Market Power, Collusion, and Cartels II

Paul T. Scott
Toulouse School of Economics
ptscott@gmail.com

Empirical IO
Spring 2014

Outline

Genesove and Mullin (1998)

Genesove and Mullin (2001)

Albæk et al. (1997)

Porter and Zona (1999)

Asker (2010)

"Testing static oligopoly models: conduct and cost in the sugar industry, 1890-1914"

Genesove and Mullin (1998)

Overview

- Bresnahan (1982) and BLP pioneered demand-based estimation of marginal cost and markups, but there are some concerns with these strategies:
    - Functional form assumptions are crucial.
    - θ might not be stable, in which case Bresnahan's regressions can give a biased estimate of the mean level of market power.

- Genesove and Mullin aim to test a Bresnahan-based estimation of costs for the sugar industry, where we have at least a rough idea of what marginal cost should be.

- Looking at the US sugar industry 1890-1914 is interesting because the industry became more competitive; it was the time in between the Sherman Act's passage and when antitrust policy actually started being enforced.
    - Also, price wars

Industry background

- Sugar Trust controlled 80-95% of US sugar refining capacity in late 19th century
- There were documented periods of price wars in 1889-1892 and 1898-1900 following entries
- Dissolution of the trust in 1911 after federal government filed suit.

Marginal costs: direct measures

- The main input in sugar refining is raw sugar, with approximately 1.075 units of raw sugar needed per unit of refined sugar.
- A measure of refined sugar's marginal cost:

  $$c = c_0 + 1.075 * P_{RAW}$$

  where c_0 represents the cost of inputs other than raw sugar.
- Genesove and Mullin argue that we can derive a lower bound on c_0 by assuming labor costs are fully fixed, and an upper bound by assuming labor is fully proportional to output.
  - This places c_0 between 18 and 26¢, per 100 pounds of sugar. This is a small range of uncertainty as the non-raw-sugar inputs are only about 5% of costs.

Identification of market power

- Recall Bresnahan's generalized pricing condition:

$$P + \theta Q P'(Q) = c$$

- We can show that θ is equal to the elasticity-adjusted Lerner index:

$$\theta = \eta(P) \frac{P - c}{P}$$

- Thus, given demand estimates and a measure of cost, we can *construct* θ directly. However, we're also interested in *estimating c* and comparing to the direct measures.

Demand

- GS consider a general demand function:

$$Q\left(P\right)=\beta\left(\alpha-P\right)^{\gamma}$$

- They estimate several versions of this demand system. For example, the estimating equation for the linear case ($\gamma=1$) is:

$$Q=\beta\left(\alpha-P\right)+\epsilon.$$

- They use imports from Cuba to instrument for price (arguing that the only variable shifting Cuban imports are supply shocks in Cuba).

Genesove and Mullin (1998)

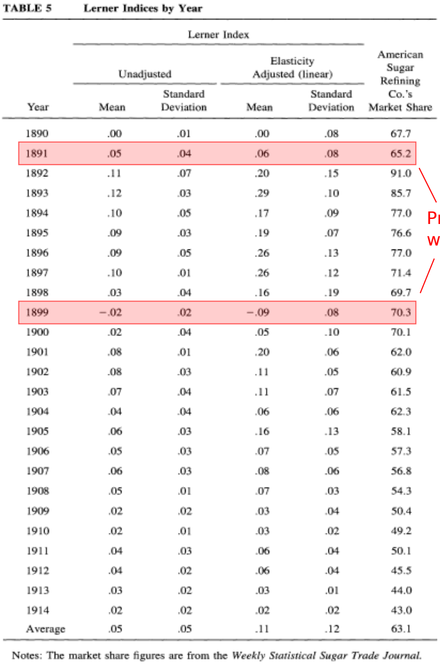


TABLE 5 **Lerner Indices by Year**

	Lerner Index				
	Unadjusted		Elasticity Adjusted (linear)		American Sugar Refining Co.'s
Year	Mean	Standard Deviation	Mean	Standard Deviation	Market Share
1890	.00	.01	.00	.08	67.7
1891	.05	.04	.06	.08	65.2
1892	.11	.07	.20	.15	91.0
1893	.12	.03	.29	.10	85.7
1894	.10	.05	.17	.09	77.0
1895	.09	.03	.19	.07	76.6
1896	.09	.05	.26	.13	77.0
1897	.10	.01	.26	.12	71.4
1898	.03	.04	.16	.19	69.7
1899	−.02	.02	−.09	.08	70.3
1900	.02	.04	.05	.10	70.1
1901	.08	.01	.20	.06	62.0
1902	.08	.03	.11	.05	60.9
1903	.07	.04	.11	.07	61.5
1904	.04	.04	.06	.06	62.3
1905	.06	.03	.16	.13	58.1
1906	.05	.03	.07	.05	57.3
1907	.06	.03	.08	.06	56.8
1908	.05	.01	.07	.03	54.3
1909	.02	.02	.03	.04	50.4
1910	.02	.01	.03	.02	49.2
1911	.04	.03	.06	.04	50.1
1912	.04	.02	.06	.04	45.5
1913	.03	.02	.03	.01	44.0
1914	.02	.02	.02	.02	43.0
Average	.05	.05	.11	.12	63.1

Notes: The market share figures are from the *Weekly Statistical Sugar Trade Journal.*

Price wars

Estimating θ

- After estimating demand, they can jointly estimate the cost parameters and θ.
- For the linear case, they estimate using the following moments:

$$E\left[\left\{(1+\theta)\,P-\alpha\theta-c_0-kP_{RAW}\right\}\mathbf{Z}\right]=0$$

- Is the identification idea here the same as in Bresnahan (1982)?

