Segregation and spatial patterns of recent immigration in Barcelona

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Presentation structure

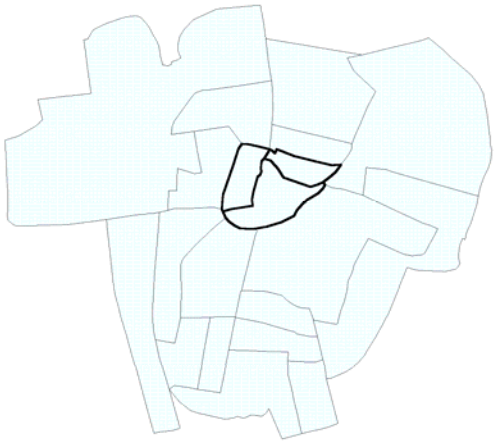
- Introduction
- Objectives
- Segregation measures and spatial autocorrelation
- Data and methodology
- Results
- Conclusions

Introduction

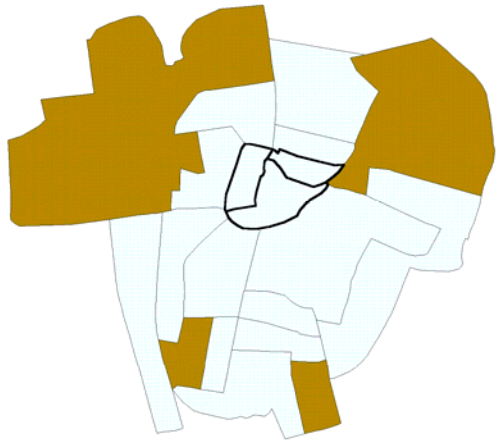
- Segregation measures
  - Statistics to detect the different distribution between population groups.
  - Five dimensions
    - Evenness
    - Exposure
    - Clustering
    - Concentration
    - Centralization

