



Emiliano Ippoliti, Ping Chen (Eds.)

Methods and Finance

A Unifying View on Finance, Mathematics and Philosophy

Series: Studies in Applied Philosophy, Epistemology and Rational Ethics

- Outlines a unique contrastive approach between externalist and internalist views on finance
- Presents contributors from different fields—philosophy, mathematics, physics, finance—give a multifaceted vision of the subject
- Includes a cutting-edge theory to help readers navigate the evolution of modern markets

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Preface

Two views shape our understanding and approaches to finance, and stock markets in particular—as well as to a lot of other domains of human knowledge: the view from inside and the view from outside. This book examines these two views, analyzing their interconnections—when and where they clash, reconcile, or act independently—and the ways by which these views, in turn, affect various approaches to the study of finance and its branches. To this aim, the volume puts together contribution from experts from different fields: philosophy, economics, and physics. The core idea that motivates this choice is that the increasing complexity and pervasiveness of finance, and its computational turn, have to be dealt with several viewpoints.

These two views on finance employ radically different assumptions about the set of the relevant features of the domain and the way to look at them—e.g. the ontology, the methods, what counts as ‘data’, and the role of mathematical modeling. Accordingly, these views tackle very differently the two main sides of the problem of stock markets behavior—namely the quantitative and the qualitative side. The quantitative side requires figuring out an answer to prices’ series—a mathematical tool to approximate them in the most cogent way. The qualitative side requires determining the variables that affect the dynamics of stock market prices, and their “machinery”, as the result of the actions, or better interaction, of investors who sell and buy stocks.

But the view from inside and the view from outside are not necessarily conflictual. Mixed approaches emerge from a combination of the features of the two views. The two views serve goals and have scopes that might differ, but that can, and sometimes have to be used together since they can complement and extend each other. In effect, just like with triangulation, they offer distant viewpoints that can be combined in order to better map the land of financial phenomena. A conceptual triangulation that put in use a methodological pluralism.

The essays collected in this volume will provide new insights into, critical examinations of, and improvements to these approaches, dealing with both the quantitative and the qualitative approaches, the issue of prediction and the use of mathematics.

The volume is in two parts. The first looks at the view from outside, the second at the view from inside.

The first part of the volume starts with a description of the view from inside with the contribution Chapter “[Methods and Finance: A View from Outside](#)” by Emiliano Ippoliti. In his chapter Ippoliti emphasizes that that the outside view on finance maintains that that we can make sense of, and profit from stock markets’ behavior, or at least few crucial properties of it, by crunching numbers and looking for patterns and regularities in certain sets of data. The basic idea is that there are general properties and behavior of stock markets that can be detected and studied through mathematical lens, and they do not depend so much on contextual or domain-specific factors. In this sense the financial systems can be studied and approached at different scales, and it is virtually impossible to produce *all* the equations describing at a *micro* level *all* the objects of the system and their relations. The typical view of the externalist approach is the one provided, for instance, by the application of statistical physics. In describing collective behavior, this discipline neglects all the conceptual and mathematical intricacies deriving from a detailed account of the inner, individual, and at micro level functioning of a system. The chapter examines how the view from outside deals with critical issues such as the mathematical modeling (Section “[Mathematical Modeling](#)”), the construction and interpretation of data (Section “[Constructing and Interpreting Data](#)”), the problem of prediction and performativity (Section “[The Problem of Prediction and Performativity](#)”).

After this essay, five chapters highlighting important features of the view from outside follow.

In Chapter “[Mathematical Representation in Economics and Finance: Philosophical Preference, Mathematical Simplicity, and Empirical Relevance](#)” Ping Chen argues that, as pointed out by Keynes, classical economics is similar to Euclidean geometry. The problem is that the reality is non-Euclidean. Ping Chen argues that we have now robust evidence, and then we can take for granted, that market movements are nonlinear, non-equilibrium, and economic behavior is collective in nature. This contrasts the mainstream economics and econometrics, which are still dominated by linear, equilibrium models of representative agent. Moreover Chen argues that a critical issue in economics is the selection criteria among competing math models. He stresses that economists may choose the preferred math representation by philosophical preference, by mathematical beauty or by computational simplicity. He continues saying that he chooses the proper math of his models by its empirical relevance, even at the costs of increasing mathematical dimensionality and computational complexity. His main argument is that recent historical events of financial crisis reveal the comparative advantage of the choice of advanced math representations. He finishes arguing that technological progress eases future advancements in mathematical representation and philosophical change in economic thinking.

