Hungarian Regional Science Association – 19th Annual Meeting
New forms of territorial disparities and transforming regional policy
*Budapest, 04-05 November 2021*

# A Mission Not Impossible: Reducing Regional Disparities by Improving Territorial Capital The Case of Central Europe

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# Introduction: aims of the paper

- **The primary aim of this paper:** to show empirical evidence from the EU-28 regions (NUTS 2 level) in the 2010s through measuring territorial capital (TC)
  - Based on ROBERTO CAMAGNI's model on TC
  - By identifying of the key factors of TC and classifying EU-28 regions based on these factors
- **The specific aim of this paper:** to reveal which factors of TC play a crucial role in narrowing the 'development gap'
  - The case of Central European regions receives special attention in the light of catching up with more developed regions in the EU

# Introduction: applied methods

- **Methods involved in this research:**
  - *Secondary research method:*
    - Literature review on the theoretical taxonomy of TC and on the relation of TC and regional growth
  - *Primary research methods – data collection, data transformation & data analysis*
    - 40 indicators were involved/created based on the available national and subnational (NUTS 1, NUTS 2 level) data
    - Dimension reduction – principal component analysis (PCA)
    - Classification of cases - twostep cluster analysis & hierarchical cluster analysis based on the results of the PCA
    - Artificial neural network (ANN) – multilayer perceptron (MLP)

# Literature review

**The theoretical taxonomy of the components of TC**

| Rivalry | Tangible goods (hard) | Mixed goods (hard + soft) | Intangible goods (soft) |
|---|---|---|---|
| High rivalry (private goods) | Private fixed capital stock<br>Pecuniary externalities (hard)<br>Toll goods (excludab.)<br>3 | Relational private services operating on:<br>– external linkages for firms<br>– transfer of R&D results<br>University spin-offs<br>9 | Human capital:<br>– entrepreneurship<br>– creativity<br>– private know-how<br>Pecuniary externalities (soft)<br>6 |
| (club goods) (impure public goods) | Proprietary networks<br>Collective goods:<br>– landscape<br>– cultural heritage (private "ensembles")<br>2 | Cooperation networks:<br>– strategic alliances in R&D and knowledge<br>– p/p partnerships in services and schemes<br>Governance on land and cultural resources<br>8 | Relational capital:<br>– cooperation capability<br>– collective action capability<br>– collective competencies<br>5 |
| (public goods) Low rivalry | Resources:<br>– natural<br>– cultural (punctual)<br>Social overhead capital:<br>– infrastructure<br>1 | Agencies for R&D transco-ding<br>Receptivity enhancing tools<br>Connectivity<br>Agglomeration and district economies<br>7 | Social capital:<br>– institutions<br>– behavioural models, values<br>– trust, reputation<br>– associationism<br>4 |

Materiality

Source: CAMAGNI (2008)

# Literature review

- The relation of TC and regional growth:
  - Regional growth can be estimated as a sum of national growth component and a differential regional growth component (Camagni–Capello, 2013):

$$\Delta Y_r = \Delta Y_N \mp s_r$$

where $\Delta Y_r$ and $\Delta Y_N$ denote the growth rates of the region and the nation and $s_r$ represents the stock of TC and its elements

  - Based on this equation, the growth of the EU NUTS 2 regions can be estimated as a sum of EU growth component, a differential MS growth component and a differential regional growth component:

$$\Delta Y^{REG}_{t;t-n} = \Delta Y^{EU}_{t;t-n} \mp s^{MS}_{AVG[t;t-n]} \mp s^{REG}_{AVG[t;t-n]}$$

Country data

Regional data

# Data collection & data analysis: Dimension reduction

- Geographical level: 280 EU regions (NUTS 2)
  - NUTS version: 2016
  - Reference period: the 2010s
- Total number of indicators: 40 variables
  - Average value calculation for the reference period
  - 24 indicators based on NUTS 0 data
  - 16 indicators based on regional (NUTS 1, NUTS 2) data
- Results of the PCA:
  - After 10 runs, the remaining 32 indicators merged into 7 factors
  - Explained variance: 80.699%; KMO: 0.821 – meritorious; lowest MSA value > 0.500; lowest value of comm. > 0.500

