

The heart of the book is Part II on international economic forecasting; it contains a description of the genesis and characteristics of the INTERLINK model and its central role in the development of the semi-annual forecasts prepared for the meetings of the OECD Economic Policy Committee and subsequently published in the *OECD Economic Outlook*. In keeping with the purposes of the authors, the description of the structure of INTERLINK is qualitative and informal—no equation is to be found—providing the general reader with a basic outline of the system and its capabilities but containing little documentation for informed judgment on the technical merits of the model.

In common with most multinational systems, INTERLINK comprises a set of structural country models which are linked together by endogenous trade flows and prices as well as endogenous exchange rates and capital flows. The country models themselves are basically disaggregated IS-LM models augmented with supply-side equations for wage (labor-market Phillips curves) and price (markup equations with capacity utilization constraints) determination. On the international level, commodity prices also feed back to domestic cost and price structures. Consistency of trade and financial flows and prices is assured by appropriate weighting procedures in the world solution algorithms.

The description of the role of INTERLINK in the making of the periodic OECD forecasts will be especially interesting to users of the forecasts. The INTERLINK model basically determines the international consistency of the linked country forecasts, operating within the nontrivial constraints that policy variables must be set consistently with announced economic policies of the member governments and that nominal exchange rates are assumed to be unchanged over the 18-month forecasting horizon. Country-model inputs are provided largely by desk officers, and procedures have been worked out for systematic interaction between the INTERLINK model and the country specialists as the linked forecast evolves through successive rounds. The final forecasts as published have therefore been scrutinized closely within the OECD research organization and also by experts from OECD member countries and the Economic Policy Committee. Presumably, however, the published forecasts may not rep-

resent the preferred unconditional forecasts of the INTERLINK team, owing to the aforementioned constraints involving announced policies and constant exchange rates.

Part III contains a capsule history of macroeconomic policies in the OECD region during 1979–1983 and a chapter on international cooperation in economic policy making, including historical examples of successful cooperation during the Smithsonian currency realignment of 1971 and the agreement on a coordinated policy package at the Bonn Summit of 1978. The authors conclude that cooperation involving joint commitments to specified policy actions has been disappointingly slim and discuss some of the obstacles to greater cooperation. Positive suggestions are offered as immediate steps to improved international cooperation: (1) achievement of agreement on appropriate policies to improve supply-side performance by moving toward more market-conforming behavior, and (2) intensification of timely exchange of information among countries about current policy motivations, plans for the period ahead, and the ways in which they would be likely to respond to various contingencies.

As the authors note, INTERLINK is not a research vehicle but a framework for deploying the empirical work of OECD Secretariat's Economics and Statistics Department on issues which the Secretariat is regularly called upon to address (p. 162). This book provides an excellent description of the policy environment and institutional setting within which the model is employed and a judicious appraisal of the successes and failures of macroeconomic policy making in general since the 1950s.

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## 200 Quantitative Economic Methods and Data

### 210 ECONOMETRIC, STATISTICAL, AND MATHEMATICAL METHODS AND MODELS

*Fixed point theorems with applications to economics and game theory.* By KIM C. BORDER. Cambridge, New York and Sydney: Cambridge University Press, 1985. Pp. viii, 129. \$29.95. ISBN 0-521-26564-9. *JEL* 86-0447

I remember that, as a graduate student studying mathematical economics, I was constantly

on the lookout for good reference books. Where could I find the most elementary proof of Michael's selection theorem? What was the relationship between Brouwer's fixed point theorem and the Knaster-Kuratowski-Mazurkiewicz lemma? The problem with looking through mathematics textbooks is that the topological tools used by economists are so specialized and that mathematics books contain so much information not immediately relevant to a mathematical economist. Books about mathematical economics, on the other hand, contain only the mathematics directly relevant to a specific application, often given without proofs and without explanations of interconnections between different mathematical results.

This little book is the one that I was always looking for as a graduate student. It is a systematic presentation of the fixed point theorems used in mathematical economics and game theory. As well as presenting statements and proofs of these theorems, the author shows how they are relevant in economics and game theory.

After a brief introduction to general equilibrium models and games, the book develops the basic concepts of convexity theory and topology to be used. It then goes on, over the space of four short chapters, to prove the Knaster-Kuratowski-Mazurkiewicz lemma and Brouwer's fixed point theorem. The approach used is the combinatorial one: the author defines the concept of simplicial subdivisions and proves that each one contains a completely labeled subsimplex. This is, of course, Sperner's lemma. Using the fact that every sequence on a compact set has a convergent subsequence, he then easily obtains the K-K-M lemma and Brouwer's theorem. This approach is a popular one in economics because, as the author explains, Herbert Scarf has converted a constructive proof of Sperner's lemma into an algorithm for computing approximate fixed points.

Using similar elementary approaches the author proves a number of important results that have been used by mathematical economists and game theorists. The most central of these are: the maximum theorem, which gives conditions under which the set of solutions to a constrained maximization problem varies as an upper-hemi-continuous, point-to-set correspondence with the parameters of the problem; Michael's selection theorem, which gives conditions under which a continuous function can

be selected from a correspondence; Kakutani's fixed point theorem; and the Fan-Browder theorem, which gives conditions under which two correspondences defined on the same set have image sets that intersect.

