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Immigration in Barcelona: a Holistic Approach

Analysis and Visualization of Big Data

MSc Physics of Complex Systems and Biophysics

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NOVEMBER 28, 2025

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ABSTRACT

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2. Motivation: Population density evolution
3. Immigration distribution and diversity analysis
4. Socioeconomic and Educational Impact of Immigration in Barcelona
5. Temporal Analysis of Immigration in Barcelona
6. Relationship between Latin immigration and Spanish emigration
7. Conclusions

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Description of the Data

NAME	SOURCE	INFORMATION USED
Població per lloc de naixement i sexe	Open Data BCN	Population inside vs outisde Spain, district, neighborhood (1997-2025)
Població per regió geogràfica de naixement i sexe	Open Data BCN	Population from diferent UN regions, district, neighborhood, sex (1997-2025)
Població de 16 anys i més per titulació acadèmica i lloc de naixement	Open Data BCN	Level of education of the population in the different neighborhoods.
Indicadors socioeconòmics. Valors. Per barris de Barcelona	Idescat	Percentage of immigrants from low rent countries and average income per person in the different neighborhoods.
Població de 16 anys i més per titulació acadèmica i continent de naixement	Barcelona Dades	Level of education of the population in the different districts and their continent of origin.
Tasas de actividad, paro y empleo por provincia y sexo	datos.gob.es	Unemployment rate, Barcelona province (2002-2025)

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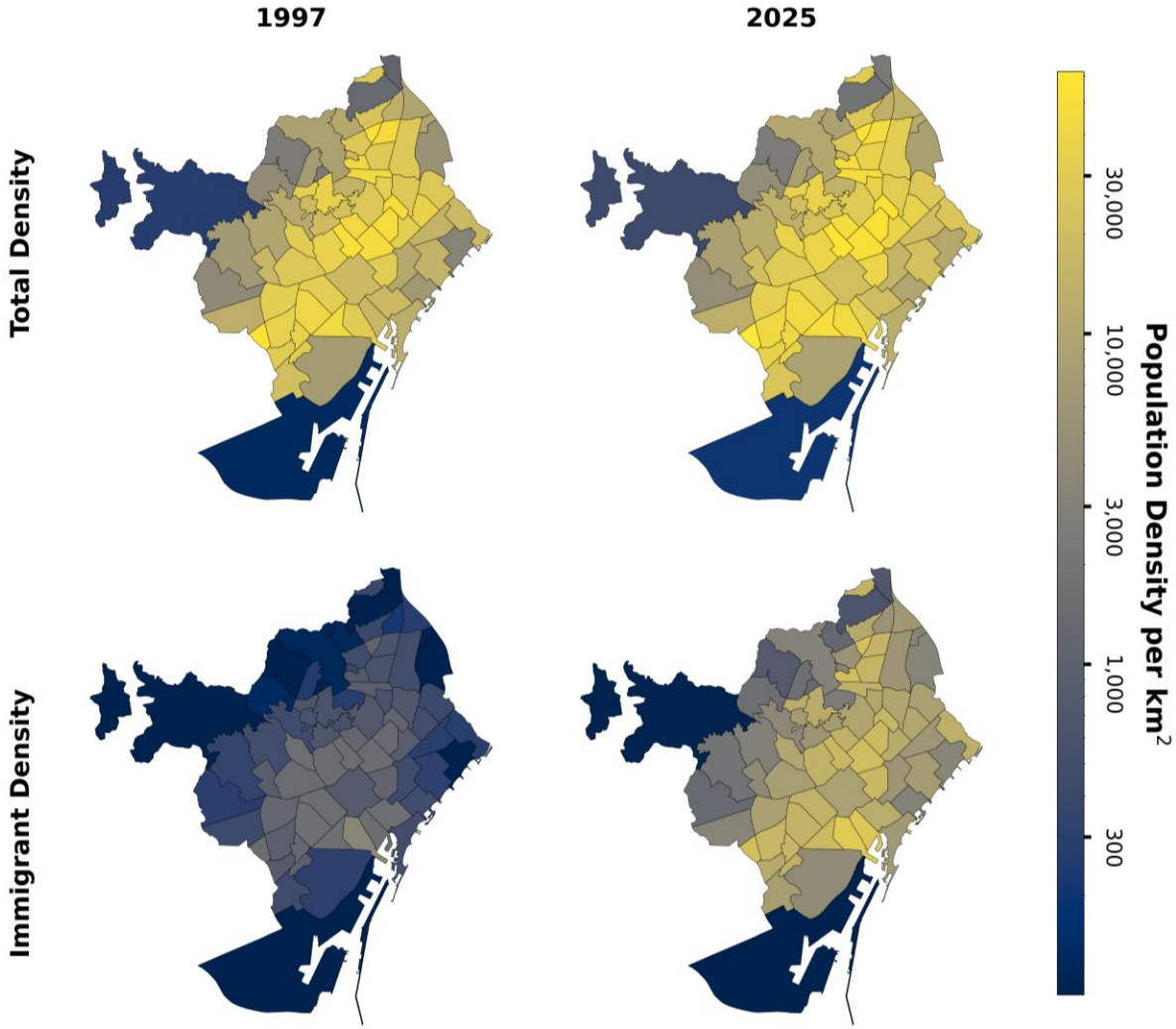
Motivation: Population density evolution



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Immigration distribution and diversity analysis

- **Objective**:

  To study the distribution of different immigrant groups and the diversity across neighborhoods.

- **Questions**:

  1. Where are people coming from?
  2. Which groups are dominant and how are they distributed?
  3. How has the total and immigrant diversity changed from 1997 to 2025?

