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## Program Report

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## Industrial Organization

Nancy L. Rose\*

The NBER's Program on Industrial Organization (IO) celebrates its fifteenth anniversary this year. Researchers in the IO program explore a wide range of topics within the field. Rather than attempting to skim the full scope of program activity, this report highlights work in three broad areas: regulation and antitrust policy; pricing behavior by firms; and auctions markets.<sup>1</sup> Discussion of the substantial body of research on technology and technical change is deferred to reports of the Productivity Program and the NBER Project on Industrial Technology and Productivity. Those interested in learning more about the IO program may visit the NBER website for links to the full set of Industrial Organization Working Papers: <http://www.nber.org/programs/io/io.html>

### Regulatory and Antitrust Policy

When markets deviate from competitive ideals, assessing the desirability of government intervention requires a careful assessment of the costs of market failures relative to the benefits of imperfect regulation. The recognition that even imperfect markets may be preferable to regulated outcomes accompanied a dramatic transformation in the nature and extent of government intervention across a broad range of markets over the past thirty years. Many industries long subject to price and entry regulation in the United States — among them airlines, trucking, railroads, and banking — were deregulated. Telecommunications and electric utilities have been vertically disintegrated and structurally competitive segments were opened to market-based outcomes. Privatization of state-owned enter-

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\* Rose directs the NBER's Program on Industrial Organization and is a Professor of Economics at MIT. In this article, the numbers in parentheses refer to NBER Working Papers.

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prises outside the United States has substantially increased reliance on market outcomes in many sectors, although regulators in some cases have replaced government managers in providing oversight. Where government intervention has been maintained, various forms of incentive-based regulation increasingly have replaced state ownership or traditional cost-of-service rate determination.

IO program members are among the leading scholars of antitrust and regulatory policy, and many have been directly involved in the design or implementation of reforms through their government service, advice to regulatory agencies, or consulting to affected firms. In the face of continuing policy debates over regulatory reform, highlighted more than a decade ago by Paul Joskow and Roger Noll in the NBER's 1994 *American Economic Policy in the 1980s*, the NBER recently sponsored a research project designed to leverage this expertise. Project participants were asked to identify key issues in economic regulation, assess the impact of regulatory reforms across a variety of industries, and evaluate significant contemporary concerns about these reforms. Two dozen scholars assembled for a September 2005 conference in Cambridge to discuss the results of this project, to be assembled in an NBER volume on "Economic Regulation and Its Reform: What Have We Learned?" This project complements a substantial body of primary research by NBER associates on regulatory and antitrust policy. A selection of research from the conference and from NBER working papers is described below.

## Economic Regulation and Its Reform

### *Electricity Restructuring: Competition and Incentive Regulation*

NBER researchers continue in the vanguard of research, market design, and implementation of electricity restructuring. Much of the empirical work to date has focused on restructured generation markets, in which prices generally are determined through a competitive bidding process. Frank Wolak<sup>2</sup> describes the evolutionary nature of the restructuring process, emphasizing the tension between an imperfectly competitive market and an imperfect regulatory process in providing incentives for least-cost supply at various stages of the production process. In one of the first empiri-

cal analyses of restructuring supply-side benefits (11001), the potential for these incentives to reduce costs is highlighted: Kira Fabrizio, Catherine Wolfram, and I show that restructuring is associated with increased productivity, documenting generating-plant efficiency gains in the use of labor and materials input from replacing a regulated monopoly with market competition. As Wolak points out, though, the technical characteristics of electricity supply and demand suggest that market power may be of particular concern, limiting the benefits of restructuring. Joskow (8442) discusses the role of market power and other contributors to the 2000–1 California electricity crisis; Ali Hortacsu and Steven Puller (11123) measure efficiency losses from strategic bidding in the Texas ERCOT market; and Dae-Wook Kim and Chris Knittel (10895) compare direct measures of markups to those inferred from oligopoly models of market power in California generation markets. Wolak also describes market design and regulatory policies that limit the ability of suppliers to exercise unilateral market power—such as forward contracting, horizontal divestitures, demand-side participation, and local market power mitigation—and uses examples from worldwide wholesale electricity markets to illustrate the importance of effectively addressing each aspect of the market design process to ensure the maximum benefits of electricity restructuring.

