
<td>18.43***</td>
<td>21.48***</td>
<td>17.09***</td>
<td>23.50***</td>
</tr>
<tr>
<td>$r_{t,t+10}$</td>
<td>-1.34***</td>
<td>-2.58***</td>
<td>-3.33***</td>
<td>-3.85***</td>
<td>-2.13***</td>
<td>-3.84***</td>
</tr>
</tbody>
</table>

Lambda: p-value < 2.22e-16

Signif.: *** < 2.2e-16

Source: Authors’ calculation from ISTAT data
Conclusion and future developments

- The relationship between population growth and ageing exists and is increasingly important
  - more depopulation $\rightarrow$ more and more population ageing
    - = link that is leading to a vicious circle

This is a work in progress

- Improve the model
  - different areas of the country
  - other exogenous variables
- The population growth
  - naturale balance
  - net migration of Italian population
  - net migration of foreign population
THANK YOU VERY MUCH FOR YOUR ATTENTION

Reynaud Cecilia*, Miccoli Sara**

* cecilia.reynaud@uniroma3.it; ** sara.miccoli@uniroma1.it