

Comparative Analysis on the Application of Mathematical Model in Evolutionary Economics

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Keywords: Evolutionary Economics, Mathematical Model, Organism Structure

Abstract: Some mathematical models are often used in the economic field. The application of mathematical models in the field of evolutionary economy has great significance for the formation of rational logical thinking patterns. Based on the three dimensions of the evolutionary model, this paper analyzes the current evolutionary model, compares the models, studies the relationship between the models, and finally discusses the choice of mathematical models in evolutionary economics.

1. Introduction

Evolutionary, also known as evolution is a common phenomenon in the natural and social fields. Evolution and co-evolution were first studied in biology, and later this method of research was increasingly applied to non-biological research, and the concept was translated into evolution and co-evolution. From the general sense, the evolution of things mainly from one state to another state or from one thing to another thing in the dynamic process of change, especially the biological from a lower level, a relatively simple state to Higher-level, more complex state changes. In Evolutionary Economics, evolution involves not only the process of dynamic change but also the meaning of complex, uncertain and unbalanced. It refers to the discipline that studies the evolution of economic phenomena and economic behavior by means of evolutionary thinking. As well as the system innovation as the core research object, draws lessons from the biological evolution thought and the natural science domain research result, with dynamic, the evolution idea analyzes and comprehends the economic system the movement and the development. Advocating the replacement of the equilibrium model of neoclassical economics with the evolutionary model with the concept of historical time, and incorporating the factors such as system, culture, and habits neglected by mainstream economics into the analysis of economics, which provides a theoretical basis for the development of economics. As new framework, a new paradigm interpretation is from the neoclassical world of economics. Evolutionary economics is considered to be one of the mainstream economic theories. Since the 1980s, evolutionary economics has become a new paradigm of economic research based on modern philosophy and natural science. It has become the most important and significant progress in the social sciences in the last twenty years.

2. Consensus and Dimensions of Evolutionary Economics

In recent years, Evolutionary economics is more popular. And gradually become a fashionable academic label. But it is an extremely complex theoretical system. So far, it has not formed a mature and unified research paradigm. The theory of evolutionary economics labels at least includes the Old Institutionalism and the New Schumpeterianism, General Darwinism. Evolutionary Institutional Economics, Austrian School, Innovation Economics Evolutionary economic geography and subject-based computational theory. These theories have great differences in ontology and methodology. But in a variety of research methods vary in theory. Summed up the four basic consensus of evolutionary economics, one that the world changed. And this change is not just quantitative or parametric. It also deals with technologies such as Schumpeter's emphasis. Organization and economic structure and this qualitative change is precisely the mainstream equilibrium theory is difficult to explain. Second, recognition of an important feature of economic

change is the emergence of novelty. It is an important theme of modern evolutionary economics to promote the emergence of diversity through innovation. Third, we emphasize on the complexity of socio-economic system characteristics. This complexity is mainly related to the heterogeneity between the various non-linear or even chaotic interaction or chaos. Thereby, it limits the predictability, also contributed to the novelty and the emergence of various emerging features of the possibility. Fourth, as Darwin emphasized, various complex phenomena are emerging. Not artificially created or created by God. Evolutionary economics inherited Smith and Hayek's insight into spontaneous order.

In the above four points consensus. The first concerns the subject of evolutionary economics. It shows that evolutionary economics must study the evolution of social economy or change phenomenon. This is different from the mainstream economics of socio-economic equilibrium phenomenon) the second point involves the evolution of power. It points out that the main motivation for evolution is innovation. Innovation drives the generation or addition of diversity. The third and fourth points are all related to theoretical research methods, it is pointed out that because of the complexity of evolution, participants are bounded rational and heterogeneous, and must be interactive from the participants to describe the evolution of economic phenomena, which is The generation and evolution of complex systems, which may be accompanied by the emergence, selection and diffusion of novelty.

Complete evolution analysis and local evolution analysis. On the basis of the above-mentioned consensus, the complete evolution analysis not only recognizes the importance of innovation, but also emphasizes the endogenous process of innovation, and further emphasizes that the process of interaction among participants must be accompanied by novelty, process of selection and diffusion, Also covers the interaction of these three processes. The selection process and the diffusion process can be difficult to distinguish clearly. Therefore, a complete evolutionary analysis must be innovation. It is a more rigorous and thorough evolutionary analysis. When this evolutionary analysis is extended from a single-level evolution to a multi-level co-evolution, it can explain the evolution of more complex systems. If this evolutionary analysis is used as the basic analytical method of evolutionary economics, it is a criterion to determine whether a theory belongs to evolutionary economics. Many of the labeled evolutionary labeling models may not belong to true evolutionary economics. The theory that focuses on the selection process or the diffusion process with an emphasis on the exogenization of innovation is not, in essence, the camp of evolutionary economics. Thus, many evolutionary models are likely to be excluded, for example, the evolutionary game model and some learning models. But it is undeniable that many evolutionary models that do not take into account the process of innovation generation can provide insight into the evolution of socioeconomic systems, especially for novel selection processes or diffusion processes, and thus for such models. It can not easily be excluded from the camp of evolutionary economics. We need a more lenient definition of evolution analysis. This is referred to as local evolution analysis, a local evolution analysis. While acknowledging the importance of innovation, simplifying the analysis does not endogenous the process of innovation. It focuses on the process of selection or diffusion that accompanies the participant's interaction. Local evolutionary analysis usually regards innovation as exogenously given random shocks. Or even without regard to the factors of innovation, just focus on innovation after the choice or proliferation of novelty.

