Multi Agent-Based Simulation of the government's policies on the regional economic development

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1.Introduction

Multi-agent modeling provides a bottom-up approach for the research of regional economic development. It is a good way for analyzing the dynamic factors of regional economic development. However, many of multi-agent models about the regional economic development usually regard the geo-space as a kind of homogeneous space, which is not the exact expression of real geo-space. In order to establish a heterogeneous and dynamic simulation environment, this paper integrates multi-agent modeling with GIS. Based on spatial reacting diffusion theory(Hagerstrand, 1966; Darwent, 1969; Richardson, 1978; Malecki, 1983, 1986; Nelson, 1991), we simulate the different government's policies, such as preferential rate and financial subsidy, to discover how the government's policies influence the development of regional economics.

In this simulation system, it includes three kinds of agents: 1.labor agent; 2.capital organization agent; 3.government agent. The capital organization agent represents the company in the real world. They will produce, sell in the market and, based on the level of market competition and their capital stocks, research and develop the technology of production. Labor agents work for the capital organization agents and consume their products. At the same time, labor agents may move from one region to another region with the consideration of the differences of regional economic

development level, geographic environment, education faculties and so on between the two regions. In order to make the economy of different regions progress better, the government agent will make specific policies for different regions.

We use C++ and GDAL to establish the simulation system, and set different situations to simulate the influences of different policies on the regional economic development. This is the continuation of Zhang (2002), Wang, Dai, Liu (2010)'s works.

2.Hypotheses and modeling frame

In this paper, we regard 362 prefecture-level cities and autonomous regions in China as capital organization agents, and regard capital cities and some economically developed cities (Shenzhen, Dalian, Qingdao, Xiamen) as group leaders. The hypotheses of the market and the capital organization agent are listed as following:

1. Technology levels are depicted as a sequence of technology generations. During one step, a capital organization agent only produces a kind of products;
2. There's no trade barrier among regions, thus the market is totally free. The same generation products have a same price in different regions; products of different generations have different prices;
3. The initial capital stock of the capital organization agent is the capital stock of the city where the agent locates, and the initial labor force is the labor force of that city;
4. The innovation behaviors of the capital agents is affected by the local geographic conditions including the nature conditions, the regional economy conditions, the communal facility, and the human capital conditions, including education levels, R&D capability;

The calculating methods of the natural conditions, the regional economy conditions, the communal facility and the human capital conditions can be accessed from the works of Wang, Xia, Han (2012).

Based on these hypotheses, we make models for the following behaviors: the

economic behavior of a capital organization agent, the R & D behavior of a Capital organization agent, the flow behavior of a labor agent, and the policy of the government agent. The interactions among the agents are depicted in figure 1.