In Chapter “[Behind the Price: On the Role of Agent’s Reflexivity in Financial Market Microstructure](#)” Fabrizio Lillo and Paolo Barucca review some recent results on the dynamics of price formation in financial markets and its relations to the efficient market hypothesis. Specifically, they present the limit order book

mechanism for markets and they introduce the concepts of market impact and order flow, presenting their recently discovered empirical properties and discussing some possible interpretation in terms of agent's strategies. They argue that their analysis and findings support the idea that a quantitative analysis of data is crucial for the qualitative validation of hypothesis about investors' behavior in the regulated environment of order placement. They also argue that a quantitative analysis of data is crucial to connect micro-structural behaviors to the properties of the collective dynamics of the system as a whole, for instance market efficiency.

Finally they discuss the relation between some of the described properties and the theory of reflexivity. They basically propose that in the process of price formation both positive and negative feedback loops between the cognitive and manipulative function of agents are present.

In their Chapter "[On the Description of Financial Markets: A Physicist's Viewpoint](#)" Sergio Caprara and Francesco Sylos-Labini examine the main concepts of the neoclassical description of financial markets from a physicist's viewpoint. They start noting that, at least in the last two decades, physicists have devoted an increasing activity to the scrutiny of ideas and concepts that are at the basis of that branch of economic theory customarily called neoclassical. This activity, they continue, appeared as surprising in the early days of its rise and development, since the objects studied by physicists are usually atoms, molecules, planets or galaxies that look quite different from the objects studied by social sciences, the queen of which is economics. Human beings, they argue, on contrary to elementary particles or stars, are endowed with free will and, more importantly, the laws that rule the ways in which an individual makes her/his own choices and by which different individuals establish relations among them, developing a social behavior, are unknown to us. So, they conclude, it seems legitimate to doubt that such laws are well defined.

In their Chapter "[Research Habits in Financial Modelling: The Case of Non-normality of Market Returns in the 1970s and the 1980s](#)" Boudewijn de Bruin and Christian Walter consider finance at its very foundations, namely, at the place where assumptions are being made about the ways to measure the two key ingredients of finance: risk and return. It is well known, they emphasize, that returns for a large class of assets display a number of stylized facts that cannot be squared with the traditional views of 1960s financial economics (normality and continuity assumptions, i.e. Brownian representation of market dynamics). Despite the empirical counterevidence, they continue, normality and continuity assumptions were part and parcel of financial theory and practice, embedded in all financial practices and beliefs. Their goal is to build on this puzzle for extracting some clues revealing the use of one research strategy in academic community, model tinkering defined as a particular research habit. We choose to focus on one specific moment of the scientific controversies in academic finance: the 'leptokurtic crisis', opened by Mandelbrot in 1962. The profoundness of the crisis, they note, come from the angle of the Mandelbrot's attack: not only he emphasized an empirical inadequacy of the Brownian representation, but also he argued for an inadequate grounding of this representation. They conclude their chapter by giving some insights into this

crisis and displaying the model tinkering strategies of the financial academic community in the 1970s and the 1980s.

Matthias Leiss begins his Chapter “[Super-Exponential Bubbles and Expectations: Theory, Simulations and Empirics](#)” by reminding us that transient super-exponentially is a well-known statistical regularity of financial markets, which is generally associated with unsustainable growth and bubbles. His goal is to contribute to the understanding of super-exponential dynamics by assessing it from two new viewpoints. To this end, first he introduces an agent-based model of super-exponential bubbles on a risky asset market with fundamentalist and chartist traders. Then he shows analytically, and by simulations, that their mutual interactions repeatedly generate super-exponentially growing prices. Moreover, he combines our agent-based model with the methodology of log-periodic power law singularities (LPPLS) often used for bubble econometrics. Leiss introduces a new type of trader who employs the LPPLS framework to detect the existence of a bubble and invests accordingly, trying to ride the bubble while it lasts and to quit before the subsequent crash. His findings show that the presence of LPPLS traders increases market volatility. In the second part of the chapter, he constructs risk-neutral return probability distributions from S&P 500 option prices over the decade 2003 to 2013 and argues that the data strongly suggest increasing option-implied return expectations prior to the crash of 2008, which translates into transient super-exponential growth expectations. Finally, he presents evidence for a regime-change from an abnormal pre-crisis period to a “new normal” post-crisis.

The second part of the volume, devoted to the view from inside, begins with an overall account of that view.

