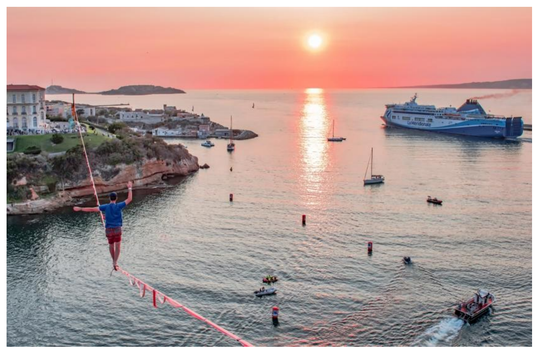


Dynamic approach of spatial segregation

A framework with mobile phone data

Lino Galiana ; Benjamin Sakarovitch ; François Sémécurbe ; Zbigniew Smoreda

Introduction

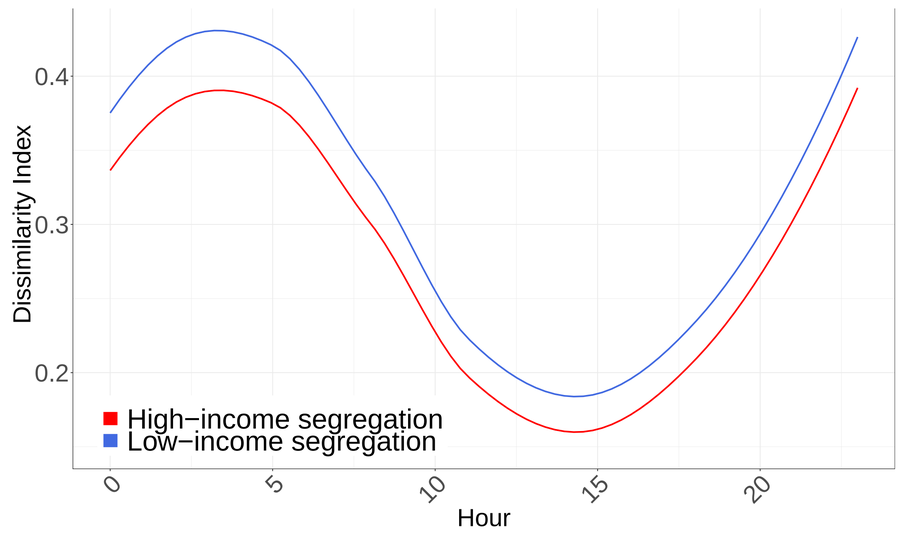
Segregation is usually studied through the glance of residential data. However, people are not bound to spend time at home. From phone data, we estimate that less than 20% of people are at home during daytime. It is thus important to have a more complete vision of segregation by taking into account mobility. Call Details Record (CDR) enable us to follow people movements. They can be used to better understand the dynamics of segregation.

Marseille is a city where both rich and poor neighborhoods coexist side-by-side. Marseille residents are of diverse social and racial origins, yet appear to share a similar identity. Old Port has been the city harbour since the Antiquity and is now the most popular place in Marseille.

The purpose of our project is to better understand the mechanisms underlying aggregated segregation results at city level. Marseille municipality with its fascinating social organization is a perfect case study for this purpose.

Segregation evolution at city level

A dissimilarity index is used to measure segregation at city level through a typical weekday. Results suggest that residential segregation (nighttime segregation) is two times higher than daytime segregation. Phone data help to better grasp segregation dynamics at city level.

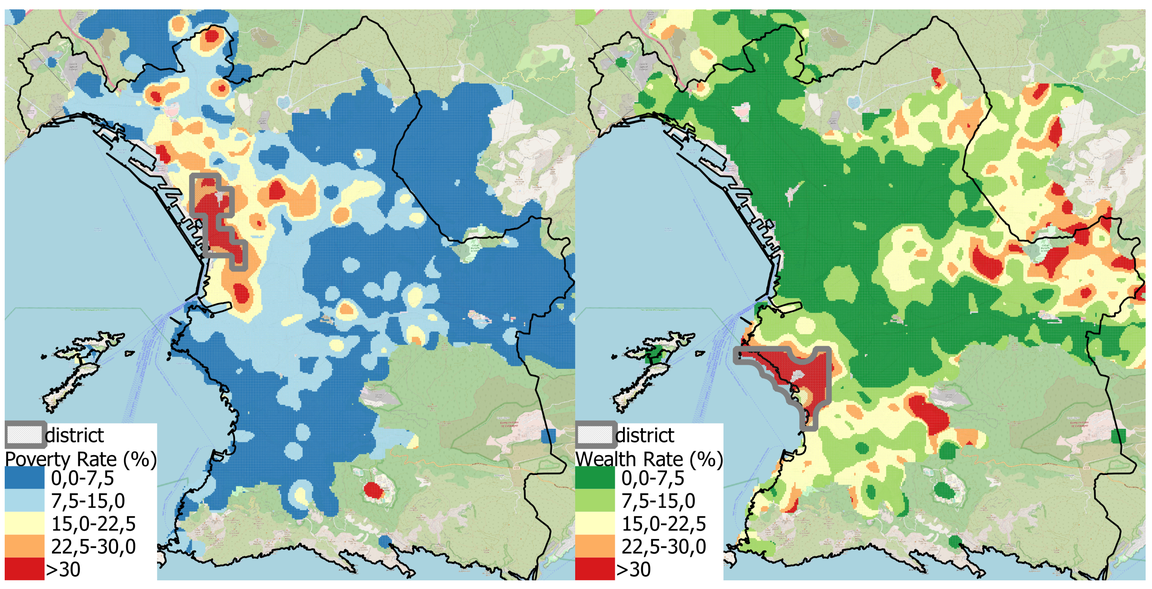


Tax data: a snapshot of segregation

Income distribution is known at a fine granularity level with tax data. We use 2014 exhaustive French tax data to characterize neighborhoods. In Marseille, we identified two districts :

