Are EU Rural Areas still Lagging behind Urban Regions? An Analysis through Fuzzy Logic

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OUTLINE

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4. Describing EU rural areas
5. Rural areas between backwardness and future challenges
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1. Background & aim of the paper (i)

➢ Rural areas and economic backwardness (e.g., circular cumulative causation, core-periphery models, New Economic Geography).

➢ Since the 80s, links rurality-economic backwardness have been questioned:
  - strengthening of medium sized towns in rural areas, supplying services (Courtney et al., 2007; Courtney et al., 2008);
  - diffusion of SMEs networks out of large cities (Piore and Sabel, 1984; Brusco; 1989; Becattini, 1998);
  - new infrastructures and ICT (Castells, 1996), reducing rural remoteness and fostering counter-urbanization processes;
  - diffusion of tourism (European Commission, 1998) and multifunctionality in agriculture (Murdoch and Marsden, 1994).

➢ Increasing heterogeneity among rural areas. Thus, new need for comparable definitions at international level.
1. Background & aim of the paper (ii)

- Major aims of the paper:

  1. Overcoming measures of rurality just based on density (e.g., OECD-Eurostat definition)
     - adopting a **comprehensive** indicator of rurality (multidimensional approach)
     - adopting a **continuous** indicator of rurality: several nuances in the EU urban-rural continuum can be defined

  2. Contributing to debate on rural areas’ backwardness. Is rurality still linked to specific socio-economic issues?
2. Quantitative approaches in defining rurality

What is a “rural” region?

- Evolutionary concept of rurality suggested by Sotte et al. (2012). According to *Post-industrial Rurality* framework:
  - New features: territorial dimension (urban-rural integrations) and polymorphism (different typologies of rural areas coexist)

- Here, a multidimensional approach is adopted. Thematic areas:
  - *Sector-based approach* (role of agricultural activities)
  - *Population-based approach* (population density)
  - *Territorial approach* (land use features)

- Major novelty: rurality is measured through Fuzzy Logic.
3. A fuzzy rurality indicator (FRI): fuzzy logic

- Fuzzy logic (FL) is a mathematical approach reproducing human logic (Zadeh, 1965; 1968). No clear cut-offs to classify observations within well-defined classes. Single observations are linked to their probability of belonging to a given class (role of nuances).

- Boolean algebra is a typical binary logic (law of non-contradiction, law of excluded middle). FL handles the concept of partial truth: codomain of membership functions is the whole set of values within the closed interval [0,1].

- Decision trees: complex decision-making processes are broken down into simpler decisions. Rules are set in natural language.

- A whole inferential system may be derived:
  - Designing the most suitable fuzzy system
  - Fuzzification of the inputs
  - Definition of if-then rules & inference (antecedent-consequent aggregation)
  - Defuzzification
3. A fuzzy rurality indicator (FRI): input variables

Territorial level of analysis: NUTS 3 level / EU-27 (1 288 observations).

**Input variables by thematic area**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Definition</th>
<th>Year</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sector-based approach</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GVA Agriculture (%)</td>
<td>Share of GVA from sector A (NACE classification rev. 2) out of total GVA</td>
<td>2009</td>
<td>Eurostat</td>
</tr>
<tr>
<td>Employment Agriculture (%)</td>
<td>Share of employment in sector A (NACE classification rev. 2) out of total employment</td>
<td>2009</td>
<td>Eurostat</td>
</tr>
<tr>
<td>Agricultural areas + Forest lands (%)</td>
<td>Share of total surface which is covered either by agricultural areas or by forests and other semi-natural areas</td>
<td>2006</td>
<td>CORINE-Eurostat</td>
</tr>
<tr>
<td><strong>Population-based approach</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Population density</td>
<td>Ratio of the resident population on the total surface (in km²)</td>
<td>2010</td>
<td>Eurostat</td>
</tr>
<tr>
<td><strong>Territorial approach</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Artificial areas (%)</td>
<td>Share of total surface which is covered by artificial areas (urban fabric, industrial and commercial units...)</td>
<td>2006</td>
<td>CORINE-Eurostat</td>
</tr>
<tr>
<td>Forest lands (%)</td>
<td>Share of total surface which is covered by forests and other semi-natural areas</td>
<td>2006</td>
<td>CORINE-Eurostat</td>
</tr>
</tbody>
</table>
3. A fuzzy rurality indicator (FRI): decision tree

Fuzzy decision tree and signs of relationships
3. A fuzzy rurality indicator (FRI): membership functions, rule blocks

- **Fuzzification**: transforming input variables into grades of memberships for linguistic terms of fuzzy sets (e.g., low-medium-high).

A membership function is associated to each defined linguistic term: here, quartile distribution is used to shape them.

- **Rule blocks**: lists of linguistic control rules transforming input variables into a single output (inference).

They provide fuzzy numbers. Defuzzification restores crisp numbers.