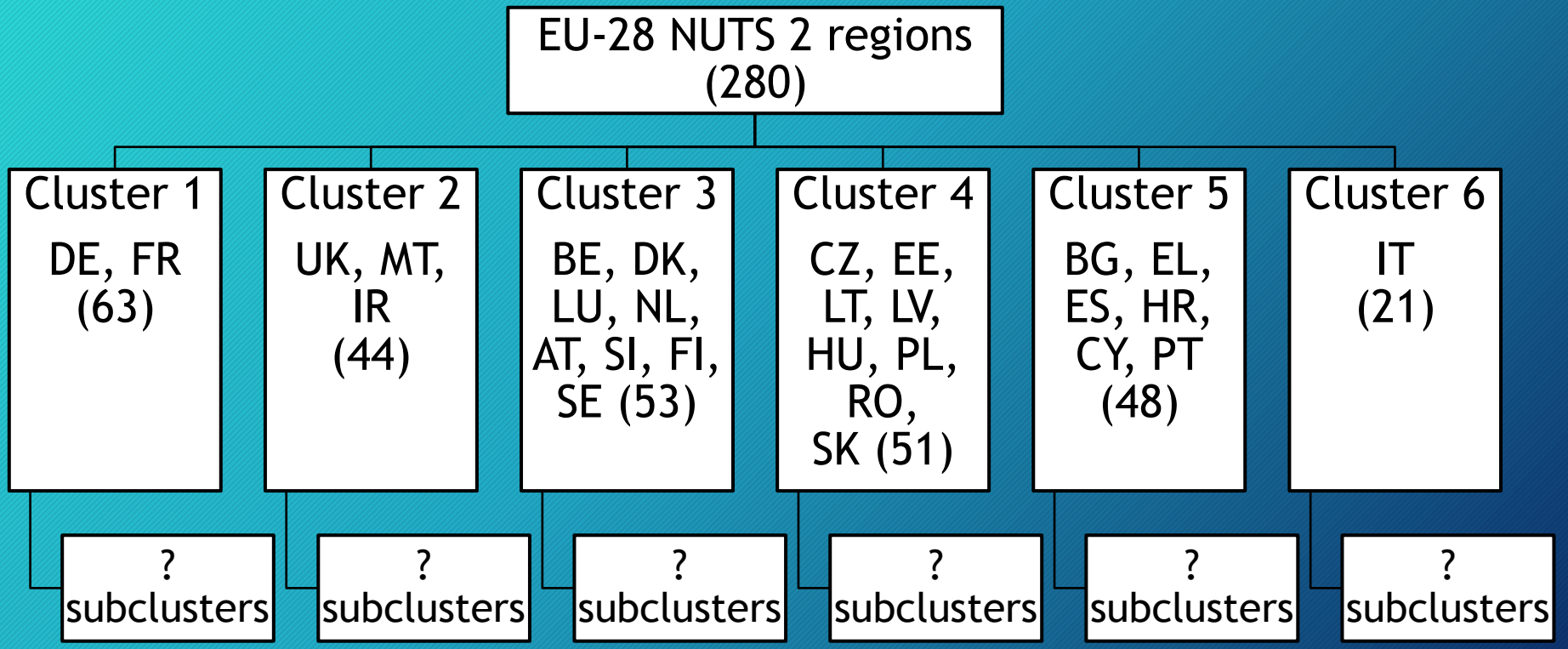
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|
| Social Justice Index | ,919 | ,145 | ,176 | ,001 | -,014 | ,006 | ,139 |
| Corruption Perception Index | ,853 | ,441 | ,182 | ,001 | -,117 | ,044 | ,029 |
| Industrial Competitiveness Index | ,839 | ,237 | ,209 | -,102 | -,258 | ,164 | ,239 |
| Recycling rate of municipal waste | ,814 | -,132 | ,272 | ,011 | -,214 | ,207 | ,152 |
| Quality of Work and Emloyment Index | ,798 | ,360 | ,133 | ,048 | ,265 | ,130 | ,178 |
| Share of terrestrial protected area | -,720 | -,285 | -,143 | ,134 | -,084 | -,274 | ,310 |
| Eco-innovation Index | ,706 | ,072 | ,204 | -,127 | -,394 | ,221 | ,160 |
| Share of households with broadband access | ,672 | ,450 | ,417 | ,131 | -,025 | ,240 | -,045 |
| Share of individuals using the internet daily | ,632 | ,504 | ,410 | ,083 | -,080 | ,264 | ,045 |
| Share of individuals using the internet for interaction with public authorities | ,601 | ,444 | ,230 | -,014 | -,086 | ,027 | ,421 |
| Share of agricultural areas affected by severe erosion | -,563 | -,387 | -,064 | -,081 | -,218 | ,488 | ,176 |
| Share of employed persons being able to influence decisions that affect their work | ,182 | ,780 | -,052 | -,060 | ,209 | ,061 | ,152 |
| Share of individuals using the internet for participating in social networks | ,327 | ,769 | ,128 | ,065 | ,098 | -,175 | -,054 |
| Share of population with tertiary education | ,160 | ,657 | ,613 | -,051 | -,099 | -,068 | -,108 |
| Share of employed persons whose jobs involves improving their skills | ,557 | ,651 | ,092 | -,120 | ,081 | ,234 | ,123 |
| Share of employment in high-technology sectors | ,093 | ,244 | ,806 | ,020 | ,299 | ,051 | ,001 |
| Gross fixed capital formation | ,127 | -,200 | ,679 | -,030 | -,071 | ,130 | ,078 |
