Learning of Social Behaviors in a Society of Economic Agents

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Abstract

This paper describes the research of studying social learning leading to the cooperative behaviors of economic agents We obtain the mutual enforcement mechanism among autonomous economic agents so that each economic agent gradually learns to behave both as an autonomous economic agent of a selfish-interest and a social competence..

Formulations of Competitive and Cooperative Behaviors

A decentralized society with the principle of a market will be defined as one with more than one autonomous economic agent. in which different economic agents are responsible for different decisions and make those decisions on the basis of different information, and in which the outcome to the society depends jointly on the market principle. The economic agents may have different preferences, conflicting objectives or they may have the same goal in a decentralized society . Each economic agent in a decentralized society faces the problem of optimizing its own object. Each agent's objective is expressed as its utility function in the form of

$$U_i(x_1,\ldots,x_i,\ldots,x_n) = U_i\{x_i, x(i)\} \qquad (1)$$

The socially rational (or socially optimal) behavior is defined as the set of the decisions optimizing the summation of the utility functions of all agents given as

$$S(x_1,\ldots,x_i,\ldots,x_n) = \sum_{i=1}^{n} U_i\{x_1,\ldots,x_i,\ldots,x_n\} \qquad (2)$$

It is obvious that the conditions of the individual rationality and that of social rationality are different. Our question such that how will the evolution of cooperation proceed and how the emergence of cooperation can take place in a decentralized society can be described as the problem of the compatibility between the individual rationality and the social rationality. We now consider the following modified individual utility function

$$\bar{U}_i\{x_i, x(i)\} = U_i\{x_i, x(i)\} - \lambda_i(x(i)) \qquad (3)$$

we have

$$\lambda_i(x(i)) = -\sum_{j\neq i}^{n} (\partial^2 U_j / \partial x_j \partial x_i) x_j \qquad (4)$$

We term $\lambda_i(x(i))$ as the social shadow price of the i-th economic agent. The shadow price indicates the influence of the decision of i-th economic agent to the utility functions of the other agents in a society.

The Model of Social Learning

The process of building up cooperative intentions may be called mutual or social learning. Social learning is in this sense is the outcome of a web of activity emerged from the mutual interactions among economic agents. Economic gents are quite apparently both selfish agents and social actors, and economic agents need to present and reason about the knowledge, action, and plans of the other economic agents in a society. Social learning would require the exchange of actions of the other economic agents. We define the social learning as the adjustment process of each agents' individually rational behavior.

$$\begin{aligned} &M_i\{x_i, x(i)\} > \lambda_i\{x(i)\} \quad \textit{then} \quad x_i := x_i + \delta x_i \\ &M_i\{x_i, x(i)\} < \lambda_i\{x(i)\} \quad \textit{then} \quad x_i := x_i - \delta x_i \end{aligned} \qquad (5)$$

The above social learnng process may converge to the optimal social behaviors.

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