Martin et al. (2025): Underbidding for oil and gas tracts

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The Puzzle: Underbidding in Oil & Gas Auctions

The Puzzle: Average lease profit is **5× the winning bid**

- New Mexico oil & gas leases generate **$4.1 billion** annually
- Monthly auctions by NM State Land Office

$\Rightarrow$ Suggests potential collusion among bidders

Data & Setting

- **Data:** NMSLO monthly auctions, 1994-2015
- **Format:** First-price sealed-bid and English auctions
- **Market facilitates collusion!**
  - Highly concentrated
  - Homogeneous product
  - Multiple lease auctions at same sale date
  - Regular monthly sales

Summary Statistics

	All	First-price	English
Number of auctions	9717	4535	5182
Gross revenue ($, thousands)	464.1	521.9	413.6
Net revenue, v ($, thousands)	283.6	338.5	235.5
Winning bid ($, thousands)	52.82	58.68	47.70
Fraction drilled	0.125	0.119	0.131

- Key finding: Winning bids = **1/5** of net revenue
- Only **12.5%** of tracts drilled (lease hoarding?)

Market Concentration

Bidder	No. of bids	No. of wins	Return v ($ thousands)	Bid b	ROI (%)
Yates Petroleum Corp.	5,810	4,087	210.46	30.67	1225
Daniel E. Gonzales	828	592	571.12	65.57	589
Doug J. Schutz	784	548	235.56	68.78	20
The Blanco Comp.	617	103	413.48	14.39	6240

Top bidders account for over 50% of market share.

- Few large players dominate market
- Monthly interactions facilitate coordination
- Extraordinary ROI (up to 6,240%!)

Theoretical Framework: The Common Value Auction Model

- A single tract is for sale with a common value $v \in [\underline{v}, \overline{v}]$, drawn from known $G(v)$
- Each of N risk-neutral bidders receives a private signal x_i about the value.
- The joint distribution of signals and value is $F(x_1, \ldots, x_N, v)$.
- A bidding strategy is a map $\beta_i : x_i \to b_i$.
- Bidder i's ex-ante payoff in a first-price auction is:

$$U_i(\beta) = \int_v \int_x [v - \beta_i(x_i)] q_i(\beta(x)) F(dx, dv)$$

  where $q_i(\cdot)$ is the probability of winning.
- **Bayesian Nash Equilibrium:** No bidder can unilaterally improve payoff

$$U_i(\beta) \geqslant U_i(\beta_i', \beta_{-i}) \quad \forall \beta_i', \forall i$$

$\Rightarrow$ Key insight: Ex-post returns reveal if bidding was optimal

Test 1: Conditional Independence

Key assumption: Bids should be independent given true value.

- **Test:** Bivariate probit on participation decisions

$$H_0 : B_i \perp B_j | v$$

- **Rejection of H_0:** Coordination or correlated information

Result 1: Participation Decisions are Correlated

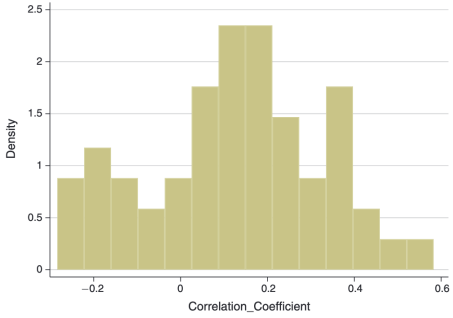
Biprobit Correlation Results

	Pairs (of 55)
$H_0 : \rho = 0$ rejected at 10%	26
$H_0 : \rho = 0$ rejected at 5%	25
$H_0 : \rho = 0$ rejected at 1%	14
Positive Correlation ($\rho > 0$)	40
Negative Correlation ($\rho < 0$)	15

Independence rejected for half of bidder pairs.