| Share of scientists and engineers in total active population | ,284 | ,587 | ,637 | ,001 | ,074 | -,039 | -,190 |
| Net national income of households per inhabitant | ,526 | ,071 | ,615 | ,007 | -,221 | ,282 | ,100 |
| Net occupacy rate of bedrooms in hotels and similar accomodations | ,282 | ,227 | ,608 | -,050 | -,191 | -,069 | -,011 |
| Length of motorways per 1.000 square kilometres | ,264 | -,008 | ,559 | ,028 | -,124 | -,029 | ,320 |
| Growth rate of employment in professional, scientific and technic activities | -,212 | ,065 | -,063 | ,851 | -,013 | -,110 | ,077 |
| Growth rate of employment in information and communication activities | -,039 | -,057 | -,026 | ,850 | ,099 | -,069 | -,013 |
| Growth rate of employment in wholesale, retail trade and repair activities | ,032 | ,107 | ,086 | ,825 | ,201 | ,181 | ,111 |
| Growth rate of employment in transportation and storage activities | ,157 | -,154 | -,022 | ,730 | ,015 | -,025 | -,302 |
| Share of domestic value added in foreign controlled enterprises | -,031 | ,195 | ,027 | ,131 | ,849 | -,286 | -,192 |
| Share of domestic employment in foreign contolled enterprises | ,018 | ,358 | -,058 | ,171 | ,845 | -,079 | -,167 |
| Share of public transport in total inland passenger transport | -,363 | -,235 | -,119 | ,059 | ,754 | ,029 | ,207 |
| Stock of vehicles per 1.000 inhabitants | ,180 | -,153 | ,032 | ,048 | -,189 | ,768 | ,001 |
| Share of employed persons being able to influence their pace of work | ,389 | ,375 | ,016 | -,008 | ,088 | ,637 | ,174 |
| Circular material use rate | ,409 | ,103 | ,203 | -,124 | -,143 | ,531 | ,017 |
| Industrial Democracy Index | ,470 | ,060 | ,066 | -,082 | -,144 | ,186 | ,784 |
| Rotated factor weights above ,400 are labelled. | | | | | | | |

