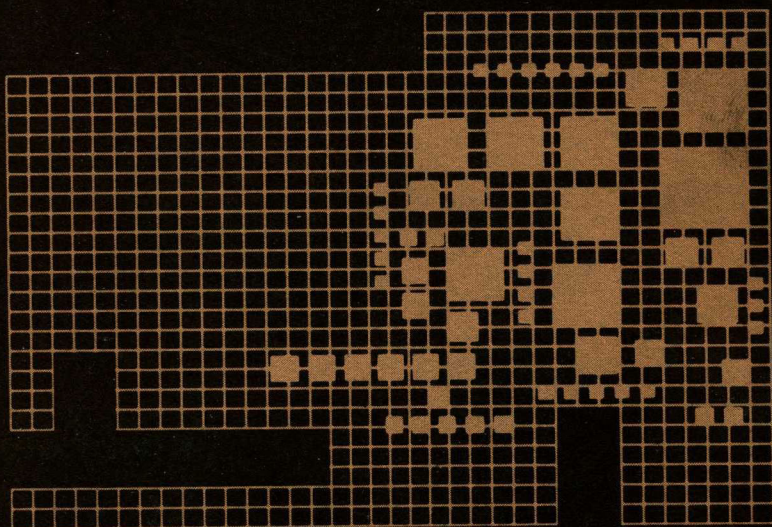


REGIONAL INPUT-OUTPUT ANALYSIS



**Geoffrey J. D.
HEWINGS**

Volume 6

**SCIENTIFIC GEOGRAPHY
Series**

**Editor:
Grant Ian THRALL**

REGIONAL INPUT-OUTPUT ANALYSIS

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SERIES EDITOR'S INTRODUCTION

Input-output analysis is a method by which the flow of production can be traced among the various sectors of the economy, through to final demand or export. The most fundamental problem of input-output analysis is to calculate the necessary output levels of each industry required to achieve a final output. Included among the uses of input-output analysis is the ability to determine the following: What is the effect upon the local economy from the introduction of a new firm? What are the economic linkages between regions and how is equilibrium between regions achieved? What if the supply of an input in one region becomes restricted through some bottleneck?

The foundations of modern input-output analysis can be traced to work in both economics and geography. The linkages to geography have been largely through the earlier analysis of urban economic base and city classification. In economics the work can be traced to the 1930s pioneering efforts of W. W. Leontief, which led to his receiving the Nobel Prize. Much of the recent contributions in input-output analysis falls within the purview of regional science, the overlap of interests in economics, geography, city and regional planning, and engineering. This literature has refined the ability of input-output analysts to work with incomplete data sets, arrive at stable and accurate estimates, and apply the general input-output method in practice to actual planning situations. With the exception of gravity and spatial interaction models, no topic in scientific geography has achieved greater practical application.

Professor Geoffrey Hewings is recognized as one of the leading contemporary scholars in input-output modeling, and has presented here one of the most readable introductions to the input-output problem and the contemporary literature that refines the technique. At the same time, save for the requirement that the reader have a grasp of elementary matrix algebra, Hewings keeps the book entirely at a level that can be understood by a reader who is encountering the material for the first time.

Professor Hewings first establishes the historical links between input-output models and the earlier macroeconomic accounting framework, economic base models, and the fundamental regional input-output model. Following the development of the basic model, and a discussion of the interpretation of the components of the model such as income and employment multipliers, Hewings discusses how the general model can be applied in practice. On applying the model he first describes how to construct the input-output tables for interregional and multiregional input-output matrices; he then presents a general discussion of estimation; and finally he presents practical examples of implementing the input-output model. The book brings the reader up to a discussion of the contemporary research frontier and likely future developments in input-output analysis.

This book will prove to be a valuable resource to students and practitioners of the planning sciences, including urban and regional economics, regional science, engineering, public administration, business management science, city and regional planning, as well as scientists in economic geography.

—*Grant Ian Thrall*
Series Editor

REGIONAL INPUT-OUTPUT ANALYSIS

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1. INTRODUCTION

Imagine a national economy that has been divided into a set of regions. Within each region, grouped into sectors, there is a set of firms producing a variety of commodities that are consumed by other firms in the course of the production of other more finished commodities (e.g., automobile parts are assembled into a finished automobile), consumers, government, export markets, or other firms using these commodities as investment goods. In addition to engaging in sales activities, firms are also active in the purchase of commodities and other inputs—labor, entrepreneurial skills, as well as commodities purchased from outside the region. It would not be unusual to find in a region of several million people well over 100,000 firms producing as many as half a million or more commodities.

Suppose that a newly elected national-level or federal government proposes to reorient priorities away from social spending to defense spending. What will be the resulting impact on our regional economy and other regions making up this nation? As a result of these changes or in response to other stimuli, assume a new firm locates in the region employing 2000 people. What will be the impact of this new activity on the region? From another perspective, assume that the comparative advantage that the region once enjoyed in the export of its commodities is eroded, with the resulting closure of many local firms and an increase in regional unemployment levels. Again, what will be the impact of this activity change on the regional economy?

