
Introduction

Input–output analysis is an important quantitative economic technique that shows the interdependencies between the various branches of a national economy and even between the various branches of different, possibly competing economies. It has been invented by Wassily Leontief, who received the Nobel Prize for this contribution. Perhaps the main contribution of input–output analysis is that it facilitates a consistent picture of the economic system. The input–output accounts of an economy are the core of the national accounts. The so-called System of National Accounts has been designed by Richard Stone and is now the world-wide standard, authorized by the United Nations. Stone was a keen student of input–output analysis and used it as point of departure. In the old days, students of economics had to learn national accounting, but it went out of fashion, and nowadays many economists feel uncomfortable when confronted with national economies. Imagine that you are dispatched on a mission to a developing economy with the task to report on its performance and to suggest policies for improvement. It would be extremely useful, if not necessary, to comprehend the System of National Accounts, particularly its input–output core, and its connection with applied economic models.

Much like the length of ladies skirts, economic fashion changes in a cyclical manner. Like the miniskirt, input–output analysis is back. I can think of an array of reasons to explain this resurgence. First and foremost, unlike mainstream Western economic models, input–output analysis transcends free market economies. In fact, many economists think input–output

is a tool for planned economies, but it transcends that as well. One of the fascinating recent applications of input–output analysis is the measurement of market power, the distance from the free market competitive benchmark, and the investigation if such a departure is good or bad. Ultimately, these are empirical issues and their resolution demands a solid quantitative framework. This book provides it. A second, related reason of the resurgence of input–output analysis is globalization, including international trade and environmental impacts. The traditional approach to international trade is that economies specialize according to their comparative advantages and that the latter are determined by the relative abundance of their resources. Nowadays, at least as much prominence is ascribed to technological advantages and it takes input–output analysis to expose that driver of international trade. A third reason of the recent popularity of input–output analysis is a practical one. The OECD in Paris has organized and maintained a consistent international input–output database which facilitates worldwide use.

Most people get hooked on input–output economics when they see it in action. In my case, that happened in the late 70s, when I was a research assistant to Wassily Leontief at New York University and we analyzed the foreign dependence of the United States economy on mineral resources, which is still a hot issue. I studied the use of those inputs in steel plants with different modes of production and outputs, and had the task to construct sensible input coefficients which were subsequently used to project future import requirements. I must confess that my preference has been to probe theory and therefore, I changed my focus to an economy with better organized national accounts. The System of National Accounts was (and still is) much better organized in Canada, under the leadership of input–output economist Kishori Lal. This explains why I have studied extensively the Canadian economy independently, and with my friend and co-author Pierre Mohnen, who then worked in Montreal. The center of gravity has shifted to the Pacific Ocean and very exciting developments are taking place in Asia, particularly China and India. This is also true academically, and recently, I have been fortunate to supervise bright students from there, who were keen to analyze the transition of their economies from planning to openness and competition. Input–output is a great tool to analyze the reallocations that prompted competitive pressure. I am proud to expose these studies to a

broad public. Roughly speaking, globalization is good for the standard of living, but bad for the distribution of the latter.

Since this book is fairly advanced, you may wish to consult my textbook, *The Economics of Input–Output Analysis*, published by Cambridge University Press (2005).

This book consists of eight parts. In Part I, I analyze the relationship between national accounts and economic analysis. In the first chapter, I present the textbook case of an economy with industries which produce their own specific products. This serves as an easy introduction, but in reality, industries produce overlapping varieties of products and we distinguish industry and product classifications in the second chapter. I close this part with my views on the relationship between input–output and national accounting, published by the United Nations.

In Part II, I analyze the derivation of input–output coefficients from national accounts. A key problem is how to sweep secondary products under the carpet. The first three chapters show that one procedure, the so-called commodity technology model, is attractive, but not trouble-free. The fourth chapter provides a more general framework that encompasses the main competition, the so-called industry technology model. The last chapter is very new and returns to Leontief's idea that input–output coefficients represent the production function of an industry or an economy, in which case, minimum proportions seem more relevant than the accounting based average proportions.

Part III connects input–output accounts with economic models. Perhaps surprisingly, I show that there is a close connection with mainstream economic analysis, including the substitutability of inputs in neoclassical models and the relationship between time and capital in a classical model.

Dynamic input–output models are analyzed in Part IV. The first chapter shows that the basic idea of input–output analysis still applies when an input coefficient is distributed over time. They are still multiplied with outputs to determine requirements, but the multiplication must now be the so-called convolution product. Some technical problems are resolved. The first chapter shows that although capital matrices are not invertible, the input–output model can be solved nonetheless. The second chapter applies it to the Polish economy and the third analyzes working capital.

Stochastic input–output analysis is the subject of Part V. The first chapter shows that input–output coefficients can be considered regression coefficients and tested to see if they are the same for different production units. The second chapter shows how firm data can be used to assess the precision of input–output coefficients.

Part VI is important. It shows how input–output analysis can be used to measure the performance of an economy. The concept of productivity is the key link. This should not come as a surprise, because an input–output coefficient measures input per output and productivity output per input. It all has to be connected across industries and products. The first chapter does so in a neoclassical framework. The second chapter connects neoclassical growth accounting with frontier analysis (data envelopment analysis). The third chapter investigates the difference between observed market prices and marginal productivities to get a handle on market power — the main departure from perfect competition — and to assess if it is good or bad. Input–output analysis throws light on the debate between neoclassical and Schumpeterian economists.

Part VII analyzes the Canadian economy further. The first two chapters investigate if services suffer from the Baumol productivity disease, but find them in good health. The last chapter is a much applied trade model, that shows how one can pinpoint the comparative advantage of an economy and decompose it in resource advantages and technology differences.

Part VIII is the climax of the book, addressing the difficult problem of the transition of Asian economies to competitive market economies. In this part, a firm connection between input–output analysis and income distribution measurement is established. In the first paper, Haoran Pan develops a huge input–output data base for the Chinese provinces and we use it to track the pressure of free competition on income differences, consequent migration pressures, and development. In the second paper, the impact of free trade between India and Bangladesh is projected. The last paper extends the input–output model to a Social Accounting Matrix for India and shows that globalization has a positive effect on efficiency, productivity and poverty, but an adverse effect on income distribution. All these are seemingly slippery economic issues, but this book shows how input–output analysis puts numbers on them.

There is no way I could have achieved this by myself and I am grateful to my co-authors. First and foremost, I thank Pierre Mohnen, who co-authored a quarter of the chapters. Our prolific collaboration dates back to the period when we were Ph.D. students at New York University, and is a constant source of satisfaction. José Rueda-Cantuche, whose Ph.D. work I supervised at Universidad Pablo de Olavide, Seville, has become one of the movers and shakers in the input–output world, and I enjoy our collaboration. I am grateful to my Tilburg students, Pieter Kop Jansen, Haoran Pan and Amar Sahoo, for the beautiful joint work. I thank Joe Matthey for our early work in stochastic input–output analysis. I am grateful to Jan van Tongeren for input, particularly on chapter 3. Last, but not least, I thank co-authors Debesh Chakraborty, Tuhin Das and Chandrima Sikdar, who were all with Jadavpur University. I dedicate this book to the memory of Wassily Leontief. His total independence of thinking is an enduring flame.