Evenness indices

Low Segregation

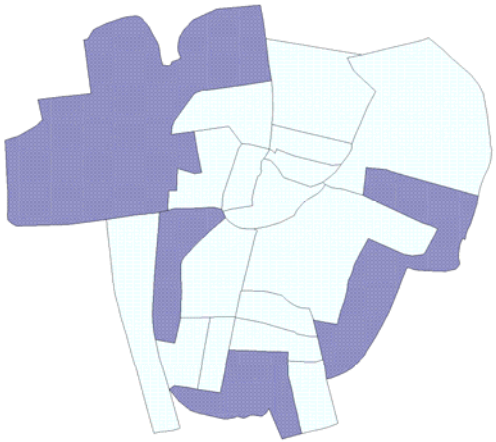


High Segregation

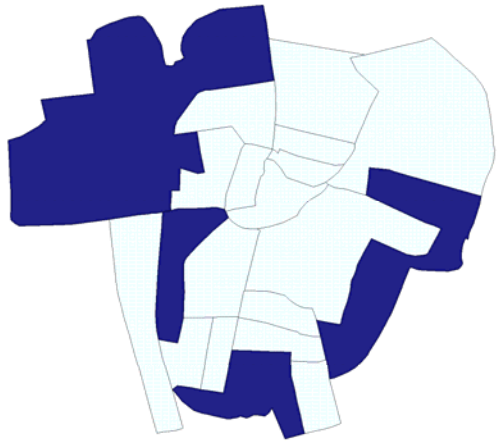


Exposure indices

Low Segregation
Group X:50%, Group Y:50%

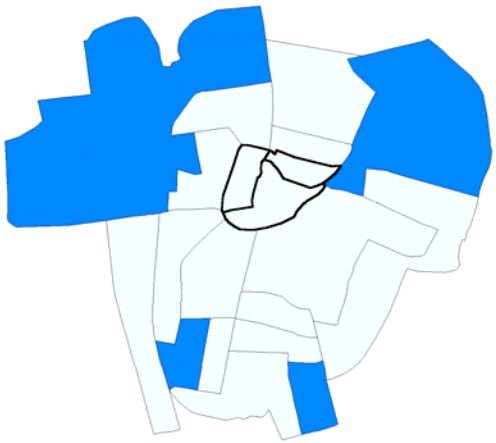


High Segregation
Y:100%

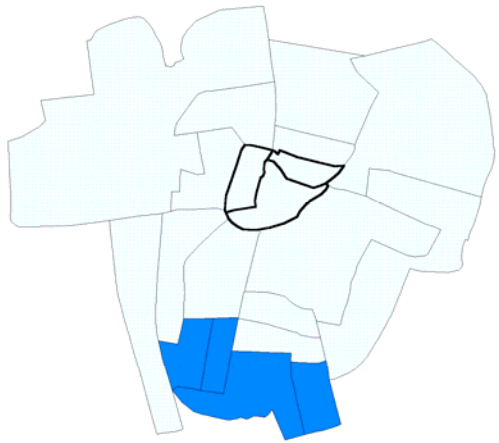


Clustering indices

Low Segregation

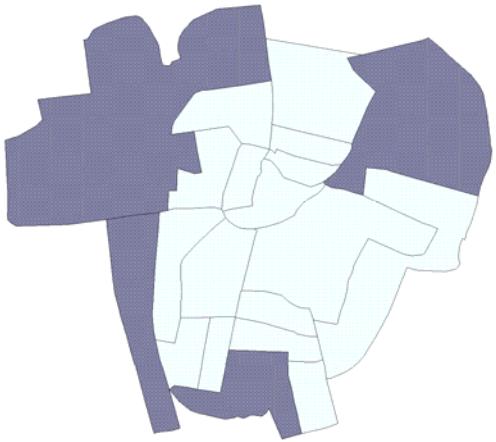


High Segregation

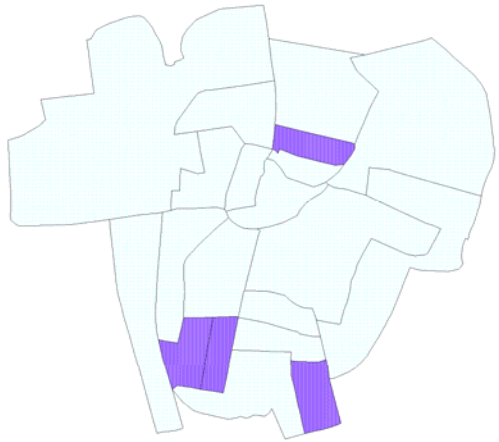


Concentration indices

Low Segregation

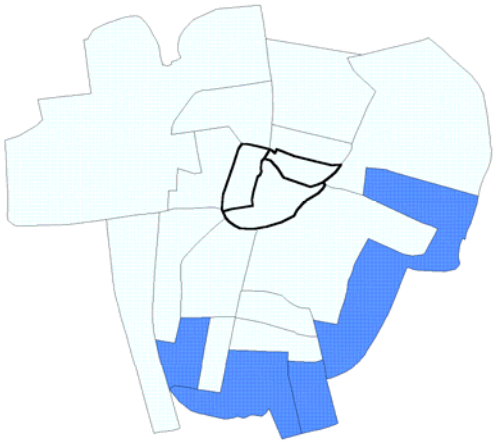


High Segregation

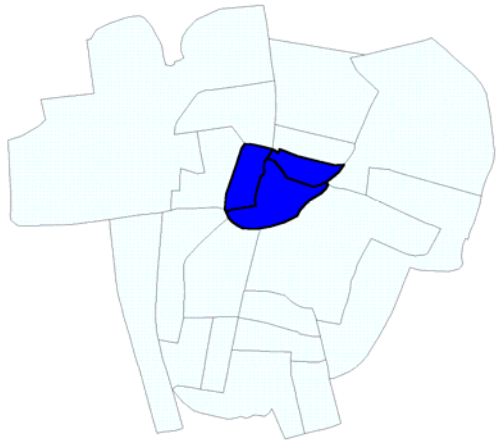


Centralization indices

Low Segregation



High Segregation



Migration in Spain

- Shift from emigrants to immigrants country
- Fast change, e.g. in Barcelona municipality the immigrant population increased from 53,428 in 2000 to 167,223 in 2003.
- Very different situation to other European countries.

Objectives

- Which pattern of localization do immigration minorities in Barcelona follow?
- Is this pattern unique or are there some differences between nationality groups?
- Analyzing the residential segregation and localization patterns, is the combination of traditional segregation measures with global and local spatial statistics useful?
- Which is the statistical relationship between segregation indices and spatial autocorrelation measures?

Non spatial measures

Segregation index

$$IS = \frac{1}{2}\sum_{i=1}^{n}\left|\frac{x_i}{X} - \frac{t_i - x_i}{T - X}\right|$$

Dissimilarity index

$$D = \frac{1}{2}\sum_{i=1}^{n}\left|\frac{x_i}{X} - \frac{y_i}{Y}\right|$$

Exposure index

$$\eta^2 = \frac{xPx - P}{1 - P} \qquad xPx = \sum_{i=1}^{n}\left(\frac{x_i}{X}\right)\left(\frac{x_i}{t_i}\right)$$

Concentration index

$$DEL = \frac{1}{2}\sum_{i=1}^{n}\left|\frac{x_i}{X} - \frac{a_i}{A}\right|$$

Centralization index

$$ACE = \left(\sum_{i=1}^{n} X_{i-1} A_i\right) - \left(\sum_{i=1}^{n} X_i A_{i-1}\right)$$

Note: All indices range from 0 to 1, except ACE (from -1 to 1).

Spatial measures

- Non spatial dissimilarity: intra-zonal interaction between groups.

- Spatial dissimilarity: inter-zonal interaction between groups.

Spatial measures (I)

- Dissimilarity boundary-modified index (Morrill, 1991)

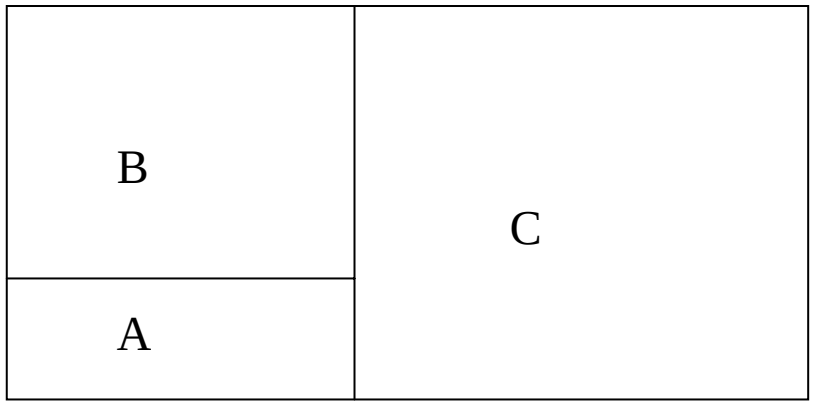
$$D(adj) = D - \frac{\sum_{i=1}^{n}\sum_{i=1}^{n}\left|c_{ij}(z_i - z_j)\right|}{\sum_{i=1}^{n}\sum_{j=1}^{n}c_{ij}}$$

Pattern of differences in proportions minority across all adjacent boundaries

Spatial measures (II)

- Dissimilarity weight-modified index (Wong, 1993)