Genesove and Mullin (1998)

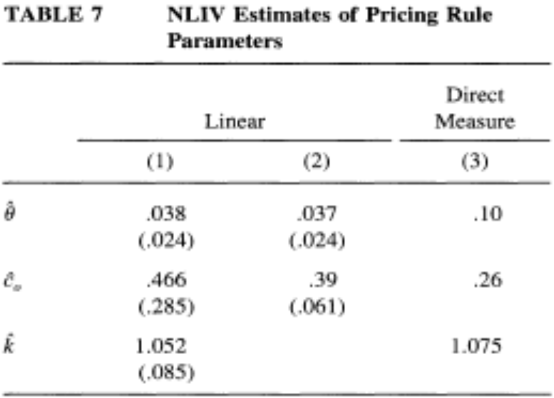


TABLE 7 **NLIV Estimates of Pricing Rule Parameters**

	Linear		Direct Measure
	(1)	(2)	(3)
$\hat{\theta}$	.038 (.024)	.037 (.024)	.10
$\hat{c}_0$	.466 (.285)	.39 (.061)	.26
$\hat{k}$	1.052 (.085)		1.075

Dynamics and bias

- Note that the estimated θ is lower than the constructed θ.
- This might reflect bias resulting from dynamics (think back to Rotemberg and Saloner).

Genesove and Mullin (1998)

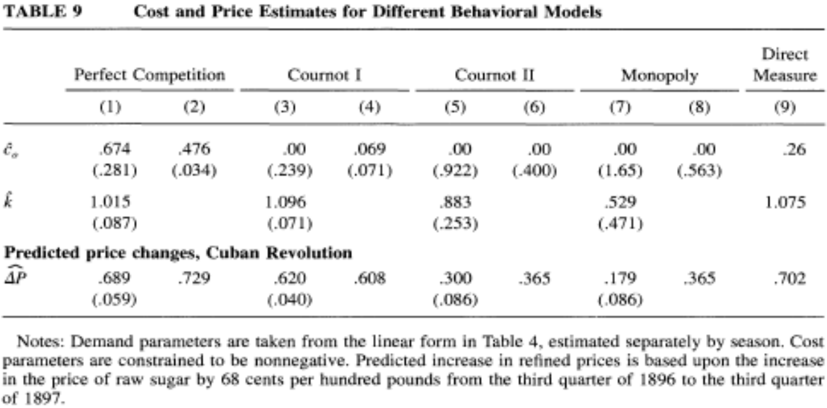


TABLE 9 **Cost and Price Estimates for Different Behavioral Models**

	Perfect Competition		Cournot I		Cournot II		Monopoly		Direct Measure
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
$\hat{c}_o$	.674	.476	.00	.069	.00	.00	.00	.00	.26
	(.281)	(.034)	(.239)	(.071)	(.922)	(.400)	(1.65)	(.563)	
$\hat{k}$	1.015		1.096		.883		.529		1.075
	(.087)		(.071)		(.253)		(.471)		
Predicted price changes, Cuban Revolution									
$\widehat{\Delta P}$	.689	.729	.620	.608	.300	.365	.179	.365	.702
	(.059)		(.040)		(.086)		(.086)		

Notes: Demand parameters are taken from the linear form in Table 4, estimated separately by season. Cost parameters are constrained to be nonnegative. Predicted increase in refined prices is based upon the increase in the price of raw sugar by 68 cents per hundred pounds from the third quarter of 1896 to the third quarter of 1897.

Estimates and implied responses to a 68¢increase in the raw sugar price.

External validation

- One thing that can go wrong in the external validation is that misestimating k implies the wrong passthrough of inputs to costs:

$$\Delta P = k \Delta P_{RAW}$$

- The other thing that goes wrong is that if we have the wrong θ, we have the wrong passthrough of costs to price:

$$P = \frac{\theta \alpha + \gamma c}{\gamma + \theta}$$

- For instance, the monopoly model predicts a price increase which is way too small because it predicts a very low cost-to-price passthrough.

Comments

- Perhaps surprisingly, the sugar industry around 1900 appears to have been much closer to perfect competition than monopoly.
- The potential for bias from seasonality points to a broader issue: there's little reason to expect θ (or markups) to be stable in a changing environment.
- Therefore, one might say it makes more sense to use Bresnahan's strategy to validate a model of competition than as a reduced-form model on its own.

"Rules, Communication, and Collusion: Narrative Evidence from the Sugar Institute Case"

Genesove and Mullin (2001)

Background

- In contrast to Sugar Trust (c. 1891-1911), the Sugar Institute (c. 1927-1936) was ostensibly a trade organization which was not *explicitly* aimed at limiting competition.
- Extensive internal memos reveal that it was undoubtedly *unofficially* aimed at limiting competition. The Institute served to help firms coordinate on rules which facilitated tacit collusion.
- In 1936, Supreme Court rules its practices illegal. "The stated aim of [the Institute's] rules was to eliminate discriminatory pricing... why it would have been in their interest to do so was never explained. The defendants... were silent on why compliance required collective action."

Important features

- Some broad features are consistent with theoretical literature:
    - Secret price cutting (understood broadly) was the main threat to cooperation.
    - Collusion was sustained by threat of retaliation.
- Other features contrast with theories of collusion:
    - Collusive agreements were incomplete (the games actual firms play are much more complicated than Bertrand or Cournot games).
    - Extensive communication was involved; it's definitely not the case that firms only acquired information through some exogenous information structure.
    - Cheating was typically not met with strong punishments (e.g., reversion to competitive conditions). Punishment strategies resembled tit-for-tat more than grim triggers.

Genesove and Mullin (2001)