- **Bimodal distribution** of correlations
- Pattern suggests strategic coordination

Distribution of ρ



Test 2: Best Response (Underbidding) Test

- **Logic:** In BNE, no profitable unilateral deviation
- **Method:** Find optimal bid scaling factor α^*

$$\alpha^* = \arg\max_{\alpha} \mathbb{E}\left[(v - \alpha b_i) \cdot \mathbb{I}(\alpha \cdot b_i > \max_{j \neq i} b_j)\right]$$

- **Null Hypothesis:** If bidding is optimal, the best scaling factor is 1.

$$H_0 : \alpha^* = 1$$

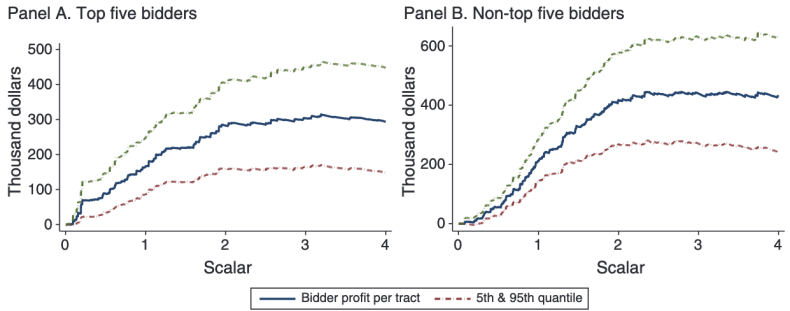
  - $\alpha^* < 1$ suggests overbidding (Winner's Curse).
  - $\alpha^* > 1$ suggests underbidding.

Result 2: Systematic Underbidding

$$\hat{\alpha}^* = \arg\max_{\alpha} \frac{1}{|S|} \sum_{i \in S} \frac{1}{|\mathcal{T}_i|} \sum_{t \in \mathcal{T}_i} \left[v^t - \alpha \cdot b_i^t \right] q_i \left(\alpha \cdot b_i^t, b_{-i}^t \right)$$

Optimal Bid Scalar $\hat{\alpha}^*$

Bidder Group	$\hat{\alpha}^*$
Overall	3.26
Top 5	3.19
Non-Top 5	2.78



- Tripling bids $\implies$ **double profits**
- Clear BNE violation

Test 3: Uniform Upward Deviation

- **Logic:** Group deviation cannot be profitable in BNE
  - **Gain:** Winning auctions they otherwise would have lost (where winning bid $p < b$), earning $(v - b)$.
  - **Loss:** Paying more in auctions they would have won anyway (with bid $p < b$), losing $(b - p)$.
- **Test:** H_0 : Net gain $\leqslant 0$

$$D_S^T = \frac{|S| \int_{\underline{v}}^{\bar{v}} [v - b] H(b \mid v) G(dv) - \int_{\underline{v}}^{\bar{v}} \int_0^b [v - p] \sum_{i \in S} H_i(dp \mid v) G(dv)}{\int_{\underline{v}}^{\bar{v}} \int_0^b [v - p] \sum_{i \in S} H_i(dp \mid v) G(dv)} \leqslant 0$$

Result 3: Profitable Uniform Upward Deviations

D_S^T: Deviation Test Statistic

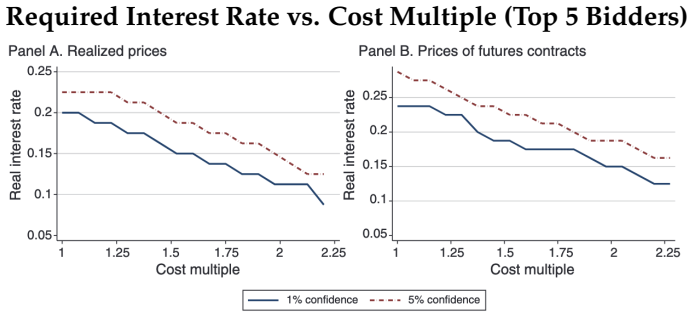
- Under BNE, we expect $DTS \leqslant 0$.

	Set of Bidders (S)			
	All (13)	All (7)	Top 5	Top 3
D_S^T Estimate	5.29	2.55	4.24	3.61
	(1.15)	(0.58)	(1.00)	(1.51)

- $H_0 : D_S^T \leqslant 0$ rejected at 1% level
- Bids far too low for any BNE

Robustness of Upward Deviation Result

- What parameter values would rationalize observed bids?



- Requires unrealistically high parameters:
  - Well costs **doubled** (at 10% rate)
  - OR interest rate **> 20%**

Key Findings

Underbidding for oil and gas bidding:

(1) Correlated participation decisions

(2) Systematic underbidding

- Strongly inconsistent with Bayesian Nash equilibrium bidding

$\Rightarrow$ Collusion to suppress prices

References I

Martin, J., M. Pesendorfer, and J. Shannon (2025, August). Underbidding for Oil and Gas Tracts. *American Economic Review 115*(8), 2755–2780.