

Research Statement

Lixin Ye , July 2014

My research fields are microeconomic theory and applied game theory, with current focus in auctions, mechanism design, industrial organization, and contract theory. My research also intersects with the field of experimental economics. In what follows, I summarize my research projects to date.

A. Projects in Auctions and Mechanism Design

My research in auctions has focused on auctions with costly entry and costly information acquisition, multi-stage auctions, reserve price signaling, collusion detection in procurement auctions, hybrid auctions/mechanisms, auctions with multi-dimensional signals, and auctions with resale. In terms of methodology, my research has involved theoretical, experimental, and empirical analysis.

1. Auctions with costly entry/information acquisition. As many practitioners may attest, the single most important determinant of success in many auctions is bidder participation, or entry. My research interest originated with my Ph.D. dissertation “Auctions with Costly Entry,” in which I explicitly assume that bidders incur entry costs either to acquire information or to prepare a bid. As a result, the set of final bidders is endogenously determined, which is the main departure of my approach from traditional auction modelling. By taking endogenous entry into account, the nature of optimal auctions changes significantly. In “Optimal Auctions with Endogenous Entry,” published in *Contributions to Theoretical Economics*, I show that under certain environments, an optimal (i.e., revenue-maximizing) auction with endogenous entry is *uniquely* a Vickrey auction. This is in stark contrast to the traditional wisdom that optimal auctions typically differ from efficient auctions (such as a Vickrey auction). My paper “Indicative Bidding and A Theory of Two-Stage Auctions,” published in *Games and Economic Behavior*, was originally motivated by the practice of “indicative bidding,” a two-stage auction procedure that is widely used in complex and valuable asset transactions such as procurements, privatization, takeover, and merger and acquisition contests. Based on the assumption that learning valuations is costly, I develop a theory of two-stage auctions under a general framework allowing for rich information structures. A surprising finding from the analysis of such a general framework is that under the established practice of indicative bidding, the most qualified bidders may be left out of the final stage of the sale. I then propose and analyze alternative mechanisms that can induce efficient entry in the sense that the most qualified bidders will be surely selected for the final sale. This research has practical relevance given the widespread use of indicative bidding, which often involves high-valued assets worth billions of dollars. Despite the importance of two-stage auctions described above, the optimal (revenue-maximizing) mechanism design in this context remains an unsolved problem in the literature. My recent papers with Jingfeng Lu seek to provide an answer. Our paper “Efficient and Optimal Mechanisms with Private Information Acquisition Costs,” published in *Journal of Economic Theory*, considers a setting of two-stage auctions where bidders must incur privately known information

acquisition costs to learn valuations. We characterize optimal two-stage mechanisms with the first stage being the entry right allocation mechanism and the second stage being the traditional private good allocation mechanism. We show that optimal entry can be implemented via all-pay auctions but, interestingly, not via the more conventional auction formats such as uniform-price or discriminatory-price auctions. This finding also highlights the sensitivity of the optimal mechanism to specific environments. In our recent working paper, “Optimal Two-stage Auctions with Costly Information Acquisition,” we explore optimal two-stage mechanisms in a more general framework combining both sequential screening and costly information acquisition. We demonstrate that optimality of the generalized Myerson allocation rule is robust to such a setting; optimal entry thus admits the set of bidders that maximizes expected *virtual surplus* adjusted by both the second-stage signal and entry cost. We also demonstrate that the optimal mechanism can be implemented via a two-stage auction that is essentially a handicap auction augmented with an entry mechanism. Our normative analysis offers a “market design” approach to guide refinement of extremely important selling procedures widely used in practice. Our analysis is also general enough to nest many existing studies in the literature of auctions with costly entry.