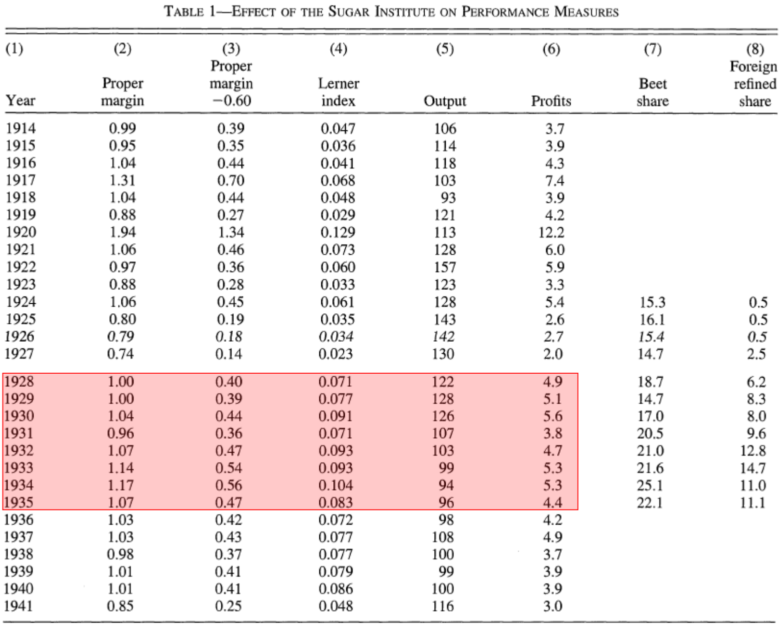


TABLE 1—EFFECT OF THE SUGAR INSTITUTE ON PERFORMANCE MEASURES

(1) Year	(2) Proper margin	(3) Proper margin −0.60	(4) Lerner index	(5) Output	(6) Profits	(7) Beet share	(8) Foreign refined share
1914	0.99	0.39	0.047	106	3.7		
1915	0.95	0.35	0.036	114	3.9		
1916	1.04	0.44	0.041	118	4.3		
1917	1.31	0.70	0.068	103	7.4		
1918	1.04	0.44	0.048	93	3.9		
1919	0.88	0.27	0.029	121	4.2		
1920	1.94	1.34	0.129	113	12.2		
1921	1.06	0.46	0.073	128	6.0		
1922	0.97	0.36	0.060	157	5.9		
1923	0.88	0.28	0.033	123	3.3		
1924	1.06	0.45	0.061	128	5.4	15.3	0.5
1925	0.80	0.19	0.035	143	2.6	16.1	0.5
1926	*0.79*	*0.18*	*0.034*	*142*	*2.7*	*15.4*	*0.5*
1927	0.74	0.14	0.023	130	2.0	14.7	2.5
1928	1.00	0.40	0.071	122	4.9	18.7	6.2
1929	1.00	0.39	0.077	128	5.1	14.7	8.3
1930	1.04	0.44	0.091	126	5.6	17.0	8.0
1931	0.96	0.36	0.071	107	3.8	20.5	9.6
1932	1.07	0.47	0.093	103	4.7	21.0	12.8
1933	1.14	0.54	0.093	99	5.3	21.6	14.7
1934	1.17	0.56	0.104	94	5.3	25.1	11.0
1935	1.07	0.47	0.083	96	4.4	22.1	11.1
1936	1.03	0.42	0.072	98	4.2		
1937	1.03	0.43	0.077	108	4.9		
1938	0.98	0.37	0.077	100	3.7		
1939	1.01	0.41	0.079	99	3.9		
1940	1.01	0.41	0.086	100	3.9		
1941	0.85	0.25	0.048	116	3.0		

Secret price cuts

- "The Sugar Institute was primarily a mechanism to increase the probability of detection of sectret price cuts." But "secret price cuts" must be understood broadly.
- The Institute had many rules to avoid various forms of secret price cuts.
    - The "full details" of sales of damaged sugar had to be documented.
    - Favorable credit terms were banned as they are a substitute for price cuts.
    - Refiners were prohibited from operating storage warehouses for customers through which discounts could be laundered.
    - Refiners were required to enforce their contracts (especially specified delivery times)
    - Freight rates could be cut rather than f.o.b. prices, and eventually refiners switched to c.i.f. (delivered) pricing.

Quality suppression

- Some of the forms of secret price cuts could be understood as quality of auxiliary services, and the Institute's avoidance of them could be understood as collusion in quality suppression.
- "We view the supppression of non-price competition as complementary to contractual harmonization... If one is already choosing, and enforcing, one single contractual standard among many, one might as well limit nonprice competition along the way."

Communication

- The first reason for extensive communication was in updating the terms of collusion: closing loopholes, updating to changing circumstances. This happened mostly at weekly meetings
- Firms also were expected to notify each other before many actions. This meant the firms knew what each other were up to, and if a firm was found to be engaging in an unapproved practice without notification, it would raise a red flag.
- Prior notification also facilitated mutually beneficial changes (e.g., if the monopoly price falls, all firms will want to lower their prices together) without triggering retaliation.
- The meetings were important to clarify when retaliation was warranted, and to ensure that retaliations were not seen as instances of cheating on their own.

Punishments

- "When one firm openly lowered its rate for rail shipments... other firms would respond by lowering their rail rates to the same level. When the Pacific refiners gave a freight allowance on certain contracts, American announced that it would match it... the response to a deviation was generally restricted to the instrument of violation."
- These observations contrast with theories of optimal collusive equilibria in repeated games, where the best collusive equilibria involve the most extreme punishments available.

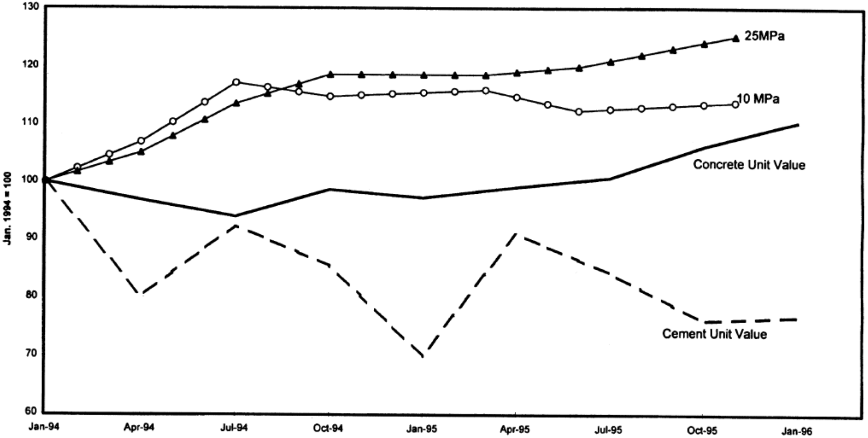
"Government-Assisted Oligopoly Coordination? A Concrete Case"

Albæk, Møllgaard, and Overgaard (1997)