# Rotated component matrix

1. Quality of life & competitive economy
2. Digitalization & qualification
3. Material wealth & qualified labour force
4. Service sector employment growth
5. Dependence on external companies
6. Stability & security needs
7. Democracy index & participation

# Classification of cases

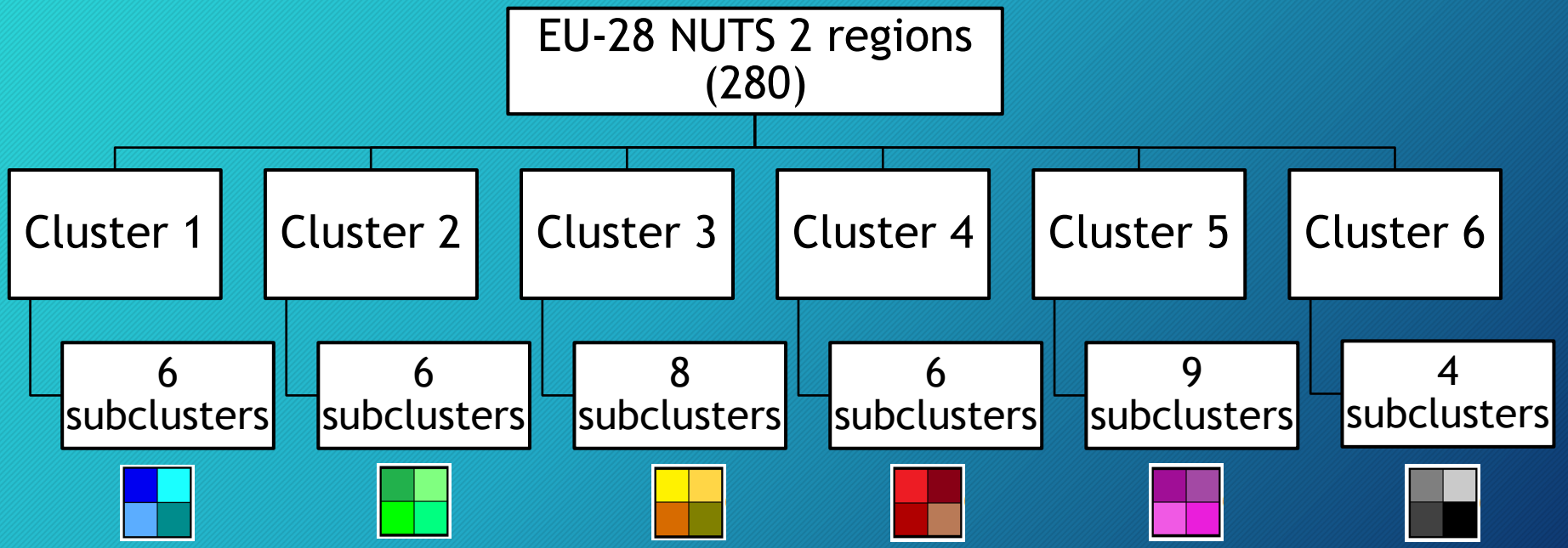
**The composition of clusters after the two-step cluster analysis***




* Cluster number determination based on silhouette measure of cohesion and separation.