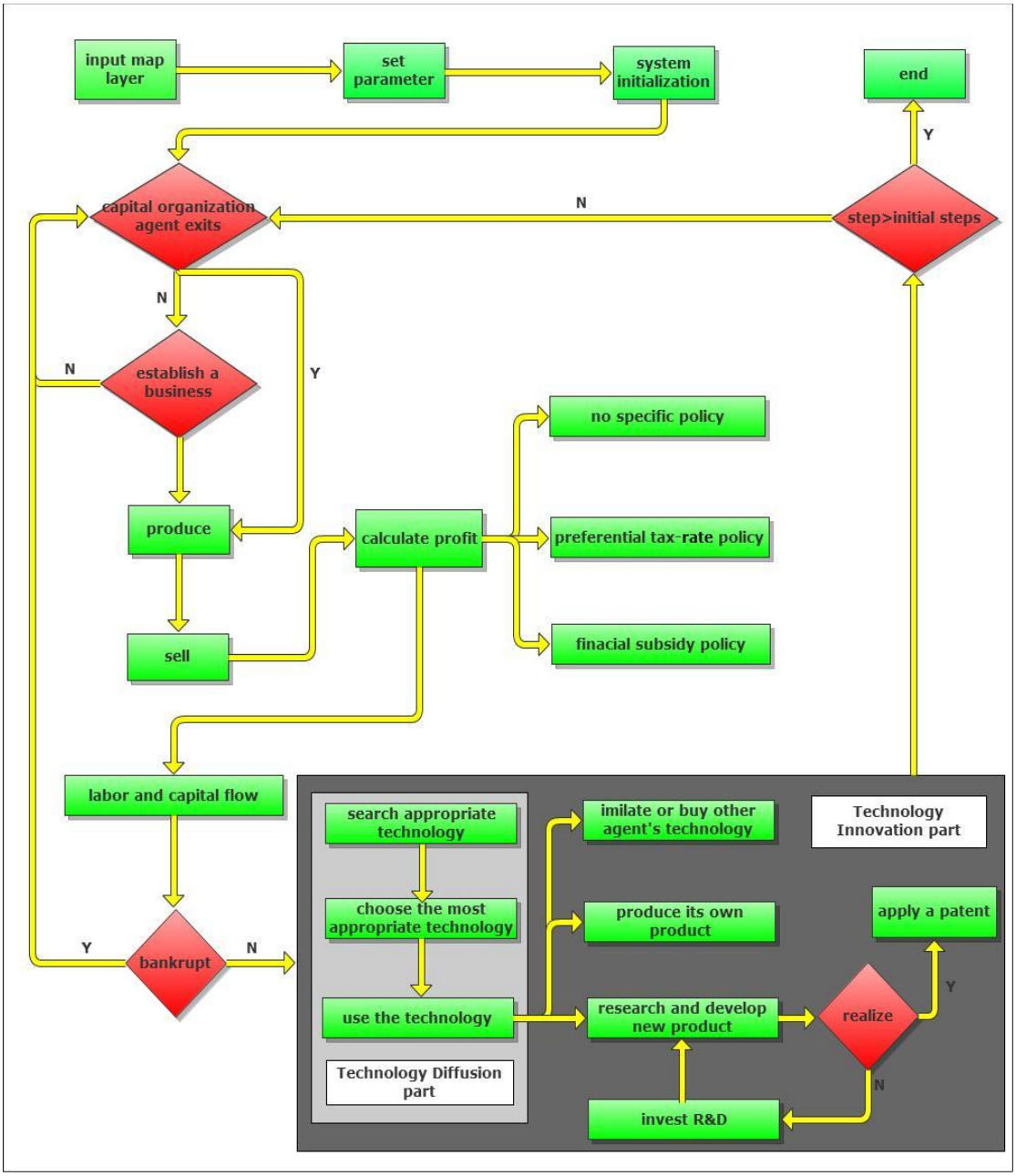

Figure 1:System flow

3.Experiments

Due to the different government policies, we set three situations for experiments:1. no specific policy; 2. preferential tax-rate; 3. financial subsidy policy. Then make a 500-step simulation and get the following data. Figure 2 4 6 represent the average technology development of the middle, southwest, north, southwest, east, northeast, north of China and Jingjin. Figure 3 5 7 represent the development of maximum and minimum technology in the middle, southwest, north, southwest, east, northeast, north of China and Jingjin.

