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Program Report

Industrial Organization

Nancy L. Rose

The NBER Program in Industrial Organization (IO), established in 1991, promotes applied economic research on a broad set of questions relating to firm behavior, the organization and operation of markets, and the economic analysis of government regulation. The last decade has provided a wealth of new, interesting, and important questions for industrial organization and regulatory economists to study. There have been substantial changes in market structure in many industries, from sources as varied as merger waves, reorganization of production and distribution, and increased international competition. Market-based institutions increasingly are replacing government regulation or ownership of firms, in industries as diverse as airlines, railroads, electricity, and telecommunications. Even where regulation has been retained, it often has been transformed to replace "command-and-control" with economic incentives and enhanced flexibility. Finally, researchers have developed a wealth of new databases and microeconometric techniques to study firm behavior, including issues such as pricing decisions in differentiated product markets, the effect of search costs on market outcomes, and the determinants of firms' contracting and internal organization decisions, that previously had been subject to only theoretical discussion.

This report describes several broad research themes analyzed by members of the Industrial Organization program. Rather than presenting an exhaustive summary of past research, I have chosen to focus on a set of major topics, and to explain critical findings in each one.

Deregulation, Restructuring, and Market Design: The Case of Electricity

In the late 1980s and the 1990s, throughout the world, basic infrastructure industries including electricity, telephone, natural gas, railroads, and even water distribution have undergone dramatic reorganizations. Government ownership or administrative regulation typically has been replaced with sub-

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stantial reliance on private market mechanisms within much or all of the restructured industry, and "natural monopoly" characterizations have given way to notions of "workable competition." NBER researchers have been active in assessing the consequences of market restructuring and exploring market design issues in a variety of settings. I focus here on the work relating to electricity markets.

The electricity generation, transmission, and distribution industry, long operated as a vertically integrated, publicly-owned or regulated natural monopoly in virtually all markets worldwide, has attracted particular research attention. Catherine Wolfram has taken advantage of a wealth of data created by the United Kingdom's electricity restructuring to test competing models of firm behavior in deregulated markets.[1] She finds that while the two dominant generating firms in the England and Wales have been able to raise the pool price for wholesale electricity above their marginal costs of generation, they appear not to exploit their potential market power fully. Wolfram argues that this may be the result of efforts to reduce the threat of competitive entry or re-regulation. Frank Wolak and Robert Patrick provide further evidence on the potential magnitude of generators' market power in their study of the real-time price sensitivity of electricity demand for a group of industrial customers in the United Kingdom.[2]

A critical issue in the restructure of these markets is how specific institutions may enhance or mitigate the exercise of market power. England and Wales, which rely on an auction mechanism to clear the wholesale power market, provide an important research laboratory for exploring the effect of particular auction rules on market outcomes. Wolfram focuses on the multi-unit character of this auction to model generating firms'

incentives to raise their bid price for a given unit, as a function of the total quantity of generation they bid into the pool.[3] Because the price of all electricity traded through the pool is set by the bid price for the last unit selected to run, a generator that thinks its unit may be marginal has an incentive to increase its bid. This raises the price received on that unit and all inframarginal units it owns. Wolfram's empirical analysis finds behavior consistent with these predictions.

Wolak and Patrick focus on the pool rules that determine capacity payments at peak demand periods.[4] As a result of these rules, generator revenues can include substantial payments intended to reflect the shadow cost of capacity needed for reliable operation of the system during these high demand hours. They also document the incentive that this gives firms to strategically manipulate the amount of generating capacity made available to the power pool during peak periods, and they provide econometric evidence that suggests this behavior is an important mechanism by which the two dominant generators raise their overall profitability.

These studies of the electricity market in England and Wales are important for the information they provide about that market in particular, but they also are of more general interest. Wolak's current research focuses on the broad lessons for market design in a comparative study of restructured electricity markets that includes Australia and New Zealand, a number of Latin American countries, Norway and Sweden, as well as England and Wales. This body of work illustrates how detailed institutional characteristics of a deregulated market may affect its performance.

This research also provides substantial guidance on issues facing policymakers involved in restructuring electricity and other markets across the United States and elsewhere. Within the United States electricity market, the restructuring movement is in its infancy but growing fast; California and a number of New England states are slated to move to a more decentralized, market-based pricing and allocation system in early 1998. Matthew White explores the political and economic determinants of the heterogeneity across states in the timing and intensity of these restructuring efforts.[5] A number of NBER researchers have been active in the design of restructured markets at the state level, and the execution of these varied reforms is likely to provide the data to fuel further research on the role of market institutions on firm behavior and market performance.

