A systematic comparison of interaction models for systems of cities

J. Raimbault[1,2,*]

juste.raimbault@polytechnique.edu

[1]Complex Systems Institute, Paris, UPS CNRS 3611 ISC-PIF
[2]UMR CNRS 8504 Géographie-cités

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Urban systems

Source:

Modeling urban growth

An evolutionary urban theory

[Raimbault, 2017] Citation network analysis of core publications in the evolutionary urban theory

Towards a systematic model comparison

Research objective :

Urban systems interaction models

Comparison of three approaches based on the evolutionary urban theory [Pumain, 1997] capturing different dimensions of urban systems:

- The Favaro-Pumain model for the diffusion of innovation [Favaro and Pumain, 2011]
- The Marius model family based on economic exchanges [Cottineau, 2014]
- An interaction model including physical transportation networks [Raimbault, 2018]

Network interaction model

The Favaro-Pumain model

Datasets

Data preprocessing

Remove small cities ([Adam, 2006] for definition of medium-sized)

Stylized facts

Model calibration

Computationally intensive: high-dimensional parameter space and possible spatial setup.

$\rightarrow$ use of grid computing, made smooth with the OpenMOLE software
`https://next.openmole.org/`

OpenMOLE: (i) embed any model as a black box; (ii) transparent access to main High Performance Computing environments; (iii) model exploration and calibration methods.

Model calibration

Results: comparison of models on the different systems

Results: particular cases

Discussion

Implications

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Developments

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$\rightarrow$ More elaborated method to compare models in a "fair" way (correcting for additional parameters, open question for models of simulation).

Conclusion

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$\rightarrow$ Multiple perspectives on urban systems ? **Need for more interdisciplinarity.**

Related works

Raimbault, J. (2018). Indirect evidence of network effects in a system of cities. Environment and Planning B: Urban Analytics and City Science, 2399808318774335. `https://halshs.archives-ouvertes.fr/halshs-01788559`

Raimbault, J. (2018). Modeling the co-evolution of cities and networks. *Forthcoming in Handbook of cities and networks, Rozenblat C., Niel Z., eds.* arXiv:1804.09430.

Raimbault, J. (2018). Caractérisation et modélisation de la co-évolution des réseaux de transport et des territoires (Doctoral dissertation, Université Paris 7 Denis Diderot). `https://halshs.archives-ouvertes.fr/tel-01857741`

Open repository (code, data and results) at
`https://github.com/JusteRaimbault/UrbanGrowth`

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Reserve Slides

References I


Adam, B. (2006).
Medium-sized cities in urban regions.
European Planning Studies, 14(4):547–555.


Cottineau, C. (2014).
L'évolution des villes dans l'espace post-soviétique. Observation et modélisations.
PhD thesis, Université Paris 1 Panthéon-Sorbonne.


Favaro, J.-M. and Pumain, D. (2011).
Gibrat revisited: An urban growth model incorporating spatial interaction and innovation cycles.
Geographical Analysis, 43(3):261–286.


Pumain, D. (1997).
Pour une théorie évolutive des villes.
Espace géographique, 26(2):119–134.

References II


Raimbault, J. (2017).
An applied knowledge framework to study complex systems.
In *Complex Systems Design & Management*, pages 31–45.


Raimbault, J. (2018).
Indirect evidence of network effects in a system of cities.
Environment and Planning B: Urban Analytics and City Science, page 2399808318774335.