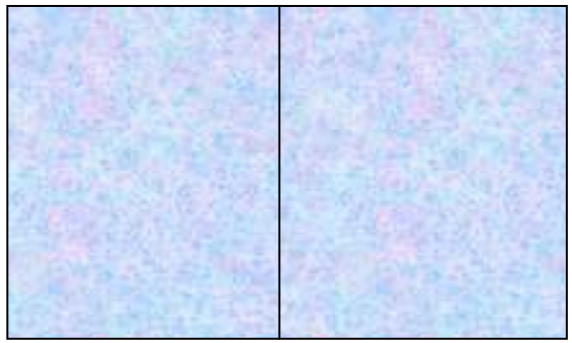
$$D(w) = D - \frac{1}{2}\sum_{i=1}^{n}\sum_{j=1}^{n} w_{ij}\left|z_i - z_j\right| \qquad w_{ij} = \frac{d_{ij}}{\sum d_{ij}}$$

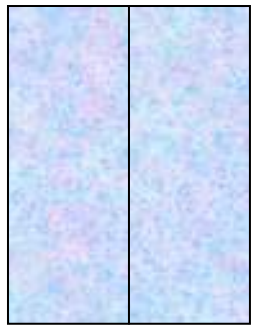


Spatial measures (III)

Dissimilarity shape modified index

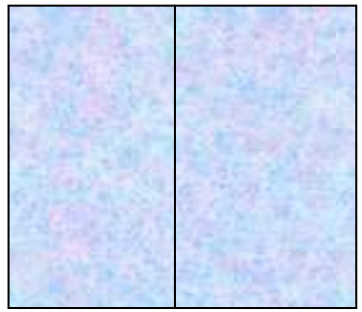
$$D(s) = D - \frac{1}{2}\sum_{i=1}^{n}\sum_{j=1}^{n} w_{ij}\left|z_i - z_j\right| \frac{\frac{1}{2}\left[\left(P_i / A_i\right) + \left(P_j / A_j\right)\right]}{màx\left(P_i / A_i\right)}$$





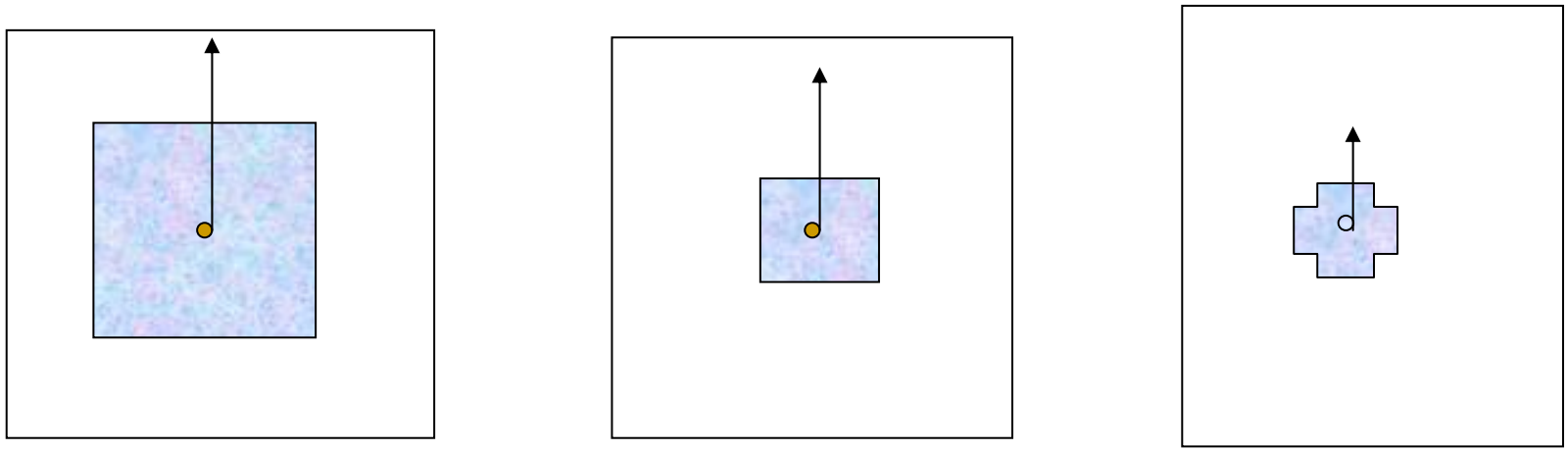
Shape *vs* Interaction (I)

- Compactness measure: Perimeter/Area



More compact units: low perimeter-area ratio = lower chance to interact with members of others units

Shape *vs* Interaction (II)



Spatial measures (IV)

Absolute clustering index $$ACL = \left\{ \left[\sum_{i=1}^{n} (x_i / X) \sum_{j=1}^{n} (c_{ij} x_j) \right] - \left[X / n^2 \sum_{i=1}^{n} \sum_{j=1}^{n} c_{ij} \right] \right\} / \left\{ \left[\sum_{i=1}^{n} (x_i / X) \sum_{j=1}^{n} (c_{ij} t_j) \right] - \left[X / n^2 \sum_{i=1}^{n} \sum_{j=1}^{n} c_{ij} \right] \right\}$$

Global Moran's I

$$I = (N / S_o) \sum_{i=1}^{n} \sum_{j=1}^{m} c_{ij} (x_i - \mu)(x_j - \mu) / \sum_{i=1}^{n} (x_i - \mu)^2$$