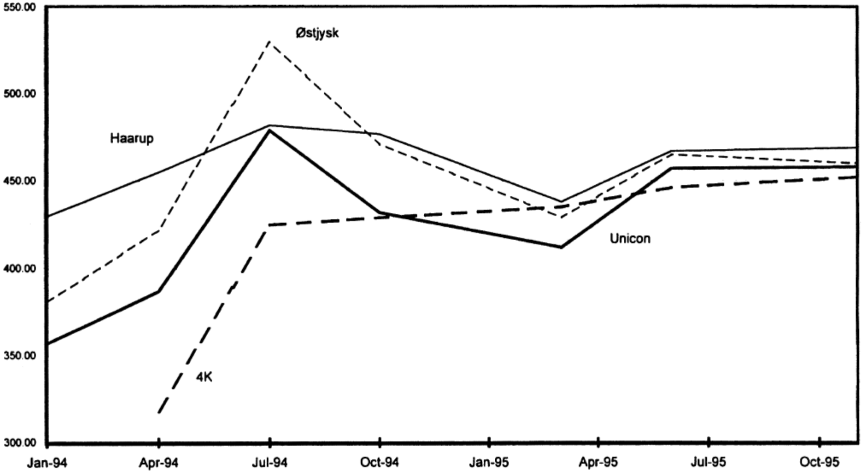
Abstract

"In 1993 the Danish antitrust authority decided to gather and publish firm-specific transactions prices for two grades of ready-mixed concrete in three regions of Denmark. Following initial publication, average prices of reported grades increased by 15-20 percent within one year. We investigate whether this was due to a business upturn and/or capacity constraints, but argue that these seem to have little explanatory power. We conclude that a better explanation is that publication of prices allowed firms to reduce the intensity of oligopoly price competition and, hence, led to increased prices contrary to the aim of the authority."

Average concrete prices



Prices at concrete plants around Aarhus



"Ohio School Milk Markets: An Analysis of Bidding"

Porter and Zona (1999)

Overview

- Milk processors and distributors bid for school milk contracts on an annual basis.
- Unfortunately, the market is well suited to collusion.
- Price fixing convictions in ≥ 12 states with 90 convictions!
- Looking at auctions in the 1980's in Ohio, Porter and Zona find that bidding behavior for most firms is consistent with competitive bidding, but behavior for accused firms is measurably different.

The setting

- Demand is seen as very inelastic – schools will pay a high price for milk if they have to.
- Milk is arguably a commodity, and firms bid only in price, so there is no incentive for product differentiation.
- Firms basically have the same production cost structure (milk processing is a mature industry), but delivery costs vary depending on plant and school locations.
  - Firms typically face the same input (raw milk) costs due to regulation.

Aspects facilitating collusion

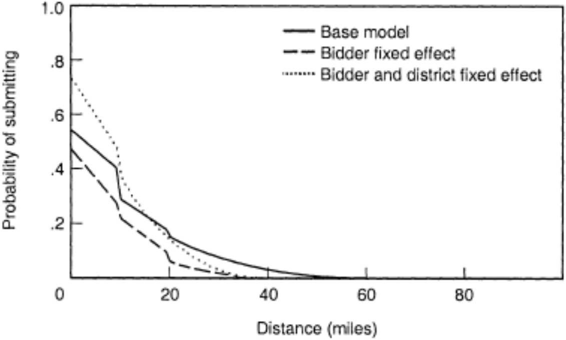
- Bids and identities of bidders are publicly announced after auctions.
- Auctions are held at different times of the year for different schools.
- Multi-market contact (see Bernheim and Whinston (1990))
- Milk processors are frequent customers of one another and have trade associtations.
- Typically a small number of plants are close enough to be viable suppliers for a given school. 45% of auctions receive one bid, 34% of auctions receive two, ...

Empirical model

- They estimate a model of bidder behavior with two pieces:
    - A model of the probability firm j will submit a bid for the auction in school s
    - A model of bid prices for submitted bids.
- Both models involve a bunch of characteristics of the firm, school, and (most importantly) the distance between the two.
- For non-accused firms, bid submissions and bid prices have the expected relationship with distance.

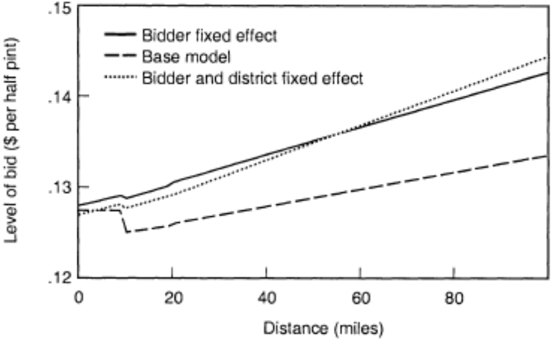
Porter and Zona (1999)

PREDICTED PROBABILITY OF SUBMITTING A BID BY DISTANCE



Porter and Zona (1999)

PREDICTED LEVEL OF SUBMITTED BIDS BY DISTANCE: CONTROL GROUP



- On the other hand, firms in Cincinatti (which admitted to coordinating their bids for nearby schools) had relatively high bids for nearby auctions.

Porter and Zona (1999)

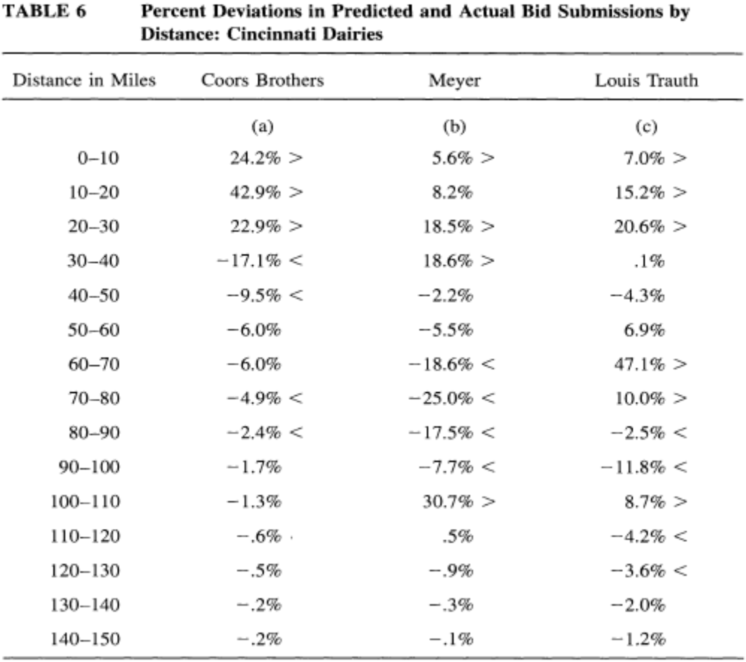


TABLE 6 **Percent Deviations in Predicted and Actual Bid Submissions by Distance: Cincinnati Dairies**