2. Other theoretical analysis of auctions. In “Reserve Pricing Signaling” (with Hongbin Cai and John Riley), published in *Journal of Economic Theory*, we show that in a fairly general environment allowing for signal affiliation, there is a unique separating equilibrium in which the seller can signal her private information to bidders by setting a reserve price. An interesting corollary which has caught specialists’ attention is that, the reserve price can be increasing in the number of bidders. This result contrasts with the previous theory which predicts that the optimal reserve price should be set without regard to the number of bidders. We also show that the probability that the item is sold at the reserve price can increase as the number of bidders increases, which suggests a more central role for reserve prices than previously understood in the standard auction models. In the paper “Bad News Can Be Good News: Early Dropouts in an English Auction with Multi-dimensional Signals” (with Dan Levin and James Peck), published in *Economics Letters*, we provide an example of an English auction with multi-dimensional signals about private and common value components. Contrary to the traditional wisdom that early dropouts of bidders normally spell “bad news” to the seller, we demonstrate that a “reversal” may arise with multi-dimensional signals: an earlier dropout can be good news to the seller, and before the first dropout occurs, the expected revenue can decrease over some range of clock prices. In the paper “Hybrid Auctions Revisited” (with Dan Levin), published in *Economics Letters*, we examine an important auction design that mixes the ascending-bid and sealed-bid phases in a setting with risk-averse bidders and affiliated signals. We show that the optimal hybrid auction should trade off the benefit of information rent extraction in the ascending-bid phase against the revenue loss due to reduced competition in the sealed-bid phase. In the paper “Auctions with Entry and Resale” (with Xiaoshu Xu and Dan Levin), published in *Games and Economic Behavior*, we study how resale affects auctions with costly entry in a model where bidders possess two-dimensional private information signals, entry costs and valuations. Our analysis suggests that the opportunity of resale affects both entry and bidding, and in particular, it induces speculative entry and resale-

hunting abstention. While resale usually increases entry, its effects on expected revenue and efficiency, however, are both ambiguous in our model. In the paper “Auctions with Synergy and Resale” (with Xiaoshu Xu and Dan Levin), published in *International Journal of Game Theory*, we study a sequential auction of two objects with two bidders, where the winner of the package obtains a synergy from the second object. While allowing resale always improves efficiency, we demonstrate that the effect of resale on expected revenue and the probability of exposure are both ambiguous.

3. Experimental auctions. In my theoretical analysis of indicative bidding (described above), I have identified a potential flaw in the established design of indicative bidding, a two-stage auction procedure. This potential flaw is that the most qualified bidders may not be safely selected for the final stage of bidding. This presents an economic conundrum as to why indicative bidding is nevertheless widely employed. In the project “Indicative Bidding: An Experimental Analysis” (with John Kagel and Svetlana Pevnitskaya), published in *Games and Economic Behavior*, we investigate how indicative bidding actually performs in laboratory experiments. The experimental approach is particularly useful for our purpose for two reasons. First, the field data from the real world cases of indicative bidding are generally hard to obtain for empirical analysis. Second, because we are not able to pin down the existence of an equilibrium under indicative bidding, the magnitude of efficiency loss is hard to assess within a game-theoretic framework. Our laboratory findings provide a behavioral explanation for the widespread use of indicative bidding despite its lack of a clear equilibrium solution. In a separate project, I have theoretically proven that there exists an isomorphic relation in bidding strategies between a standard English ascending auction and a survival auction, a type of multi-stage sealed-bid auction in which the lowest bidder is eliminated at each successive stage of bidding. In the experimental project “Survival Auctions” (with John Kagel and Svetlana Pevnitskaya), published in *Economic Theory*, we test this isomorphism and demonstrate that the survival auction can be used as a viable alternative to the English ascending auction. When a seller finds it impractical to assemble many bidders in an auction house to conduct an English auctions, the seller may instead implement a survival auction which only requires sealed-bid submissions. In a recent experimental project, “Theoretical and Experimental Analysis of Auctions with Negative Externalities” (with Youxin Hu, John Kagel, and Xiaoshu Xu), published in *Games and Economic Behavior*, we investigate auctions in which upon winning a single “entrant” imposes a negative externality on two “regular” bidders. We show that in the clock auction when all bidders are active, “regular” bidders *free ride*, exiting before the price reaches their value; in the first-price sealed-bid auction, however, incentives for free riding and aggressive bidding coexist, limiting the scope of free riding. These theoretical predications are fully examined in our experiments which in particular, find substantial, though incomplete, free riding in the clock auction.
4. Empirical analysis on collusion detection in procurement auctions. Bid rigging is a serious problem in many procurement auctions. In “Deciding between Competition and Collusion” (with Patrick Bajari), published in *Review of Economics and Statistics*, we develop a structural approach to identify and test for bid-rigging in procurement auctions. In an auction model with asymmetric bidders, we derive a set of conditions

that are both necessary and sufficient for a distribution of bids to be generated by a competitive bidding model. We also discuss how to elicit a prior distribution over a firm's structural cost parameters from industry experts. Given this prior distribution we use Bayes' theorem to compare competitive and collusive models of industry equilibrium. Our methodology is applied to analyze a dataset of bidding by construction firms for doing a type of road repair work, "seal coating," in the Midwest. The necessary and sufficient conditions developed in this paper have been followed by many other empirical studies on collusion detection in procurement auction settings.