Pricing and the Exercise of Market Power

The relationship between firms' marginal costs of production and the prices they charge is a central question in industrial organization. A range of new databases and new research tools have permitted substantial advances in its analysis. One strand of this research uses data on the dynamic pattern of prices within markets to test models of oligopoly behavior. This research is of considerable interest within the I.O. community, as it informs us of the ability of firms to achieve more cooperative, and therefore more profitable, price outcomes. It also is relevant to researchers in macroeconomics, as it may have implications for the counter cyclical behavior of price-cost margins, an important component of some models of macroeconomic fluctuations.[6] Severin Borenstein, in work with Colin Cameron and Richard Gilbert, and with Andrea Shepard, explores these issues using data on retail gasoline markets over time.[7] His research suggests that gasoline retailers exercise at least short-run market power, and that price patterns over seasonal demand cycles are consistent with the predictions of Rotemberg-Saloner style supergame models of sustainable price collusion.[8]

Judith Chevalier and David Scharfstein develop a model in which liquidity constraints can generate countercyclical mark-ups. They find empirical support for its predictions in their study of supermarket pricing.[9] Fiona Scott Morton analyzes a particular event—passage of 1990 legislation establishing a "Most Favored Customer" clause for Medicaid pharmaceutical reimbursements—that may have provided firms with a mechanism for coordinating price increases.[10]

The public availability of detailed microdata on United States airlines, combined with the large number of geographic airline markets to study, has generated a wealth of empirical work on pricing behavior in this sector. NBER researchers have analyzed the determinants of market power; estimated structural models of demand, cost, and mark-ups; and studied the determinants of price dispersion, including the role of competitive price discrimination in generating the huge variation in prices paid by different passengers on the same airline and route that is observed in fare data.[11] My recent work with Borenstein explores the effect of bankruptcy on airline fares.[12] We conclude, in contrast to claims by some industry participants, that there is little evidence that bankrupt carriers harm their more healthy rivals. Indeed, while carriers may lower their prices prior to filing for Chapter 11 bankruptcy protection, their rivals appear to maintain their price level and maintain or increase their passenger volume.

A number of NBER researchers have turned to historical data to test

models of firm behavior and to explore the mechanisms by which firms achieve collusive outcomes. Historical data may be more readily available than contemporaneous data, given firms' concerns about the sensitivity of price data and potential antitrust liability. It also may shed light on firm behavior under different antitrust regimes. Glenn Ellison, for example, has extended Robert Porter's classic analysis of price collusion by 19th century railroads to compare and test the formal predictions of competing supergame models of collusion.[13] Ellison suggests that price patterns in this market are characterized by periods of collusion punctuated by episodic price wars, and that these wars may be triggered by secret price cutting by some market participants.

David Genesove and Wallace Mullin study the exercise of market power in the sugar industry around the turn of the century.[14] Their work compares results from both traditional and "new empirical I.O." techniques for measuring the exercise of market power, explores the use and effectiveness of predatory pricing as an entry deterrent, and chronicles the development of the industry trade association as a device for coordinating pricing behavior. Scott Morton analyzes the determinants of predatory pricing responses to entry in British shipping cartels.[15]

Differentiated Products Markets

NBER researchers have made significant methodological advances in modeling price formation in differentiated product markets. This research involves the specification and estimation of "structural" models of firm behavior, linking models of cost and demand with specific parameterizations of firm behavior in equilibrium. Steven Berry, James Levinsohn, and Ariel Pakes develop and apply a set of these techniques to model the behavior of firms in the U.S. automobile industry.[16] In recent work, they estimate the distributional and welfare effects of the voluntary export restraints that were initiated in 1981 on Japanese cars sent to the United States. Their research suggests that this policy resulted in substantial transfers from U.S. consumers to U.S. auto producers, a relatively negligible effect on Japanese auto producer profits, and an overall U.S. welfare loss.

Timothy Bresnahan, Scott Stern, and Manuel Trajtenberg develop and estimate an alternative discrete choice model to analyze product differentiation and the sources of rents in the market for personal computers.[17] Their results, along with a substantial body of new research on differentiated products markets within the context of the market for new products, is reported in the NBER volume, *The Economics of New Goods,* edited by Bresnahan and Robert J. Gordon.[18]

Internal Organization of Firms

The questions of what a firm is, how its boundaries are determined, and how firms choose to organize their production, have attracted considerable attention from economic theorists in recent years. Despite this, empirical research lags far behind. This results, at least in part, from the difficulty of getting data on the internal choices and operations of firms. If the data problems can be solved, there are a host of exciting empirical research questions to be answered. NBER I.O. program members are beginning to make real inroads on a number of these.

