Preface

We are very happy to introduce you to the next two volumes of the Handbook of Industrial Organization. As the latest volume in the series was published in 2007, our contributors have striven to describe developments in the field of industrial organization in the last decade and a half. This has been a fruitful time for the field, in which the "econometric revolution" that started with the New Empirical Industrial Organization (NEIO) approach described in Volumes 1 and 2 of this Handbook continued to gain maturity, alongside important developments in the microeconomic theory landscape. Perhaps most strikingly, the theory-based empirical methods toolbox that has now become the mainstay of industrial organization economists has expanded its reach in a variety of application domains, covering broad swathes of the modern economy. This is not surprising, as the lifeblood of any empirical enterprise is data, and data has become quite abundant thanks to the increasing use of information and computing technologies by modern economic enterprises. The data comes in many shapes and sizes, encompassing firm level data that powers productivity studies, to product and even consumer level data that allows researchers to estimate demand with a high level of fidelity. The abundance of such data opens up many new opportunities as well as challenges, as will be discussed by the chapters in these next two volumes.

We have chosen to organize Volumes 4 and 5 in a thematic manner. The first 5 chapters, in Volume 4, review developments in the empirical/econometric methodology domain, which is the continuation of the NEIO program. Chapters 6 through 9, also in Volume 4, cover important developments in industrial organization theory, much of which has been accompanied by important empirical applications that have taken these theories to data. Chapters 10 through 17, in Volume 5, are focused on applications of the theory and econometric toolbox to longstanding economic policy questions and the in-depth study of important sectors of the economy. The policy questions range from the design of matching and auction markets, to regulation, antitrust, and innovation policies. The expanding reach of the "IO" approach is further demonstrated in sectoral studies on credit and insurance markets, financial markets, healthcare, the energy sector, and the environment. These are application areas where there has been an explosion in methods and models that are of use not just for those applications but also more broadly. That is, methods developed for application to these markets have been used elsewhere in Industrial Organization, as well as in these particular areas. This is one reason why they merit particular consideration here. Further, the results of many of these papers have had measurable effects on the real world, for example on antitrust policy and enforcement.

Chapter 1, titled "Foundations of Demand Estimation," by Steven Berry and Philip Haile, provides a unified discussion of the key conceptual ideas that have been

developed by several literatures on demand estimation. Maintaining a focus on discrete choice approaches popular in industrial organization applications, the chapter begins by discussing the unique and difficult challenges posed by the problem of demand estimation. This is followed by discussions on the choice of instrumental variables, the utilization of different data types that are typically available (market-level, consumer-level, and panel data), and the question of nonparametric identification.

Chapter 2, titled "Empirical Models of Demand and Supply in Differentiated Products Industries," by Amit Gandhi and Aviv Nevo, complements Chapter 1 by focusing on the implementation and applications of modern demand estimation methods utilized by industrial organization researchers. The chapter opens with a brief recap of the classic paper by Bresnahan (1987) that has set the framework for many empirical papers: formulate and estimate a model differentiated product demand (in Bresnahan's case, for automobiles), and use demand estimates to infer unobserved supply side parameters and test hypotheses about firm conduct. Gandhi and Nevo then discuss subsequent developments in the demand estimation literature, especially discrete choice demand models, reviewing how different types of data and sources of exogenous variation/instrumental variables can be used to identify and estimate the parameters of interest. They then discuss applications of demand estimates, such as simulating the effects of mergers, and testing alternative models of firm conduct, with close attention to the vertical organization of the supply side. The chapter also discusses extensions to the static discrete choice demand model, including models allowing for multiple purchases, and dynamic considerations such as storable and durable goods.