Local Moran's I

$$I_i = \frac{(x_i - \mu)}{m_0} \sum_{j=1}^{n} c_{ij} (x_j - \mu)$$

with $$m_0 = \sum_{i=1}^{n} (x_i - \mu)^2 / n$$

Study area and Data

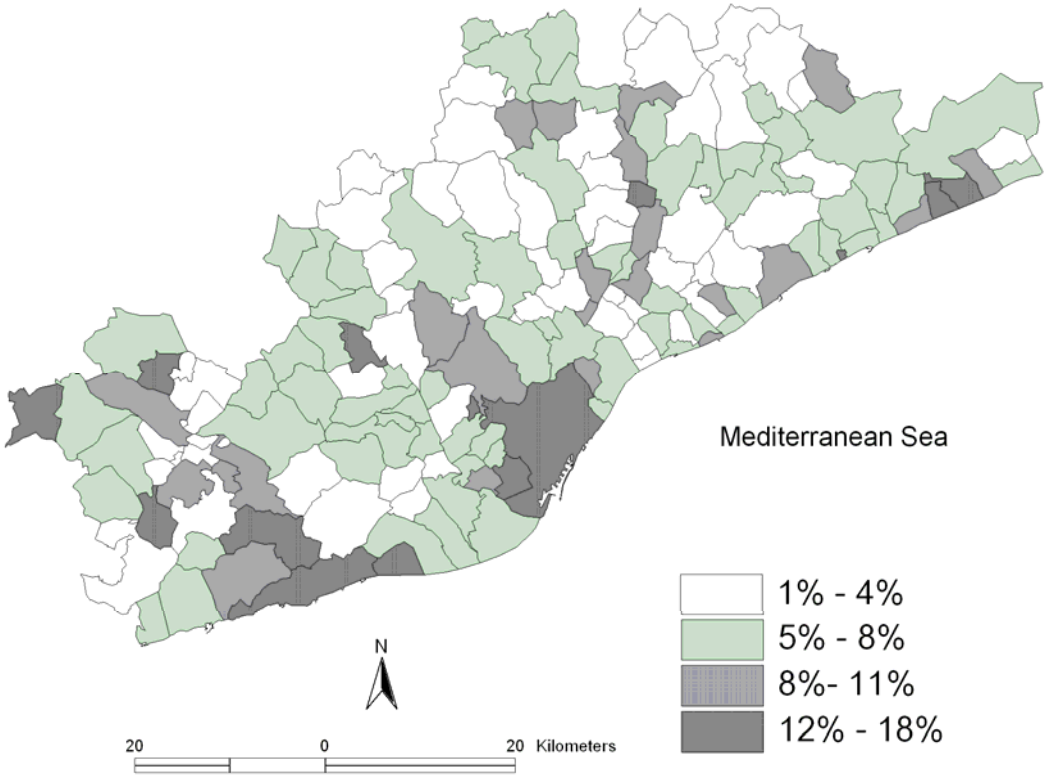
- Barcelona municipality (2003)
  - Population 1,582,738 (10.5% immigrants)
  - 1,491 census tracts

- Barcelona Region (2003)
  - Population 4,615,918 (8% immigrants)
  - 3,478 census tracts