Judith Chevalier and Glenn Ellison have used a novel database on mutual funds to explore a variety of issues that arise in a principal-agent setting.[19] Their studies on the behavior and performance of mutual fund managers, provide interesting insights on a number of agency questions. For example, they find that shareholder responses to variations in fund performance, combined with management contracts that base manager compensation on total fund assets, have strong incentive effects on managerial risktaking. Fund managers, moreover, respond to these incentives differently at year-end. Those who are "ahead" in September adopt more conservative investment strategies relative to those who are "behind." Those behind seem to take on greater risk in a gamble to "catch up" with the market. Chevalier and Ellison currently are extending this research to explore the role of career concerns in structuring incentives and determining fund manager behavior.

The decision of what activities to include within a firm's boundaries is fundamental but not well understood. The generally disappointing performance of diversified enterprises over the past 20 years has generated a substantial debate over the extent to which this reflects the difficulty of managing a diversified corporation well, or is a result of the actions of entrenched managers who pursue their own gain at the expense of shareholders' interests. Andrea Shepard and I use data on chief executive officers' (CEOs) compensation to analyze these competing claims.[20] We document a substantial pay premium for managers of diversified firms, but find that incumbent CEOs who diversify the firm earn less than their counterparts who maintain or increase the focus of the firm's activities. We argue that the data are more supportive of an ability-matching explanation for the pay premium than of managerial entrenchment models.

A number of I.O. program members also have explored the determi-

nants of CEO compensation.[21] Paul Joskow, Shepard, and I argue that variations in executive pay across industries and over time suggest that political hostility to high CEO pay, mediated through regulatory institutions, may limit the compensation of executives in the most politically sensitive industries. Joskow, Wolfram, and I document a similar phenomenon within the electric utility industry. The incentive effects of compensation and the pay-for-performance relationship in executive pay also have attracted research attention.

Finally, a number of I.O. program members are involved actively in the NBER Project on Industrial Technology and Productivity, supported by the Sloan Foundation and described in the Spring 1996 *NBER Reporter*. This research combines traditional data sources with direct access to firms to understand how the organization of production lines, firm decisionmaking, or technology use may influence productivity and efficiency within the firm.

Vertical Organization of Firms

What determines the vertical structure of production: for example, are suppliers and manufacturers linked through common ownership, long-term contracts that may specify a variety of constraints on the parties' actions, or arms-length spot market transactions? The extent to which these choices are motivated by the quest for market power alone or reflect real efficiencies in production has important ramifications for theories of the firm as well as for the design and execution of antitrust policy. Theoretical work emphasizes that the balance between anticompetitive effects and efficiency may be context-specific. Douglas Bernheim and Michael Whinston, for example, explore this tension in a model of exclusive dealing contracts, in which a manufacturer prohibits retailers who carry its products from selling certain other specified products.[22]

Wallace and Joseph Mullin empirically investigate the tension between efficiency and market power motives in an analysis of the U.S. Steel long-term lease of iron ore properties of the Great Northern Railway in 1906.[23] While this lease often has been explained as vertical foreclosure of rival steel firms by U.S. Steel, their analysis suggests that the lease was expected to lower the market price for steel, and that the terms of the lease may be explained best as devices designed to achieve efficient relationship-specific investment.

Francine Lafontaine explores vertical relations in the context of business format franchising. She analyzes the variety of motives that may give rise to the development of franchising, and studies the way franchisors may act to solve a variety of principal-agent problems, through their choice of implicit and explicit contracts.[24] Her work on McDonald's with Patrick Kaufman, for example, suggests that franchisees earn substantial ex ante rents when they are awarded a franchise. While a variety of theories may explain the existence of ex post profits for franchisees, traditional models would not predict ex ante rents. Lafontaine argues that their presence may be explained by incentive models similar to "efficiency wage" type models, and by liquidity constraints among the potential franchisees most desired by McDonald's.

