Agent-based simulation of finanical markets: a new mainstream in econophysics

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Abstract

Classical models in finance and economics are analytical models. These models make assumptions regarding the economy, the financial market and the behavior of individuals and derive their results by mathematical analysis. Many of the assumptions done are necessary for analytical tractability but are often unrealstic.

We discuss the use of agent-based computer simulation for building theoretical models in economics and finance. This research methodology has been already developed in the physical sciences as a tool for the study of complex systems with many interacting microscopic elements whch do not yield to analytical treatment. The main idea of the agent-based computer simulation methodology is to study complex systems by representing each of the microscopic elements individually on a computer and simulating the behaviour of the entire system, keeping track of all of the elements and simulating the behaviour and their interactions in each time period. The main advantage is that, unlike analytical models, it does not force one to make simplifying assumptions for the sake of simplicity. Thus virtually any sistem with heterogeneous elements and complicated interactions can be investigated.

The validation process of an agent-based simulation depends on the similarity beetwen the output of the computer model and the the data collected from the real world. Generally, the researcher also look for emergent phenomena, that is some patters arising at the macro-level that are not self-evident from consideration of the capabilities of the individual agents.

In the last decade, an increasing number of agent-based computer-simulated artificial financial markets have been proposed [1]. A special mention is devoted to the pioneering work done at the Santa Fe Institute [2]. We developed an artificial stock market: the Genoa Artificial Stock Market (GASM), a computational laboratory conceived to offer a simulated experimental facility with realistic trading features [3,4]. The GASM simulator has been conceived as an evolving system, able to be continuously modified and updated. It has been implemented using object-oriented technology and extreme programming as development process. An essential feature of the GASM is The finiteness of agents' financial resources. It is a realistic feature of real markets. It poses significant constraints on possible trading strategies if different populations of agents are to coexist indefinitely. We claim that, in the long

run, is the interplay between the flow of cash in and out financial markets and the creation/destruction of stocks that determine the price trends of the market.

The other important structural element of the GASM is the agents' wealth distribution. It is well known empirically that wealth distribution tends to follow a Pareto inverse power law [5]. It has been demonstrated theoretically that auto-catalytic processes naturally lead to inverse power law distribution of wealth [6]. The wealth of agents in the GASM is indeed governed by an auto catalytic process which explains the emergence and conservation of inverse power law distributions.

References

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