Chapter 3 is "An Industrial Organization Perspective on Productivity," by Jan De Loecker and Chad Syverson. The chapter opens with a discussion of the concept of productivity and some motivating stylized empirical facts about firm and establishment level measured productivity: dispersion across producers, persistence within a producer, and the correlation of productivity with other producer-level outcomes such as profitability, size, survival, prices charged to customers, and wages paid to workers. The chapter then discusses an equilibrium model that can generate these stylized facts. The rest of the chapter focuses on empirical work on productivity. Starting with a discussion of the measurement of outputs and inputs, it discusses the factor share and production function approaches to productivity measurement, focusing on challenges introduced by the endogeneity and mismeasurement of inputs, and departures from assumptions of perfect competition, homogeneous products, and single product firms/establishments. It then discusses several significant applications of productivity analysis, ranging from the analysis of productivity drivers/dispersion to the (mis)allocation of inputs across enterprises with different levels of productivity. The chapter concludes with a "look ahead" to some recent developments in the productivity literature, especially the study of product market and labor market power using the production function approach that has gained considerable attention in recent years.

Chapter 4 is "Dynamic Games in Empirical Industrial Organization," by Victor Aguirregabiria, Allan Collard-Wexler, and Stephen Ryan. The theory and econometrics of dynamic games are central to understanding the endogenous evolution of

market structure and competitive outcomes. The chapter lays out the Markov Perfect Nash Equilibrium (MPNE) framework that has found many applications in industrial organization. It then overviews the types of data that are typically available for empirical research, and discusses whether and how model parameters can be identified using available data. Estimation of structural parameters of MPNE models is discussed next, with a focus on addressing implementation challenges introduced by computational complexity and curse of dimensionality. The chapter concludes with a discussion of the many empirical applications of the MPNE framework. The application topics discussed include innovation, antitrust and mergers, regulation, uncertainty and investment, advertising, dynamic pricing, product repositioning, and other topics.

Chapter 5 is "Moment Inequalities and Partial Identification in Industrial Organization" by Brendan Kline, Ariel Pakes, and Elie Tamer. This chapter presents recent developments in the use of moment inequality models and partial identification more generally in Empirical Industrial Organization. It begins by formalizing the distinctions between the different notions of identification and their relationship to various estimators. The following sections provide a set of assumptions that are useful in enabling the researcher to use revealed preference inequalities for estimation. The resulting framework allows for strategic interaction, alternative information sets, and measurement and mis-specification error. A particular implementation is then covered in detail, motivated by the standard discrete choice literature. Alternative assumptions are also considered that allow the researcher to analyze likely counterfactual equilibria. Estimation and inference are considered in detail, including the problems that arise in analyzing interacting agent models with a complete information assumption. Overall, the chapter should be useful to applied researchers in I.O. who might wish to use these methods in their own research, helping them understand many of the primary ideas underlying their use in the previous literature.

Chapter 6 is "Frictions in Product Markets" by Alessandro Gavazza and Alessandro Lizzeri. This chapter considers several types of frictions that impede efficient transactions. The focus is on market frictions rather than firm-level frictions, although the presence of such frictions may lead to the emergence of intermediaries or dealers. Following the recent literature in Industrial Organization, the focus is largely on markets with large numbers of participants rather than on transactions with a small number of players. The sections of the chapter consider transactions costs; their effects in secondary markets for durable goods; asymmetric information; and search and matching frictions. In each section, the authors consider how the relevant friction affects allocations and consumer behavior; discuss the effect of these frictions on incentives; and also consider how the presence of frictions gives scope for third parties such as intermediaries to play an important role in some markets.

Chapter 7, titled "Two-sided Markets, Pricing, and Network Effects," is by Bruno Jullien, Alessandro Pavan, and Marc Rysman. This chapter overviews the literature on the economics of platforms. Platforms are intermediaries between different market sides. Examples are ride-hailing companies that mediate the delivery of transportation services by drivers and its demand by riders; credit card companies that offer payment

services between buyers and sellers; cable TV companies that mediate between content providers and viewers; and many others. Platforms often display network effects in that the value of being on the platform depends on who else is also on the platform. Platforms pricing decisions can have complex consequences that are quite different from standard pricing intuitions because the effects of a price change on one side of the market has repercussions for the willingness to pay of the other side. The chapter surveys both the rapidly growing theoretical literature, and the more recent empirical contributions.

