

# Research Statement

Dong-Hyuk Kim  
University of Arizona

My research is in the areas of Industrial Organization and Econometrics. I use structural models to provide policy recommendations in the presence of parameter uncertainty. In particular, I develop Bayesian methods that uses structural auction models to analyze bid data and produce policy recommendations. For choosing a reserve price, I introduce the Bayesian decision method to consider the payoff structure and parameter uncertainty. I also develop an empirical framework that fully exploits all the shape restrictions arising from economic theory, which may lead to more precise inference than current nonparametric methods. In this statement, I discuss my current work and research agenda for the next three to five years. Then, I briefly outline my longer term goals.

## Current Research

For choosing a reserve price, the previous literature estimates parameter values for a structural auction model and then uses the point estimates to infer the optimal reserve price. However, I point out that the seller can obtain a larger payoff in my paper,

- **“Auction Design using Bayesian Methods,”** *Univ. of Arizona 2008-11*

The seller’s payoff (expected revenue) function is generally not symmetric about the optimal reserve price. This suggests that the seller can obtain a larger payoff by considering the payoff structure and parameter uncertainty. To see this, consider a seller whose payoff increases slowly up to the optimal price, but then drops sharply thereafter. Then, the seller should avoid overestimation more than underestimation systematically taking into account the sampling error. For this purpose, I propose the Bayesian decision method that maximizes the seller’s predictive payoff for a given sample by formally considering the payoff structure and parameter uncertainty. Monte Carlo experiments show that this Bayes rule is especially useful when the payoff is fairly asymmetric and there is a large amount of uncertainty (due to either small samples or flexible specifications).

However, for first price auctions with affiliated private values (APV), current nonparametric methods are not well-suited to a formal decision framework. More importantly, since they do not fully consider the shape restrictions arising from economic theory, their inferences are often based on an estimated bid density that cannot be generated by an equilibrium. Particularly, I find this problem in the sample from the Outer Continental Shelf (OCS) auctions that has been of interest to researchers.<sup>1</sup> For this reason, I develop a new Bayesian method:

- **“Flexible Bayesian Analysis of First Price Auctions using Simulated Likelihood,”**  
*(Job Market Paper)*

I develop an empirical framework that satisfies all the theoretical shape conditions: bidding monotonicity and density affiliation. I directly parametrize the valuation density so that bidding monotonicity is automatically satisfied, and restrict the parameter space to rule

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<sup>1</sup>See Li, Perrigne, and Vuong (2000, 2003) among many others.

out all the non-affiliated densities. My method uses a simulated likelihood to allow for a very flexible specification, but its posterior is exact for the chosen likelihood. This Bayesian framework allows for a formal decision analysis and controls the smoothness and tail behavior of the valuation density. I reanalyze the sample from Outer Continental Shelf auctions that has been widely used. My approach gives significantly different policy prescriptions on the choice of reserve price than previous methods, suggesting the importance of the theoretical shape restrictions.

Most structural models in Industrial Organization have been estimated by classical methods, but the Bayes rule can be useful for better decision making as I discuss in my first paper on auction design. Then, it may be useful if the Bayes rule can be approximated by estimates from other methods.

- **“Approximate Bayesian Methods for Post-Estimation Policy Analysis,”** (work in progress with Keisuke Hirano)

One important motivation for estimating causal and structural models is to construct policy recommendations. A Bayesian approach to forming policy prescriptions can account for parameter uncertainty and the structure of payoffs. However, in practice structural models may be estimated by other methods, such as the method of moments and semiparametric estimators. We develop a simple approximate Bayesian approach that can be applied in many situations, and explore its asymptotic risk properties.

## Research Agenda

In the near future, I plan to develop empirical methodologies that provide more convincing policy recommendations by taking into account important features of the OCS auctions, such as

- Endogenous Entry. Not all the potential bidders participate in every auction, while reserve prices are very low. If bidders make entry decisions first, the theoretical optimal reserve price will be dramatically different.<sup>2</sup> I plan to collect data with variation in the number of actual bidders and develop an empirical framework that analyzes these data using a structural auction models with bidders' entry decisions.
- Multi-unit Auctions. The government typically holds many auctions at a given date, creating another strategic situation among the bidders. For example, the bidders may target the tracts close to the areas in which they are currently operating. Then, a social planner would take into account the geographical distribution of the active tracts and the ownership for each of them, when he organizes the future auctions. Naturally, the auction design would involve the number of tracts to be auctioned and the location of the tracts.
- Common Value (CV). Some economists have argued that the CV model better approximates the OCS wildcat auctions than the APV model.<sup>3</sup> A policymaker would want to make a decision considering the risk under all alternative models. For this purpose, I plan to develop a decision framework that considers the implications of employing the APV assumptions when the CV model is actually true, and vice versa.

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<sup>2</sup>See Levin and Smith (1994) and Moreno and Wooders (2008)

<sup>3</sup>See Hendricks, Pinkse, and Porter (2003).

These are issues that will provide more reasonable policy prescriptions for the offshore oil and gas auctions. Moreover, these are also issues commonly shared by many other important public auctions such as onshore mineral rights and timber rights. Thus, these projects would make a valuable contribution to the literature and help the government to design better allocation mechanisms.

However, I expect to face many challenging computational and/or identification problems. For example, it is well known that the CV auctions are not identified. But, social planners would need a technical expertise for policy establishments regardless of identification results. This motivates me to consider:

- A Decision Method for Partially Identified Models (with Keisuke Hirano) that proposes  $\Gamma$ -minimax solution to use the concept to develop policy recommendation when data do not fully identify the structural parameter. The  $\Gamma$ -minimax solution maximizes the payoff for the worst case parameter value.

This decision method can be usefully employed in many situations. For instance, a recent report from US department of Interior discusses the possibility of significantly revising their onshore mineral auctions.<sup>4</sup> Since oral ascending auctions are practiced there, only winning bids are recorded; thus, the model is generally not identified.

## Longer Term Goals

When my current and near-future projects blossom into well-established papers, I plan to expand my research agenda into other industries such as electricity and telecommunication. For these industries, many local markets are either monopolies or highly concentrated oligopolies. The government's decision on allowing mergers and/or issuing licenses would have a critical impact on social welfare. I am interested in developing a decision framework for maximizing the social welfare. Furthermore, for these industries I am also interested in various firm level decision problems, such as optimal bundling and nonlinear pricing.

## Cited Papers

Hendricks, Pinkse, and Porter (2003) "Empirical Implications of Equilibrium Bidding in First-Price, Symmetric, Common Value Auctions," *Review of Economic Studies* 70, 115-145

Levin and Smith (1994) "Equilibrium in Auctions with Entry," *American Economic Review* 84, 585-599

Li, Perrigne, and Vuong (2000) "Conditionally independent private information in OCS wildcat auctions," *Journal of Econometrics* 98, 129-161

Li, Perrigne, and Vuong (2002) "Semiparametric Estimation of Optimal Reserve Price in First Price Auctions," *Journal of Business and Economic Statistics* 21, 53-64

Moreno and Wooders (2008) "Auctions with Heterogeneous Entry Costs," *University of Arizona, 08-05*

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<sup>4</sup>See Office of INSPECTOR GENERAL Report No. CR-EV-BLM-0002-2009, August 2009.