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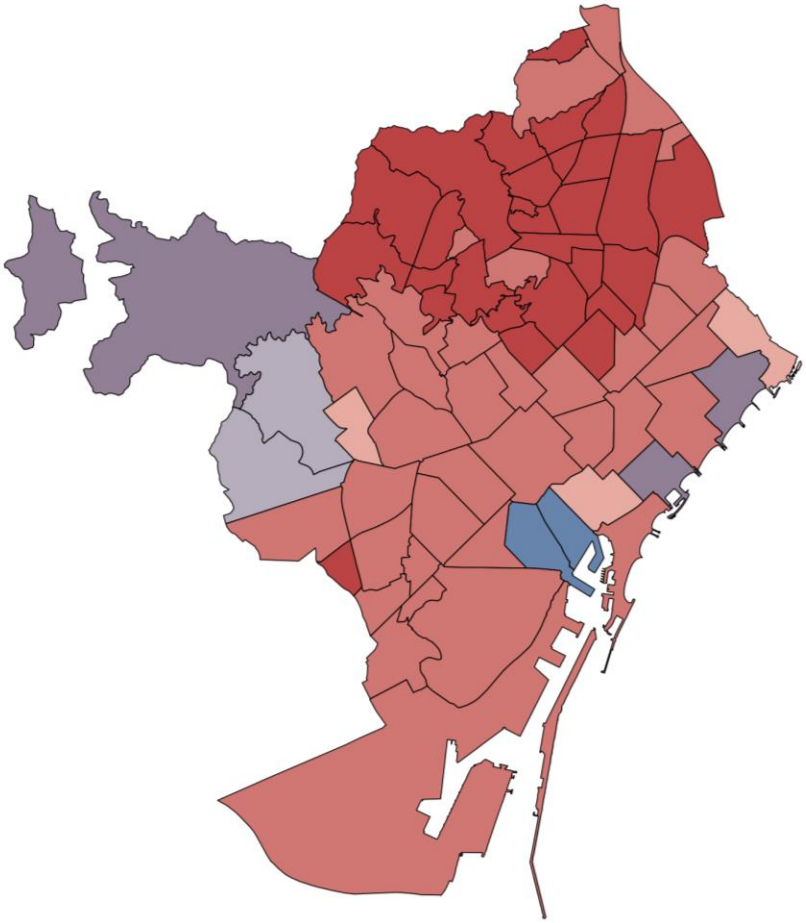
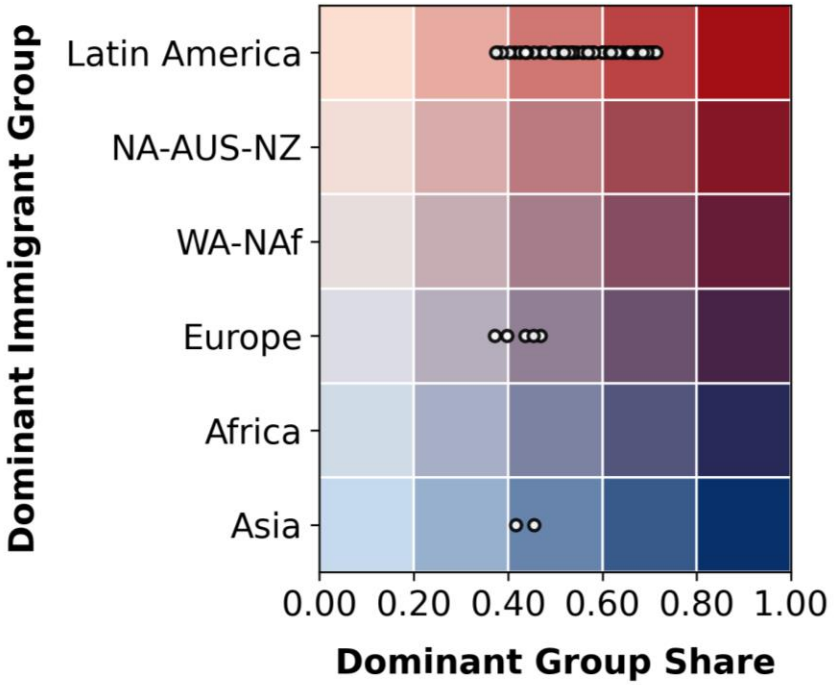
Immigrant group predominance