Data source: Bureau Statistics Barcelona

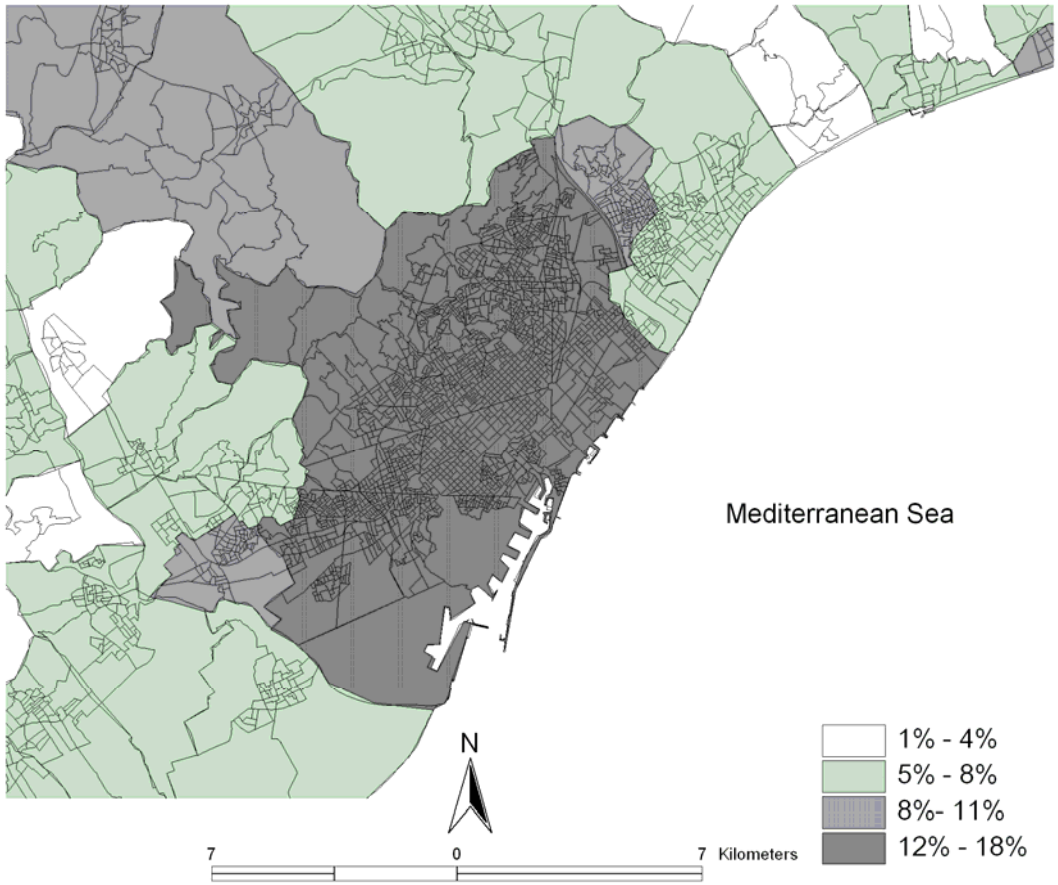
Barcelona metropolitan region

Municipality division



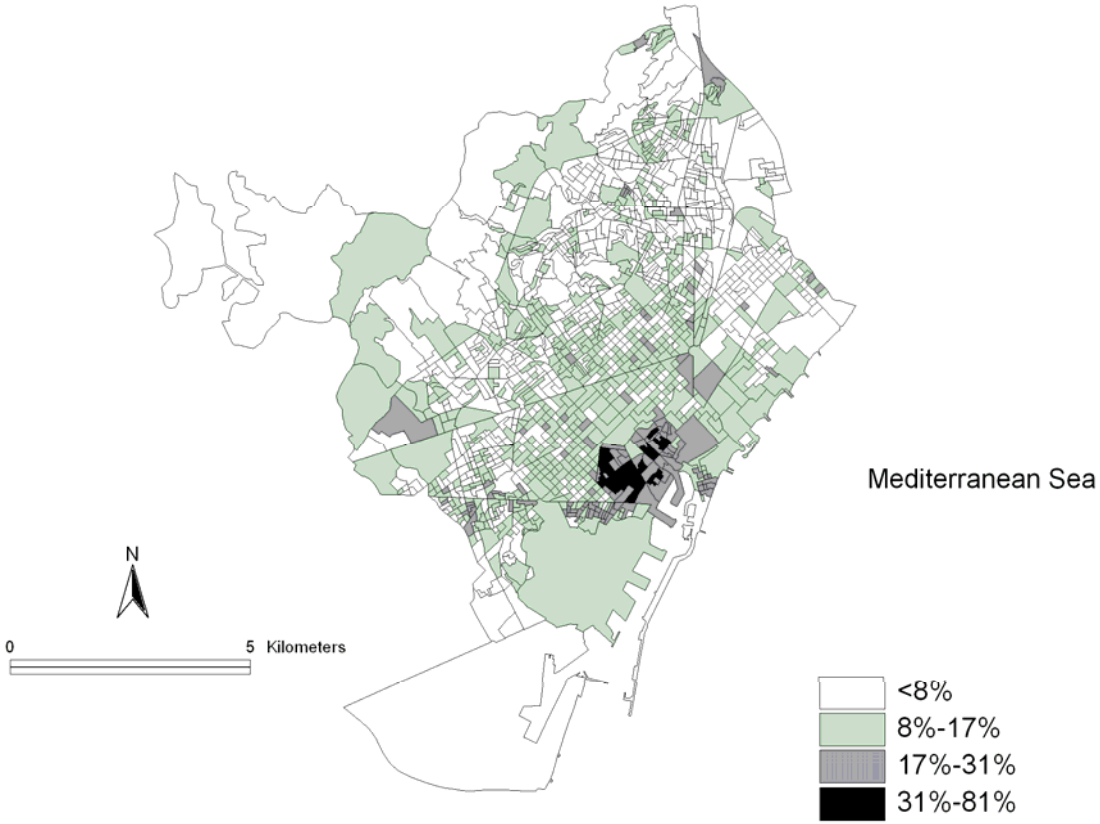
Central municipalities

Census tract division



Barcelona municipality

Census tract division

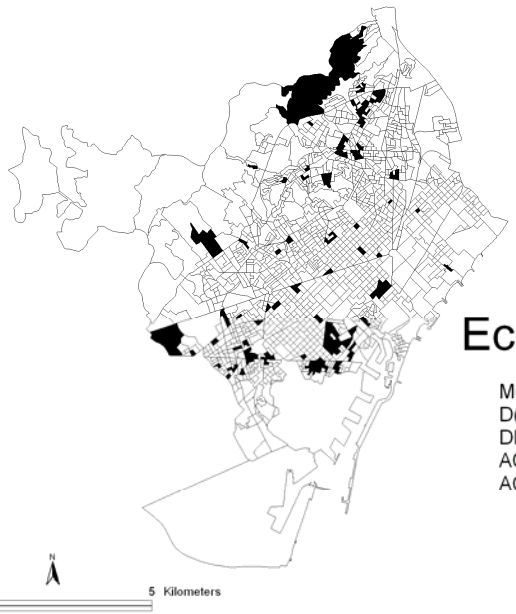


Segregation indices and Moran's I for each immigrant group

Indices / Immigrant group	Ecuador	Colombia	Morocco	Peru	Argentina	Pakistan	Italy	Dominican Rep.	France	The Philippines	China
Barcelona (n =1.491)											
Index of segregation	0.389	0.351	0.597	0.384	0.353	0.807	0.370	0.579	0.424	0.784	0.599
Dissimilarity shape modified	0.384	0.348	0.594	0.382	0.351	**0.805**	0.369	0.577	0.423	**0.783**	**0.598**
Eta-squared	0.018	0.007	**0.035**	0.007	0.006	**0.085**	0.004	0.015	0.006	**0.074**	0.011
Delta	0.675	0.654	0.745	0.689	0.635	**0.879**	0.634	0.773	0.633	**0.872**	**0.782**
Absolute Centralization index	0.196	0.291	**0.453**	0.255	0.358	**0.660**	0.379	0.393	0.355	**0.724**	0.388
Index of absolute clustering	**0.017**	**0.008**	**0.008**	0.007	0.006	0.006	0.005	0.004	0.003	0.003	0.003
Moran's I	0.249*	0.123*	0.522*	0.209*	0.343*	**0.655***	**0.497***	0.365*	**0.538***	**0.620***	0.151*