The emphasis here is on the mathematical results themselves rather than their economic applications. Nonetheless, proofs of the existence of equilibrium in market economies, of Nash equilibria in noncooperative games, and of the core of cooperative games are included. The author has an interest in economies and games in which the agents do not have transitive preferences, and so the book puts special emphasis on this topic, proving a number of original results.

Perhaps the book's greatest strength is that the level of mathematical sophistication it requires is uniform throughout. If the summary of its contents in the previous three paragraphs does not sound familiar, then this book is not for you. There is nothing in it, however, that a graduate student studying mathematical economics should not be able to follow and understand. Another feature that I find particularly attractive is the stress that it puts on the interconnections and cross-references between results. There are, in fact, two chapters devoted to such interconnections, for example, how the Fan-Browder theorem implies Kakutani's theorem, how the equilibrium existence theorem implies Brouwer's theorem, and, of course, how the K-K-M lemma both implies and is implied by Brouwer's theorem.

One minor shortcoming is that the author cannot seem to decide whether he wants a textbook or a reference book. On one hand, too many proofs of results are left for exercises for it to be an ideal reference. On the other hand, the material is too specialized and there are not enough applications for it to serve as the principal textbook for a graduate course in mathematical economics. I would also have liked to see more use of simple diagrams to illustrate results, although there are a number of diagrams used effectively in the early parts of the book.

A reviewer is always tempted to criticize a book for not being the one that he would write if faced with the same task and endowed with the same amount of energy as the author. As much as I enjoy this book, I will give in to this temptation and mention how disappointed

I was not to see any material on topological index theorems or the Poincaré-Hopf theorem. These results, which are closely related to the material presented in this book, have been used over the past decade to prove the uniqueness of equilibrium in economies and games and, more recently, to prove the existence of equilibria in models with financial assets and models with sunspots. I would have very much liked to have a ready reference to these topics, written with the same conciseness and clarity as the material presented.

Overall, this is a beautiful little book. As a researcher in mathematical economics and a teacher of graduate courses in the subject, I am very glad to have it on my bookshelf. I only wish that it had been written ten years ago so I could have had it as a student.

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220 ECONOMIC AND SOCIAL STATISTICAL  
DATA AND ANALYSIS

*Income distribution: Theory, modeling, and case study of Brazil.* By GIAN S. SAHOTA AND CARLOS A. ROCCA. Ames, Iowa: Iowa State University Press, 1985. Pp. ix, 236. \$24.95. ISBN 0-8138-0988-6. JEL 86-1082

In this book, Sahota and Rocca analyze income distribution in Brazil using an ambitious multisector multiregion model. While most specialists accept that the determination of income distribution in less developed countries is a very complex matter, only a handful of intrepid explorers have charged ahead in this direction. Though not the largest such model in terms of number of equations, this one's subtlety of specification makes it an interesting test of the potential of the genre in helping us to better understand income distribution and the policies that affect it. Brazil is an appropriate subject country. If not the extreme case of economic inequality in the world it is in the running; it also has a history of rapid growth and structural change. Both authors have studied Brazil extensively.

Sahota and Rocca begin with a useful chapter reviewing the competing theories of personal income distribution. They then provide chapters on the major building blocks of the overall model—the urban sector, the agricultural sec-

tor, the public sector, and the interregional flows of capital, labor, and goods. These self-contained submodels are tied together in the overall model, which is then used for several exercises in policy optimization. The submodels are used to calculate impact elasticities to show how changes in the exogenous variables affect the income of each of three income classes.

The heart of the book, in which the models are developed and put through their paces, is a hard read, due both to the size of the apparatus and to the frequent terseness of the discussion associated with individual equations. But it is a good base from which to consider the hoped-for strengths and the inevitable weaknesses of the large computable general equilibrium approach to the study of income distribution.

Chapter Two's review of personal income distribution theories, while only loosely connected to the rest of the book, effectively argues the importance of integrating the Cambridge theories of inherited fortunes and the Chicago human capital model. While that need should have been obvious to any but the wearer of ideological blinkers, the marriage has indeed been belated. The modeling of the rest of the book is similarly judicious in weaving together supply and demand side factors, so that results are not prejudiced by built-in bias toward either a strongly neoclassical or a strongly Keynesian structure. Unlike most analysts of distribution, the authors do try to incorporate public consumption in the income concept. And they allow, both in principle and in their estimating procedures, for the possibility that imperfect markets can leave marginal value products unequal to factor payments.

Despite these promising features, avoidable and unavoidable problems diminish the contribution of this modeling effort to a better understanding of income distribution in Brazil. Weakness and incompleteness of the data base is in the main unavoidable, though time does bring improvement. Inadequate time to probe individual relationships and the lack of solid prior work to aid one are matters of degree. Most of the few large distribution-oriented models undertaken so far, including this one, would have benefited from two to three times more work in trying to get the individual equations right, and from more team members to provide