With the large number of firms, commodities, consumers, and other actors in the regional economy, it should be obvious that tracing the impacts on a firm-by-firm or consumer-by-consumer basis would be a daunting proposition. Clearly, we need some accounting system into which these interactions can be placed in the hope that some analytical method could be employed to trace the impacts in a systematic fashion. In a sense, we are going to have to sacrifice the richness of the reality of the regional economy for some reduced-form picture or model that is tractable and, we hope, representative as far as is possible of the micro level interactions. As happens with a great deal of analytical work in the social sciences, the gains from model development are not without cost; as we shall see, this is the case in the development of a family of analytical tools that are referred to as *social accounting systems*. Regional input-output analysis is one subset of these accounting systems.

This book will focus on some of the more elementary versions of these social accounting models (or SAMs) to provide a guide to their underlying theoretical structure and to explore ways in which they can be used to answer the sort of questions posed in the preceding paragraph. Thereafter, some excursions will be made into new developments that have extended the range and analytical complexity of these models, thereby enabling us to use them to answer more complex questions. One of the most interesting features of SAMs is that, on the one hand, they are strongly linked with standard macroeconomic accounting principles, and, on the other hand, they can be linked with many of the more traditional avenues of inquiry in the geographic and regional science fields. For example, interest in spatial interaction of commodities or individuals can be linked with a SAM framework; hence, we have the capability to explore the effects of the federal program changes alluded to earlier, not only on the structure of the economic system but potentially on the degree to which these changes will in turn promote changes in regional attractiveness for migration decisions.

These changes, in their turn, will have a further impact on the structure of production in the regional economy. How? Consider the case of a new firm opening up in the region. Because we are assuming a freely mobile society, with no restrictions on interregional movement, competition for the new jobs may come not only from local residents but from other persons immigrating from other regions. Assuming that total employment rises and that some of this increase is associated with immigration, it is likely that the demand for local services will rise. The new immigrants and their families will demand commodities, public

services such as schools, health care and so forth, and thus create the necessary conditions for an expansion of the economic base of the region. Whether this occurs will depend in part on the degree of excess capacity that may already exist in some firms and public services.

Without getting too embroiled in the details at this stage, we can begin to see a very strong link emerging between the structure of *production* and the structure of *consumption*. Changes in either component of the regional economy are likely to lead to changes in the other and, in turn, to further changes in the first component. Viewing the regional economic system in this fashion—as a broadly based system of interdependence—provides substantial insights into the functioning of regional economies. It will enable us to begin to understand why regional economies may or may not be responsive to changes that may take place at the national or even at the international level, why some regional economies are exhibiting characteristics of decline, why others are growing, and why still others seem to be relatively immune from the effects of major structural changes that have been observed in many Western economies over the last two decades. The modeling systems to be described here will not provide answers to all our questions; many of these models contain very restrictive assumptions, precluding their use in many contexts. Neither are these models to be considered theories of regional economic growth and development. For the most part, they are empirical models that, although resting on some theoretical assumptions, are not exclusively associated with any one paradigm. In fact, these models have one very interesting attribute—they have been used in centrally planned, socialist, free market, developed, and developing economies alike. This flexibility provides one of their attractions.

The field of regional social accounting in general and input-output analysis in particular has a rich legacy. Some of the more prominent economists of this century have worked in this area; four—Tinbergen in 1969, Kuznets in 1971, Leontief in 1973, and Stone in 1984—have been awarded the Nobel Prize in Economics for their work in developing many of the accounting frameworks that will be used in this book. At the regional and interregional level, input-output analysis has attracted the interests of many scholars, among them Isard (the founder of the field of Regional Science), Tiebout, Moses, Miernyk, and Miller. Reference will be made to the contributions of these individuals throughout the text.

In the next chapter, we shall attempt to resolve the problem of linking all the actors in our regional economy in a way that will enable us to perform some simple analytical experiments. We will see how the input-output model was derived and how it is linked with some well-known

models used by economists, geographers, and regional scientists. Chapter 3 will develop the basic analytical framework and derive the system of equations that drives the input-output model; Chapter 4 will explore some basic applications with this simple model. The construction of regional input-output models will be addressed briefly in Chapter 5. Thereafter, in Chapter 6, we shall branch out to consider the ways in which this model can be expanded from a one-region version to consider interaction among two or more regions. It will be here that we find a link with other popular models in the geographic literature—namely, gravity and spatial interaction models. The seventh chapter will provide an introduction to the ways in which this simple model can be extended, especially ways in which it can be linked with other analytical frameworks—such as linear programming and demographic models—to provide a more sophisticated representation of reality. The final chapter provides examples of some of the ways in which these models can be made more flexible and explores new directions in research. A guide to further reading is provided at the end of this final chapter.

Because the models to be described here rely on representation in matrix form, the reader might find it useful to refresh his or her memory of simple matrix operations prior to reading the next chapter. However, no proofs are provided for the existence of solutions. The major focus is on the understanding of the model structure and its workings.

2. LINKS BETWEEN ECONOMIC BASE, KEYNESIAN, AND INPUT-OUTPUT MODELS

In the first chapter, reference was made to some of the important contributors to the field of regional input-output analysis; many of these individuals were trained as economists and thus were strongly influenced by the Keynesian view of the functioning of the economic system. Many of the geographers who became associated with the emerging field of regional analysis and regional science were exposed to the ideas contained in the so-called basic-nonbasic ratio and its role in understanding the functioning of city systems. The basic-nonbasic idea was eventually recast to become the economic base model, one of the major contributors to the explanation of differential urban and regional growth in national economies. Another important influence on this field was the work being undertaken in international trade theory—particularly the role of the foreign trade multiplier. These seemingly disparate views of aspects of the economy, at different spatial levels (international,