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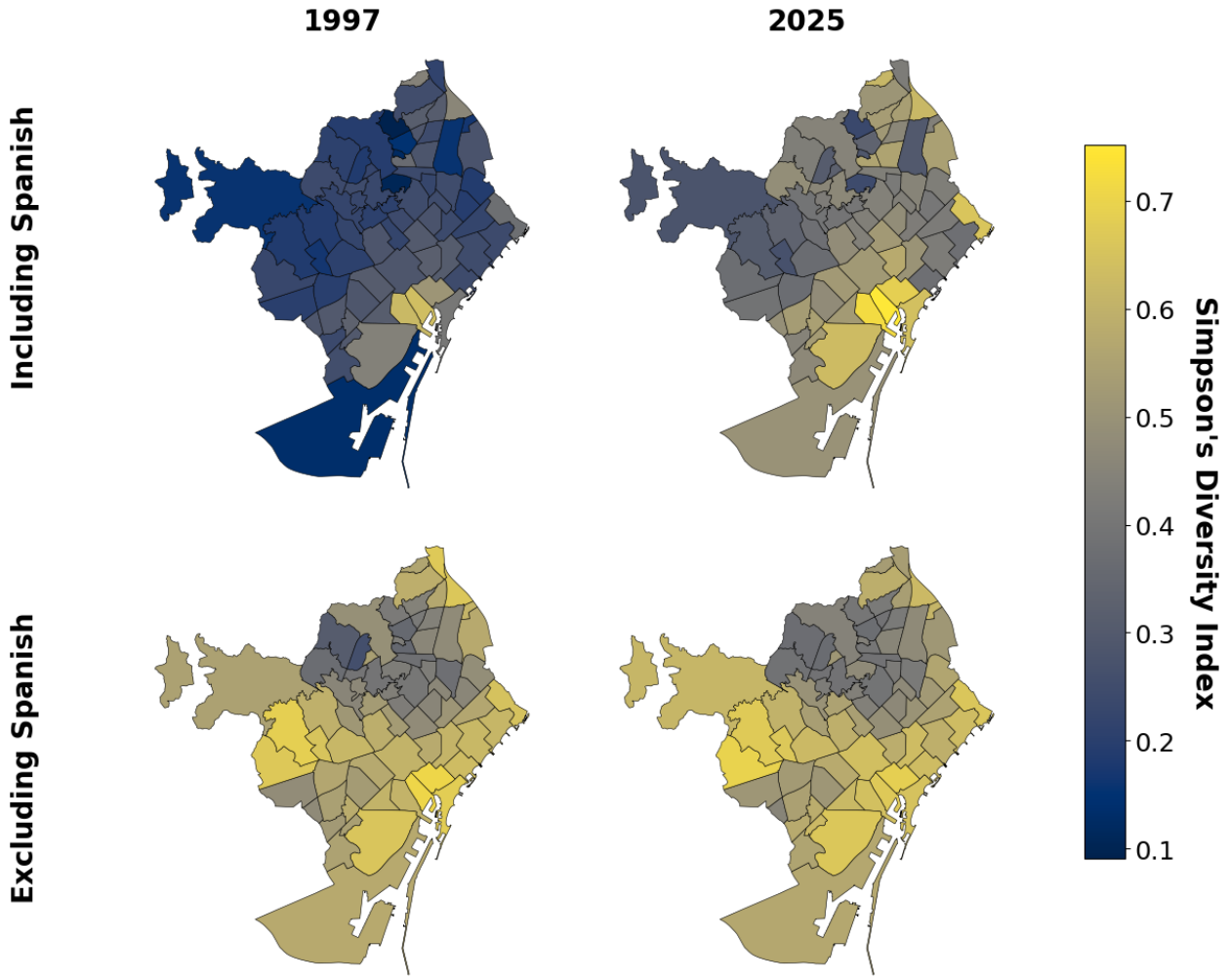
Diversity Map Evolution



$$D = 1 - \sum_{i=1}^{S} \left(\frac{n_i}{N}\right)^2$$

Nationality Group Share

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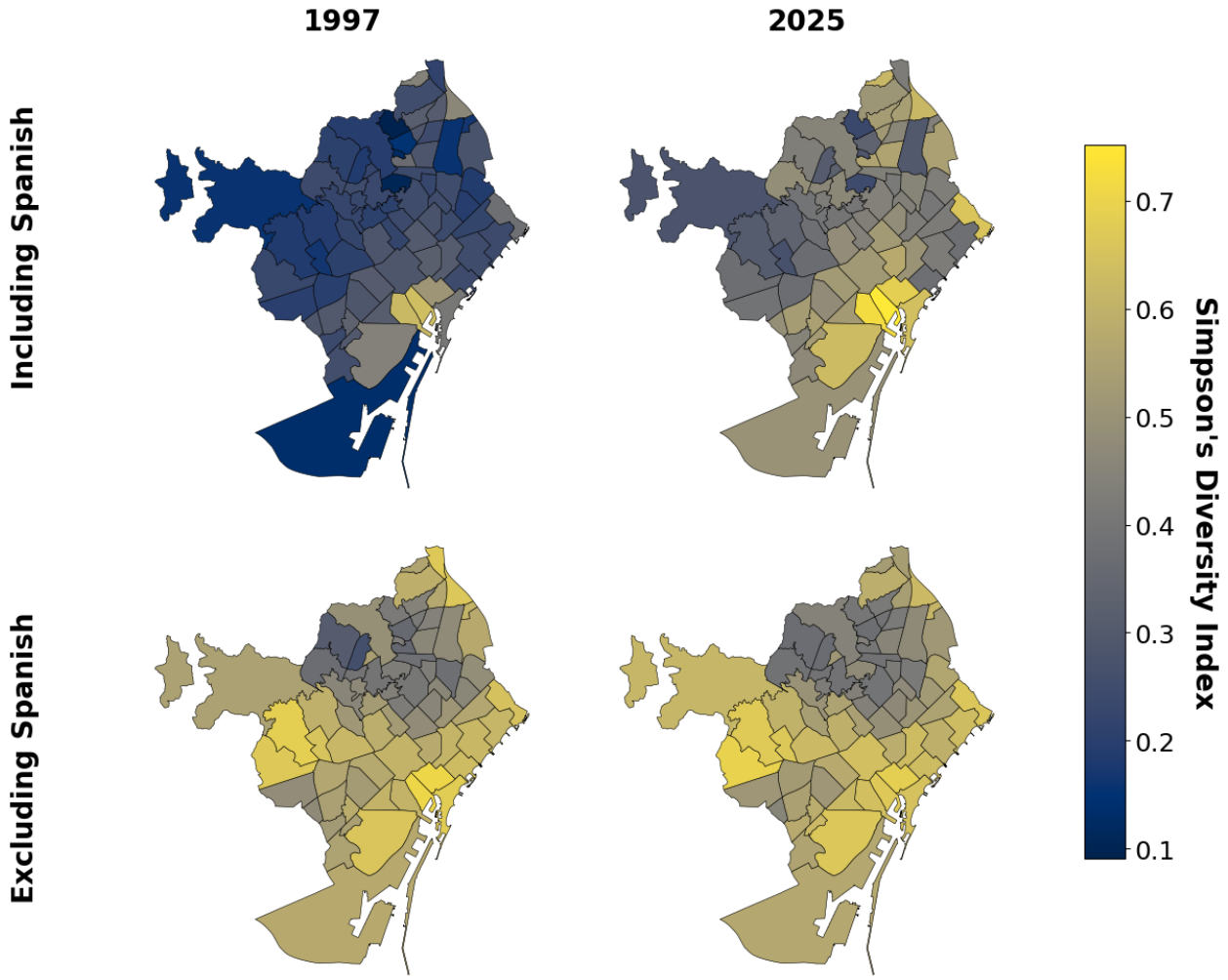
Diversity Map Evolution