In his Chapter “[Methods and Finance. A View from Inside](#)” Emiliano Ippoliti characterizes this approach as the one maintaining that not only to study and understand, but also to profit from financial markets, it is necessary to get as much knowledge as possible about their internal structure and machinery. This view, Ippoliti stresses, argues that in order to solve the problems posed by finance, or at least a large part of them, we need first of all a qualitative analysis. In this sense the rules of trades executions, laws, institutions, regulators, the behavior and the psychology of traders and investors are the key elements to the understanding of finance, and stock markets in particular. Accordingly, data and their mathematical analysis are not the crucial element, since data are the output of a certain underlying structure of markets and their actors. The underlying structure is the ultimate object of the inquiry. Ippoliti in particular examines how the view from inside raises, and deals with, critical issues such as markets failure, information disclosure, and regulation; the notion of data, performativity, and the study of micro-structures.

After this introductory essay, four chapters highlighting important features of the view from inside follow.

In Chapter “[The Sciences of Finance, Their Boundaries, Their Values](#)” Alex Preda (King’s College London) examines how several approaches from the social and natural sciences take finance, and especially financial markets as a domain of systematic inquiry. Preda notes that historians of economic thought have discussed extensively the emergence and evolution of some major, competing paradigms

within finance, focusing on differences in their methodological and theoretical assumptions, as well as on the ways in which they have achieved dominant positions in the academia. Preda then consider a critical issue. More precisely: how these paradigms do see the problem of their own value, in relationship to the value of their field of study. In other words, he examines how they present finance as a set of phenomena worth studying, and what is valuable about studying them from a particular angle. To this end he examines five significant scientific approaches to finance: *financial economics*, *market microstructure*, *behavioral finance*, *social studies of science*, and *econophysics*. He shows how they represent the study of financial markets as a valuable, systematic endeavor, and how they represent their own value in providing a distinctive approach to the study of finance. He then distinguishes between internalistic and externalistic claims to value among these approaches. Internalistic value claims make reference to data accuracy and to methodological adequacy, while externalistic claims make reference to investigating links between finance and other forms of social organization and institutions.

In his Chapter “[Quantification Machines and Artificial Agents in Global Finance: Historical-Phenomenological Perspectives from Philosophy and Sociology of Technology and Money](#)” Mark Coeckelbergh raises questions about the societal, cultural and ethical significance of finance, mathematics, and financial-mathematical technologies, in particular the phenomenon of quantification as mediated by contemporary electronic information and communication technologies (ICTS). He first relates the history of mathematics to the history of financial technologies, and argues, inspired by Simmel and Marcuse, that from ancient times to now there seems to be an evolution towards increasing quantification not only in finance, accounting etc., but in modern society in general. His chapter then examines current shifts of financial agency that exemplify what seems to be a moment of hyper-quantification through the use of ICTs: experiences of “the market” as an independent agent and money machines as artificial agents in high frequency trading. The chapter ends by acknowledging the human character of finance and mathematics, warning that there are real human and social consequences of quantification, in ancient times and today, for society and responsibility.

In Chapter “[Contemporary Finance as a Critical Cognitive Niche: An Epistemological Outlook on the Uncertain Effects of Contrasting Uncertainty](#)” Lorenzo Magnani and Luca Bertolotti (University of Pavia) employ the cognitive niche construction theory, which aims at providing a new comprehensive account for the development of human cultural and social organization with respect to the management of their environment, to account for economic and financial phenomena. They start with their argument that cognitive niche construction can be seen as a way of lessening complexity and unpredictability of a given environment. In their chapter, they analyze economic systems as highly technological cognitive niches, and identify a link between cognitive niche construction, unpredictability and a specific kind of economic crises.

In Chapter “[Dark Data. Some Methodological Issues in Finance](#)” Emiliano Ippoliti argues that the nature of the data of financial systems raises several theoretical and methodological issues, which not only impact on finance, but have also

philosophical and methodological implications, viz. on the very notion of data. In his chapter he examines several features of financial data, especially stock markets data: these features pose serious challenges to the interpretation and employment of stock markets data. In particular he focuses on two issues: (1) the way data are produced and shared, and (2) the way data are processed. The first raises an internal issue, while the second an external one. He argues that the process of construction and employment of the stock markets data exemplifies how data are theoretical objects and that “raw data” do not exist. Data are not clean, light and ready-to-use objects, and have to be handled very carefully and are a kind of “dark matter”. *Dark data*, for the note.

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