

The Economics of Input-Output Analysis

Input-output analysis is the main tool of applied equilibrium analysis. This textbook provides a systematic survey of the most recent developments in input-output analysis and their applications, helping us to examine questions such as: Which industries are competitive? What are the multiplier effects of an investment program? How do environmental restrictions impact on prices? Linear programming and national accounting are introduced and used to resolve issues such as the choice of technique, the comparative advantage of a national economy, its efficiency and dynamic performance. Technological and environmental spillovers are analyzed, at both the national level (between industries) and the international level (the measurement of globalization effects). The book is self-contained, but assumes some familiarity with calculus, matrix algebra, and the microeconomic principle of optimizing behavior. Exercises are included at the end of each chapter, and solutions at the end of the book.

THIJS TEN RAA is Associate Professor of Economics at Tilburg University.

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Preface

Input-output analysis is the main tool to help us answer three key questions that pertain to the economy as a whole. What is the performance of an economy, in terms of efficiency and productivity growth? What is the comparative advantage of an economy *vis-à-vis* the rest of the world? How are these measures affected when environmental constraints are taken into account? Of course, many other interesting questions can be posed.

The focus on the economy as a whole gives input-output analysis a macroeconomic flavor, but its foundation and techniques are more microeconomic, including a rigorous grounding in production and consumption. Some people argue that it is at the interface of the two and define it as the study of industries or sectors of the economy. The name mesoeconomics has been coined for this.

Input-output analysis may be considered a rather mechanical tool, not be easily applicable to free market economies with competitive valuations. Specialized as well as general textbooks reinforce this perception, but it is my goal to undermine it.

This book presents input-output analysis from a mainstream economic perspective. It offers a unified, simultaneous treatment of the so-called “quantity and value systems.” The main framework is the United Nations’ System of National Accounts (SNA), an ingenious device to provide a coherent snapshot of all the sectors of an economy; the main tool is that of linear programming. The book is self-contained – the elements of input-output analysis, linear programming, and national accounting are introduced starting from scratch and all the derived constructs (such as efficiency and applied equilibrium analyzes) follow naturally. The book provides a complete synthesis of linear economic models and neoclassical theory and offers a thorough basis in linear programming as well as input-output analysis.

The reduction of the economic structure to fundamental primitives is undertaken rigorously and the results are significant and deep. Let me mention a few. The conditions for the existence of the so-called “Leontief inverse” are simple, yet necessary and sufficient. An intuitive result on inequalities facilitates quick proofs of the main results of linear programming. This, in turn, is used to establish the most general form of the so-called “substitution theorem”. The main neoclassical tool of macroeconomics, the Cobb–Douglas production function, is derived from a microeconomic analysis of production units with different input-output coefficients. These theoretical elements are entered into the System of

National Accounts and thus produce concrete results: the questions on national economies posed above are answered.

To put the book in perspective, a short historical note is in order. Originally I was invited to write a modern version of Gale's out-of-print but still-demanded monograph *The Theory of Linear Economic Models*. In 1995, my *Linear Analysis of Competitive Economies* came out in the *LSE Handbooks in Economics* series published by Harvester Wheatsheaf. After a quick reprint, the title sold out and the publishing house was swallowed by ever-larger ones: Prentice-Hall, Pearson, Paramount, and Time Warner. To cut a long story short, the entertainment industry threw me back to square one, but Cambridge University Press stepped in and convinced me of the need to rewrite the book entirely. *The Economics of Input-Output Analysis* is the resulting textbook, with detailed treatment of new applications, including globalization and spillovers.

Strictly speaking, there are no prerequisites. In other words, if you are a bright Liberian who completely missed out on education for reasons of prolonged civil war rather than lack of capabilities you will be able to comprehend the contents after an in-depth study. This having been said, it is only fair to admit that a few preliminaries do help. Familiarity with the analysis of maximizing behavior subject to constraints, as treated in any course on microeconomics, is one. Calculus is another. And although I define them, some familiarity with vectors and matrices would be very useful. The final chapter 14 also presumes basic knowledge of random variables (the concepts of mean and variance), but it can be skipped if the reader wishes. In short, I target advanced undergraduate or new graduate students of economics who do not panic when a function is differentiated or integrated.

Input-output analysis is probably the most practical tool of economic analysis. Yet my background as a theorist is apparent in the text: The results are quite general, and this feature facilitates the use of the book as a reference source, particularly by applied equilibrium economists and national accountants using input-output measures.

I have been teaching the material in this book at Tilburg, New York, Jadavpur (Calcutta), and Utrecht Universities and also in specialist courses – one organized by the Vienna-based International Input-Output Association for the PhD students of three Montreal schools and another by Statistics Finland for PhD students from six Finnish schools. I am grateful for the feedback received; more is welcome at tenRaa@UvT.nl.

Borrowing the words of my teacher and friend Will Baumol, I dedicate this volume to my “three ladies”: Anna, Rosa, and Miryam.

Glossary

c.i.f	cost, insurance, freight
EC	Efficiency change
f.o.b	free-on-board
FP	Frontier productivity
GDI	Gross domestic income
GNP	Gross national product
IODB	Input-Output Data Base
ISDB	Industrial Structure Data Base
NAMEA	National Accounting Matrix including Environment Accounts
PPF	production possibility frontier
R&D	Research and development
SAM	Social Accounting Matrix
SNA	System of National Accounts
SR	Solow residual
TFP	Total factor productivity
VAT	Value-added tax