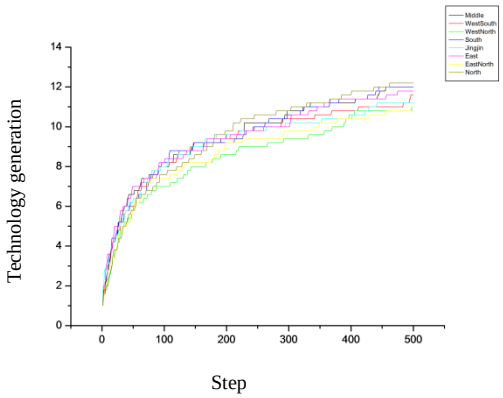

Figure 2: Situation 1

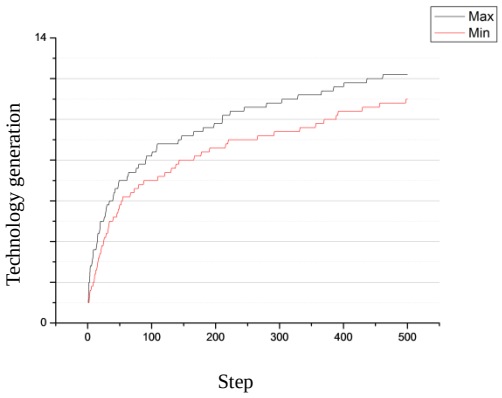

Figure 3: Situation 1

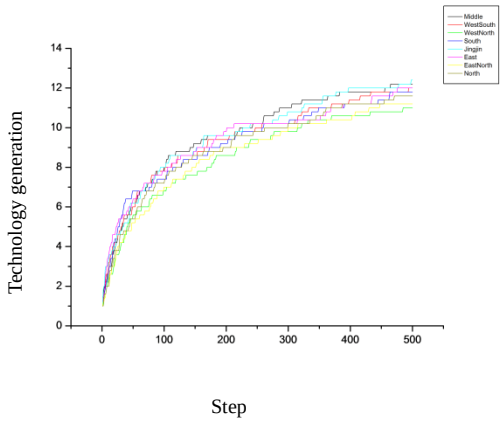

Figure 4: Situation 2

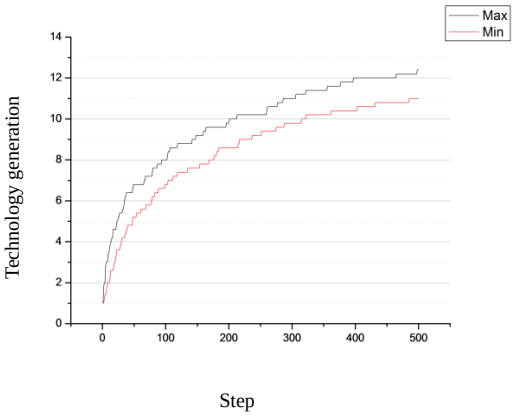

Figure 5: Situation 2

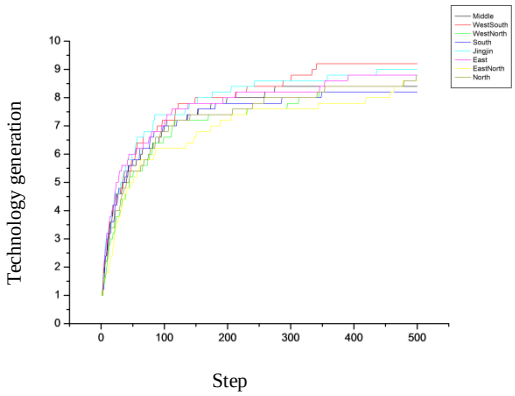

Figure 6: Situation 3

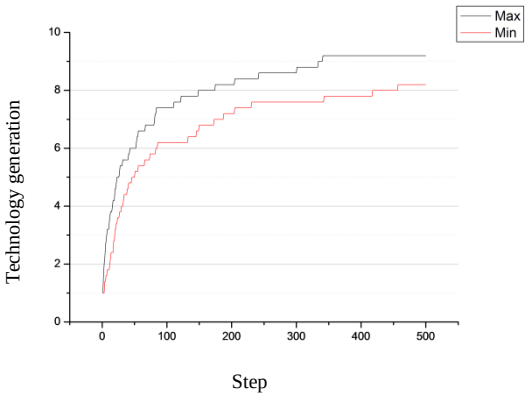

Figure 7: Situation 3

4.Conclusion

The result suggests that preferential tax-rate is good for technology development, but not good for reducing the gap of regional technology level; financial subsidy is good for reducing the gap of regional technology level and the movement of labor population, but not good for technology development. Although some uncertainties remain in this paper, this paper provides a useful method to simulate the regional economic development and helps us to understand and explore the dynamic causes of regional economic development.

5.Acknowledgements

This research is supported by The Key Project of National Natural Science Fund, # 70933002, “Research on regional coordinated management mode based on the mechanism of land differentiation”. The data is provided by Gaoxing Gu, Haibin Xia, Xiaoye Dai.

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