Distance in Miles	Coors Brothers	Meyer	Louis Trauth
	(a)	(b)	(c)
0–10	24.2% >	5.6% >	7.0% >
10–20	42.9% >	8.2%	15.2% >
20–30	22.9% >	18.5% >	20.6% >
30–40	−17.1% <	18.6% >	.1%
40–50	−9.5% <	−2.2%	−4.3%
50–60	−6.0%	−5.5%	6.9%
60–70	−6.0%	−18.6% <	47.1% >
70–80	−4.9% <	−25.0% <	10.0% >
80–90	−2.4% <	−17.5% <	−2.5% <
90–100	−1.7%	−7.7% <	−11.8% <
100–110	−1.3%	30.7% >	8.7% >
110–120	−.6%	.5%	−4.2% <
120–130	−.5%	−.9%	−3.6% <
130–140	−.2%	−.3%	−2.0%
140–150	−.2%	−.1%	−1.2%

Damages

- They do a reduced-form regression to assess damages. Basically, this involves regressing prices on the number of collusive firms involved in an auction.
- What are the limitations of this? What else could they do?

"A Study of the Internal Organization of a Bidding Cartel"

John Asker (2010)

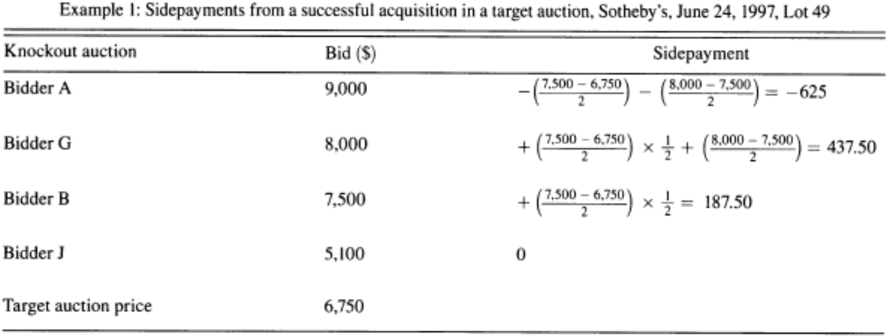
Overview

- A study of a bidding ring of stamp dealers, bidding on collectible stamps in New York auction houses.
- The ring used *knockout auctions*, internal auctions among members to allocate the good among ring members.
- The knockout mechanism leads to some interesting and counterintuitive effects:
  - Side-payments provided incentives to bid above valuations.
  - Overbidding sometimes caused inefficient allocations.
  - Overbidding sometimes increased the price received by sellers.
  - Overall, reduced competition more than compensated for the overbidding, and ring members benefited substantially from the scheme on average.

The Knockout Auctions

- Before the actual (target) auction, ring members could submit bids in knockout auction run by a hired agent.
- The ring's bidding limit in the target auction is the maximum price from the knockout auction. A bidding agent would submit the ring's bid.
- If the ring wins the target auction, the highest bidder from the knockout auction gets the item and may owe side-payments to other knockout participants.
    - "Sidepayments involve ring members sharing each increment between bids, provided that their bids are above the target auction price. Half the increment is kept by the winner of the knockout, and the balance is shared equally between those bidders who bid equal to or more than the "incremental" bid."

Asker (2010)



Example 1: Sidepayments from a successful acquisition in a target auction, Sotheby's, June 24, 1997, Lot 49

Knockout auction	Bid ($)	Sidepayment
Bidder A	9,000	$-\left(\frac{7{,}500-6{,}750}{2}\right)-\left(\frac{8{,}000-7{,}500}{2}\right)=-625$
Bidder G	8,000	$+\left(\frac{7{,}500-6{,}750}{2}\right)\times\frac{1}{2}+\left(\frac{8{,}000-7{,}500}{2}\right)=437.50$
Bidder B	7,500	$+\left(\frac{7{,}500-6{,}750}{2}\right)\times\frac{1}{2}=187.50$
Bidder J	5,100	0
Target auction price	6,750	

Asker (2010)

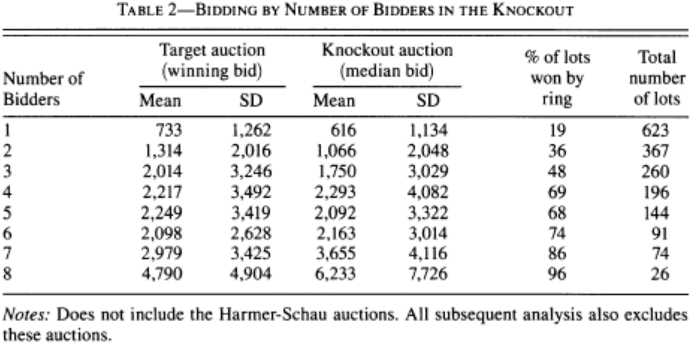


TABLE 2—BIDDING BY NUMBER OF BIDDERS IN THE KNOCKOUT

Number of Bidders	Target auction (winning bid) Mean	Target auction (winning bid) SD	Knockout auction (median bid) Mean	Knockout auction (median bid) SD	% of lots won by ring	Total number of lots
1	733	1,262	616	1,134	19	623
2	1,314	2,016	1,066	2,048	36	367
3	2,014	3,246	1,750	3,029	48	260
4	2,217	3,492	2,293	4,082	69	196
5	2,249	3,419	2,092	3,322	68	144
6	2,098	2,628	2,163	3,014	74	91
7	2,979	3,425	3,655	4,116	86	74
8	4,790	4,904	6,233	7,726	96	26

Notes: Does not include the Harmer-Schau auctions. All subsequent analysis also excludes these auctions.

