The invisible hand and the rational agent are behind bubbles and crashes

Serge Galam*

CEVIPOF, Centre de recherches politiques, Sciences Po and CNRS 98, rue de l'Université, 75007 Paris, France

ARTICLE INFO

ABSTRACT

The 2000 dot-com crash and the 2008 subprime crisis have fueled the belief that the two classical paradigms of economics, the invisible hand and the rational agent, are not well appropriate to describe market dynamics and should be abandoned at the benefit of alternative new theoretical concepts. At odd with such a view, using a simple model of choice dynamics from sociophysics, the invisible hand and the rational agent paradigms are given a new legitimacy. Indeed, it is sufficient to introduce the holding of a few intermediate mini market aggregations by agents sharing their own private information, to recenter the invisible hand and the rational agent at the heart of market self regulation. An elasticity is discovered in the market efficiency mechanism due to the existence of an agent collective anticipation. This elasticity is shown to create spontaneous bubbles, which are rationally founded. At the same time, crashes occur at once when the limit of elasticity is reached. Plasticity can also be achieved through a combination of a crash with a sudden shift of the collective anticipation. Although the findings disclose a path to put an end to the bubble-crash phenomena, it is argued to be rationally not feasible. Bubbles and crashes are thus an intrinsic internal part of classical economics.

1. The invisible hand and the rational agent

In the last decades several crises in the financial world with subsequent heavy damages in the labor market and economy growth have put at stake the two classical paradigms of economics which are the invisible hand, the rational agent and their drive to associated equilibrium states [1]. Indeed, the substantial turmoil created by the 2000 dot-com crash and 2008 subprime crisis have shaken quite many economists and financial analysts leading them to believe that those classical two paradigms should be abandoned at the benefit of alternative new theoretical concepts. At the heart of the questioning is the fundamental incapacity of neoclassical theory to embody the formation of bubbles and their following crashes, stating that

equilibrium is always prevailing, thanks to the existence of precisely the invisible hand and the rational agent. Before the recent 2000 and 2008 crashes a good deal of works had been performed to study bubbles formation and their bursts by physicists [2–7] as well by economists [8–16].

At odd with such innovative prevailing views, we present a model inspired from sociophysics [17–21], which produces bubbles as equilibrium states of a given market and crashes as the emergence of a new equilibrium. The model is rooted in neoclassical economy combined with the Galam model of opinion dynamics as the underline mechanisms leading to the step by step aggregation of individual choices toward the final collective equilibrium state. Accordingly, the invisible hand and the rational agent paradigms are shown to be indeed responsible in the making of market bubbles as well as in the associated crashes. Indeed the existence of an elasticity, together with a limit of the possible amplitude, in the market efficiency is un-

covered and driven by the making of local market efficiencies implemented by agent rationality.

To substantiate above surprising claim, it is enough to enlarge the perimeter of agent rationality to incorporate as self-interest the confrontation of one's own actual decision to those of some other peer agents on the same market or asset restoring the concept of market self regulation.

To avoid ambiguity about the paper focus, it is worth to stress that I am not advocating in favor of of the rational agent, the invisible hand and efficient market hypothesizes. I am showing that bubbles and crashes appear naturally within a theoretical frame powered by the combination of rational agents and the market invisible hand. Not more but not less.

The main hypothesizes and the underlying model of individual choice aggregation are presented in next section. The model is solved in third section while the fourth section introduces the existence of an elasticity in the efficiency of the market with respect to reaching the fundamental values providing a theoretical basis to Keynes statement about the possible departure of stock prices from their fundamental values [22,23]. The instrumental role of anticipation is emphasized in the process of bottom up aggregation of agent's individual choices. The limit of elasticity is evaluated in section fifth and last section contains some concluding remarks.

2. Model and main hypothesizes

At the heart of market behavior in addition to the economical reality stands human behavior and to study human behavior stands sociophysics. What is sociophysics? It is the use of concepts and techniques from Statistical Physics to describe some social and political behaviors. It does not aim at an exact description of the reality but at singling out some basic mechanics which may be rather counter intuitive. Initiated more than 33 years ago [24,25], it has started to become a main stream of research only in the last decade [17–21].

Sociophysics deals with a rather large spectrum of problems including group decision making, coalition forming, terrorism, hierarchical voting, networks, linguistic, religion spreading, evolution, and finance should be included. One main focus is opinion dynamics, where models looks for generic mechanisms, which can be at work for a series of different public problems as Social, Political, Ecological, Societal, Economical, Behavioral, Innovation, Smoking, Rumors, Marketing, and Financial [26–30].

The background of the model is a bare frame of bimodal opinion dynamics in which agents are defined as rational. A rational agent has an opinion and advocates for it. However, although a rational agent has a well grounded opinion, it is aware that the information it has access to is limited and may be misleading. Accordingly, it is susceptible to shift to the other opinion, if given more arguments for it. As it wants to make the best choice to optimize its profit, a rational agent does confront its current choice to the choices of other agents chosen from its social network. We consider that given a group of agents checking their mutual choices, each one advocating for its own choice, they end up following the local majority of initial choices.

Therefore, a rational agent updates its opinion by following the majority opinion from a group of selected agents including its own opinion. The update process produces a local polarization. Since we have no access to the details of each agent discussions, we assume the groups are formed randomly.

However, within above framework, given an even size group, considering one agent one vote, a local tie may occur, with as many arguments in favor of buying a given asset as in favor of selling it. At this stage we make the additional hypothesis that the group of agents at a tie decides to lift the associated doubt aligning along the leading anticipation trend among them. If two agents are selling and two are buying, within a shared positive anticipation, the two sellers shift to two buyers and vice-versa in case of a shared negative anticipation. The introduction of possible tie, which in turn creates a local collective doubt, which is eventually turned to a common choice along the leading shared anticipation, makes the model counter-intuitive and non-trivial. Putting the process of local updates in equation leads to a threshold dynamics with a tipping point, which may be located anywhere between zero and one, depending on the group size distribution and the average market anticipation. Above the tipping point the update process increases the value of the relevant quantity and below the tipping point, the quantity is decreased. Our two main hypothesizes can be formulated as follows:

(i) The fundamental value of an asset or a stock is not accessible at once directly. All the information required to access to it is scattered into pieces of information among all the agents, which thus have all individual incomplete data. Accordingly, the total aggregation of all those pieces of information, which is revealed indirectly in the market value at the opening, contains the position of the current price fixing with respect to the fundamental value. Based on their respective private information some agents reach the right choice of selling or buying while others reach the wrong decision of buying or selling.

If the proportion of initial buyers b_0 (with a proportion $(1 - b_0)$ of initial sellers) is larger than 50%, the current price is underpriced. As a net result of the excess of buyers over the sellers the price should go up validating the market efficiency. In contrast, if the proportion of initial buyers b_0 (with a proportion $(1 - b_0)$ of initial sellers) is smaller than 50%, the current price is overpriced. As a net result of the deficit of buyers over the sellers the price should go down validating again the market efficiency.

(ii) Once every agent came out with its initial choice, to buy or to sell, it wants to get a kind of extra-check by creating a mini market aggregating a few other agent choices. In case of a local majority in favor of buying or selling, the agent adopt the majority choice. However in case of a local tie with the same number of buyers and sellers, the agent adopt the choice in adequacy with the current leading anticipation of the market about the given stock or asset. Every agent repeats this local market updating number of times before the market closure.