

## Towards Complexity Adjusted Efficient Market Hypothesis

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Last decades witnessed a rapid development of evolutionary models in different areas of economics. The standard textbooks in evolutionary game theory are [1-2]. In evolutionary models players change their action gradually in response to their realized payoff and the behavior of the others. One advantage of these models is their ability to account explicitly for the interaction between the players. This ability can be of the outmost importance for the modelling of the financial markets. Indeed, [3] reported the following distribution of answers to the question: What first draw your attention to the company? Friend or relative (13%); worked for company (21%); broker (33%); spin-off of successful company (2%); someone involved with a company (3%); IPO-publicity (2%); periodicals-newspapers (6%); customer of a company (2%); stock was inherited or a gift (2%); performance of a similar company (0%); other (18%). Note that 19% of customers were attracted simply by word of mouth communication, while highly relevant factors (4) and (10) counted only for 2%. This means that social learning can be potentially important for the stock price behavior.

The above discussion suggests that an evolutionary model of social learning could be highly relevant for the description of the financial markets. In such a model individuals are not fully rational. Instead, they adjust their strategies gradually in the light of the realized payoffs and social information. Such a behavior will result in predictable price trends in financial markets. The last idea, however, faces a major objection. It suffice to have a small fraction of rational arbitrageurs (just one if there are no borrowing constraints) to eliminate the trend. Though the models with noise trades were used in finance [4], in these models irrational traders do not adjust their beliefs; hence there is no systematic price dynamics. I would like to argue that systematic price dynamics can be consistent with existence of arbitrageurs as long as this dynamics is sufficiently complex and the arbitrageurs are boundedly rational. Indeed, the traditional idea than any predictable price dynamics will be eliminated by arbitrageurs implicitly relies upon the investor's ability to detect any trend, no matter how complex. In practise, however, the investors use some standard econometric package to analyze the financial data, and any trend that is not detectable by the package can

persist for a long time without been detected and eliminated. The more complex a trend the more likely it will go undetected. Therefore, I will formulate a complexity adjusted efficient market hypothesis: any trend that is not eliminated for a sufficiently long period of time should have some fixed minimal level of complexity.

Therefore improving the financial software in general, and the detection techniques for the patterns in chaotic dynamic systems, in particular, can be rewarding. It can shed some light on the usefulness of technical analysis, which was documented, for example, in [5-7]. There exists strong evidence for nonlinear stock price dynamics (see, for example, [8]). Some evidence for low-dimensional chaos is also reported in [9]. Providing microfoundations for the complexity adjusted efficient markets hypothesis and chaotic behavior of prices is both theoretically challenging and of great practical importance.

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