Bidder heterogeneity

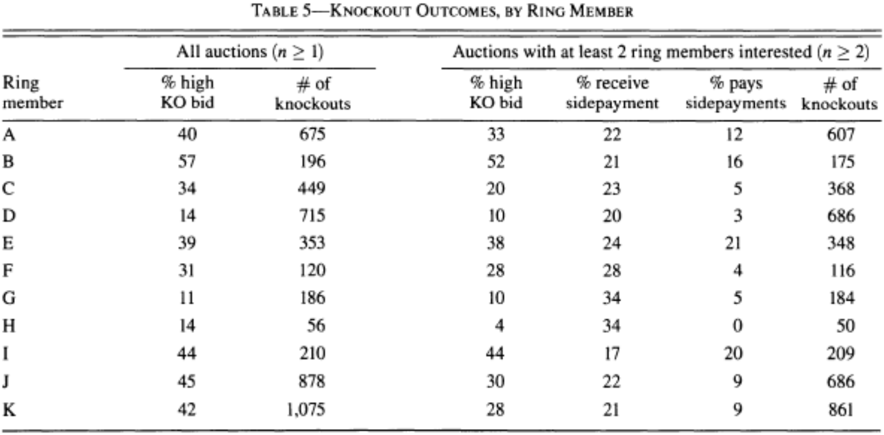


TABLE 5—KNOCKOUT OUTCOMES, BY RING MEMBER

	All auctions ($n \geq 1$)		Auctions with at least 2 ring members interested ($n \geq 2$)			
Ring member	% high KO bid	# of knockouts	% high KO bid	% receive sidepayment	% pays sidepayments	# of knockouts
A	40	675	33	22	12	607
B	57	196	52	21	16	175
C	34	449	20	23	5	368
D	14	715	10	20	3	686
E	39	353	38	24	21	348
F	31	120	28	28	4	116
G	11	186	10	34	5	184
H	14	56	4	34	0	50
I	44	210	44	17	20	209
J	45	878	30	22	9	686
K	42	1,075	28	21	9	861

Asker (2010)

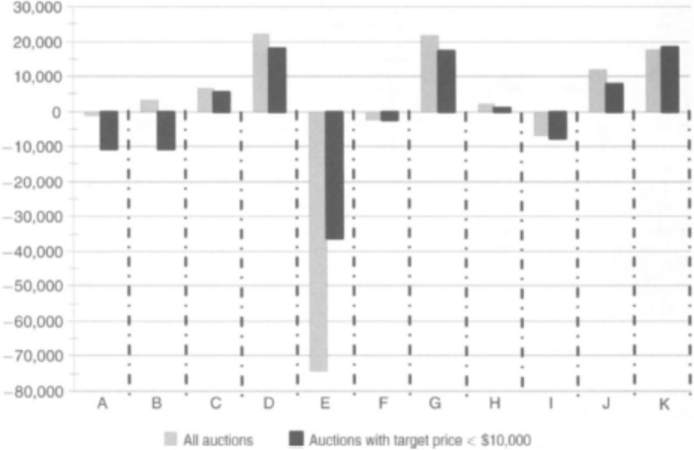


Figure 1. Net Sidepayments from the Ring, by Members in Dollars

Bidder D: "My objective, basically was, you know, make money from these people as opposed to actually buying the stamps."

Naïve analysis

- Naïve estimates of damages can be easily calculated by assuming that knockout-auction bids represent true valuations.
- Then, the difference between the transaction prices in target auctions and the second highest bid in corresponding knockout auctions is a measure of damages (in cases where the second highest bid in the knockout was higher than the transaction price in the target auction).
    - Note: target auctions were English auctions.
- However, incentives created by sidepayments call for a more careful assessment.

Asker (2010)

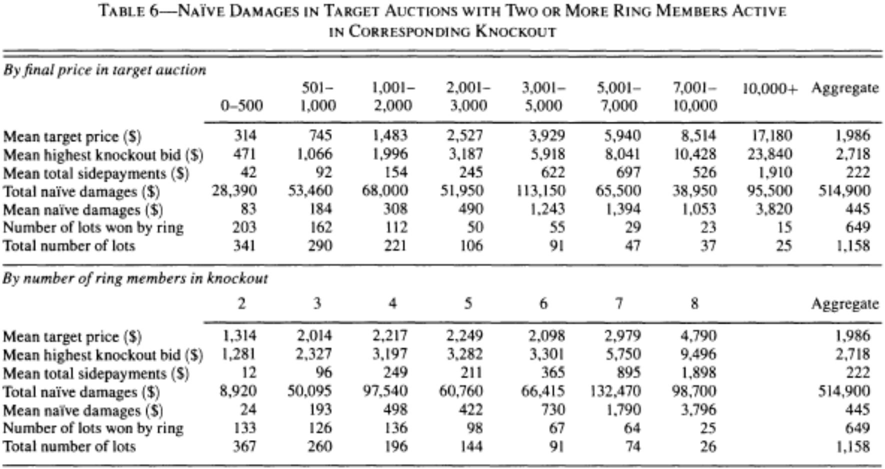


TABLE 6—NAÏVE DAMAGES IN TARGET AUCTIONS WITH TWO OR MORE RING MEMBERS ACTIVE IN CORRESPONDING KNOCKOUT

By final price in target auction	0–500	501–1,000	1,001–2,000	2,001–3,000	3,001–5,000	5,001–7,000	7,001–10,000	10,000+	Aggregate
Mean target price ($)	314	745	1,483	2,527	3,929	5,940	8,514	17,180	1,986
Mean highest knockout bid ($)	471	1,066	1,996	3,187	5,918	8,041	10,428	23,840	2,718
Mean total sidepayments ($)	42	92	154	245	622	697	526	1,910	222
Total naïve damages ($)	28,390	53,460	68,000	51,950	113,150	65,500	38,950	95,500	514,900
Mean naïve damages ($)	83	184	308	490	1,243	1,394	1,053	3,820	445
Number of lots won by ring	203	162	112	50	55	29	23	15	649
Total number of lots	341	290	221	106	91	47	37	25	1,158

By number of ring members in knockout	2	3	4	5	6	7	8		Aggregate
Mean target price ($)	1,314	2,014	2,217	2,249	2,098	2,979	4,790		1,986
Mean highest knockout bid ($)	1,281	2,327	3,197	3,282	3,301	5,750	9,496		2,718
Mean total sidepayments ($)	12	96	249	211	365	895	1,898		222
Total naïve damages ($)	8,920	50,095	97,540	60,760	66,415	132,470	98,700		514,900
Mean naïve damages ($)	24	193	498	422	730	1,790	3,796		445
Number of lots won by ring	133	126	136	98	67	64	25		649
Total number of lots	367	260	196	144	91	74	26		1,158

Model basics

- Each bidder i has valuation in auction k of $v_{ik} \in [\underline{v}_i, \bar{v}_i]$ drawn from $F_i(v)$.
- Valuations are private and independently distributed, but not identically distributed across bidders.
- Ring members know the number of other bidders participating in a knockout, but not the identities.