While early empirical electricity research focused predominantly on generation markets, researchers increasingly have turned their attention to retail markets and demand-side policy. Peter Reiss and Matthew White (8687, 9986) use data from San Diego households to measure consumer responsiveness to changing electricity prices and conservation programs enacted during the California electricity crisis. They argue that consumers may be more responsive to price fluctuations than previously thought. Severin Borenstein and Stephen Holland (9922) suggest that substantial efficiency gains could be obtained from shifting even modest shares of relatively price-insensitive customers from fixed retail electricity prices to those that reflect time-varying

wholesale electricity prices. Borenstein (11594) provides insight into continued resistance to real-time pricing, highlighting substantial distributional effects of real-time prices across heterogeneous industrial and commercial customers that may make it difficult to gain political support without some system to compensation losers.

For services such as transmission and distribution, which typically remain subject to regulation even in restructured markets, innovations have shifted the focus from cost-based price setting toward incentive mechanisms. Joskow<sup>3</sup> provides a comprehensive review of the theory and complexities involved in applying incentive-based regulation. He then discusses applications of incentive mechanisms to the regulation of prices and service quality for “unbundled” electricity transmission and distribution networks. Further, he assesses the evidence on the performance of incentive regulation for electric distribution and transmission networks and describes challenges for future policy and research.

Among those challenges are determining the role of competition in electricity retailing and transmission. Joskow and Jean Tirole (9534) analyze the likely performance of competitive merchant transmission markets, and conclude that this model is likely to yield substantial investment inefficiencies. While their prognosis for retail electricity competition is more optimistic (10473), they note a variety of challenges and efficiency limitations of competitive outcomes. In their work on “Reliability and Competitive Electricity Markets” (10472), they analyze the complexity involved in integrating economists’ approach to market design with engineering system design for reliability across the entire electricity network. Finally, they highlight the implications for system investment, operation, and reliability of interactions among competitive markets, operational constraints, and regulatory and administrative practices.

### *Telecommunications*

The telecommunications sector similarly has undergone a dramatic trans-

formation over the past quarter century. Although telecommunications regulators adopted various incentive-based policies early, “forward-looking” cost-based regulation still plays a prominent role in setting prices for unbundled network elements (UNEs) that must be leased by local telephone companies to their competitors. As noted by Robert Pindyck (10287, 11225), the typical pricing formulas used to set UNE lease rates induce substantial investment and entry inefficiencies by failing to account properly for the substantial sunk costs of telecom investments.<sup>4</sup> Jerry Hausman and Gregory Sidak<sup>5</sup> compare the outcomes of regulatory approaches in the United States, the United Kingdom, and New Zealand. They conclude that in both the United States and the United Kingdom, unbundling may have caused an increase in competition if one measures competition by market share of entrants, at the cost of adverse investment effects by both incumbents and new entrants. In the last section of their paper, they argue that emerging facilities-based competition should allow the end of telecom price regulation and the regulatory burden that it creates for both consumers and the economy. If the nature of local exchange competition during the 1990s is a guide to the future, then Shane Greenstein and Michael Mazzeo’s (9761) research suggests that we may see increasing product differentiation as a result of local competition.

### *Cable Television*

Greg Crawford’s<sup>6</sup> analysis of the cable television industry highlights the impact of economic regulation on product quality and innovation. Regulation in this industry has varied greatly over time, as federal legislation has deregulated, re-regulated, and deregulated consumer cable prices. More recently, penetration by Digital Broadcast Satellites raises questions about the need for regulation to constrain cable prices (see research by Austan Goolsbee and Amil Petrin on welfare gains from DBS introduction, 8317). Crawford analyzes the interplay of price regulation and firm quality choices, with attention to the implications of satellite



competition for performance in cable television markets. His work highlights ongoing concern over horizontal concentration and vertical integration in the programming market, and bundling by both cable systems and programmers, the latter being the subject of current policy debate at the Federal Communications Commission.