RMB (n =3.478)											
Index of segregation	0.464	0.411	0.522	0.536	0.425	0.843	0.463	0.619	0.502	0.845	0.665
Dissimilarity shape modified	0.463	0.410	0.520	0.535	0.425	**0.843**	0.463	0.618	0.501	**0.845**	**0.665**
Eta-squared	0.022	0.008	**0.040**	0.009	0.007	**0.073**	0.005	0.013	0.007	**0.070**	0.018
Delta	0.896	0.865	0.825	0.918	0.845	**0.975**	0.842	0.926	0.802	**0.954**	**0.945**
Absolute Centralization index	0.823	0.763	0.515	0.886	0.683	**0.933**	0.737	0.842	0.690	**0.945**	0.801
Index of absolute clustering	**0.012**	**0.005**	**0.015**	0.004	0.004	0.003	0.003	0.002	0.002	0.001	0.003
Moran's I	0.431*	0.260*	0.453*	0.402*	0.415*	**0.637***	**0.546***	0.392*	**0.564***	**0.626***	0.422*

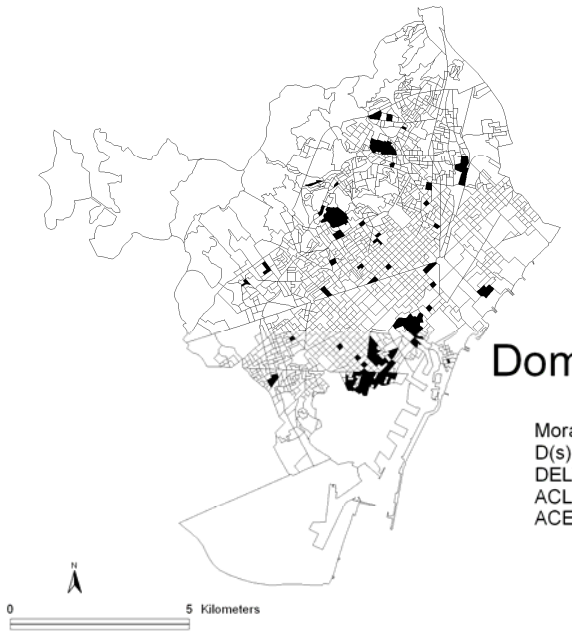
Note: ** significance 5% (999 permutations). Contiguity weight matrix. Rook criteria.*

Cluster map (I)



Ecuador

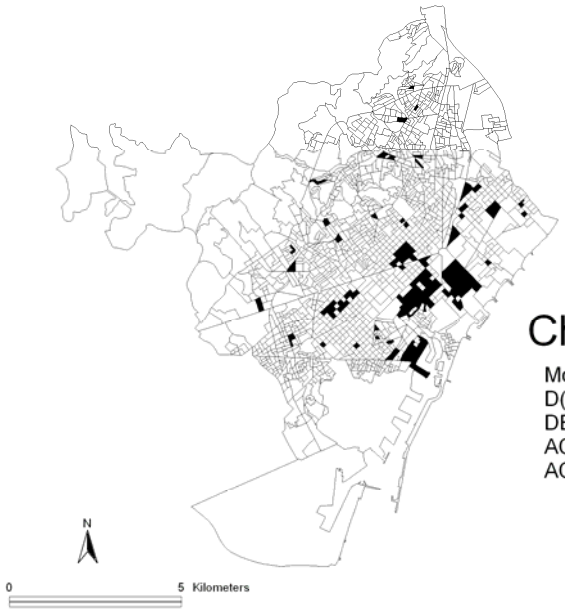
Moran's I = 0.249
D(s) = 0.384
DELTA = 0.675
ACL = 0.017
ACE = 0.196



Dominican Rep.

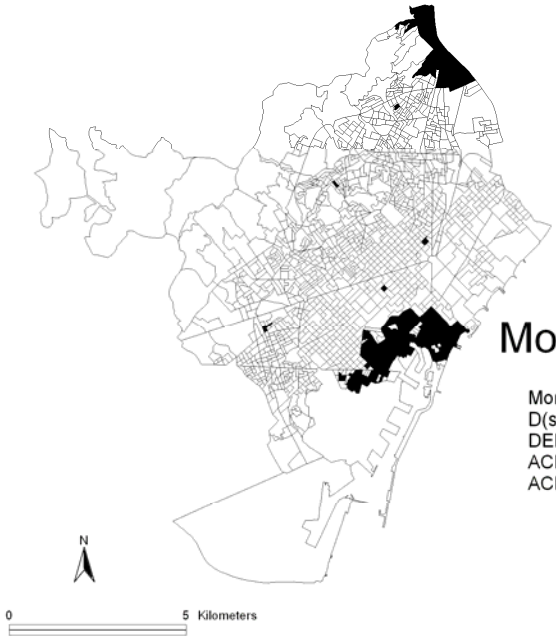
Moran's I = 0.365
D(s) = 0.577
DELTA = 0.773
ACL = 0.004
ACE = 0.393

Cluster (II)