Global Diversity
INCREMENT

Immigration Diversity
NOT SIGNIFICANT CHANGES

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Socioeconomic and Educational Impact of Immigration in Barcelona

- **Objective**:

  To investigate the effects of immigration on neighborhood wealth and education.

- **Questions**:

  1. How does the presence of low-educated immigrants relate to the overall educational level of Barcelona's neighborhoods?
  2. Do immigrants with lower education mainly come from low-income countries?
  3. Are low-educated immigrants concentrated in low-income neighborhoods?

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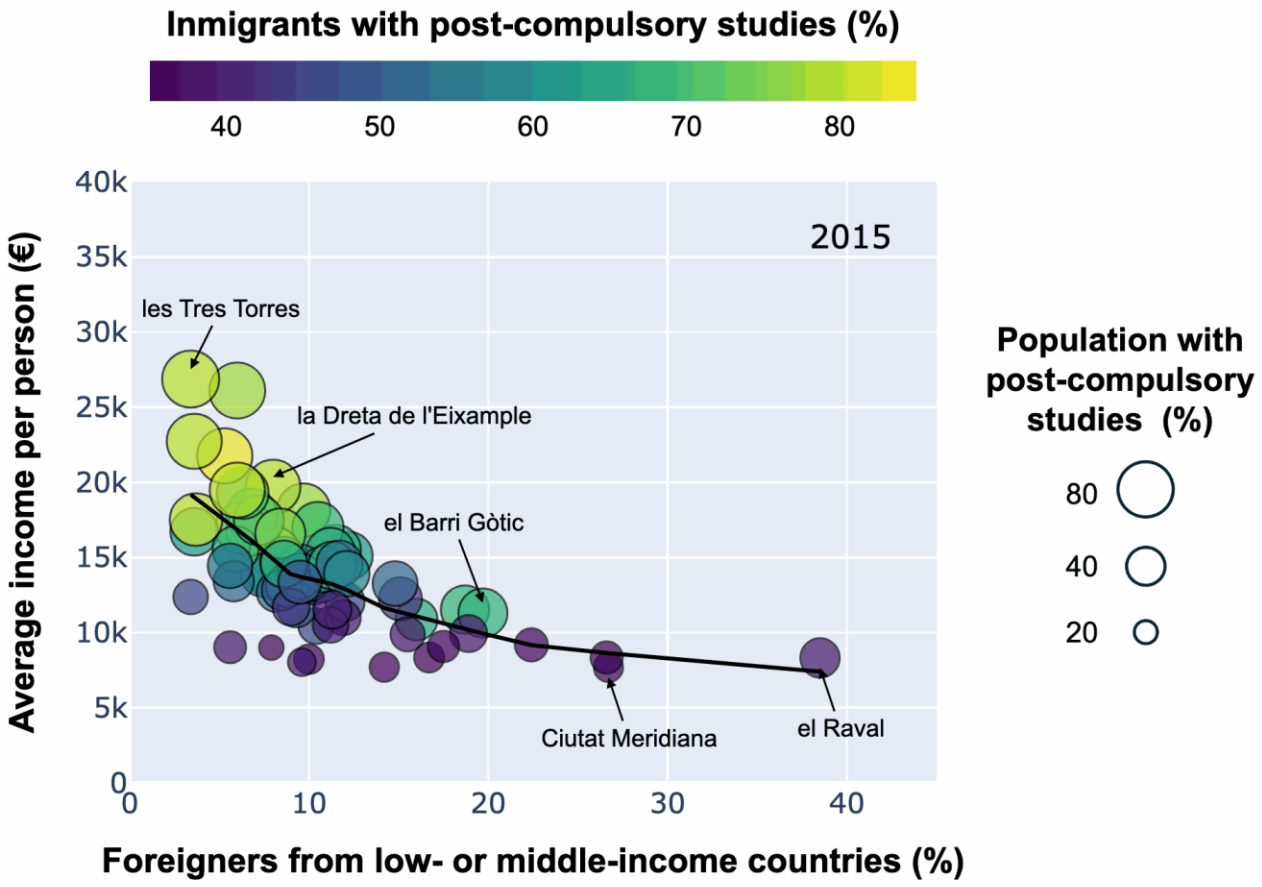
Neighborhood Profiles of Immigration, Income, and Education