### Artificial areas

<table>
<thead>
<tr>
<th>Artificial areas</th>
<th>IF Forest Lands</th>
<th>Density</th>
<th>THEN Landscape Indicator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>Low</td>
<td>Low</td>
<td>High</td>
</tr>
<tr>
<td>Low</td>
<td>Low</td>
<td>Medium</td>
<td>Medium</td>
</tr>
<tr>
<td>...</td>
<td>...</td>
<td>...</td>
<td>...</td>
</tr>
<tr>
<td>Low</td>
<td>High</td>
<td>Low</td>
<td>Very High</td>
</tr>
<tr>
<td>...</td>
<td>...</td>
<td>...</td>
<td>...</td>
</tr>
<tr>
<td>Medium</td>
<td>Medium</td>
<td>High</td>
<td>Low</td>
</tr>
<tr>
<td>...</td>
<td>...</td>
<td>...</td>
<td>...</td>
</tr>
<tr>
<td>High</td>
<td>Low</td>
<td>High</td>
<td>Very Low</td>
</tr>
<tr>
<td>High</td>
<td>High</td>
<td>High</td>
<td>Low</td>
</tr>
</tbody>
</table>

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[graphic showing membership functions and rule blocks]

4. Describing EU rural areas:
a Nuanced Urban-Rural Continuum (i)

The Fuzzy Rurality Indicator

![Map of EU with color coding for the Fuzzy Rurality Indicator]

- **Fuzzy Rurality Indicator**
  - <.1
  - .5-.6
  - .1-.2
  - .6-.7
  - .2-.3
  - .7-.8
  - .3-.4
  - .8-.9
  - .4-.5
  - >.9
4. Describing EU rural areas:
a Nuanced Urban-Rural Continuum (ii)

EU is (also) a rural continent....

Cumulative distributions by FRI classes (EU-27)

... some Countries are deeply rural!
4. Describing EU rural areas: comparing classifications

- FRI is a continuous indicator (urban-rural continuum)

**FRI values: distribution by Eurostat urban-rural typologies**

According to a One-Way ANOVA (Analysis of Variance): groups’ average values are statistically different....

... BUT:

1. While PU and PR typologies are well shaped, IR is not (wider within-group variance)
2. Some NUTS 3 regions are classified in opposite ways.
5. Rural areas between backwardness and future challenges (i)

Economic theory vs. Cases of rural success. Which are main strengths and weaknesses of rural areas?

Some questions. Compared to urban areas, are rural regions still characterised by:

i. Weaker demographic trends?

ii. Weaker economic development?

iii. Lack of diversification of the agricultural sector?

iv. Major remoteness from larger EU metropolitan areas?

These hypotheses can be tested by collecting socio-economic and other geographical variables.

- One-Way ANOVA (referring to Eurostat urban-rural typologies)
- Pearson correlation coefficients (referring to FRI)
# Long-term dynamics among urban-rural typologies

<table>
<thead>
<tr>
<th>i. Population Growth (%)</th>
<th>-0.11</th>
<th>1.92</th>
<th>3.50</th>
<th>5.97*</th>
<th>29.69* (0.000)</th>
<th>-0.14* (0.000)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aged Dependency Ratio</td>
<td>30.00</td>
<td>29.33</td>
<td>26.86</td>
<td>1.48</td>
<td>23.91* (0.000)</td>
<td>0.07* (0.01)</td>
</tr>
<tr>
<td>Net Migration Rate</td>
<td>-0.08</td>
<td>1.46</td>
<td>2.96</td>
<td>0.30</td>
<td>32.46* (0.000)</td>
<td>-0.25* (0.000)</td>
</tr>
</tbody>
</table>

| ii. Per capita GDP (000 €) | 18.57 | 22.21| 27.10| 9.76* | 73.04* (0.000) | -0.50* (0.000) |
| Employment changes 2001-2007 (%) | 3.64 | 4.39 | 5.26 | 11.20* | 2.84 (0.059) | 0.05 (0.079) |
| Employment changes 2007-2009 (%) | -1.19 | -0.47| 0.01 | 18.82* | 4.60* (0.010) | -0.15* (0.000) |
| Employ. Industry (%) | 19.24 | 19.74| 16.72| 1.05  | 14.29* (0.000) | 0.09* (0.001) |
| Employ. Services (%) | 60.25 | 67.48| 74.95| 9.58* | 188.80* (0.000) | -0.57* (0.000) |
| Unemployment Rate | 8.79  | 8.29 | 7.77 | 5.28* | 7.85* (0.000) | 0.19* (0.000) |

| iii. Farm diversification | 37.20 | 39.54| 33.77| 7.19* | 12.52* (0.000) | -0.01* (0.679) |
| Average Farm Size | 40.89 | 50.87| 32.52| 14.76* | 17.57* (0.000) | -0.09* (0.001) |
| Average SGM | 31.94 | 48.00| 45.09| 6.60* | 21.23* (0.000) | -0.31* (0.000) |
| Touristic Bed-Places | 97.36 | 66.46| 32.71| 31.59* | 55.82* (0.000) | 0.24* (0.000) |

| iv. Distance – Capital cities | 282.3 | 295.3| 268.0| 14.27* | 2.19 (0.112) | 0.02 (0.464) |
| Distance – Large cities | 192.5 | 165.7| 114.1| 1.87  | 53.73* (0.000) | 0.39* (0.000) |

Statistically significant at 5%

14 | Alghero, June 26th, 2014
5. Concluding remarks

- The FRI: a comprehensive and continuous indicator of rurality at EU level.

- New picture of EU rural areas. EU is still a rather ‘rural’ continent and some groups of Countries show important rural traits.

- Latest socio-economic trends within rural areas:
  - socio-economic weaknesses still affect EU rural areas (e.g., depopulation trends and demographic ageing; low resilience in their labour markets).
  - New opportunities from the diversification of the agricultural sector (e.g., touristic activities).

- The debate on rural areas cannot be considered as completely over:
  - Large imbalances across EU rural areas
  - A strong stimulus towards more “place-based” and “place-aware” rural policies
Thanks for your attention

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