Chapter 8, titled "Information Markets and Nonmarkets," is by Dirk Bergemann and Marco Ottaviani. This chapter examines market failures and potential policies in the context of information goods, and also considers the interaction between market and non-market incentives. The topic is particularly timely given the increasing relevance of data for many transactions, and the importance of data for some of the most valuable (in terms of market capitalization) companies in the world, such as Amazon, Google, and Facebook. The chapter first overviews recent contributions to the topic of mechanism design approaches to buying and selling information; it then discusses the organization of markets for information; it then moves on to consider tools that facilitate or impede the trade of information; it next discusses institutional arrangements for the collection of information and for aggregating expert judgments such as forecasts. Finally, it discusses the literature on science as a form of production of information and knowledge that is not organized as market. These themes come up again in Chapter 13 on innovation.

Chapter 9 is "Structural Empirical Analysis of Contracting in Vertical Markets" by Robin S. Lee, Michael D. Whinston, and Ali Yurukoglu. The paper synthesizes the developing literature on vertical markets in Industrial Organization over the last 15 years. Recent empirical work on vertical and intermediate goods markets has utilized advances in the theory of vertical contracting and in empirical demand estimation literatures. This chapter pulls together the somewhat different theoretical structures from different papers into a single, useful framework. It is clear that assumptions regarding the nature of the supply chain, where several layers may be characterized by an oligopolistic market structure, and regarding how contract terms are negotiated, are often important for the predicted effects of counterfactual policy choices. The chapter also considers the availability of data in different vertical markets.

Chapter 10, titled "Market Design," is by Nikhil Agarwal and Eric Budish. This chapter surveys both theoretical and empirical contributions in the rapidly growing field of market design. As the authors frame it, the market design field studies the rules governing market interactions among various participants in order to understand their effects, to identify potential market failures, and to remedy them by designing better institutions. One possible alternative definition of the field is as "applied mechanism design," offering diagnoses of problems in existing institutions, and suggesting workable improvements. Classic examples of important settings where market design has had an important influence is the case of school choice, where students must be matched to schools, auctions, kidney exchange, the design of suitable financial market trading mechanisms, etc. The field has generated important theoretical insights

starting with work in the 1960s, and has more recently seen a flourishing of empirical work; overall these insights have been influential in affecting policy in a number of settings. The chapter thoroughly discusses these various angles.

Chapter 11, titled "Empirical Perspectives on Auctions," is by Ali Hortaçsu and Isabelle Perrigne. Auctions are used to allocate a wide variety of goods ranging from paintings, to electricity, to treasury securities, to advertising slots on the internet. A vast literature has emerged to study the properties of various auction formats. Since the late 1980s the empirical analysis of auctions has grown tremendously. This chapter provides an overview of the field which offers both an update and a different perspective compared with the chapter by Hendricks and Porter in the previous volume of the *Handbook of Industrial Organization*. Hendricks and Porter combine all aspects of the analysis of auction data by stressing the link between auction theory, empirical practice and public policy questions. The present chapter instead is organized by the type of good sold because the policy and design questions often depend on the nature of the product auctioned. In contrast with prior surveys this one focuses on policy and design questions rather than econometric methods.

Chapter 12, titled "Collusion, Mergers, and Related Antitrust Issues", is by John Asker and Volker Nocke. The chapter surveys the recent literature on antitrust regulation, considering in particular questions relating to collusion and mergers. In terms of collusion, the authors begin by asking how pervasive collusive conduct is, and then analyze how collusive schemes operate. They also consider both theoretical and empirical work on the impact of collusion on market outcomes. They then turn to mergers. The discussion considers in particular the impact of enforcement institutions, work on unilateral effects, and theory relating to the selection of which mergers are proposed to antitrust agencies and optimal policy in the face of that selection. The small literature considering optimal remedies is also discussed, together with the empirical evidence on the effects of mergers.