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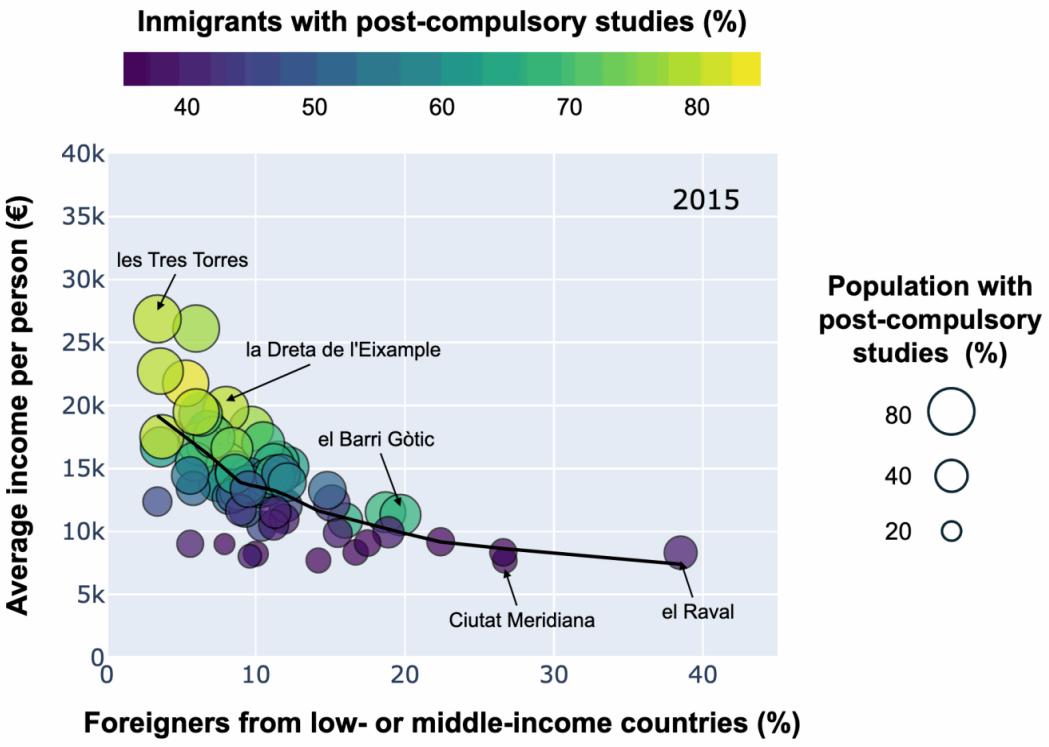
Neighborhood Profiles of Immigration, Income, and Education



- **Clear socioeconomic segregation**: people with high/low incomes and studies live apart.
- **Strong negative correlation** between percentage of inmigrants from poor countries and average income of a neighborhood.
- **Insight:** Some of these low-rent neighborhoods have a remarkable percentage of inmigrants with high studies.
- **Pandemic effect** on 'El Barri Gòtic'.

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Temporal Analysis of Immigration in Barcelona

- **Objective**:

  To investigate the changes of immigration and population with respect to time.

- **Questions**:

  1. Are immigrants concentrating in specific neighborhoods or are they spreading through the city?

  2. Is the growth of immigration affecting the Spain-born population?

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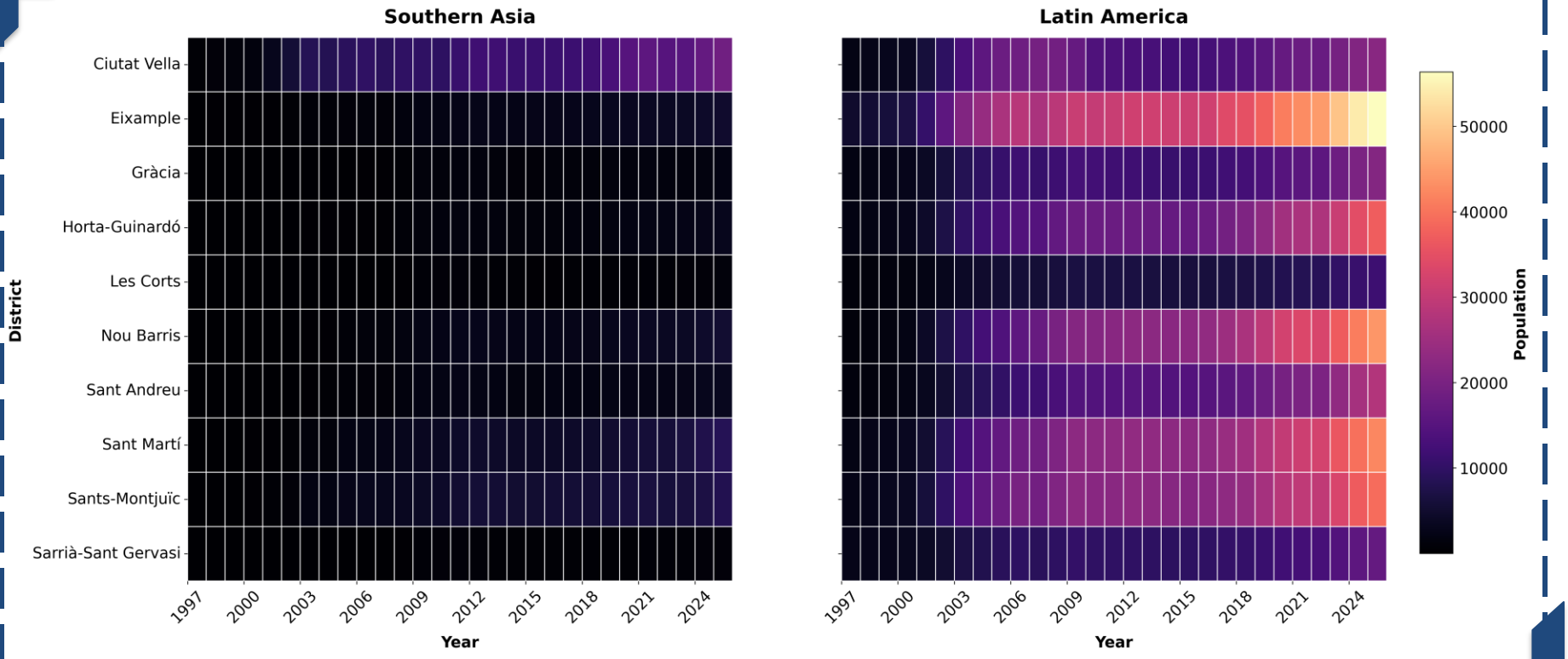
Evolution of Southern Asia and Latin America Population



