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Study of market model describing the contrary behaviors of informed and uninformed agents: Being minority and being majority

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HIGHLIGHTS

- We identified the general classification: vested interests and non-vested interests in competition systems.
- We use contrary behaviors: to be minority or majority to model the different characters between the informed and uninformed investors.
- We find the periodic fluctuation competition inter- and intra-groups in the dynamic progress.

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ABSTRACT

In this paper we analyze the contrary behaviors of the informed investors and uniformed investors, and then construct a competition model with two groups of agents, namely agents who intend to stay in minority and those who intend to stay in majority. We find two kinds of competitions, inter- and intra-groups. The model shows periodic fluctuation feature. The average distribution of strategies illustrates a prominent central peak which is relevant to the peak-fat-tail character of price change distribution in stock markets. Furthermore, in the modified model the tolerance time parameter makes the agents diversified. Finally, we compare the strategies distribution with the price change distribution in real stock market, and we conclude that contrary behavior rules and tolerance time parameter are indeed valid in the description of market model.

1. Introduction

Nature is a huge complex system with many kinds of competitions and collaborations. Financial markets are typical systems with competition, which play a very important role in modern economics. They have attracted many researchers from various fields to study the mechanism including the stylized facts emerging from collective behavior underlying the

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Table 1
Rules of being winner or loser.

	Un-agents	In-agents
Winner	In the majority side of in-agents	In the minority side of un-agents
Loser	In the minority side of in-agents	In the majority side of un-agents

markets, such as peak-fat-tail non-normal behavior, long range correlation, and volatility clustering [1–3]. Unlike in many physical systems, we have no direct way to gain insights into the nature of microscopic interactions in financial markets, thus our understanding on their underlying mechanism remains rather limited and ambiguous. As a result, approaches originally developed to understand complex physical systems are adopted to analyze financial markets.

Among the existing approaches, agent-based approach has become one of the key tools, resembling many-body interactions in physics [4–7]. Compared to conventional quantitative analysis, these approaches aim at revealing a qualitative understanding on the mechanism underlying financial market. The minority game is such an example for describing the competition systems [8,9]. While many interesting phenomena are observed in minority game, it failed to provide a correct picture of the financial markets in other perspective. To make the models more like real financial markets, various influence can be considered, such as relation network, information transmission, communication, and learning progress etc. [10–12]. Various types of agents are also modeled, such as fundamentalists, chartists and noisy traders, momentum traders and reverse momentum traders [13–15]. While the models become more realistic, they usually end up being too complex for thorough understanding and analytical treatment. It is thus necessary to build an appropriate simple model to study the inherent character of the financial markets.

Specifically, when an individual becomes a member of a group, her behavior may change to a behavior consistent with the group, and is contrary to her original personal intention [16]. Similarly, in financial markets, groups and individuals may have contrary aims. For example, in European and America stock markets, the investors are classified into informed investors and uninformed investors [15]. The informed investors exploit the insider information to make profits, they buy or sell, and wish other investors to choose the opposite action (i.e. respectively sell or buy). In other words, the informed investors want to take an action where minority of the uninformed investors take. On the contrary, the uninformed investors want to follow the action of the informed investors, and the uninformed investors want to take an action where majority of the informed investors take. Similarly, in the Chinese stock market, investors are classified into bankers and retailers, whose behaviors are similar to those of the informed investors and the uninformed investors. In different systems, the classification of the two opposite group is not the same, such as vested class and non-vested class, ruling class and ruled class, bakers and retailers, etc.

In this paper, we will introduce a model where the agents (such as the informed and uninformed investors) perform according to the former mentioned behaviors. These contrary behaviors of the two groups of agents lead to a hierarchy of inter- and intra-community competition. Interesting phenomenon such as a periodic fluctuation of strategies among agents is observed in the model. The distribution of strategies also shows a prominent central peak relevant to the characteristic distribution of price change in stock markets. The model hence deepens our understanding of competition among investors in stock markets.

2. Model

Specifically, we introduce N agents to simulate a competition system. The stock market is a typical financial competition system, and we will construct the model based on the stock market concept. The investors are classified into informed investors and un-informed investors in European market. Then the model consists of N_i informed agents (in-agents) and N_u uninformed agents (un-agents). We set both N_i and N_u to be odd numbers to avoid a tie of on deciding the minority or majority side, such that $N_i + N_u = N$ is an even number. In the market, it is bad thing for the informed investors that if many uninformed investors see through what the informed investor are tend to do(or choose). Correspondingly, in the model, in-agents and un-agents stand for two kinds of agents with different behaviors: in-agents try to hide their action from the un-agents, and we model this behavior by rewarding in-agents if they take the same action as minority of the un-agents take, otherwise they lose. On the contrary, un-agents try to follow the action of the in-agents, and we model this behavior by rewarding un-agents if they take the majority action of the in-agents take, and otherwise they lose [17,18]. We denote that the proportions of un-agents and in-agents among the whole population by $\rho_u = N_u/N$ and $\rho_i = N_i/N$, respectively.

For all agents to make up their choices, each of them is characterized by a strategy(gene value) g, which is a random number in [0, 1] [19–21]. In each time step, all agents choose '0'(such as 'buy') with a probability g, and '1' (such as 'sell') with a probability $1 - g$. After all the agents have made a choice, one can obtain the number of un-agents who choose the '0' or the '1' actions, as well as the number of in-agents who choose the '0' or the '1' actions. An un-agent is rewarded with one point $r = 1$ if she chooses the majority choice of the in-agents, and otherwise loses one point $r = -1$ [22–24]. On the other hand, an in-agent is rewarded with one point $r = 1$ if she chooses the minority choice of the un-agents and otherwise she loses one point $r = -1$. A summary is found in Table 1. At the end of each round, if an agent's score falls below a critical value $d = -4$, its strategy is replaced [19], by a newly drawn strategy in [0, 1], and the score is reset to zero.

Although the score counts the number of times an investor wins or loses, it does not directly represent profit. We do not introduce a measurement of profit to our model since it would lead us to define many other rules and variables, such as funds,