

## **Multi-agent systems for modelling the dynamics of interacting cities: the case of Europe 1950-2050**

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Cities do not grow in a stationary way. Urban growth varies as well in time as in space. Three interdependent factors intervene on a city's growth potential: 1- the internal properties of the city; 2- the "historical context" (characteristics of the time period as well as path dependency); 3- the interactions that the city has with the other cities, whose form and intensity depend on its relative position in the urban system. Multi-agent systems are a useful tool for modelling this latter effect. The cities themselves, considered as collective entities, are represented by agents. The purpose of the Eurosim model is to simulate the evolution of the European system of cities during the past 50 years, and to explore its future dynamics during next half century according to different scenarios.

The idea is to combine networking principles with spatial proximity principles. Networking has been modelled in applications in sociology and in economy, but without integrating the spatial dimension. In geography most classical models are based on the driving role of proximity and jointly on the repulsive effect of distance on interactions between individuals and between places. Multi-agent system helps to connect network and proximity principles. The presentation will focus on the construction of the networks and on the effects of their functioning in different contexts of opening or closing of international borders. Each city is connected to a set of cities through associated networks, which could be, depending on its specialization, limited to a single country, a regional sub set, or extended to whole Europe. The networks evolve through time, remaining partly stable and being partly renewed. The dynamics of each city depend on its ability to gain wealth through successful exchanges within its networks. The mechanisms of supply demand and exchanges which determine the interactions between the cities are formalized using the protocol of communication of the multi-agent system.

The outputs of the model are analyzed through a multi-scalar approach in order to get an insight in the macro-structure of the European urban system as well as in the dynamics of individual cities, and also of different geographical sub areas. They show the ability of the model to simulate a classical feature of an urban system, that of the stability of its spatial and hierarchical macro-structures, and, in parallel, shifts at the level of the cities. The model is then a useful tool to get an insight in the effects of different forms of interurban networking on cities' trajectories in the European system of cities in the next 50 years.