B. Projects in Industrial Organization and Contract Theory

My research in the areas of industrial organization and contract theory involves analysis on competitive nonlinear pricing, competitive nonlinear income taxation, firms' quality disclosure, trademark sales, asymmetric price adjustments, etc. A common theme in most of these projects is the study of how entry or increased competition affects firms' strategies in different industry environments.

1. Competitive nonlinear pricing and nonlinear pricing with consumer entry. In the paper "Nonlinear Pricing, Market Coverage, and Competition" (with Huanxing Yang), published in *Theoretical Economics*, we study how increased competition affects nonlinear pricing, in particular market coverage and quality distortions. By endogenizing the set of consumers served in the market, we are able to investigate the interplay between the vertical screenings of consumers and the degree of horizontal competition. We show that when the market structure moves from monopoly to duopoly, market coverage increases and quality distortions decrease. As the market structure allows more firms than duopoly, however, the effect of increased competition is not necessarily monotonic. When the initial number of firms is not too low, an increase in the number of firms will lead to larger market coverage and a reduction in quality distortions; when the initial number of firms is low, an increase in the number of firms will lead to smaller market coverage but an ambiguous effect on quality distortions. In the follow-up paper "Competitive Nonlinear Pricing and Contract Variety" (with Jian Shen and Huanxing Yang), we work with a finite number of consumer types to explicitly explore the effect of increased competition on the number of contracts offered. In the base model with two consumer types, we identify conditions under which entry prompts an incumbent to expand or contract its low end of the product line. Our analysis thus offers a novel explanation for the widespread use of "fighting brands" and "product line pruning" in business. We also extend our analysis to asymmetric firms and three types of consumers and show that depending on the specific environment, entry may lead the incumbent to expand or contract the middle range of its product line (middle contracts), a phenomenon that has not been previously studied in the literature. Our results are also consistent with some empirical studies on how entry into a local cellular phone market affects the number of calling plans offered by each incumbent firm. In a recent working paper, "Monopolistic Nonlinear Pricing With Consumer Entry" (with Chenglin Zhang), we consider consumer entry in the canonical monopolistic nonlinear pricing model wherein consumers learn their preference "types" after incurring privately known entry costs. We show that by taking into account consumer entry, the nature of optimal nonlinear pricing

contracts changes significantly: compared to the benchmark without costly entry, both quality distortion and market exclusion are reduced; sorting is more likely; and whenever bunching occurs, the bunching interval is necessarily smaller. Moreover, under certain conditions the monopoly solution may even achieve the first best (i.e., production efficiency). We also demonstrate that the optimal monopoly solutions can be ranked according to inverse hazard rate functions of the entry cost, suggesting an interesting dynamic for monopolistic nonlinear pricing with consumer entry, a potentially testable implication.

2. Competitive nonlinear income taxation. My research on competitive nonlinear income taxation is a direct extension of my research on competitive nonlinear pricing described above. In “Competitive Nonlinear Taxation and Constitutional Choice” (with Massimo Morelli and Huanxing Yang), published in *American Economic Journal: Microeconomics*, we consider an economy where agents vary by productivity (*vertical types*) and mobility (*horizontal types*) and compare unified nonlinear optimal taxation with the equilibrium taxation that would be chosen by two competing tax authorities if the same economy were divided into two states. We show that the overall level of progressivity and redistribution is unambiguously lower under competitive taxation; the “rich” are always in favor of the competitive regime, whereas the “poor” are always in favor of unified taxation; and the preferences of the middle class depend on the initial conditions in terms of the distribution of productivities, the relative power of the various classes, and mobility costs. In this paper and the current literature on competitive nonlinear income taxation, competition is usually modeled as a game in which different tax authorities compete in tax schedules. An undesirable feature of this traditional approach is that the resource constraint is required only on the equilibrium path: following a deviation by one state, the resource constraints in other competing states are typically unbalanced. In a recent working paper “Competitive Nonlinear Income Taxation Revisited” (with John Wilson and Chenglin Zhang), we propose a new approach in which the tax authorities compete in marginal tax rates, with the poll subsidies adjusting to satisfy budget balance. We show that our new approach in general leads to an equilibrium outcome different from the traditional approach. In cases where high-income workers are at least as mobile as low-income workers, the new approach leads to increased competition, reducing the amount of income redistribution from high-income to low-income workers.
3. Other projects in industrial organization. In the paper “Quality Disclosure and Competition” (with Dan Levin and James Peck), published in *Journal of Industrial Economics*, we analyze costly quality disclosure with horizontally differentiated products under duopoly and a cartel, and characterize the effect of increased competition on disclosure and welfare. We show that more disclosure can be expected under a cartel than under duopoly, and the welfare comparison depends on the level of disclosure cost. When the disclosure cost is low, welfare is higher under the cartel, but when the disclosure cost is high, welfare is higher under duopoly. In the paper “Trademark Sales, Entry, and the Value of Reputation” (with Howard Marvel), published in *International Economic Review*, we offer the first general equilibrium analysis to ask whether allowing trademark sales is beneficial to the economy. One might expect that trademark sales benefit firms

