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Preface

Complexity in quantitative finance and economics

Although History is punctuated with episodes where people with graduate or undergraduate degrees in Physics worked on financial and economical problems – which includes some Nobel Memorial Prize in Economic Sciences like J. Tinbergen (the first awarded, in 1969, jointly with R. Frisch) or R.F. Engle (awarded in 2003, with C.W.J. Granger) – the last two decades are marked by the establishment of a clear and long-lasting interest of the Physics community in social, economical and financial matters. The reasons thereof are diverse, but taking Statistical Physicists as default, the rampant increase in the number of works can be seen as a plausible outcome of our understanding of phase transitions, nonlinear phenomena, as well as nonequilibrium statistical mechanics, areas which paved the way to the study of Complex Systems. Within this scenario, economical and financial systems – where many nonlinearly interacting agents give rise to self-organization and emergence of rich collective patterns – are consistently regarded as archetypical instances of complexity, ideal to probe concepts and tools of Complex Systems. These features have lured Statistical Physicists as well as Economists willing to use an approach stemming from an initial empirical data analysis at the expense of the typical econometrician *modus faciendi* which privileges obtaining closed analytical solutions.

Twenty years after the appearance of the neologism "Econophysics" is a good time to gather top-notch researchers in the field of Quantitative Economics and Finance to edit this special issue that aims to review significant results and introduce problems that can be regarded as promising subjects within this context. In respect of the latter, it has been possible to recognize the strengthening of the role of Network Theory in Economics and Finance. That goes from the scale where nodes represent institutions, endowed to provide answers to the problem of systemic risk – that has become an issue in the limelight since the financial crisis of 2008 – to the network of participants in a financial market whose microscopic data are becoming ever more accessible. Obtaining such detailed trading relations between agents and the flow of information that leads to order placement and price formation, clearly improved by big data analysis, can certainly help us have a better understanding about the cornerstones of complexity in economics or to improve market efficiency and risk hedging.

That said, we can cluster the articles in this special issue as follows: The papers by Arismendi and De Genaro [1], Ballestra and Cecere [2], Borland [3] and Yoon and Park [4] introduce approaches to stock option pricing that take into account one of consensual contributions of Quantitative Finance: the robustness of the power-law distribution of returns across several scale beyond the geometric Random Walk paradigm for the evolution of the price. Bariviera et al. [5], Cerqueti et al. [8], Kozłowska et al. [9], Soares et al. [6] and Tsallis [7] show the relevance of measures of complexity, nonlinearity and related functionals in the understanding of economic phenomena and their quantitative resemblance to several other natural systems; Duarte [10], Kaizoji and Miyano [11], Lux and Alfarano [12] review major quantitative features traditionally dubbed stylized facts of financial quantities and their replication by means of dynamical and agent-based models; Buonocore, Aste and Di Matteo [13] and Grech [14] treat the analysis of a typical signature of complexity in financial data: multi scaling and multifractality; Musciotto et al. [15] and Gu et al. [16] present analyses on the properties of ultra-high-frequency data and order-books; Barucca and Lillo [17], González-Avella et al. [18] and Silva et al. [19] employ network theory results to appraise the structure of financial networks and its relation to systemic risk and, finally Biondo et al. [20], Dhesi and Ausloos [21] and Galam [22] introduce agent-based models with the goal of describing the dynamics of financial markets.

We hope that these selected papers, giving an overview on such exciting topic, will inspire you in searching new methods to cope with current challenges and bringing forth new ones.

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