### *Airline Deregulation*

In general, the empirical evidence on deregulation of structurally competitive industries suggests considerable gains from removal of price and entry regulation, although the transition from regulated to competitive markets may be longer and more costly than academics or policymakers originally envisioned. Borenstein and I<sup>7</sup> describe the significant consumer benefits from reduced fares and increased flight frequencies and from nonstop service subsequent to airline deregulation, while acknowledging the industry's considerable financial volatility. We argue that market power concerns have diminished as growth by low-cost carriers now challenges legacy airlines in virtually all parts of the country. Recent research by Goolsbee and Chad Syverson suggests that even the threat of entry by carriers such as Southwest may reduce incumbent prices (11072). This surge in competition, combined with adverse demand shocks, high fuel prices, and high labor costs, has contributed to current financial distress among many legacy airlines, though. Financial distress and accompanying bankruptcies have been costly for shareholders, high-wage workers, and the Pension Benefit Guaranty Corporation, although many costs and dislocations may be transitional. For example, Borenstein and Rose (9636) show that schedule disruptions associated with airline bankruptcies are largely transitory; where they are more permanent, they appear to be modest relative to background fluctuations in flights and destinations served, and to be isolated to medium-sized airports. Overall airline investment and consumer benefits continue to be substantial. The greater long-run challenge may be the performance of government-controlled airports, air traf-

fic control, and security infrastructure, which have not in general kept pace with the growth and changes in the industry.

### *Pharmaceutical Regulation*

Pharmaceutical regulation has long generated concern over its effect on innovation incentives and product launch delays. Patricia Danzon and Eric Keuffel<sup>8</sup> tackle these and other issues in their analysis of pharmaceutical safety, price, and marketing regulations on a variety of industry performance measures. They note that regulatory reforms such as the adoption of user fees, fast track, and priority review may have reduced review-induced delays, especially for priority drugs. For example, Ernst Berndt et al. (10822) finds that implementation of performance goals and user fees for FDA drug applications substantially reduced approval lags — by an average of roughly six months. They estimate a net savings of more than 125,000 life-years from these reforms.

Discouragement of innovation also can be a significant hidden cost of price regulation. Price controls present in many countries may reduce the price of existing pharmaceuticals, but also appear to discourage the development and diffusion of innovative new treatments (see analyses by Danzon, Richard Wang, and Liang Wang (9874); Danzon and Jonathan Ketcham (10007); and the late Jean Lanjouw (11321)). In their work on Medicaid prescription drug purchasing, Mark Duggan and Fiona Scott Morton (10930) highlight another indirect effect of price regulation: government rules that base Medicaid purchase price on the average price of that drug across private-sector purchasers increase equilibrium drug prices for non-Medicaid purchasers, and increase a firm's incentives to introduce new versions of a drug at higher prices.

### *Financial Services*

Randall Kroszner and Phillip Strahan<sup>9</sup> analyze the evolution of banking regulation of prices (interest rates), entry, capital, and investment decisions from the 1930s to the last part of the twentieth century. They note that while industry adaptations to constraints par-

tially reduced the costs of regulatory distortions, banking efficiency improved following the removal of most price and entry controls, generating substantial real benefits for the economy as a whole. Patrick Bolton et al. (10571) show that opening the banking sector to price and product-offering competition also may improve information provision and consumer-product matching, given the superior information that financial services sellers may have about product suitability for buyers of those services.

Eric Zitzewitz<sup>10</sup> analyzes the implications of such asymmetric information for the regulation of non-banking financial services firms. He argues that agency conflicts created by information asymmetries and consumer behavioral biases may impede market efficiency. For example, asset management and financial advisor firms may have incentives to discriminate according to customer sophistication or search ability, offering low-price, high-quality products to sophisticated clients and high-price, low-quality products to the less sophisticated. Ali Hortacsu and Syverson (9728) provide some evidence of this phenomenon in research on product differentiation and search costs in the mutual fund industry. Zitzewitz too discusses the implications of these factors for regulatory and antitrust policy in this sector, with particular attention to recent interventions by the New York Attorney General and the SEC.

### *Antitrust Policy*

In regulated industries, firms may be subject to overlapping jurisdiction by both regulators and antitrust authorities. Dennis Carlton and Randal Picker<sup>11</sup> analyze the tension that this produces, describing the historical origin of antitrust and regulation policy and the ongoing struggles to define the appropriate mechanism and substantive scope for regulating competition. They note that debates over the role of antitrust and regulation continue with particular prominence in today's network industries, whether telecommunications, transportation, or electricity. Moreover, core issues such as interconnection and mandatory access have increased in salience as reform-induced

restructuring has led to vertical disintegration of firms and increased competition with incumbents in many industry segments, while the Supreme Court's decision in *Trinko* leaves open substantial questions about how these relationships will be governed.

