

Contributions to Management Science

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Econometric Models Used in the  
Management of Organizations

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Econometric Models Used in the Management  
of Organizations

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*Never regard study as duty but as an enviable opportunity to learn to know the liberating influence of beauty in the realm of the spirit for your own personal joy and to the profit of the community to which your later work belongs.*

Albert Einstein





# Foreword

The globalisation we face nowadays derives from the fact that, by starting from the technological and economical development, a significant number of human activities are situated on such a large scale and scope that they exceed the national borders within the limits of which the sovereign states exercise their right to govern. The enhancement of current globalisation represents the fundamental feature of world economy at the beginning of the twenty-first century and is characterised by emphasising the trend to reduce and remove the barriers between the national economies and enhancing the connections between these economies.

The diversity and flexibility, the ability to adapt and respond to changes in the environment and the focus on customer needs satisfaction are key categories in the future management. Rapidly changing business environment in the economic, social and technological areas poses new challenges for the creation of effective management tools. Because of the complexity and volume of information and knowledge affecting the organisation functioning, contemporary organisations operate inefficiently because of the old, rigid and hierarchical decision-making system. Companies operating in such a dynamic environment are looking for management models based on the knowledge that allows them for intensive utilisation of the development of science, technology, organisation and management and the whole range of specific skills and dynamically developing competence.

The current management models insufficiently apply the knowledge and skills of employees and their undoubted advantages as a willingness to create new solutions, taking initiative and responsibility, which can in effect create a competitive advantage.

Moreover, it is well-known maxim *“You can’t manage what you don’t measure. It is an old management adage that is accurate today. Unless you measure something you don’t know if it is getting better or worse. You can’t manage for improvement if you don’t measure to see what is getting better and what isn’t.”* In this context, the consideration included by I.C. Dima in the book *“Econometric Models Used in the Management of Organisational Entities”* based on econometrics

methods' usage seems to be very useful for business practice and important for knowledge development.

The importance of a systemic approach in a market economy, which is the basis of the solutions proposed by the authors in this book, is the result of rapidly increasing flow of material and information flows. International cooperation has been expanded, which increases the corporate links that directly impact on enterprise systems. New relationships within the organisation are formed and new generations of system solutions also created causes that require a thorough knowledge of the functioning of the solutions and mechanisms for the development of management systems of economic organisation. Today, the need of reevaluation of current methods of management and search for solutions based on real econometrics foundations is clear. In this context, the consideration proposed by authors is perfect and ready for introduction.

This book is recommended to the reader by dealing with three research sub-themes in a unitary concept, which are together the research achieved by publishing this book. It is a matter of organisational entities dealt with in terms of systems theory, theoretical aspects of the econometric research and all the models used by econometrics to study the organisational management.

In the first research sub-theme, considering that the general theory of systems—cybernetics—and the current stage of the scientific research enable their approach at a more systematic scientific level, this book highlights some aspects of the genesis and development of hierarchical systems related to the hierarchy of the movement forms, matter and society, as well as that of the level of organisation. The evolution of the natural systems, in general, along with the physical, chemical, economic, political and managerial phenomena, presents unitary cybernetic aspects based on admitting the adjustments and associating the structures with invariants. Studying these aspects, the book introduces trans-disciplinary principles of epistemological level, which provide an axiomatising basis to elaborate the genesis and development of systems on all organisational levels. In this respect, the following area dealt with elements of systems theory, theory of organisations and organisational entities in the globalised market economy.

The second research sub-theme deals with econometrics as being that branch of economic sciences which studies the relations between the economic variables, as they appear postulated in an abstract model. It is operated with the distinction between *econometrics broadly*—which does not limit a priori the scope of usable methods and models and makes use of all structural and quantitative techniques—and *econometrics narrowly*—which limits a priori this scope to all the statistical methods and therefore appears as a set of applications of statistics in economic modelling. The connection between variables is obvious in both cases, through an abstract model of econometric relations. In essence, notions of model, object, relation, function, simulation, modelling, trend, input–output, etc., are accessed.

The last part of the book—through the third research sub-theme—provides the reader with elements of econometric modelling, which currently and frequently make use of the probabilistic mathematics and random analysis. The refusal to accept the uncertainty at the model level normally results in the difficulty to

introduce the design of the evolution of economic processes into analysis, if one does not take into account the information, without which the uncertainty cannot be studied. Therefore, the abstract model in econometrics is a support and a reference point of reasoning in general and in particular a generator of a certain conceptualisation of the central idea of connection between the variables describing the evolution within the system. The book presents econometric models focused particularly on the functions of organisational entities, but not only. I also give special interest to modelling the production quality, modelling the costs, modelling the innovative activity, etc.

When addressing the complex issues dealt with in the book, the authors enter into dialogue with the opinions presented by a rich classical and contemporary bibliography, as well as with the opinions presented in the communications delivered at international scientific conferences and with those existing in the papers published in journals with a high scientific impact. This study is the result of many years of author's experience expanded through international collaboration with researchers from universities in many countries and business management practices including large transnational corporations.

This book is addressed to both theoreticians and practitioners in the field of operative management of industrial production. This equally concerns those who study—students, graduates and doctoral students, those who have experience in this field—researchers and professors, as well as those who actually work in production—engineers, technicians, economists, developers, logisticians, company managers, presidents of the administrative board, etc.

It was personally a great pleasure to collaborate with the authors and we are pleased that this book is an important milestone forward in econometrics methods introduction in management. We hope that you too feel the same after reading this book, and we are sure, it can be inspiring for discussion and managerial solutions improvement.

