How Public Goods can generate regional structure: simulations on the agent-based model.

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Abstract. Regional structure varies substantially across countries. The number of tiers and size of municipalities, counties, lands are quite different. We designed an agent- based model, where it is easy to vary the extent of homogeneity of population and the rules of interactions between agents and evolved jurisdictions. Simulations show big variety of evolved regional structures. It is interesting that most sensitive parameter is a horizon of agent's vision.

Keywords: agent-based model, public goods, regional structure.

1. Introduction

The literature, devoted to the structure of territorial jurisdictions, focused basically on explanation of causes the structure's formation. Public goods play an important role in the explanations. See, for example, Besley T. and Coate Stephen (2003). Much less one can find in the issue of discovering and analyzing mechanisms, which lead to this or that regional format. I use an agent-based model (ABM) to simulate some mechanisms of peoples' behavior in choosing public goods provision. For simplicity I take into account only three types of public goods, which should be assigned to different levels of government.

2. Main rules

The first public good related to primary public services which any citizen should receive in his/her everyday life. It is maintenance of local environment, registration, post service and so on. The costs to provide this public good depend on number of people to be served, like this:

$$cost_1 = k_1 + c_1 * n^2, \quad (1)$$

where k_1 is constant expenses to keep public service functioning, c_1 is a cost to provide one unit of a public service per a person.

The other public good is associated with public schools, hospitals, courts, jails, etc. The cost of provision the public good is dependent on number of people also.

$$cost_2 = k_2 + c_2 * n^{1.5} \quad (2)$$

The third public good is related to the classic definition of a pure public good, given by P. Samuelson, (See Samuelson, P. A. (1954)). It means no dependence on a number of people. So,

$$cost_3 = k_3 \quad (3)$$

The ABM deals with finite number of agents. Each agent has the same wealth equal to *k*. The wealth is needed to an agent to pay taxes. The taxes are going to provide the described public goods. Preferences of agents to have the public goods are lexicographical type. Namely, an agent is ready to pay for the first public good. The rest is paying for the second public good and finally for the third one.

First stage. In the stage the agents move chaotically in a given 2-dimensional space.

1. If two agents meet (by chance) each other then they form a group,
2. The group moves randomly with the speed which is less then individual speed of an agent to the number of times equal to the quantity of the group's members.

The ***second stage*** begins when no one agent is alone, and no more merge between groups. The groups continue to move in slow speed chaotically. The groups merge under given conditions.

The ***third stage*** begins when the process of mergence between regions get to finish.

Fourth stage. Voting by feet according to Charles Tiebout. See, Tiebout Ch. (1956). Randomly chosen agent decides to move or not to move to the neighboring jurisdiction within a region according to the following rule. It moves if the head tax in his/her jurisdiction is greater then in the neighboring one. The process is repeating as many times as it changes the distribution of agents across jurisdictions.

3. Simulations

The basic idea of simulations is to find the parameters and initial conditions, which form regional structure close to an optimal one after running all the stages. And what are barriers, constraints, random causes, which create difficulties to reach the optimal state.

The agent – based model was developed on AnyLogic program (see www.xjtek.com). First experiments include relatively small number of agents, which gave the same features. A typical initial state looks like on the Fig. 1.

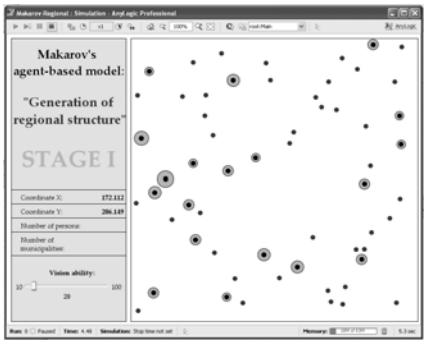

Fig. 1. Stage 1

The described simulation process comes to the stage 2, where all agents chose a jurisdiction of a low level for living. The standard picture looks like this (Fig. 2):

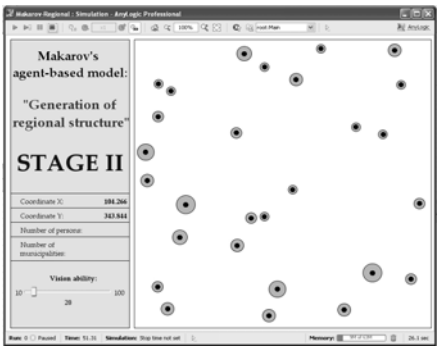

Fig. 2. Stage 2

Here, as it was mentioned above, the size of a ring shows the quantity of population. Further the “municipalities” merge to regions (Next level of government). The picture is changing but not essential. For example it looks like (Fig. 3):

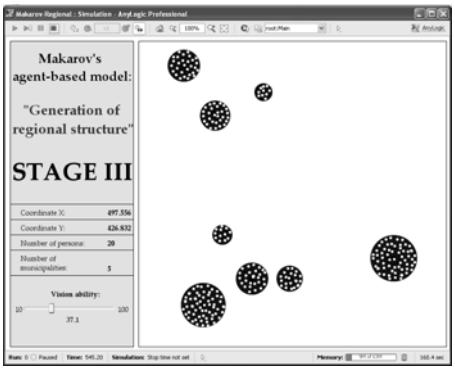

Fig. 3. Stage 3