China

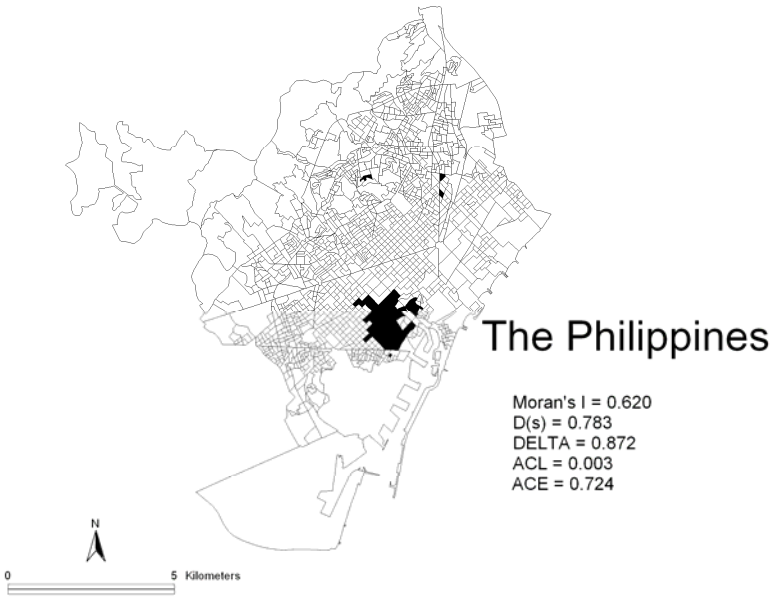
Moran's I = 0.151
D(s) = 0.598
DELTA = 0.782
ACL = 0.003
ACE = 0.388



Morocco

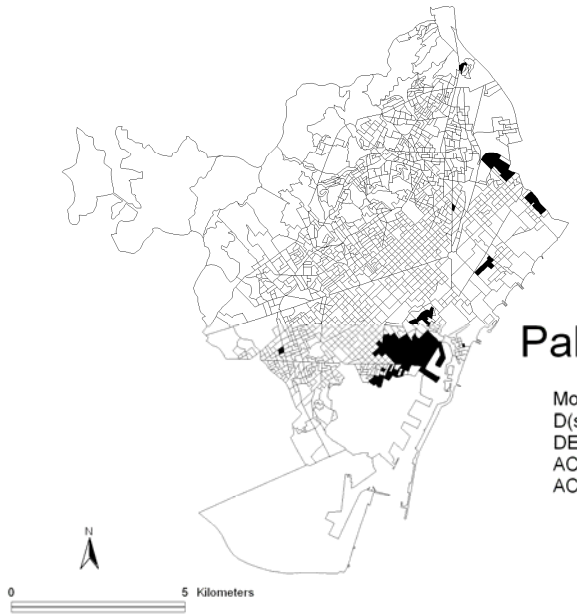
Moran's I = 0.522
D(s) = 0.594
DELTA = 0.745
ACL = 0.008
ACE = 0.453

Cluster (III)



The Philippines

Moran's I = 0.620
D(s) = 0.783
DELTA = 0.872
ACL = 0.003
ACE = 0.724



Pakistan

Moran's I = 0.388
D(s) = 0.805
DELTA = 0.879
ACL = 0.006
ACE = 0.660

Some patterns of segregation

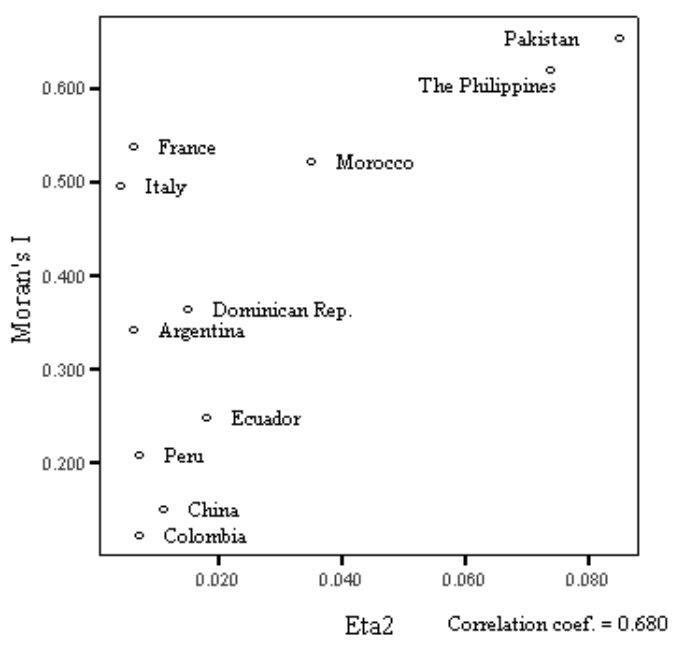
- Barcelona
  - The Philippines and Pakistan: high evenness, exposure, concentration and centralization.
  - Morocco: high exposure, clustering and centralization.
  - China: high evenness and concentration.
  - Ecuador and Colombia: high clustering.

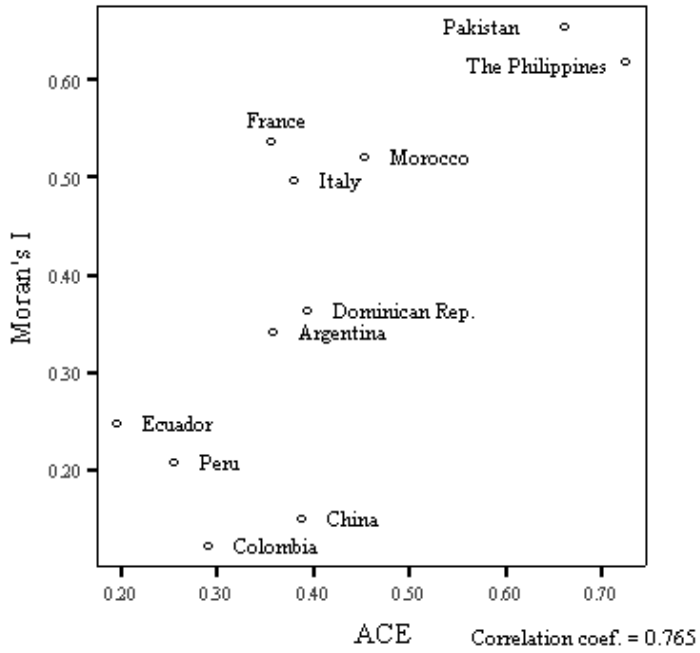
- Barcelona region
  - Pakistan and the Philippines: high evenness, exposure, concentration and centralization.
  - China: high evenness and concentration.
  - Morocco: high clustering and exposure.
  - Ecuador and Colombia: high clustering.