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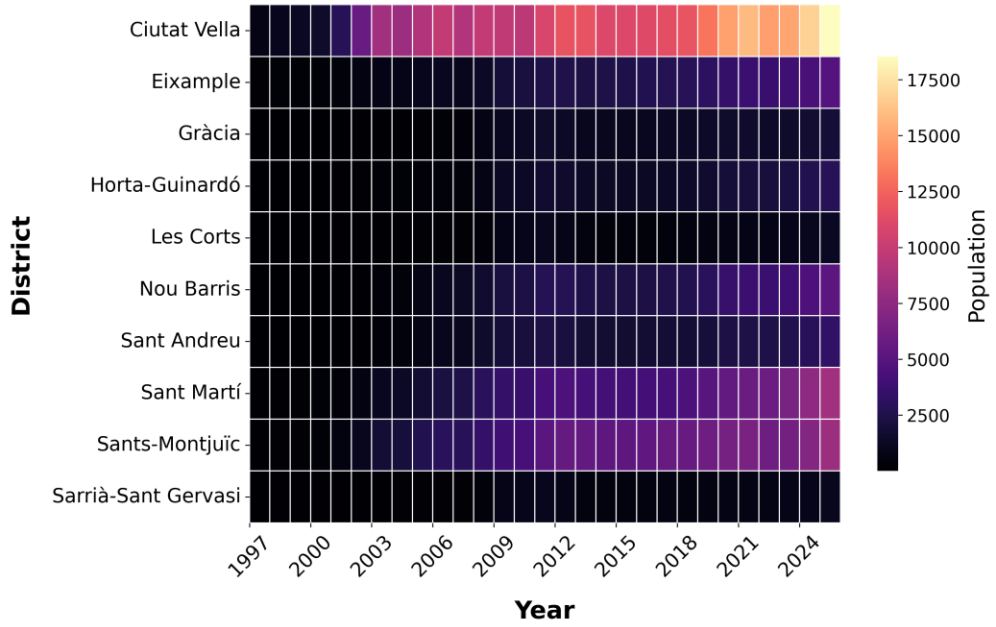
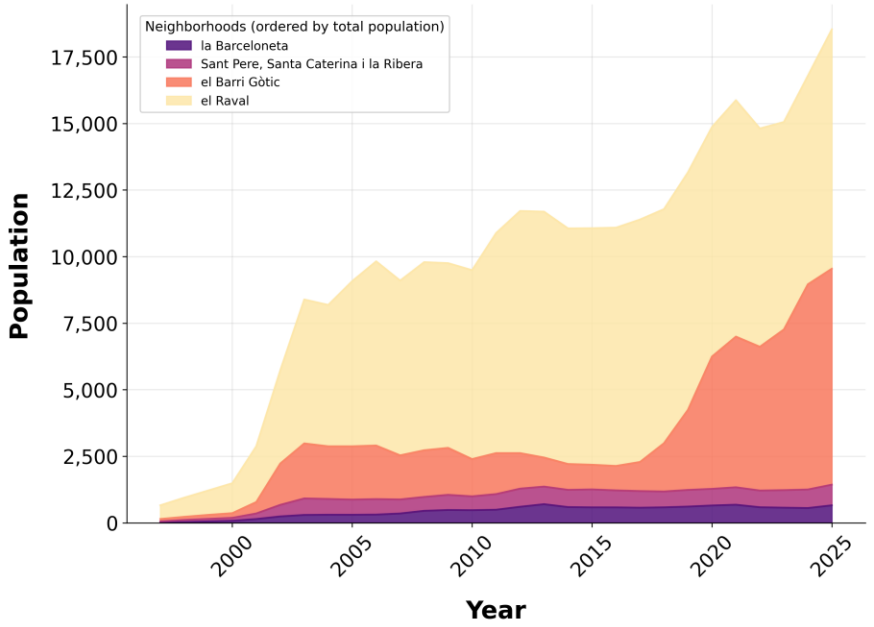
Evolution of Southern Asia Population





- Not only **dominant in Ciutat Vella**, but they have mainly stayed **only** in that district over time.
- Especially in **Raval** and, more recently, in **Barri Gòtic**.
- Explains why Asia dominates in these two neighborhoods precisely.

