

1 Concluding Remarks

The purpose of this book is to present a non-extensive entropy econometrics technique as a new, robust device of economic ill-behaved inverse problem modelling when traditional econometrical approaches may not work. Particular attention has been paid to national accounts tables supposed to display an endogenous general equilibrium of the economy. Non-extensive entropy related power law has proven to ubiquitously describe a large variety of phenomena, including those of financial markets. This book has tried to show that economic phenomena should also be described by this same law which generalises Shannon entropy and thus displays more stable solutions, including those beyond the Gaussian framework.

Nevertheless, for a new approach to deserve attention, it should be consistent with an existing theory and be proven to lead to new empirical advantages. Consequently, the second part of this study has been devoted to the main theoretical techniques for solving inverse problems. In particular, starting with the Kullback-Leibler statistical information definition, we have presented the principal inverse problem solution techniques—and their limits—before characterizing Tsallis entropy with respect to its higher generalizing qualities. Next, based on recent Shannon entropy econometrics techniques, we have proposed a non-extensive entropy econometrics approach which encompasses the Gibbs-Shannon entropy case. In terms of their probabilistic definition, both econometrical techniques are characterized by corresponding functional forms in criterion function. In both cases, constraining parts are based on the Bayesian method of moments. Nevertheless, due to the non-extensivity of Tsallis entropy, that aspect is magnified through a particular treatment of constraining moment equations, such as the use of escort distribution. Up to now, those forms of restriction have been used in statistical thermodynamics, so their successful transfer to entropy econometrics—then to the social sciences in general—constitutes the first intermediary result of this book. This is sufficiently important, seeing that, on statistical thermodynamics grounds, the discussions concerning the applicability conditions of different forms of restrictions are not yet closed. On the other hand, one cannot exclude that their application in social science could help in better understanding their use in statistical thermodynamics. In spite of sparse literature, the second intermediary result remains the formal connection of Shannon-Gibbs based Kullback-Leibler statistical theory of information to the proposed Tsallis non-extensive entropy econometrics. As mentioned in later sections of the book, such a link represents a key element for empirical investigations since it will enable measuring divergence between hypotheses when non-ergodic phenomena are analysed.

Until now, econophysicists have applied non-extensive entropy to high frequency phenomena. This book, through a probabilistic and dynamic characterization of power law—using scaling processes—puts forward the possibility of non-extensive entropy econometric modelling with low-frequency data, for instance, annual statistical series. This is significant since we then open the possibility of modelling with

data reflecting real world economic practices. A central achievement of this work remains the proposed and demonstrated theorem linking economics to statistical thermodynamics through the inheritance properties of PL. We then endeavoured to build a stronger bridge between these two disciplines.

When the non-extensive entropy procedure is used to update and forecast input-output tables, outputs remain similar to those obtained using traditional approaches, such as Shannon entropy or the RAS method. If our purpose had been to prove that the proposed new Tsallis entropy-based approach worked, obtaining similar outputs would have been sufficient. However, our target was more ambitious. We needed to show the superiority of the new approach. At least two reasons are behind this limited achievement. The first is that the structure of input-output based-tables may reflect Gaussian law, i.e., the convergence limit of power law. Consequently, Shannon and Tsallis entropies should display the same outputs. This is what has occurred in our study. As far as the RAS approach is concerned, achieving a higher performance by entropy techniques would have required, according to the existing literature, a higher number of consistent restrictions or stochastic modelling conditions. We have presented an example with powerful results when we were forecasting an aggregated input-output table of 27 EU countries. This interesting but time-consuming research deserves further investigation to better set modalities and conditions of each of the above rival approaches. In the context of these input-output table-based models, the next principal finding of this work remains the new proposed non-extensive entropy econometrics technique for estimating a large class of nonlinear stochastic models considered non-tractable. We have particularly in mind a large class of non-stationary or long memory econometric models, the data of which, at first glance, could correspond with an unknown time scaling intermediary level of power law.

The above findings were necessary to show the possibilities of extending generalized non-extensive Tsallis entropy to low frequency econometric models and, in general, to expand the estimation possibilities of econometric modelling, including static or dynamic CGE models and their extensions. Since data aggregating level—as evidenced by recent literature—may correspond to a certain probabilistic family of law, this fact could represent a paradigm shift in many fields, including applied statistics and econometrics.