For most sectors of the economy, interactions among firms are governed by court interpretations of antitrust policy rather than by economic regulatory agency decisions. NBER researchers have explored a variety of aspects of antitrust policy, from theoretical and empirical analyses of merger policy to consideration of vertical restraints. The appropriate role and application of antitrust policy in innovative sectors has attracted particular attention, both as a matter of principle and in the context of high-profile cases such as *U.S. v. Microsoft*.<sup>12</sup> In these sectors, the tension between encouraging competition through entry and maintaining profit incentives for dynamic growth and efficiency is particularly acute. Ilya Segal and Michael Whinston (11525) focus on this tension in research that analyzes a number of specific policies, highlighting those that benefit both entry and innovation. Carlton and Robert Gertner (8976) argue that dynamic efficiency requires coordination of antitrust policy with intellectual property laws in an attempt to resolve tensions created by the tendency for network industries to evolve toward closed systems. Michael Katz and Howard Shelanski (10710) argue that traditional merger analysis, based on static welfare analyses, may miss important dynamic efficiency implications of mergers in highly innovative sectors. Carlton (11645) emphasizes the importance of dynamic barrier-to-entry analysis as one component of this.<sup>13</sup>

## Pricing Behavior in Oligopoly Markets

The behavior of firms in oligopoly markets is one of the mainstays of IO research. NBER researchers have made considerable progress in better understanding firms' pricing decisions, particularly with reference to price dispersion. Although competitive models tend

to assume that consumers are perfectly informed about each firm's single price, many markets deviate substantially from this description. The ability to price discriminate — charging different prices for a product either across firms or to different customers of the same firm — may enable firms to extract greater consumer value from a transaction or to expand the set of customers they serve. This phenomenon appears ubiquitous in the economy.

Consumer search costs may be an important source of sustained price variability in a market. For example, cash prices for a given prescription drug vary widely across pharmacies within a particular geographic market. The magnitude of price dispersion is correlated with attributes that appear related to the costs and benefits of consumer search, for example, greater price variation for drugs prescribed for one-time use to treat an acute condition, relative to those prescribed for ongoing purchase as maintenance therapies. Alan Sorensen (8548) uses information on retail price dispersion and prescription attributes to analyze the distribution of consumer search costs for these products. His estimated model of consumer pharmacy choice suggests that search intensities in this market are relatively low — implying that, on average, only 5 to 10 percent of prescriptions are comparison-price shopped.

One way to increase search intensity is to lower its cost. Internet retailing often has been cited as intensely price competitive in large part because of easy consumer search for low-price vendors. Joel Waldfogel and Lu Chen (9942) argue that this reduces the price advantage of brand-name retailers. They find that consumer exposure to price comparison sites such as DealTime.com reduces Amazon purchase shares for those consumers, and that reductions are roughly twice as large for sites that include retailer reliability information (which may substitute for retailer brand reputation) in addition to item price. Goolsbee and Judith Chevalier (9085) develop a method of estimating price elasticities for online booksellers using publicly available data on Amazon and Barnes & Noble.

com, and conclude that consumers are quite sensitive to prices, particularly at Barnes & Noble.com. Glenn Ellison and Sara Fisher Ellison (10570) show that Internet retailers respond strategically to the increased pricing pressure imposed by these price comparison sites, though. Their analysis of the online computer components market demonstrates that retailers engage in a variety of practices to mitigate the extreme price-sensitivity that price comparison sites may induce, allowing firms to mark-up prices at least enough to cover fixed as well as marginal costs for efficient retailers. Glenn Ellison (9721) provides a theoretical model of one such practice, "add-on pricing" — for example, advertising low prices for one good in the expectation of selling additional (or higher quality) products to consumers at a high price at the point of sale. His work shows that this practice can sustain softer price competition as a competitive equilibrium.