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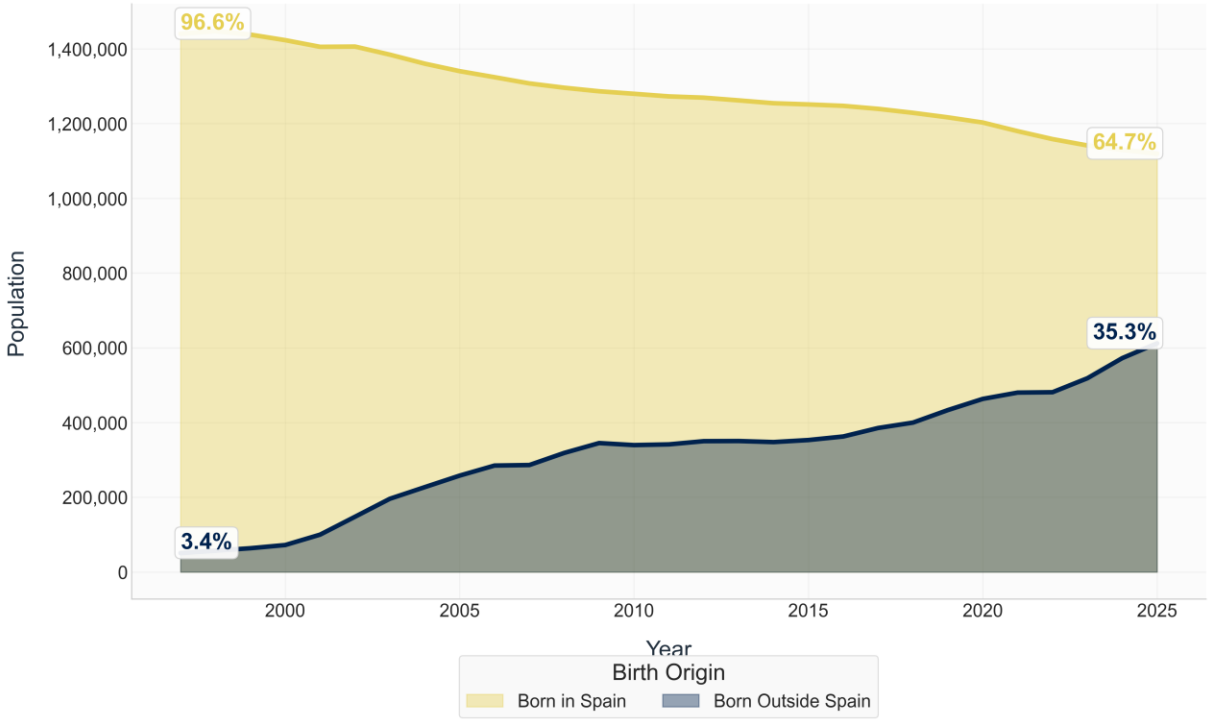
Evolution of the Population in Barcelona

- **Overall growth:** Total population has risen from 1.5M to 1.75M.
- Steady **Decline of Spain-born population** (-200K)**:** 96.6% in 1997 to 64.7% in 2025.
- Rapid **Increase of Foreign-Born Population:** from 3.4% to 35.3%.



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Relationship between Latin American immigration and Spanish emigration

- **Objective**:

  To analyze how the Latin American immigration and the Spanish emigration observed are related.

- **Questions**:

  1. Are both dynamics related or are they independent?
  2. Is the Latin American immigration the cause of the reduction of the Spanish population in the city?
  3. Are there external factors that affect simultaneously both dynamics?

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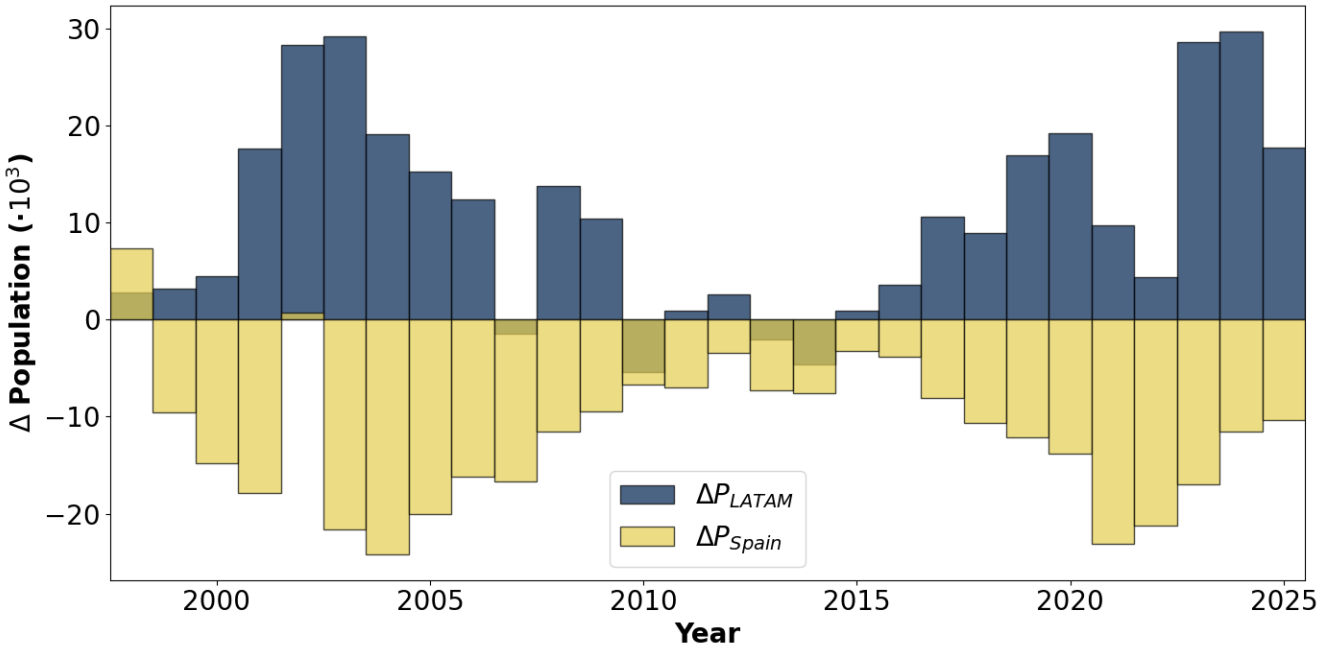
Overall behaviour for the whole city of Barcelona



- **Specular symmetry** in respect to 0.
- **No** time **delay** between the two dynamics.
- **Reduction** of **mobility** related to 2008 **crisis**.