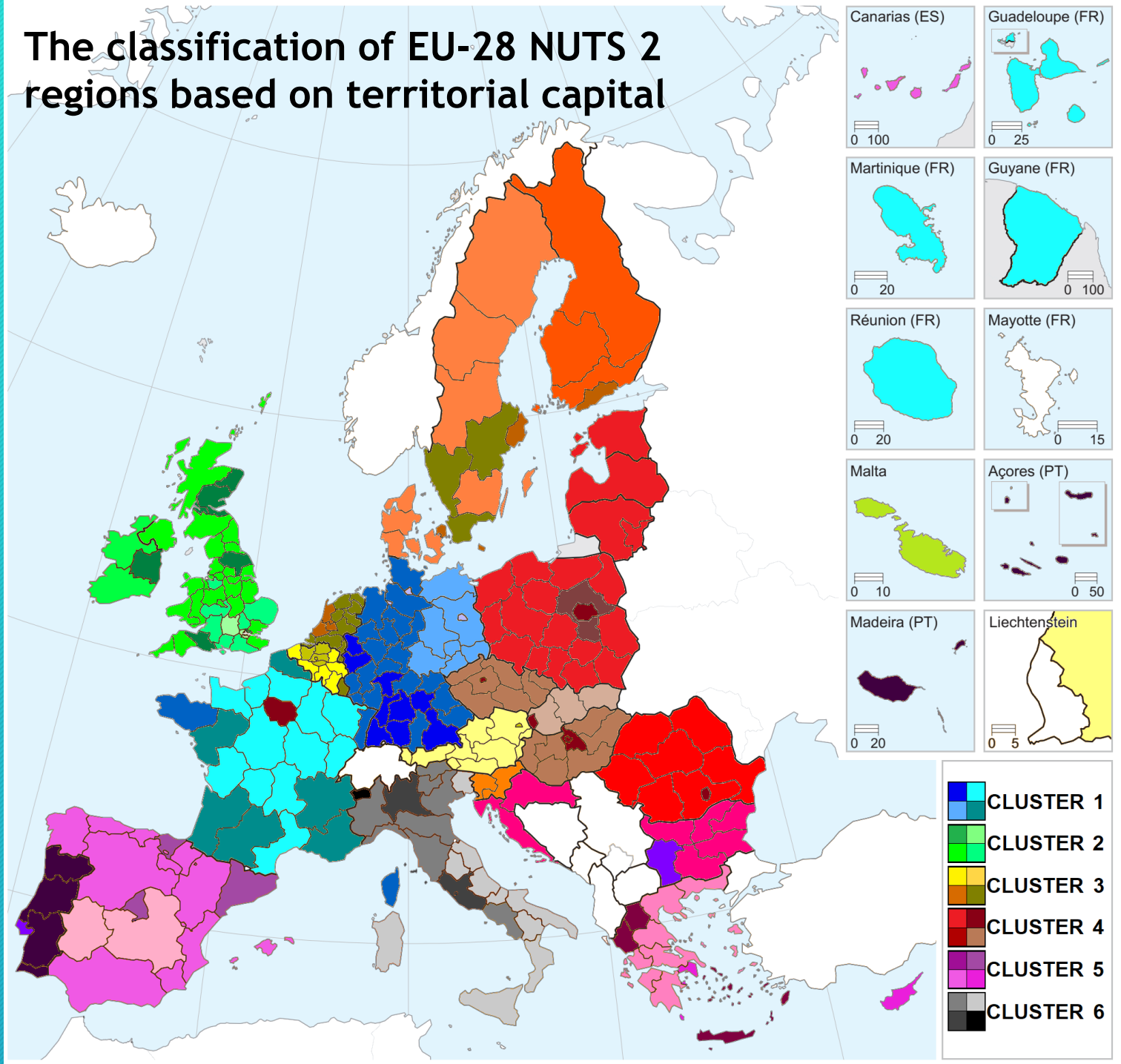
# Classification of cases

**The composition of clusters after the hierarchical cluster analysis***




* Subclusters according to the first three conjunctions. Cluster method: Ward's method (Ward linkage) with squared Euclidian distance.

