BUCHAREST UNIVERSITY OF ECONOMIC STUDIES



FIELD:

CYBERNETICS AND STATISTICS

DOCTORAL SCHOOL:

ECONOMIC CYBERNETICS AND STATISTICS

ABSTRACT OF THE HABILITATION THESIS

MODELLING ECONOMIC SYSTEMS AND DECISION SUPPORT: CONTRIBUTIONS IN CONTEXTS OF UNCERTAINTY, DIGITALISATION AND SUSTAINABILITY

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Abstract

The habilitation thesis summarises the development of my scientific, academic and professional activity since completing my doctorate in 2011 and sets out the directions in which I intend to develop research, teaching and doctoral supervision. The scientific programme is unified around quantitative modelling and the transformation of economic systems in contexts of uncertainty, digitalisation and sustainability. The programme's unity results from progressively extending the levels of analysis and matching the research problem, data, method and interpretation of results, without assuming a universal method or combining the contributions in a single empirical model.

Chapter 1 presents the continuity between doctoral research on pattern recognition in finance and the current scientific agenda. The methodological identity rests on combining quantitative modelling with contextualised interpretation and is summarised in five stages: defining the problem and system analysed; operationalising and preparing the data; representing and analysing the structure; validating results and assessing uncertainty; interpreting and using the results in decision-making. Multivariate analysis, econometrics, Bayesian modelling, network analysis, structural equation models, logistic regression, bibliometrics and systematic review perform complementary functions in investigating economic systems.

Chapter 2 develops three research directions. The first addresses financial systems, from dimensionality reduction and the identification of enterprise typologies to modelling financial time series and interdependencies between assets. The methodological and applied contributions include integrating the Student-t likelihood into Bayesian neural networks for return prediction, extending input transformations to Student-t processes, probabilistic modelling of correlation matrices and transferring uncertainty to financial network indicators, together with using multidimensional analysis to investigate the financial heterogeneity of enterprises. The common thread comprises latent structures, robustness to extreme values, interpretability and uncertainty quantification.

The second direction examines sustainability, energy policies and complex economic systems at inter-organisational, macroeconomic, global and urban levels. Research on coopetition in energy networks, environmental policy instruments and renewable energy, Finland's economic and ecological dynamics, the evolution of global research on sustainable energy, and machine learning applications in smart cities is integrated into a multilevel conceptual framework structured around technology, governance and sustainability. It relates the contributions and

highlights the units of analysis, methods and limitations specific to each study.

The third direction analyses the relationship between consumer behaviour and the digital transformation of retail. The four studies progressively address perceptions of artificial intelligence and offline-online convergence, sustainable behaviour and retailer adaptation, behavioural differentiation across national contexts, and the configuration of phygital retail through the integration of the consumer, channels, technologies and data. Structural equation models, principal component analysis and logistic regression perform complementary functions in relation to the objectives and data of each study.

Chapter 3 highlights the connection between research, applied projects, teaching and institutional responsibilities. Experience in data analysis and consultancy is used in teaching quantitative disciplines and courses in cybernetics, modelling and decision-making, developing and coordinating the Economic Cybernetics and Business Data Analysis programmes, and supervising student projects. Academic collaborations and international mobility complete the framework for training future researchers.

Chapter 4 projects this trajectory into a future programme organised in four directions: predictive modelling, causal inference and explainability in analysing the performance, risk and resilience of economic systems; modelling sustainable transitions in economic, energy and urban systems; consumer behaviour and the digital and sustainable transformations of retail; interdisciplinary extensions of quantitative modelling in medicine and geospatial analysis. The doctoral supervision strategy is based on defining relevant and feasible topics, realistic access to data and methodological suitability, and seeks to train autonomous researchers through individual plans, result validation, ethics, transparency and reproducibility. Teaching development, grants, partnerships, internationalisation, the gradual implementation plan and risk mitigation measures support the implementation of the programme.

Overall, the thesis highlights the construction of a cumulative programme relevant to the field of Cybernetics and Statistics, in which the analysis and modelling of economic systems are linked to decision support, reporting uncertainty and explicitly stating the limitations of each study. Habilitation provides the framework for transferring the accumulated experience to doctoral supervision and consolidating an academic community based on rigour, collaboration and responsibility.