

The Economics of Network Industries

This book introduces upper-level undergraduates, graduate students, and researchers to the latest developments in network economics, one of the fastest-growing fields in all industrial organization. Network industries include the Internet, e-mail, telephony, computer hardware and software, music and video players, and service operations in the banking, legal, and airlines industries among many others. The work offers an overview of the subject matter as well as investigations about specific industries. It conveys the essential features of how strategic interactions between firms are affected by network activity, as well as covering social interaction and its influence on consumers' choices of products and service. Virtually no calculus is used in the text, and each chapter ends with a series of exercises and selected references. The text may be used for both one- and two-semester courses.

Oz Shy is Associate Professor of Economics at the University of Haifa, Israel. He has also taught at Tel Aviv University, the Stockholm School of Economics, the Universities of Michigan and Minnesota, Carleton College, and the State University of New York. Professor Shy's textbook *Industrial Organization: Theory and Applications* was published by MIT Press in 1996. He has written articles for the *Journal of Economics and Management Strategy* and the *International Journal of Industrial Economics*, among other leading publications.

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For Sarah, Daniel, and Tianlai

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Preface

Motivation for Writing This Book

The motivation for writing this book grew from several years of research on the economics of network industries as well as from extensive teaching of undergraduate and graduate industrial organization courses at Haifa University, Swedish School of Economics (Hanken), Tel Aviv University, Stockholm School of Economics, the University of Michigan, and the State University of New York. I felt that the economics of networks is an important field in economics as it applies to a wide variety of industries that influence our life and will even become more influential in this millennium. In addition, it provides some link between consumer behavior and social interaction.

I chose to target this theoretical book for advanced undergraduate and beginning graduate students. I was guided by my belief that there should not be any necessary correlation between mathematical complexity and theoretical precision. That is, the purpose of this book is to bring to the advanced student the basic and the latest developments in this field in a very precise manner, but without resorting to advanced mathematical techniques.

The Level and Prerequisites

My intention is to make this book readable to undergraduates who have some training in intermediate-level microeconomics, although in some cases, such as in engineering school, even this training may not be needed. This course can be taught without using calculus. Occasionally, the student will have to have a very basic knowledge of what probability is and how to calculate the joint probability of two events in discrete spaces. Of course, students who have had a course in industrial organization will be familiar with most of the techniques used in this book, but taking such a course is definitely *not* a prerequisite.

To the Instructor

The instructor will find sufficient material in this book to fill at least a one-semester course, if not an entire year. This book is almost calculus free (all calculus topics could be skipped). All the analysis is game theoretic and therefore the course must start with the teaching of Game Theory given in the three appendices at the end of this book. I recommend spending two lectures on game theory given in Appendices A and B, which constitute the major tools of analysis used in this book. Appendix C defines the Undercut-proof equilibrium (UPE) concept, which is used commonly in this book, and therefore must be taught. Using the UPE facilitates the entire analysis of this book as it allows us to focus on non-calculus discrete models for which a Nash-Bertrand equilibrium does not exist.

It is advisable to follow the book in the order it is written. It is recommended that most sections in Chapter 2 be taught as they provide the basic definitions and the methodology used throughout the book.

At the end of each chapter and appendix, I have provided the student with several exercises. The instructor is strongly urged to assign exercises to students, in particular the exercises appearing at the end of the Game Theory chapters, Appendices A, B, and C. In general, the exercises at the end of each chapter attempt to motivate the student to understand and memorize the basic definitions associated with the various theories developed in that chapter.

Errors, Typos, and Errata Files

My experience with my first book, *Industrial Organization: Theory & Applications*, Cambridge, Mass.: The MIT Press, 1996, has been that it is near to impossible to publish a completely error-free book. Writing a book very much resembles writing a large piece of software. First, all software packages always contain some bugs which the author could not forecast. Second, just like software, 80% of the time is devoted to debugging the software. I will therefore make an effort to publish all errors known to me (if found) in this book.

Thus, errata files will be found on my home page, which is currently <http://econ.haifa.ac.il/~ozshy> and on the publisher's Internet site (with a link to my updated homepage and email addresses).

Typesetting and Acknowledgments

This book was typeset by the author using the $\text{\LaTeX} 2_{\epsilon}$ document preparation software developed by Leslie Lamport (a special version of Donald Knuth's \TeX program) and modified by the $\text{\LaTeX} 3$ Project Team.

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The book was typeset during the months from April 1999 to July 2000 and was tested in classes taught at the Swedish School of Economics and Business Administration (Helsinki, Finland) and Haifa University (Haifa, Israel).

As boring as it may sound, the following cliché is the whole truth and nothing but the truth: Without the help of the people listed below, I would not have been able to complete writing this book! Foremost, I thank Sivan Frenkel (a Graduate Student at Haifa University) for reading the entire manuscript throughout the 1999 to 2000 academic year and for providing me with a wide variety of suggestions, corrections, and wise advice. In addition, I thank: Amit Gayer (Haifa University), Ugo Merlone (University of Torino), and Joerg Oechssler (University of Bonn), for most valuable corrections and suggestions during the process of writing this manuscript. I also thank a large number of exceptional international students at the Swedish School of Economics (Hanken) for the patience needed for reading and learning from the first draft of the manuscript during a crash course given in September to October 1999; and my undergraduate students at Haifa University and for their comments and corrections throughout a course delivered during the Fall 1999 semester.

During the preparation of the manuscript, I was very fortunate in working with Scott Parris of Cambridge University Press, to whom I owe many thanks for managing the project in the most efficient way. Scott has been fond of this project for several years, and his interest in this topic encouraged me to go ahead and write this book. Finally, I thank the entire Cambridge University Press team for a fast production of this book.

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