Poland  
September 2014

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# Preface

## About the Subject

The enhancement of current globalisation represents the fundamental feature of world economy at the beginning of the twenty-first century and is characterised by emphasising the trend to reduce and remove the barriers between the national economies and enhancing the connections between these economies. Although it is one of the most used terms in the literature, it cannot be said there is a generally accepted definition. One of the best known definitions given to globalisation is that of the World Bank, which considers that over the last years, an increasingly larger part of the global economic activity takes place between people and companies from different countries.

The globalisation we face nowadays derives from the fact that, by starting from the technological and economical development, a significant number of human activities are situated on such a large scale and scope that they exceed the national borders within the limits of which the sovereign states exercise their right to govern. The new actors had to cope with the challenge caused by the monopoly-type governance. Multinational corporations, global financial markets, non-governmental organisations as well as criminal organisations and international terrorist networks appeared. Their activity is not covered by international laws which are based on formal agreements between the nation-states, for they have not been able so far to find a common ground for agreements aiming at the issue of globalisation.

In this context, this book is the result of an interdisciplinary scientific research in economy, mathematics, statistics and systems theory. By using such knowledge, modelling and simulation become successful managerial techniques that are based on broad mathematical knowledge applied in the management of organisational entities dealt with in terms of systems theory.

The theoretical elements have been used to conduct the scientific research focused on three directions:

- applying the systems theory in the study of organisational entities;
- using the theoretical knowledge of mathematics for the cybernetic approach of economic phenomena and processes;
- using the econometric models by the management of organisational entities.

All three directions emphasise the systemic approach of the research issues from this book and also the feedback relation characteristic to cybernetic systems, which are a special class of systems.

## Organisation of the Book

The book deals with the problem of scientific research carried out in 16 chapters forming its content.

The 16 chapters are grouped into three parts, namely:

- System of Organisational Entities
- Problems on the Econometric Theory
- Econometric Models Used in Management

Taking into account the scientific theory elements used in this research, each part includes a corresponding number of chapters, which are the result of the research performed.

Thus, Part I, System of Organisational Entities, is structured into three chapters dealing with notions on the systems theory (concept, techniques and methods, automatic adjustment systems, systems risk, etc.) and theoretic problems on the use of systems theory when dealing with the organisational entities (definition of the organisational entities, cybernetic system of the organisational entities, functions of the organisational entities, operating cycle, etc.).

Part II of the book, Some Problems on the Econometric Theory, is structured in three chapters and presents the main theoretical problems of econometrics underlying the development of econometric models used in management. Problems are dealt with, such as the relationship between econometrics and scientific management (defining the econometrics, contradictions in econometrics, econometric research, object-signal and model in econometrics, the econometric functions, etc.); dealing with the simulation and modelling as econometric techniques (the model, modelling, simulation, matrix calculus of the models, the input-output model, the IT technique used in modelling, etc.); presenting the production functions used in econometrics (building the production functions, calculating the production functions, difficulties in calculating the production functions, the Cobb–Douglas functions, the Leontieff Model, etc.).

Section III, called “Econometric Models Used in Management”, which is also the last one of the book, is of special importance as in its ten chapters it deals with the application of econometrics, meaning the use of econometric models in the management of organisational entities.

The problems dealt with in the chapters of this part refer to the use of linear programming to elaborate the econometric models (the technique of linear programming, the Simplex algorithm, convergence, dual Simplex algorithm, re-optimisation, parameterisation, etc.); the use of dynamic programming to create econometric models used in management (time, trend, discrete dynamic programming, stationary dynamic programming, graphs used to interpret dynamic programming, etc.); graphs used to elaborate econometric models of management (graph elements, oriented graph, transport network graph, critical path, Hamiltonian circuit, etc.); the use of the queuing string theory to create the econometric models used in organisational management (queuing networks, fundamental elements of the queuing networks, service stations, service factor, populations serviced, etc.); the use of game theory to elaborate econometric management models (game theory, use of the game theory, managerial decision-making, application of the decisions based on the game theory, etc.); the use of econometric models in the management of stocks (definition of stocks, characteristics of stocks, stochastic equations, the inverse of a matrix of the stochastic equation, heuristic models of stocks, etc.); use of econometric research to model the replacement of fixed assets from the organisational entities (the definition of fixed assets and their classification, the fixed wear and obsolescence of fixed assets, models for making the decisions to replace the fixed assets, models for making the decisions to modernise fixed assets, etc.); modelling the production cost by using econometric techniques (production cost, matrix of production cost, primary production expenses, system of organisational entities, matrix model of the production cost, etc.); the use of the budgeting technique in elaborating models of the unit production cost (definition of the budget, types of budgets, budgeting activity, budgeting types, structural elements of the unit production cost, etc.); and the elaboration of econometric models for the production quality management, in general, and of total production quality, in particular (the concept of production quality, the concept of production non-quality, continuous improvement of the quality of products, concept of total quality management, Taguchi technique used in the production quality management, etc.).

The complexity of the scientific research presented in this book is the result of a systemic and interdisciplinary approach of the knowledge in the field of economy, management, technology, systems science, mathematics and statistics.

## Target Audience

This book is addressed to both theoreticians and practitioners in the field of operative management of industrial production. This equally concerns those who study—students, graduates, doctoral students, those who have experience in this field—researchers, professors, as well as those who actually work in production—engineers, technicians, economists, developers, logisticians, company managers, presidents of the administrative boards, etc. The intention of this book is to create a