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Editorial

"No Worries": Trends in Econophysics

This topical issue includes eleven contributions selected from cutting-edge research on the frontiers of research in Econophysics. This issue spans a great variety of themes, including:

- scaling and universality in economics systems;
- fluctuations and noise in financial time series;
- models for wealth and income distributions;
- emergent phenomena in aggregate behaviours;
- an approach to nonextensive statistical mechanics;
- phase transitions in socio-economic systems;
- novel theoretical approaches for interacting agents;
- rational *vs.* irrational collective behaviours in interacting agent based models;
- mechanical and informational impact of trading orders on price formation;
- methods to distinguish between correlation and noise;
- correlation filterings.

The present volume provides a broad overview of the state of the art in Econophysics, provided directly by the scientists who are among the main actors in this burgeoning field.

Econophysics is a relatively recent discipline, but it has already a rich history, with a variety of approaches, and even controversial trends. In particular, a recent paper, *Worring Trends in Econophysics*, by four distinguished economists [M. Gallegati, S. Keen, T. Lux, P. Ormerod, Physica A **370**, 1–6 (2006)] has sparkled intense discussion across the Econophysics' community [Philip Ball, Nature **441**, 686-688 and 667 (2006); Philip Ball, Financial Times, October 29 (2006)]. Significantly, this controversial paper was conceived at the international conference "Econophysics Colloquium" (The Australian National University (Canberra) on November 2005), which was organized by the authors of the present Editorial. Also significantly, the article was published as the opening article of the conference proceedings. Indeed, in our opinion, controversies are the signature of scientific vitality, and they are always welcome.

In particular, this debate about 'worrying trends' in Econophysics is especially welcome, because it comes from economists who are strongly critical of the present mainstream economical theories, who have always supported Econophysics, and who have widely contributed to the Econophysics literature. Indeed, the opening of their paper reads: "Econophysics has already made a number of important empirical contributions to our understanding of the social and economic world". In actual fact, their 'criticisms' are more a declaration of some disappointment that, in their opinion, the physicists' community has not yet met their high expectations. These economists were probably hoping that physicists could bring a sort of 'Copernican revolution' into economics, and helping to substantially rebuild this field on a new, sound basis. Actually, from our perspective, Econophysics has already contributed significantly to the foundation of a modern economic discipline based on a strong empirical, evidence-based approach. This might not yet be a Copernican revolution, but it has certainly been a successful story.

Talk about a 'Copernican revolution' is quite appropriate since, though there have been comparisons between Neoclassical Economics and Newtonian Physics, it seems to us that the present mainstream economic theories are more like pre-Galilean Physics, where the 'laws of nature' were debated in the light of different readings of the Aristotelian Philosophy. In contrast, the success of modern science was originated by the Galileo's recipe for the scientific method, which essentially consists in gathering observable, empirical, measurable evidence, subject to the principles of rational thinking. Scientific theories must produce measurable outcomes and predictions. Newton's work is principally remembered for his elegant, compact and simple theory that yielded impressively accurate predictions for the orbits of celestial bodies, and for the trajectories of stones as well. Classical dynamics might have been overcome by Einstein's relativity, but it is still used to put our satellites into their right orbits. The same cannot be said for many existing economics theories that systematically fail to describe empirical facts.

It must be stressed that economics is dealing with a 'complex system', to which traditional reductionist scientific approaches cannot be easily applied. In the introduction of the *Principia* (1687), Newton writes: "I wish we could derive the rest of the phenomena of nature by the same reasoning from mechanical principles". However, several years later (in 1720, after a disastrous loss of 20,000 pounds over the crash of the South Seas Bubble) he had to admit: "I can calculate the motions of the heavenly bodies, but not the madness of people".

Indeed, "Prediction is very difficult, especially about the future." (Neils Bohr, 1885-1962). The problem is that complex systems are indeed very difficult to model, and established methodologies and paradigms must be revised. Let us here briefly recall that this class of systems is characterized – and often dominated – by unexpected, unpredictable and adaptive, emerging behaviours, which can span over several order of magnitudes, with distinct properties and functions associated with different scales and dynamics. One of the consequences is that we must describe the system at different abstraction levels. It is not a surprise that different models, depending on the scale or the property investigated, often describe the same system. Moreover, 'fat tails' distributions, that often characterize the statistical properties of complex systems, imply that a strictly empirical definition of the parameters characterizing such distributions is formally impossible from a finite set of measures. Furthermore, adaptivity and history imply that the system is changing while we are trying to classify and describe it. This is why "For every complex problem, there is a solution that is simple, neat, and wrong." (H.L. Mencken, 1880-1956).

In this respect, the criticisms that econophysicists are using concepts from classical thermodynamics are – *per se* – sterile. Theories such as equilibrium thermodynamics can be sometime applied to non-equilibrium and non-conservative systems, depending on the time-scales involved. The ultimate instrument to reject a theoretical approach must be related to its predictive power and its capability to encode complex behaviours into a few simple laws.

The intriguing fact is that physics itself is changing in response to the new challenging problems arising from the science of complex systems, and in this respect the issues arising from economics and finance have played a very important and stimulating role. Recent decades have seen a great deal of new methodologies being invented, and a host of new paradigms being tested. For instance, the whole branch of the physics of networks was originated and is being developed as a new instrument to tackle complex systems made of many interacting elements (agents). We are in the middle of an adaptive change, and Econophysics is an important part of this process.

The point that we want to make with this Editorial is that we should not be too worried. Indeed, the 'trends' which produce outcomes which are not consistent with the empirical observation, or are based on unrealistic assumptions, or are useful only in a few *ad hoc* cases, will be dismissed by a 'healthy' community. This is the way most empirical sciences have developed in the past, and it has proved to be a very productive process that is efficiently able to distil-out the valid approaches without the use of any *a priori* selection methodology. In the end, the best decision about the worthiness of a scientific work will unavoidably be taken by the scientific community independently on the process that led to its publication. A too-severe screening process will unavoidably result in suppressing dissent against 'mainstream' theories.

However, severe criticism and controls inside the community itself are essential elements that are needed to increase the average quality of research outputs. The question is, therefore, how can we develop and maintain a 'healthy' community, which is able to improve the average quality of scientific endeavour in Econophysics? In this respect, we do see some 'worrying trends' in the great inertia with which the academic community has greeted this new discipline. There are no chairs of Econophysics anywhere in the world. Therefore, physicists are obliged to perform Econophysics as a marginal part of their activity and this in some cases can result in overall 'dilettantism'.

We must stress that the 'reference community' and 'academia' are not empty words referring to some external unmovable entity. On the contrary, it is us, and it is up to us to change the present status. This topical issue is a clear demonstration that important 'mainstream' physical journals are open and willing to give space and credit to Econophysics. This is not by chance. It is the consequence of the action and hard work of several physicists, who for many years have been promoting these ideas from within the board rooms of scientific journals. The present topical issue is also a clear demonstration that there are many scientists who are seriously committed to Econophysics, and are contributing with very scrupulous works to raise the community standards.

Given that such debate was started in Australia, let us conclude this Editorial with the typical Australian expression: "No Worries". Indeed, as this topical issue demonstrates, Econophysics is an active and adaptive discipline with several promising trends that will yield more exciting results in the years to come.

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Guest Editors