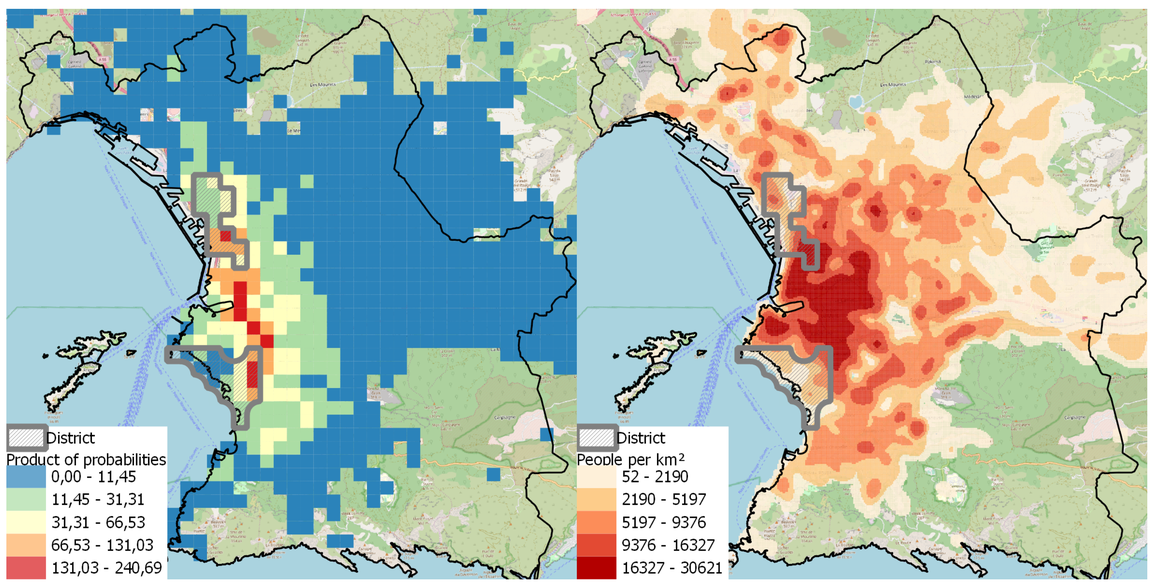
(Left-panel): Low-income concentration

(Right-panel): High-income concentration



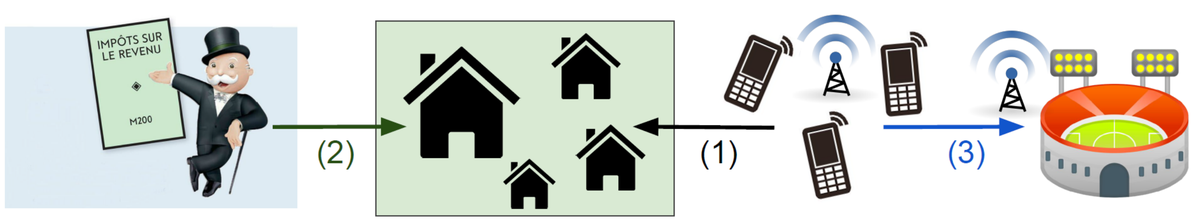
Spatial dimension

Probability of spatial co-presence of low and high income people (left-panel) is stronger in city-center, where population density (right-panel) is more important. We also see that concentration of low or high-income people decreases with distance to residential district



Combining tax and phone data

We bring together 2007 Orange CDR and French exhaustive tax data. To ensure privacy, we use the common spatial dimension to simulate phone users characteristics from their estimated residential area.



We use 500x500m cells by probabilizing presence from antennas level observations in CDR.

(1) Home detection: estimate phone user home cell from CDR

(2) Simulate phone user income from tax data neighborhood composition

(3) Look at population co-presence in hourly time windows

Gravity model

We measure spatial interaction for people that live in both low ($g = 1$) and high-income districts ($g = 2$) with a gravity model:

$$p_i^g = \alpha_g + \beta_g \log(d_i) + \gamma_g \log(\text{pop}_i) + \epsilon_i \quad (1)$$

	Low-income population		High-income population	
	OLS	*Poisson*	*OLS*	*Poisson*
Distance decay (log)	−1.625***	−1.522***	−1.872***	−1.815***
	(0.035)	(0.008)	(0.038)	(0.014)
Population in cell (log)	0.243***	0.365***	0.229***	0.307***
	(0.011)	(0.006)	(0.012)	(0.009)
Observations	4,152	4,152	4,096	4,096
R^2	0.517		0.531	
Note:				*p<0.1; **p<0.05; ***p<0.01

Low-income people spread out more than high-income people

Notations

For $g = 1$ (low-income) and $g = 2$ (high-income) districts, we define:

p_i^g: density of low (resp. high) income in cell c_i from 2 to 6 pm

d_i: distance between cell c_i and low (resp. high) income district g

pop_i: population in cell c_i

Number of 500x500m cells in Marseille: 4258

Conclusion

- Population flows reshape Marseille's composition. CDR and tax data provide a complete picture of segregation evolution along time.
- Interactions between low and high-income populations are partially driven by geography. People meet in the Old Port, in the city center.
- In further research, we would like to use signalling data to separate effects resulting from geography from behavioral and socioeconomic drivers.