Knockout bidding

- Expected profits:

$$
\begin{aligned}
\max_b \quad & \int_{-\infty}^{b} (v_{ik} - x)\, h_r(x)\, dx F_{-i}(\phi(b)) \\
& -\tfrac{1}{2} \int_{-\infty}^{b} \int_{x}^{b} (y - x)\, h_r(x)\, f_{-i}(\phi(y))\, dy dx \\
& -\tfrac{1}{2} \int_{-\infty}^{b} (b - x)\, h_r(x)\, dx \,(1 - F_{-i}(\phi(b)))
\end{aligned}
$$

  where

  - h_r is the density function for the highest nonring bid,
  - ϕ is the inverse strategy function,
  - α_j is the probability of j's participating in the auction,
  - and $F_{-i}(\phi(b)) = \left(\sum_{j\neq i} \alpha_j F_j(\phi_j(b))\right) / \sum_{j\neq i} \alpha_j$

Optimal bidding

- FOC for profit maximization:

$$\left(v_{ik}-b\right)h_r\left(b\right)F_{-i}\left(\phi\left(b\right)\right)+\int_{-\infty}^{b}\left(v_{ik}-x\right)h_r\left(x\right)dxf_{-i}\left(\phi\left(b\right)\right)$$

$$-\int_{-\infty}^{b}\left(b-x\right)h_r\left(x\right)dxf_{-i}\left(\phi\left(b\right)\right)+\frac{1}{2}\int_{-\infty}^{b}h_r\left(x\right)dx\left(1-F_{-i}\left(\phi\left(b\right)\right)\right)$$

Recovering valuations

- The first-order condition cannot be inverted for v in general, but with only two bidders,

$$v_{ik} = b - \frac{\frac{1}{2} H_r\left(b\right)\left(1 - G_{-i}\left(b\right)\right)}{\left(h_r\left(b\right) G_{-i}\left(b\right) + H_r\left(b\right) g_{-i}\left(b\right)\right)}$$

  where G_{-i} is the distribution function of b_{-i}.
- Asker focuses on auctions with two bidders to avoid identification issues.

Overbidding

- **Lemma 1** states that $\left.\frac{\partial \pi_{ik}}{\partial b_{ik}}\right|_{b_{ik}=v_{ik}} \geq 0$.
- Therefore, knockout bids are weakly greater than valuations.
- **Corollary**: the knockout auctions can lead to inefficient allocations.

Auction heterogeneity

- Extending the model to allow for unobserved auction-level heterogeneity, write valuations as:

$$u_{ik} = e^{x_k \gamma} \left(v_{ik} \varepsilon_k \right).$$

- Asker's structural approach recovers the distribution of v's and ε's. We're going to ignore details of dealing with the ε's here, but you should be able to see how the distribution of v's could be estimated if we don't have the ε's (think GPV).

Bidder heterogeneity

- For simplicity, he classifies bidders as either "weak" or "strong" and estimates a different distribution of valuations $F(\cdot)$ for each type.
- Remember that bidders don't know which other bidders are participating. Empirical frequencies of each bidder's participation are used for α_j's.

Notes on counterfactuals

- Solving for equilibria of the knockout auctions might be hard, but his counterfactuals are only English auctions, which are analogous to second price auctions and therefore easy to solve. This makes counterfactuals WAY easier.
- A difficulty is not knowing the distribution of (second highest) nonring bids.
    - U.B. assumption: second highest nonring value is equal to highest nonring valuation. This provides upper bound to damages. Why?
    - L.B. assumption: second highest nonring value is equal to minimum of highest nonring valuation and highest ring valuation. The provides lower bound to damages. Why?

Asker (2010)

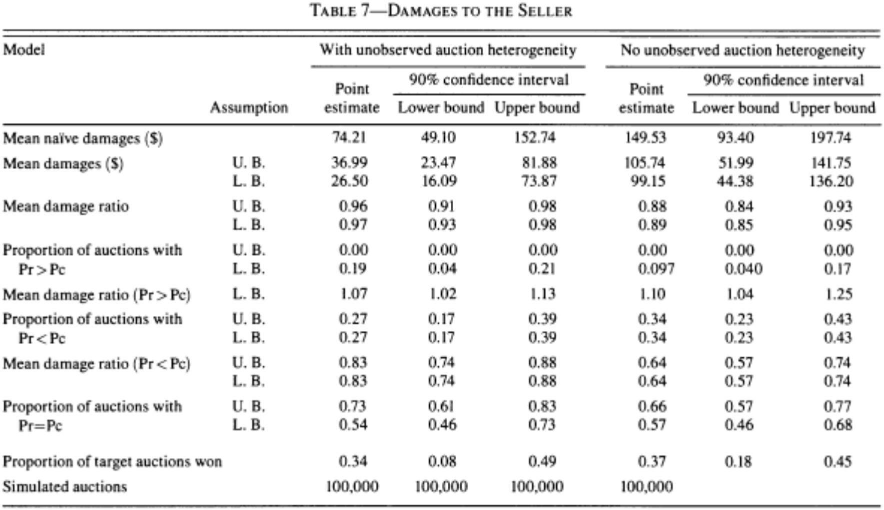


TABLE 7—DAMAGES TO THE SELLER

Model		With unobserved auction heterogeneity			No unobserved auction heterogeneity		
		Point	90% confidence interval		Point	90% confidence interval	
	Assumption	estimate	Lower bound	Upper bound	estimate	Lower bound	Upper bound
Mean naïve damages ($)		74.21	49.10	152.74	149.53	93.40	197.74
Mean damages ($)	U. B.	36.99	23.47	81.88	105.74	51.99	141.75
	L. B.	26.50	16.09	73.87	99.15	44.38	136.20
Mean damage ratio	U. B.	0.96	0.91	0.98	0.88	0.84	0.93
	L. B.	0.97	0.93	0.98	0.89	0.85	0.95
Proportion of auctions with	U. B.	0.00	0.00	0.00	0.00	0.00	0.00
Pr > Pc	L. B.	0.19	0.04	0.21	0.097	0.040	0.17
Mean damage ratio (Pr > Pc)	L. B.	1.07	1.02	1.13	1.10	1.04	1.25
Proportion of auctions with	U. B.	0.27	0.17	0.39	0.34	0.23	0.43
Pr < Pc	L. B.	0.27	0.17	0.39	0.34	0.23	0.43
Mean damage ratio (Pr < Pc)	U. B.	0.83	0.74	0.88	0.64	0.57	0.74
	L. B.	0.83	0.74	0.88	0.64	0.57	0.74
Proportion of auctions with	U. B.	0.73	0.61	0.83	0.66	0.57	0.77
Pr=Pc	L. B.	0.54	0.46	0.73	0.57	0.46	0.68
Proportion of target auctions won		0.34	0.08	0.49	0.37	0.18	0.45
Simulated auctions		100,000	100,000	100,000	100,000		