3. Evolutionary Model

The population dynamics model describes the dynamics of population density or population dynamics. But also can be transformed into the dynamic change process of the strategy frequency, and the type space and the strategy space of the species in the model are exogenous given invariable. The model does not involve the generation of new species or new strategies. That is, it does not involve the generation of innovation, therefore. This evolutionary model is clearly a local evolutionary analysis in the socioeconomic system. Species density can be considered as a participant or an actor, for example. Individuals, enterprises and other organizations, such as a certain phenotypic characteristics, such as asset size, output and so on. And the R & D decision, etc.,

the evolution model can describe the process of selection of the participants in the process of interaction, you can change the policy frequency of the rules as a kind of Policy learning rules or evolution rules. Therefore, the rules of evolution between participants are homogeneous. Such models belong to the model of population evolution, in addition. Participants in such models are less conscious. Usually using unconscious learning rules, the change in strategy is mainly affected by natural selection, for example, the role of market competition.

An important reason why many evolutionary economists refuse to evolve game theory is that evolutionary game theory does not consider innovation in essence. It only involves the selection process or diffusion process of strategy. The so-called strategy mutation is carried out in the established policy space, That is, from a known strategy to a random probability to another known strategy, this process does not produce any new strategy 3. But as we mentioned earlier, as long as we relax the definition of evolutionary analysis, this analysis, which considers only the selection process or the replication process without considering the innovation process, can be termed local evolutionary analysis. It should also belong to the mathematical model of evolutionary economics. Compared with the above reasons, another reason to reject evolutionary game theory is more fully, that is, evolutionary game theory is mainly to solve the classical game theory multiple equilibrium problem, which can resist evolutionary stability strategy of isolated mutation strategy) The Stochastic Stabilization Equilibrium and other equilibrium concepts are used to further refine the classical game theory Nash equilibrium. If evolutionary game theory is regarded as refining the equilibrium of classical game theory by developing new solution concepts, evolutionary game theory belongs to equilibrium analysis. Therefore, evolutionary game theory may belong to evolutionary analysis, it may belong to equilibrium analysis, which depends on the researchers use it when the analysis perspective. If evolutionary game theory is used to study the dynamic change process of strategy frequency, it belongs to local evolution analysis and can become the modeling tool of evolutionary economics, and the evolution process may appear sTable equilibrium. Such as the generation of the system, may not be a strategy of equilibrium. If evolutionary game theory is used to refine Nash equilibrium, evolutionary game theory is not evolutionary analysis, but equilibrium analysis.

Because of ignoring the problem of innovation generation, the game form of evolutionary game theory is given externally, and the evolutionary environment is given externally. It is a typical local evolution analysis. Evolutionary game participants have the same evolutionary rules. For example, the replicator dynamically replicates the mutant dynamics, so the evolutionary game model also belongs to the population evolution model. In the classic replicator dynamic model, the participants of evolutionary game theory have very limited rationality, and their behavior is usually unconscious or weakly conscious.

If the wrong fitness function is designed. It is difficult to get convergence solution, the third is the initialization function, which refers to how to randomly select the initial population from the population, is to set the initial value of the process, and the fourth is to choose from the population selected from the selection criteria Of the individual to reproduce according to different selection criteria exist for various types of selection functions such as. The ratio of fitness to fitness is proportional to the fitness of the population, and the selection of the tournament, that is, by randomly grouping, to select the population with the highest fitness. When the population size does not change, there is a need for an alternative mechanism in which some individuals in the population are replaced by others in the replication process according to different criteria. There are different types of substitution mechanism, the fourth is reorganization it refers to the process of information exchange between individuals, which is the process of generating new solutions through reorganization of the new operator solution, for example, the offspring from the selected solution between the possible solutions there are different types of recombination operators. For example, the number of recombinant geometric recombination plane recombination and fuzzy reorganization, the fifth is a mutation, refers to the role of the mutation operator, a solution to another solution mutation in the entire population, the proportion of mutations are usually low, Otherwise, the optimal solution search process becomes a random walk according to the different

forms of expression. Mutation operators also have different forms. For example, when a solution is represented as a binary string of bits, the mutation can be described as a substitution of the opposite sign for a symbol at a particular location. If the solution is a more complex binary Structure, the mutation operator will be relatively more complex.

4. Conclusion

Multi-agent model is a more general and open modeling method. It can cover many types of evolution models by concrete model construction and by computer simulation, it can examine how the complex macroscopic phenomena are formed and evolved. Heterogeneous micro-subject interaction process is to achieve. This is also an important reason why multi-agent models are increasingly applied to various evolutionary. However, due to the lack of a unified theoretical analysis of logic, there are many limitations in multi-agent model, the construction of specific models is also more casual and it is more to provide the idea of evolutionary modeling or perspective, far from the establishment of evolutionary analysis of the benchmark model. Therefore, in the process of exploration of the evolutionary economics benchmark model, unified evolutionary analysis logic can be established in the framework of the multi-agent model in the future, which makes it possible to establish an evolutionary model that can be shared by most evolutionary analysis. The benchmark model of evolutionary economics must be able to describe the basic driving force of the two driving evolution of selection and innovation and can be extended from the evolution of a single population analysis to multi-population evolution analysis.

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