- For European countries (i.e. Italy and France) the Global Moran is high but they don't present segregation.

Exploring linear relationships Segregation indices-Moran's I

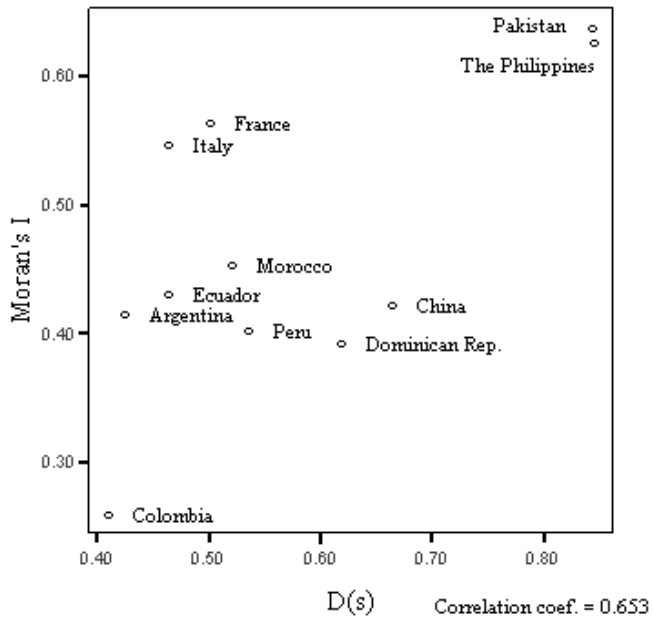
- Correlation matrix: only significance correlation in four cases.
- Barcelona

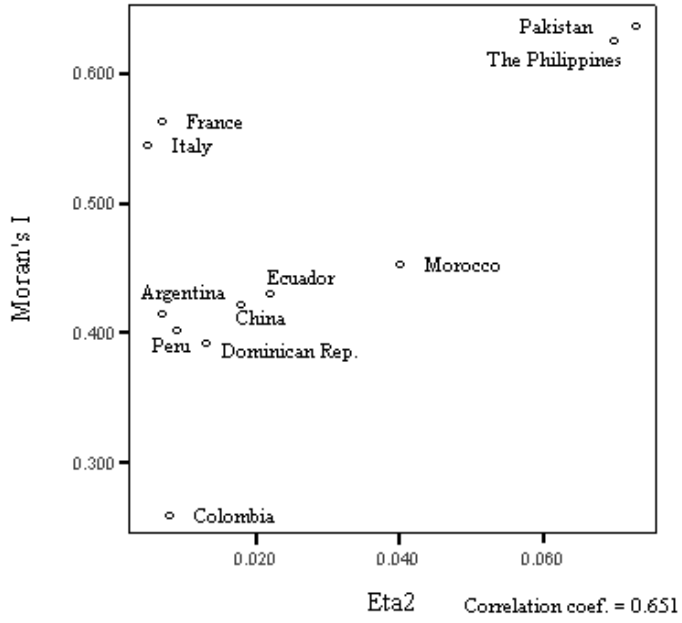




Exploring linear relationships Segregation indices-Moran's I

- Barcelona Region





Summary and conclusions

- We present a combined strategy to find out localization patterns of population groups (i.e. immigrant minorities) in an urban area.
- This approach includes non spatial and spatial measures of residential segregation and spatial autocorrelation statistics.
- For the Barcelona case the most segregated groups are Pakistanis and Philippines with relative high level segregation in four dimensions.
- By means of LISA indicators and its cluster map we found that the localization patterns are diverse and we find out two opposite situations: dispersed and concentred.
- The spatial autocorrelation statistics are useful to detect areas with the need for social assistance for immigrant groups.
- Regarding the statistical relationship between segregation indices and spatial autocorrelation measures, the results suggest the need of more case studies and simulation experiments.

References (I)

- *American Sociological Review*
- *Social Forces*
- *Social Science Quarterly*
- *Sociology and Social Research*
- *Sociological Methodology*

- *Computers, Environment and Urban Systems*
- *Demography*
- *European Journal of Geography*
- *Geoforum*
- *Geographical Analysis*
- *Geography Research Forum*
- *Housing Studies*
- *L'Espace géographique*

References (II)

- *Urban Affairs Quarterly*
- *Urban Geography*
- *Urban Studies*
- *Economic Geography*

- *Economic Letters*
- *Journal of Political Economy*
- *Journal of Socio-Economic Plannig Sciences*
- *Journal of Urban Economics*
- *Quarterly Journal of Economics*

- *Bulletin de l'Institut International de Statistique*
- *Journal of Mathematical Sociology*
- *Mathematical Social Sciences Population Index*

People and Tools

- GIS (ArcView, ArcGis, MapInfo)
- D.W.S. Wong (George Mason University)
- P. Apparicio (University of Quebec)
- L. Anselin (University of Illinois). GeoDa
- R. Bivand (Norwegian School of Economics and Business Administration). R
- J.P.Lesage (University of Toledo) Matlab

Moltes gràcies

Preguntes?