# The classification of EU-28 NUTS 2 regions based on territorial capital



# Classification of cases

Descriptive statistics of the six clusters based on factor scores

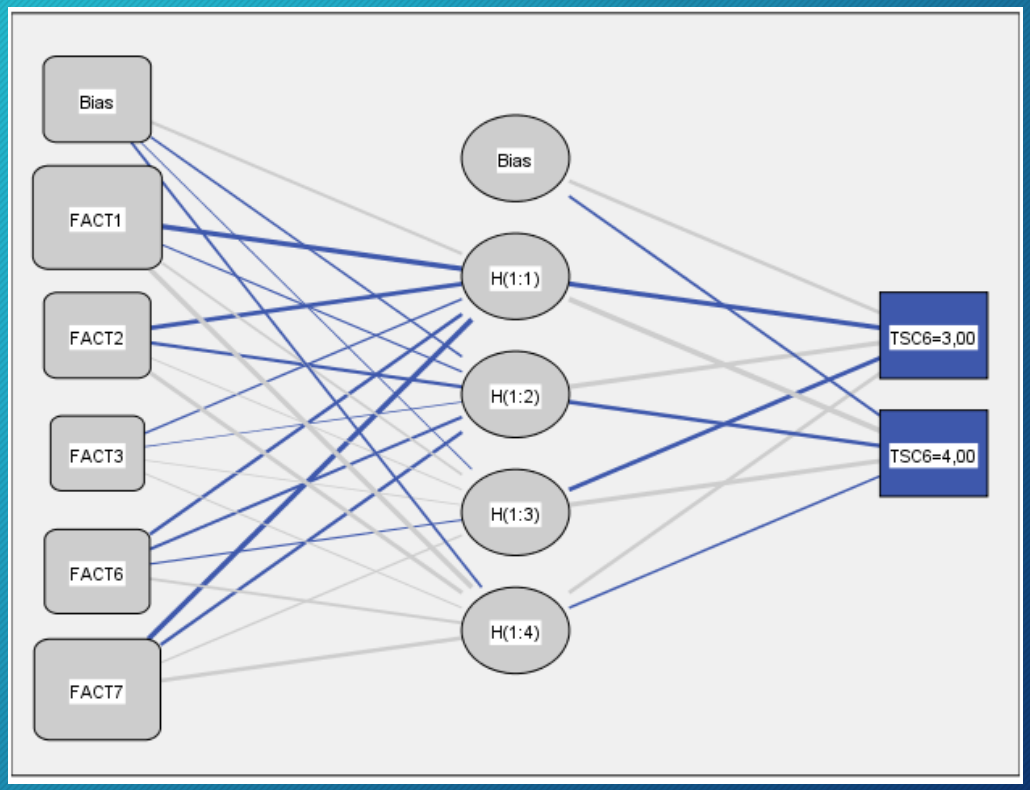
*Legend:*
Blue: highest mean
Green: 2nd highest mean
Yellow: 3rd highest mean
Orange: 3rd lowest mean
Red: 2nd lowest mean
Brown: lowest mean

* std. dev. < 1.000

| Cluster no. | Country codes | Quality of life & competitive economy | Digitalization & qualification | Material wealth & qualified labour force | Service sector employment growth | Dependence on external companies | Stability & security needs | Democracy index & participation |
|---|---|---|---|---|---|---|---|---|
| 1 | DE, FR | 1.108 (0.456*) | -0.987 (0.264*) | 0.189 (0.826*) | -0.018 (0.894*) | -0.477 (0.131*) | -0.169 (0.439*) | -0.054 (0.414*) |
| 2 | UK, MT, IR | 0.313 (0.389*) | 1.155 (0.303*) | 0.270 (0.947*) | -0.027 (0.356*) | -0.282 (0.187*) | -0.006 (0.404*) | -1.523 (0.281*) |
| 3 | BE, DK, LU, NL, AT, SI, FI, SE | 0.586 (0.540*) | 0.952 (0.878*) | -0.059 (1.050) | -0.077 (0.229*) | 0.278 (0.402*) | 0.391 (0.524*) | 1.359 (0.438*) |
| 4 | CZ, EE, LT, LV, HU, PL, RO, SK | -0.637 (0.497*) | -0.262 (0.630*) | -0.128 (1.261) | 0.368 (2.021) | 1.729 (0.714*) | -0.233 (0.823*) | -0.380 (0.721*) |
| 5 | BG, EL, ES, HR, CY, PT | -1.220 (0.531*) | -0.000 (0.377*) | -0.293 (0.902*) | -0.111 (0.366*) | -1.019 (0.499*) | -1.024 (0.638*) | 0.391 (0.536*) |
| 6 | IT | -0.180 (0.209*) | -1.226 (0.209*) | -0.005 (0.789*) | -0.333 (0.174*) | -0.546 (0.144*) | 2.441 (0.487*) | -0.050 (0.181*) |