who possess better trademarks. We show that while successful firms capture the full value of their reputations upon sale of their trademarks, they receive a smaller premium for good performance while active as service providers. Due to this trademark dilution effect, all agents (firms) are made worse off with trademark sale. Taking costly entry into account so that the set of agents is endogenously determined, we show that trademark trade typically reduces entry. When entry costs are high, welfare is increased by prohibiting such trade. Thus our analysis suggests a justification for the otherwise surprising U.S. law banning trade in “naked” trademarks. In the paper “Search with Learning: Understanding Asymmetric Price Adjustments” (with Huanxing Yang), published in *The RAND Journal of Economics*, we develop a theoretical model of search with learning to explain *rockets and feathers*, which refers to the phenomenon that vendors raise their prices readily when hit by cost increase, but lower their prices sluggishly under cost decrease. While there are extensive empirical studies documenting this pattern of asymmetric price adjustment in many product markets, there is little theoretical work examining this phenomenon. In a dynamic setting where the firms’ production costs evolve stochastically and consumers search for low-priced firms, we demonstrate that asymmetric price adjustments arise naturally. When a positive cost shock occurs, all the searchers immediately learn the true state. The search intensity, and hence the prices, fully adjust in the next period. When a negative cost shock occurs, it takes longer for non-searchers to learn the true state, and the search intensity increases gradually, leading to a slow fall in prices.

C. Research Plan

I will continue to develop my research in microeconomic theory and applied game theory, and in particular, in the areas of auctions/mechanism design and industrial organization. Besides the ongoing projects described above, I plan to work on two new projects in the near future. The first is optimal contracting with endogenously determined agent types. In the traditional optimal contracting/mechanism design literature, a fundamental assumption is that the distribution of agent types is exogenously given. This assumption is maintained mainly for technical convenience or tractability. However, agent preferences do change with learning (e.g., in the setting of nonlinear pricing), buyers can update their valuations with information acquisition (e.g., in an auction), and workers can improve their productivities with education (e.g., in the setting of income taxation). All of these suggest that agent “types” should be more appropriately modeled as being endogenously determined by their efforts, which are in turn affected by the specific form of contracting (a nonlinear pricing contract, an auction, or a taxation system). Taking into account the endogenously determined agent types, I expect that many of the insights obtained from the traditional contracting/mechanism design literature may be altered, making the implications of our theoretical analysis more relevant to real-world situations. The second project is on market design with spectrum sharing. Given the ever increasing demand for radio spectrum from the telecommunications industry, this is an extremely important topic with tremendous social and economic impact. This project is funded by a special interdisciplinary program at the National Science Foundation (Enhancing Access to the Radio Spectrum, EARS). We propose to analyze the spectrum currently allocated for radar and microwave radiometry systems and explore the feasibility of allowing dynamic spectrum access in these

traditionally restrictive frequency bands. The potentially available spectrum exhibits a distinct feature from the previous spectrum opened to the communication industry. For example, the freed spectrum will be defined by the time available for alternative usage. More importantly, the time span that can be used appears random in nature but is predictable over specified time scales and can be described over even longer time scales as “fractionally available” at a specified percentage. We plan to create an effective market design to allocate the freed spectrum subject to the sensing constraints, and to conduct a market performance analysis taking into account the incentive for market participation. Given the well-known challenge in allocation of heterogeneous multi-unit items (e.g., spectrum frequencies), both theoretical and experimental approaches will likely be involved in our effort.