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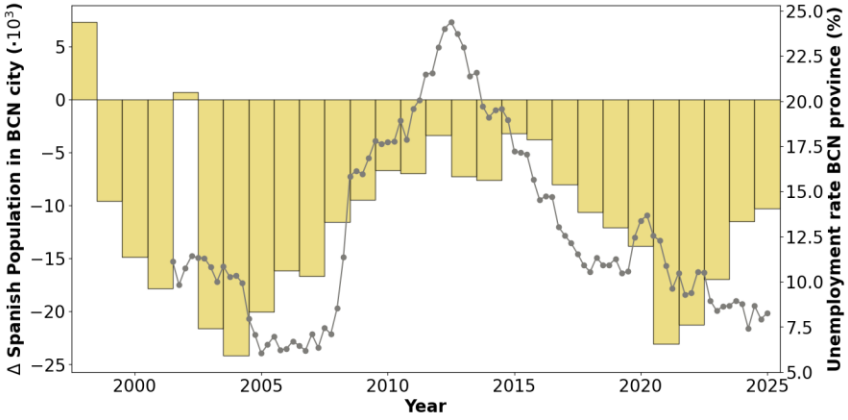
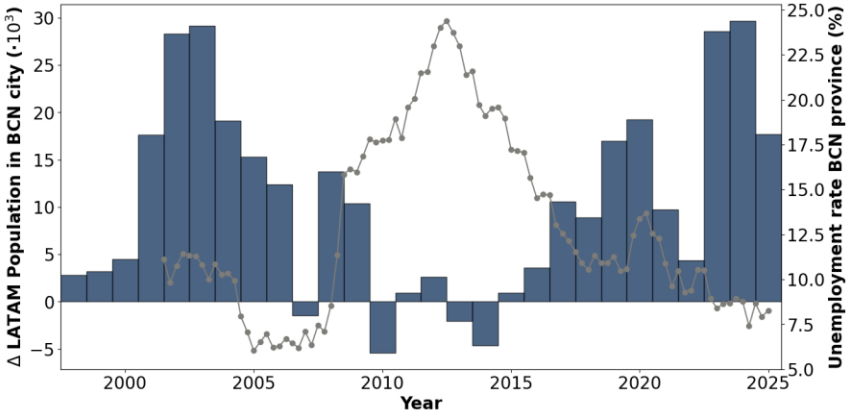
Influence of external factors: Unemployment rate

How does the unemployment rate impact the variations of the Spanish and the Latin American population?



(a) Spanish population variation.



(b) Latin American population variation.

We see that the two population types react in opposite ways to the changes in the unemployment rate.

Conclusions

- Immigration density and global diversity increase with respect to time.
- It is not the same to talk about global diversity and immigration diversity.
- Immigrants from low-income countries remain relegated to low-rent neighborhoods due to the socioeconomic segregation, even if they have a high level of education.
- Southern Asians have been clustering into two neighborhoods in Ciutat Vella. They dominate the immigration in those neighborhoods.
- Latin American immigration and Spanish emigration don't act as cause-effect: they react simultaneously to external effects in opposite ways.

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Author contributions - CRediT Contributor Roles Taxonomy

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Term	Definition
Conceptualization	Ideas; formulation or evolution of overarching research goals and aims
Methodology	Development or design of methodology; creation of models
Software	Programming, software development; designing computer programs; implementation of the computer code and supporting algorithms; testing of existing code components
Validation	Verification, whether as a part of the activity or separate, of the overall replication/ reproducibility of results/experiments and other research outputs
Formal analysis	Application of statistical, mathematical, computational, or other formal techniques to analyze or synthesize study data
Investigation	Conducting a research and investigation process, specifically performing the experiments, or data/evidence collection
Resources	Provision of study materials, reagents, materials, patients, laboratory samples, animals, instrumentation, computing resources, or other analysis tools
Data Curation	Management activities to annotate (produce metadata), scrub data and maintain research data (including software code, where it is necessary for interpreting the data itself) for initial use and later reuse
Writing - Original Draft	Preparation, creation and/or presentation of the published work, specifically writing the initial draft (including substantive translation)
Writing - Review & Editing	Preparation, creation and/or presentation of the published work by those from the original research group, specifically critical review, commentary or revision – including pre-or postpublication stages
Visualization	Preparation, creation and/or presentation of the published work, specifically visualization/ data presentation
Supervision	Oversight and leadership responsibility for the research activity planning and execution, including mentorship external to the core team

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Author contributions

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Conceptualization	X	X	X	X	X
Methodology	X	X	X	X	X
Software	X	X	X	X	X
Validation	X	X	X	X	X
Formal analysis	X	X	X	X	X
Investigation	X	X	X	X	X
Resources	X	X	X	X	X
Data Curation	X	X	X	X	X
Writing - Original Draft	X	X	X	X	X
Writing - Review & Editing	X	X	X	X	X
Visualization	X	X	X	X	X
Supervision	X	X	X	X	X

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Code and Data Availability

All the codes developed for this project can be found in a public **GitHub Repository,** and the datasets used (Raw and Processed) can be found in a Google Drive folder that can be accessed from the **readme.md**

Ethical Aspects

All the data was obtained from the Census of Barcelona, which is anonymous and public. There are **no ethical constraints** with the data.