Auction Markets

Auctions, though typically thought of in conjunction with art and rare collectibles, are an important and common market form. Their use by governments has expanded substantially over the past few decades as auctions have been used to sell Treasury bills, to let procurement contracts, and to allocate property rights in areas as diverse as off-shore oil leases, timber, radio spectrum, and pollution. In the private sector, auctions have been used in markets ranging from real estate to wholesale fish and wholesale used car sales, and are the mechanism selected to set wholesale prices in many deregulated wholesale electricity markets as well. An extensive research program in economic theory has yielded important insights on the design, bidder behavior, and performance of auctions under certain stylized conditions. This research base played a critical role in the design of recent Federal Communications Commission auctions to allocate licenses for "PCS" spectrum. A growing empirical literature has been directed toward understanding the actual performance of different auction designs, the effect of bidder characteristics and auction structure on revenue, the possibility of bidder manipulation, and auction performance more generally.

A number of studies by I.O. program members have explored issues in auction performance, beyond the work described earlier on U.K. electricity auction markets. Robert Porter's research on auctions for off-shore oil and gas leases highlights the role of imperfect and incomplete information in government property auctions.[25] He analyzes firms' strategic responses to informational issues, including both pre-auction effects such as the formation of consortia and joint ventures, and post-auction effects, such as decisions of when and where to initiate exploratory drilling.

David Genesove analyzes the role of imperfect information and search costs on bidder behavior in wholesale markets for used cars.[26] Porter and Douglas Zona develop statistical tests and apply these to data on bids submitted in procurement contract auctions to detect possible bid-rig-

ging by subsets of auction participants.[27] Finally, NBER researchers Paul Joskow and Dick Schmalensee, with Elizabeth Bailey, analyze the market for sulfur dioxide emission permits.[28] They conclude that while the Environmental Protection Agency's auction market is subject to a number of design flaws, the private market rapidly developed an apparently efficient alternative trading mechanism that has rendered these flaws largely irrelevant.

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Research Summaries

The Evolution of Retirement

Dora L. Costa*

Not only are more men living past age 65 in America today than ever before, but American men also have been abandoning the labor force at ever younger ages. The retirement rate of American men over the age of 64 has risen rapidly from a mere 25 percent at the end of the last century to over 80 percent today. At the same time the very nature of retirement has changed. For most individuals retirement is no longer a time of withdrawal from all activities and of dependence on family and friends; rather it is a time of discovery, personal fulfillment, and relative independence. In the past, such a retirement experience was limited to the wealthy few who could afford it. Now it is an option available to the majority of workers.

That most men now can look forward to a period of personal fulfillment at the end of their working lives is one of the achievements of our century, but such a retirement is expensive, and financing it poses budgetary dilemmas. Approximately 80 percent of elderly households receive over half of their income from Social Security, and Social Security is facing a fiscal crisis. If men continue to abandon the labor force at ever younger ages, the crisis is likely to be even more acute. To understand whether retirement rates will continue to rise, we must examine how retirement has evolved from 1880 to the present. Retirement rates were rising throughout this period. In fact, 41 percent of the long-run rise in retirement rates occurred before the postwar growth of Social Security and private pension plans. In my forthcoming book, *The Evolution of Retirement: An American Economic History, 1880–1990* (University of Chicago Press for NBER, 1998), I therefore investigate the factors that have fostered rising retirement rates.[1]

Income and Retirement

Retirement requires income, whether in the form of state-provided retirement or disability benefits, private pensions, income from other family members, or assets. Researchers have investigated the role that each of these income sources plays in the retirement decision, largely using cross-sectional data for the years after the 1960s. But, because 70 percent of the rise in retirement among men older than 64 occurred before 1960, only large increases in benefits could have enticed those remaining in the labor force to have withdrawn.

Previous researchers have not been able to examine the impact of income on the retirement decision prior to the 1960s because the necessary data has been unavailable. Fortunately, a longitudinal dataset that follows Union Army recruits of the American Civil War from their youth to their death can be generated from census records and from records of the Union Army pension program. At the beginning of the century, Union Army pensions were the most widespread form of assistance to the elderly, serving about a quarter of the population over age 64 in 1900. I estimate the income effect of Union Army pensions on retirement rates.

I find that pensions had a substantial impact on retirement rates both in 1900 and in 1910. My findings suggest that the high labor force participation rates of older men prevailing at the turn of the century arose because retirement incomes were too low to fully support them and, as retirement incomes have risen, so have retirement rates. I attribute much of the long-term increase in retirement rates to the rising incomes of the elderly. Their wages, and hence their savings and pensions, have increased, as have government transfers.

However, increased income is not the sole explanation for the rise in retirement. In fact, I show that the income elasticity of retirement has fallen over time. Whereas rising retirement incomes could explain up to

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