Chapter 13, titled "Innovation: Market Failures and Public Policies," is by Kevin A. Bryan and Heidi L. Williams. Innovation is responsible for a large portion of economic growth, and understanding its drivers as well as evaluating policies that may encourage innovation is clearly of first order importance. Economists have long understood that competitive markets, which have admirable efficiency properties in other settings, have important shortcomings in the context of innovation, and public policy has responded by introducing potential other distortions, such as in the context of patent policy which grants monopoly power to an inventor. This chapter discusses these theoretical and policy issues, then examines the many challenges facing the empirical researcher aiming to measure the extent of inefficiencies and the potential effectiveness of alternative policies. The paper also discusses the interaction between market and non-market incentives for science and innovation.

Chapter 14 is "The IO of Selection Markets" by Liran Einav, Amy Finkelstein, and Neale Mahoney. The vast majority of theoretical and empirical research in Industrial Organization focuses on markets where the identity of the buyer does not affect the cost. In such markets, sellers care about how consumer demand affects how many units they sell, but they do not care which consumers buy and which do not. In se-

lection markets, by contrast, consumers vary not only in their willingness-to-pay for a product but also in how costly they are to the seller. Sellers therefore care not only how many units they sell, but to whom. That is, they care about selection. This chapter considers such markets. The leading examples considered are primarily drawn from credit and insurance markets, but other markets are also addressed. The chapter begins with a brief history of theoretical work on selection markets before focusing on recent empirical research. A general framework for analyzing selection markets is provided followed by detailed examples.

Chapter 15, titled "The Industrial Organization of Financial Markets," by Robert Clark, Jean-François Houde, and Jakub Kastl, discusses recent developments in the application of industrial organization approaches in finance. The chapter starts with a model of financial intermediation where the source of funds for the investment activities can be either from retail investors/depositors, or from wholesale funds markets, such as debt markets or interbank loans. The chapter then studies competition and market structure in these markets with particular attention to imperfect competition, asymmetric information, and information frictions, utilizing empirical methodologies developed to characterize structural models of demand and supply. Specific applications considered include primary and secondary markets for government and corporate debt, interbank loans, deposits and investment products, mortgages, and other credit products.

Chapter 16 is "The Industrial Organization of Health Care Markets" by Ben Handel and Kate Ho. The chapter reviews a large and expanding literature that studies the very large healthcare sector from an industrial organization perspective. In the healthcare context, the vertical relationship between insurers and healthcare providers and adverse selection into insurance plans emerge as central economic forces. The chapter thus discusses models of bargaining between insurers and healthcare providers, and models of demand that account for self-selection that have been developed to study, respectively, insurer-provider and consumer-insurer relationships. The chapter then discusses the application of these models to the design and regulation of healthcare markets. A particular focus is on the design of health insurance exchanges, especially in the context of the implementation of the Affordable Care Act (ACA). The discussion provides a detailed survey of recent empirical analyses and insights regarding various regulatory interventions that have been implemented or proposed to improve the functioning of these markets.

Chapter 17 is "Energy and Environmental Markets, Industrial Organization, and Regulation" by Ryan Kellogg and Mar Reguant. The chapter covers a series of developments in energy markets since the 1990s that have attracted the attention of Industrial Organization economists among others. These developments include the restructuring of the electricity industry away from vertically integrated utilities and towards independent power producers that compete in wholesale power auctions; the introduction of cap-and-trade markets for greenhouse gases and local air pollutants; the tightening of fuel economy standards; and the adoption of policies to promote zero-emission energy sources. This evolution of regulation and policy has taken place concurrently with innovation in energy production and also an increasing need to re-

duce greenhouse gas emissions, now and in the future. Understanding and modeling these changes requires addressing questions that are well-suited to the use of tools from Industrial Organization. The authors review the recent literature at the intersection of Industrial Organization, energy markets, and environmental regulation. They also highlight areas where insights from energy and environmental markets are likely to be relevant for other settings.

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