The Future of Econometrics: Complex Econometrics and Implications in Time Series Analysis

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ABSTRACT

The author makes a deep revision of the main implications of Nonlinearity, Complexity and Chaos Theory in the analysis of economic behaviour and particularly in Econometric Analysis, analysing the characteristics of the new Complex Econometrics.

KEYWORDS

Chaos, Characterization, Complexity, Nonlinearity, Paradigm, Prediction, Time Series

1. INTRODUCTION

We could speak about three different paradigms in the historical evolution of science (see, for example, [Nieto de Alba, 1998] or [Morin, 1995]). Each paradigm is characterized by a way to think and to focus the analysis of the reality. These three paradigms, nevertheless, are not substitutive, but complementary. This evolution has affected to Economy like all other sciences. In this work we analyze the fundamental principles that sublie in each one of the mentioned paradigms, as well as the reasons for its sprouting and the implications for the Economy, as much at theoretical level as at practical level, making special reference to the area of the Analysis of Economic Time Series


Thus, at first, within the scientific development derived from the Newtonian mechanics, scientists worked under a Deterministic Paradigm. The Principle of Strong Causality governed this paradigm. This Principle maintained that the same consequences follow inexorably from the same causes (this is the Laplace’s demon). However, Laplace also remarked the importance of the probability. The probability arises as something necessary when scientists take conscience of the impossibility of complete knowledge of interacting causes as the number of implied variables increases. For this reason, the paradigim evolves to the Statistical Paradigm. The Principle of Weak Causality substitutes the Principle of Strong Causality. This new Principle states approximately the same consequences follows from approximately the same causes. In the new paradigm, universal determinist laws are not enunciated. Statistical laws substitute deterministic laws, stating that, in average, the behavior of the analyzed variables could be explained by means of a universal law. The prediction capacity is maintained, but now in probabilistic terms, using statistical inference. The Deterministic and Statistical Paradigms coexists, each of them applied to different fields. The first one for the systems (simple) with few degrees of freedom and the second one for the systems (complex) with many degrees of freedom. At this time, complexity was conceived as merely quantitative, due to the sum of a high number of degrees of freedom.

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1.2. From the Simplification Paradigm to the Complexity Paradigm

This two paradigms work on the bases of some common principles. According to Nieto de Alba [Nieto de Alba, 1998] these principles can be summarized as follows:

- **Locality (Science of Isolated Objects):** The whole is approximately the sum of the constitutive parts
- **Stability:** It is the science of linearity. The systems are in equilibrium, they are closed systems
- **Untemporality:** Time is an exogenous, external variable. Time is reversible, so it does not give rise to abrupt changes in the system

The union of these two paradigms can be denominated, therefore, the Simplification Paradigm. The new paradigm (Complexity Paradigm) that completes the existing one is characterized [Prigogine, 1993 and 1997]) by the importance of unstable structures, nonlinearity and the consideration of time as an endogenous variable of the system. A complex system could have a few degrees of freedom. In this case, we speak of qualitative complexity. The following principles govern this Simplification Paradigm (see Figure 1):

- **Globality (Science of the Systems as a Whole, the Open Systems to the Surroundings):** The whole is not a mere sum of the parts
- **Instability:** It is the science of the disequilibrium, the nonlinearity, the butterfly effect, opened systems…
- **Time Creation:** The time is an internal variable to the system, is irreversible and is necessary to consider the instability.

The new paradigm supposes the abandonment of the linearity hypothesis: systems are globally analyzed. The property of sensibility to initial conditions shows the importance of the study of instability and the abrupt changes of behavior (bifurcations) that mark the evolution of the system. This instability leads to the irreversibility of the studied phenomena, not due to the intrinsic ignorance but to the own dynamics of the system. The time is conceived like creator of new structures. The different conception of time has a preeminent role in the change of paradigm. In the Determinist Paradigm time is an exogenous variable, a simple mathematical parameter, a linear time, according with the untemporal vision of the world, which is concived as ordered and stable. On the contrary, in the Complexity Paradigm time is not only considered like endogenous to the system, but like creative time, historical time. This new Complexity Paradigm allows [Brock and Baeck, 1991] the quantification of concepts as vague as complexity level, instability measure, number of nonlinerar degrees of freedom, besides to show the importance of the nonlinear modelization, justifying this way its present resurgence [Ashley and Patterson, 1989].

2. ECONOMETRICS IN A COMPLEX ENVIRONMENT

Econometrics could be defined as the discipline that, making use of the models provided by the Economic Theory, the facts observed in the reality and the tools provided by the Statistic, tries to analyze the economic relations using econometric models. These models explain the underlying system and thus the relations between the variables, to predict their future evolution, or to analyze the implications for the economic policy. The econometric models, like those of the economic theory,
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