A rich body of research by Florian Zettelmeyer, Fiona Scott Morton, and Jorge Silva-Risso uses data on individual consumer automobile purchases to explore the interaction of retail auto pricing, consumer information, and Internet information and referral services. These researchers first document significant reductions in average automobile purchase price associated with using an Internet referral service (8667), on the order of 2.2 percent after controlling for selection effects in who uses the service. They then show that Internet referrals disproportionately benefit minority buyers, offsetting the average 2 percent price disadvantage these groups incur because of their personal costs of search or negotiation for purchases made through traditional dealer channels (8668). In research that matches consumer survey and transactions data to explore the mechanism underlying these price effects, these researchers conclude that increased transparency of dealer invoice costs combine with greater negotiating clout of the online referral service to reduce a customer's price by an average of 1.5 percent (11515). Consumer information appears to be particularly important in extracting value from auto price negotiations. For

example, Megan Busse, Zettelmeyer, and Silva-Risso find that purchasers obtain 80 percent of the value of auto manufacturer promotions in the form of heavily promoted customer rebates, but only 35 percent of the value of promotions that are paid as dealer discounts (10887). This research agenda has provided unparalleled insights into pricing determinants in a significant consumer market, and generated important new findings for the role of the Internet in changing outcomes in conventional retail channels.

## Auction Markets

While Internet retailing in general has attracted considerable attention and interest, the icon of Internet selling may well be eBay. Its popularity as a mechanism for matching buyers and sellers has spawned a rich economics literature as well as numerous competitors; much of this is described in Patrick Bajari and Ali Hortacsu's survey of Internet auctions research (10076). The seeming ubiquity of auctions, for goods ranging from fine art to Beanie Babies, and in settings that range from government procurement to pollution permits,<sup>14</sup> has prompted several NBER researchers to model the benefits of auctions over alternative market transaction mechanisms. Alexandre Ziegler and Edward Lazear (9795) analyze the choice between retail store-based and auction markets. They describe the relative benefits of each, and characterize the conditions that lead to more efficient market organization through retail stores relative to auctions. Eduardo Engel, Ronald Fischer, and Alexander Galetovic (8869) analyze Demsetzian auctions for exclusive rights in settings that range from procurement to royalty contracts, and conclude that "competition for the field" through ex ante auctions welfare dominates duopoly competition whenever marginal revenue is decreasing in quantities sold. Bajari, Robert McMillan, and Steve Tadelis (9757) highlight limitations of auctions relative to negotiations in procurement settings, particularly those dominated by incomplete information. With Stephanie Houghton, Bajari and Tadelis estimate adaptation

and renegotiation costs to procurement contracts awarded by auction mechanisms (12051).

As Susan Athey and Philip Haile point out (12126, p. 1), "auctions have provided a fruitful area for combining economic theory with econometric analysis ... to understand behavior and inform policy." Athey and Haile describe methodological innovations, many by NBER researchers, which have facilitated estimation of more realistic models and provided significant insights into auction market operation and performance. A significant thrust of this work has been to allow the data more freedom to drive results by relaxing parametric and functional form assumptions. For example, Haile, Han Hong, and Matthew Shum (10105) develop nonparametric tests of one of the key valuation questions in auctions: are bidders' valuations generated by independent private values for the good, in which case bidders need not be concerned about the "winner's curse," or by common values, in which case bidders must optimally shade their bids knowing that winning means they had an excessively optimistic estimate of the good's true value. They apply this test to different types of U.S. Forest Service timber auctions, and find support for its ability to distinguish between settings in which common values are likely to be more or less significant.

Another approach to allaying concerns about constraints imposed by structural model estimates of auctions looks to experimental data. In this spirit, Bajari and Hortacsu (9889) use experimental data to calibrate the quality of structural estimation based on four alternative theoretical models of bidder behavior. Andreas Lange, John List, and Michael Price (10639) develop an innovative combination of field data and lab experimental data to evaluate the impact of secondary resale markets for timber on bidding behavior in timber auctions.

Improving the models and methods available to analyze auction markets can yield important economic insights into these markets, and can aid participants in developing appropriate bidding strategies. But an important policy goal

is also to understand the performance of these markets. Mireia Jofre-Bonet and Martin Pesendorfer (8626) develop a method of estimating a dynamic model of behavior in repeated highway construction procurement auctions with firm-level capacity constraints, and then quantify efficiency losses that result in this setting. In many repeated auctions settings, the potential for collusion among bidders may also be a significant concern. Ken Hendricks, Rob Porter, and Guofu Tan (9836) develop a theory of collusion in affiliated private value and common value auction environments, and use their model to test for bidding rings in federal offshore oil and gas lease auctions. They show that the winner's curse in common value settings works against bid rigging for marginal tracts. Bajari and Fox (11671) analyze potential collusion in FCC spectrum auctions; Orley Ashenfelter and Kathryn Graddy (10795) provide a case study of price-fixing in auctions using the Sotheby's/Christie's art auctions case, drawing out the lessons for auctions and competition policy from details of this case.