# Artificial neural network

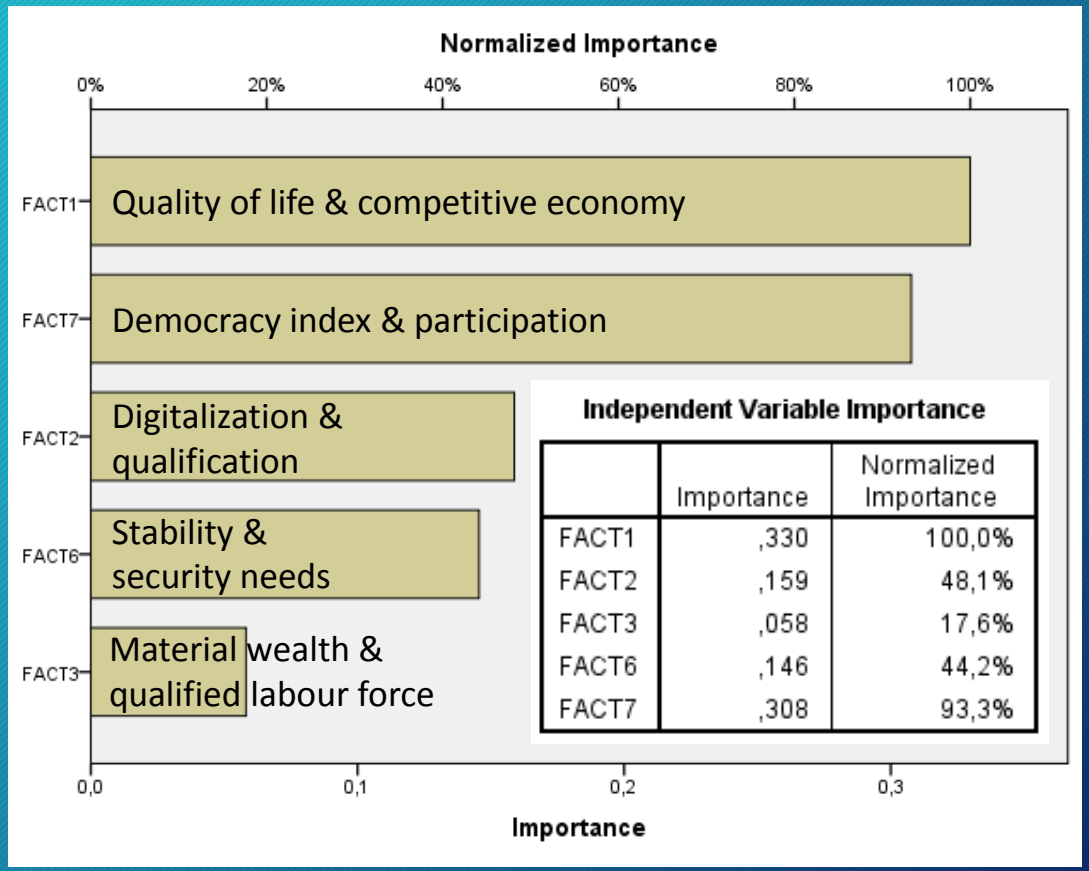
- ANN information*:
  - 5 factors as input layers:
    - F1: Quality of life & competitive economy
    - F2: Digitalization & qualification
    - F3: Material wealth & qualified labour force
    - F6: Stability & security needs
    - F7: Democracy index & participation
  - 2 clusters as output layers
    - CL 3 & CL 4
  - 1 hidden layer




* Partitions: 70% training & 30% testing. Batch training. Activation function: Sigmoid.

# Artificial neural network

- Model summary:
  - Sampling: 104 regions
    - Training: 75 (72,1%)
    - Testing: 29 (27,9%)
  - Sum of sq. error:
    - Training: 0,557
    - Testing: 0,217
  - Receiver operating characteristic (ROC):
    - CL 3 = 1 (excellent)
    - CL 4 = 1 (excellent)




**Independent Variable Importance**

| | Importance | Normalized Importance |
|---|---|---|
| FACT1 | ,330 | 100,0% |
| FACT2 | ,159 | 48,1% |
| FACT3 | ,058 | 17,6% |
| FACT6 | ,146 | 44,2% |
| FACT7 | ,308 | 93,3% |

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