Asker (2010)

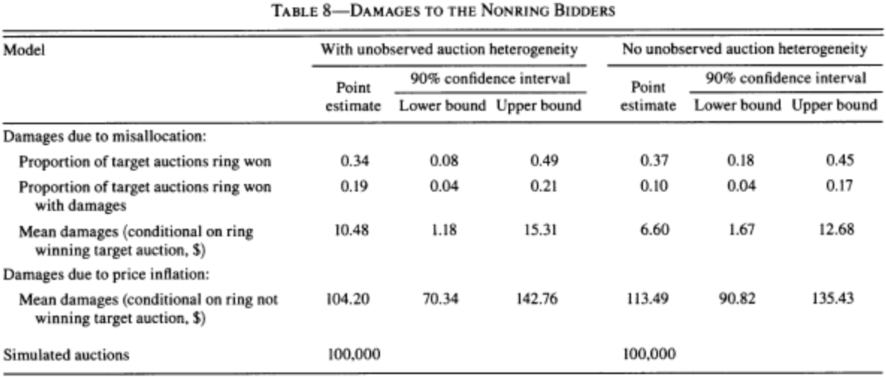


TABLE 8—DAMAGES TO THE NONRING BIDDERS

Model	With unobserved auction heterogeneity			No unobserved auction heterogeneity		
	Point estimate	90% confidence interval		Point estimate	90% confidence interval	
		Lower bound	Upper bound		Lower bound	Upper bound
Damages due to misallocation:						
Proportion of target auctions ring won	0.34	0.08	0.49	0.37	0.18	0.45
Proportion of target auctions ring won with damages	0.19	0.04	0.21	0.10	0.04	0.17
Mean damages (conditional on ring winning target auction, $)	10.48	1.18	15.31	6.60	1.67	12.68
Damages due to price inflation:						
Mean damages (conditional on ring not winning target auction, $)	104.20	70.34	142.76	113.49	90.82	135.43
Simulated auctions	100,000			100,000		

Asker (2010)

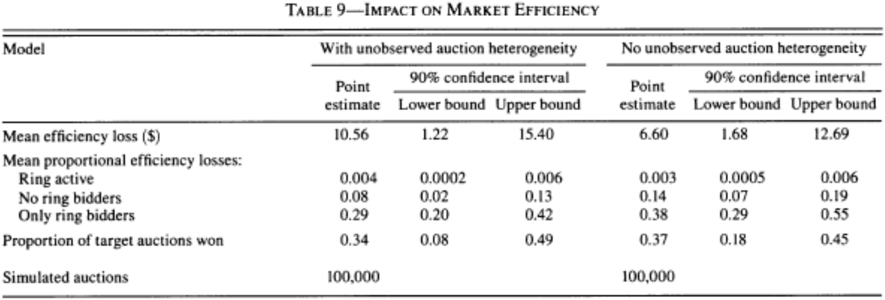
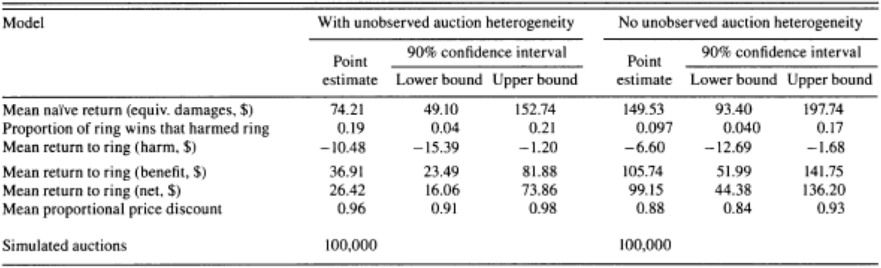


TABLE 9—IMPACT ON MARKET EFFICIENCY

Model	With unobserved auction heterogeneity			No unobserved auction heterogeneity		
	Point estimate	90% confidence interval		Point estimate	90% confidence interval	
		Lower bound	Upper bound		Lower bound	Upper bound
Mean efficiency loss ($)	10.56	1.22	15.40	6.60	1.68	12.69
Mean proportional efficiency losses:						
Ring active	0.004	0.0002	0.006	0.003	0.0005	0.006
No ring bidders	0.08	0.02	0.13	0.14	0.07	0.19
Only ring bidders	0.29	0.20	0.42	0.38	0.29	0.55
Proportion of target auctions won	0.34	0.08	0.49	0.37	0.18	0.45
Simulated auctions	100,000			100,000		

Asker (2010)

TABLE 10—RETURNS TO THE RING



Model	With unobserved auction heterogeneity			No unobserved auction heterogeneity		
	Point estimate	90% confidence interval		Point estimate	90% confidence interval	
		Lower bound	Upper bound		Lower bound	Upper bound
Mean naïve return (equiv. damages, $)	74.21	49.10	152.74	149.53	93.40	197.74
Proportion of ring wins that harmed ring	0.19	0.04	0.21	0.097	0.040	0.17
Mean return to ring (harm, $)	−10.48	−15.39	−1.20	−6.60	−12.69	−1.68
Mean return to ring (benefit, $)	36.91	23.49	81.88	105.74	51.99	141.75
Mean return to ring (net, $)	26.42	16.06	73.86	99.15	44.38	136.20
Mean proportional price discount	0.96	0.91	0.98	0.88	0.84	0.93
Simulated auctions	100,000			100,000		