## Conclusion

This report of necessity focuses on a fraction of the IO research conducted by NBER scholars, although I hope it provides an indication of the breadth and depth of contributions made in this area. Interested readers are encouraged to peruse the NBER website to access the entire body of scholarly work in this area.

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<sup>1</sup> NBER researchers also have been responsible for an extensive body of work on methodological advances in empirical industrial organization. Ariel Pakes (10154) provides an overview. Areas that have attracted considerable attention include hedonic modeling: see, for example, papers by Pakes (8715), James Heckman, Rosa Matzkin, and Lars Nesheim (9895), Lanier Benckard and Patrick Bajari (9980, 10278). Considerable work also has focused on estimation of dynamic games: for example, papers by Igal Hendel and Aviv Nevo

(9048, 11307), Jaap Abring and Jeffrey Campbell (9712), Martin Pesendorfer and Philipp Schmidt-Dengler (9726), Bajari, Benkard, and Jon Levin (10450), Pakes, Michael Ostrovsky, and Steven Berry (10506), Adam Copeland and George Hall (11870), Gabriel Weintraub, Benkard, and Ben Van Roy (11900), and Guillermo Caruana and Liran Einav (11958).

<sup>2</sup> F. Wolak, "Regulating Competition in Wholesale Electricity Supply," NBER Conference on Economic Regulation and Its Reform: What Have We Learned? 2005.

<sup>3</sup> P. L. Joskow, "Incentive Regulation in Theory and Practice: Electricity Distribution and Transmission Networks," NBER Conference on Economic Regulation and Its Reform: What Have We Learned? 2005.

<sup>4</sup> Pindyck also examines the implications of sunk costs for competition policy (11430).

<sup>5</sup> J. Hausman and J.G. Sidak, "Telecommunications Regulation: Current Approaches with the End in Sight," NBER Conference on Economic Regulation and

Its Reform: What Have We Learned? 2005.

<sup>6</sup> G. Crawford, "Cable Television: Does Cable Need to be Regulated Any More?" NBER Conference on Economic Regulation and Its Reform: What Have We Learned? 2005.

<sup>7</sup> S. Borenstein and N. L. Rose, "Regulatory Reform in the Airline Industry," NBER Conference on Economic Regulation and Its Reform: What Have We Learned? 2005.

<sup>8</sup> Danzon, P.M. and E. Keuffel, "Regulation of the Pharmaceutical Industry," NBER Conference on Economic Regulation and Its Reform: What Have We Learned? 2005.

<sup>9</sup> R. Kroszner and P. Strahan, "Regulation and Deregulation of the U.S. Banking Industry: Causes, Consequences, and Implications for the Future," NBER Conference on Economic Regulation and Its Reform: What Have We Learned? 2005.

<sup>10</sup> E. Zitzewitz, "Financial Regulation in the Aftermath of the Bubble," NBER Conference on Economic Regulation and Its Reform: What Have We Learned?

2005

<sup>11</sup> D. W. Carlton and R. Picker, "Antitrust and Regulation," NBER Conference on Economic Regulation and Its Reform: What Have We Learned? 2005.

<sup>12</sup> David Evans, Albert Nichols, and Richard Schmalensee's analysis of the Microsoft case (11727) argues that the remedies imposed struck a reasonable balance among competing concerns.

<sup>13</sup> See also antitrust analysis in more general settings; for example, Charles Calomiris and Thanavut Pornrojngkool (11351) on anticompetitive effects of bank mergers in lending markets, Evans and Schmalensee (11603) on competition policy in markets with two-sided platforms, and Carlton and Michael Waldman (11407) on tying in durable goods markets.

<sup>14</sup> See, for example, Orley Ashenfelter and Kathryn Graddy (8997) on art auctions, Bajari and Jeremy Fox (11671) on FCC spectrum auctions, and Luis Cabral and Hortacsu (NBER WP 10363) on reputation mechanisms in e-Bay auctions.

