

Preface

Since the 1970s, Complex and chaotic nonlinear dynamics (in short, Complex Dynamics) constitute a growing and increasingly important area that comprises advanced research activities and strongly interdisciplinary approaches. This area is of a fundamental interest in many sciences, including Economics.

Let us start with a comment about the interest of Complex Dynamics in Economics and in so doing the necessity of such a book and its interdisciplinarity: Mathematics in Economics have a very strong didactic role. Mathematics state theoretical models and paradigms that must conform to measurements. However, in Economics the measurements are rare, more often of a small number of points and of a very low density, except for stock markets. This chasm that separates Economics from the “dense” measurable reality has maintained economists in a kind of “isolation” (compared with other sciences): (1) that of the qualitative approach that can be conducted, for instance, in a literary way, very often of great relevance but which is not quantitative, (2) and that of the construction of models (“mathematical idealities”) with a strong didactic or mechanistic vocation often far from the richness of “the living”. This is above all a problem of *measurement*. Beyond the epistemological revolution of nonlinear theory, today there is that of the information systems and networks, which will provide the exceptional opportunity to capture dense measurements in numerous fields of Economics (e.g. from consumer behaviors up to national accounts). Thus, the economists will be in an opposite situation than before. The measure flows for the economists will have densities increasingly similar to those of other sciences whose measures come from “the living” for example. Economics will have to treat these measure flows with relevant tools, which are necessary to master. This is a turning point for Economics. Thus, Mathematics and its analytic tools are more relevant than ever for economists, in particular to study Complex Dynamics and to bring closer theoretical models and information coming from signal or time series measurements. Calculation capabilities, networks, measurements and information treatment also make the existence of such a book legitimate and necessary.

In the same vein, Economic Policy needs tools going beyond simple observation (shifted in time) offered by statistical series in order to recognize the exact and not

only the apparent state of conjuncture. This book describes these tools, with a wealth of details and precisions, and not only the tools but also many concrete applications to economic series in general. When Clive W.J. Granger published his work about the time series analysis 40 years ago, he exposed the means available at that time, of which Fourier series decomposition. These means had been refined and improved with the aim of applying them, for example, to telecommunications. The series on which telecommunications analysts work contain a great number of points, the edge effects are very often negligible and, especially, the series are almost always stationary. The use of more elaborated tools than the Fourier series decomposition is a necessity. In Economics, this had been different for a long time; everything created a problem in time series analysis, a weak extent, edge effects, a non-stationariness which cannot be reduced to the existence of a tendency, as the basic handbooks could make it believe, but is expressed by a high volatility, relative to an average value which does not have great sense, and variable according to the selected sample.

In such a context, the content of this book shows how much the recent contributions of signal theory in relation with nonlinear dynamics are powerful means of analysis and have a so important potential. Information systems and networks will contribute to this goal. In this regard, let us point out that the third part of the book is a quite essential contribution. It covers signal theory, not only in a didactic way (Fourier, Wiener, Gabor, etc.) but also by presenting highly advanced contents (polyspectra already used by economists, best basis, multi-resolution analysis, hybrid waveform dictionaries, matching pursuit algorithms with time-frequency atoms, etc.). The applications are numerous and demonstrative: stock market indexes, standard signals, signals of coupled oscillators or turbulent phenomena highlighting coherent structures. Signal theory certainly has to be promoted in Economics; this book contributes to this aim.

More than in the past, Economics calls for nonlinear formalizations which provide complex formal solutions. The increasingly frequent necessity to carry out digital simulations after still largely heuristic “calibrations” leads to thorough analyses of simulated series and reference-series (often reconstructed) for which this book offers particularly adapted tools.

What appears most clearly is the innovation and originality of many parts of this book, the diversity of the applications and the richness of the theoretical exploration possibilities. This is what makes this book a document from now on impossible to disregard for economists as for econometricians, and potentially for practitioners of other disciplines.

To end this preface, may I wish that the readers have as much pleasure as I to peruse this work that numerous illustrations make less austere without ceasing to be rigorous, and then, convinced by the diversity of the applications, that the readers implement themselves the tools.

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