Are Art Auction Estimates Biased?

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Outline

Outline

About the Authors

- Ekelund and Tollison (and Hébert) wrote *"An Economic Analysis of the Protestant Reformation" (Journal of Political Economy, 2002)* and *"An Economic Model of the Medieval Church: Usury as a Form of Rent Seeking " (Journal of Law, Economics, & Organization, 1989)*
- Jackson (and Walker) wrote *"Do Casinos Cause Economic Growth?" (The American Journal of Economics and Sociology, 2007)*

Purpose

- The purpose of this article is to use a sample of works by eight American artists to consider whether presale auction estimates are unbiased predictors of price.
- This article also considers the potential impact of "no-sales" on their empirical result.
- The order is as follows:
  1. Description of the data and the methodology used in the calculation of bias in art auction estimates.
  2. Bias correction for no-sales.
  3. A statistical study of bias in auctions.
  4. Conclusion of the analysis.

Outline

Data

- Available Information:
  - Title of the piece.
  - Date of Auction.
  - Low and High auction house estimates on the piece.
  - Height and Width of the piece.
  - Media (for example, oil, watercolor, ...).
  - Whether the piece was signed by the artist.
  - The "price" of the piece at auction.
- After deleting all paintings having incomplete data, a "complete data sample" of 557 paintings remained (422 were sold).

Data

- Eight Authors [2568 paintings, 422 sold] (1908) extracted from Askart.com:
  - Robert Henri [395 paintings, 82 sold].
  - Arthur Davies [358 paintings, 22 sold].
  - William Glackens [313 paintings, 28 sold].
  - Ernest Lawson [317 paintings, 28 sold].
  - George Luks [265 paintings, 44 sold].
  - Maurice Prendergast [262 paintings, 49 sold].
  - Everett Shinn [438 paintings, 217 sold].
  - John Sloan [212 paintings, 87 sold].
- 135 were "no-sales" (bought in).

"We single out 'The Eight' because their drive for a uniquely American art was perhaps the earliest, best organized, and most 'representative' of the new drive for independence from tradition and Eurocentric culture in the United States.

Measuring the Price

- Three types of price:
  - The price received by the seller.
  - The “Hammers down” price (hammer price).
  - The price paid by the buyer (premium price).
- The premium price is the hammer price plus a percentage of the hammer price paid by the buyer.
- The two largest auction houses are Christie’s and Sotheby’s.

Measuring the Price

1975-1992	1993-1999	2000-2003	2004	January 2005-September 2007	September 2007- June 1 2008	June 1, 2008-2001
10% all lots	15% up to $50,000	20% up to $10,000	20% up to $20,000	20% up to $200,000	25% up to $20,000	25% up to $50,000
	10% above $50,000	15% between $15,000 and $100,000	15% over $20,000	12% above $200,000	20% between $20,000 and $500,000	20% between $50,000 and $1,000,000
		10% above $100,000			12% over $500,000	12% over $1,000,000

Table: Buyer's Premia at Sotheby's and Christie's, 1975-2011

Outline

"Model"

- Let L be the low estimate, and U the upper estimate. Let $\bar{p}$ be the arithmetic mean:

$$\bar{p} = \frac{L+U}{2}$$

- A requirement to be an unbiased estimate of the hammer price is:

$$\mathrm{E}[p] = \bar{p}$$

Literature

- Agnello and Pierce (1996); Beggs and Graddy (1997); Ekelund, Ressler and Watson (1998); Ashenfelter and Graddy (2003) find that auction house estimates systematically understate hammer prices.
- Mei and Moises (2005) find the opposite lmao.
- McAndrew, Thompson and Smith (2012) provides some evidence that the bias findings of these producing previous studies could be attributable to sample selection bias, because they ignore no-sales.
- Heckman (1979) showed that bias in least squares estimates due to sample selection could be eliminated by adding an inverse Mills ratio (based on the probability of each respective observation being included in the sample) to the model as an additional explanatory variable.

Model

- n paintings ($\mathcal{N} = \{1, \ldots, n\}$).
- Hammer price: p_i, $i \in \mathcal{N}$.
- Auction house's estimate: $\bar{p}_i$, $i \in \mathcal{N}$.
- Assume that:

$$p_i = \theta \left(\bar{p}_i\right)^{\lambda} \mathrm{e}^{\varepsilon_i}, \quad \forall i \in \mathcal{N}$$

- θ and λ are unknowns parameters, and ε_i is a stochastic disturbance term.
- If $\theta = \lambda = 1$ and $\mathrm{E}[\varepsilon_i] = 0$ then $\mathrm{E}[p_i] = \bar{p}_i$.

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- If $\theta = \lambda = 1$ and $\mathrm{E}[\varepsilon_i] = 0$ then $\mathrm{E}[p_i] = \bar{p}_i$.
- *There's an error:* $\mathrm{E}[\varepsilon] \not\Longrightarrow \mathrm{E}\left[\mathrm{e}^{\varepsilon}\right]$
- *Counter example:* $\varepsilon = 1$ *or* $\varepsilon = -1$ *with* $p = 1/2$. *Then,* $\mathrm{E}[\varepsilon] = 0$, *but:*

$$\mathrm{E}\left[\mathrm{e}^{\varepsilon}\right] = \frac{\mathrm{e}^{-1} + \mathrm{e}}{2} > 1$$

Model

Probit

- Latent model:

$$\begin{aligned}\texttt{sold}_i^* \quad &= \quad \beta_0 + \beta_1 \cdot \texttt{size}_i + \beta_2 \cdot \texttt{signed}_i + \beta_3 \cdot \texttt{age}_i + \beta_4 \cdot \texttt{U}_i + \beta_5 \cdot \texttt{L}_i \\ &+ \sum_{t=1}^{4} \alpha_t \cdot \texttt{year}_i + \sum_{j=1}^{7} \gamma_j \cdot \texttt{artist}_i + \sum_{m=1}^{8} \delta_m \cdot \texttt{medium}_i + \beta_6 \cdot \texttt{drec}_i + \mu_i\end{aligned}$$

- Observed variable:

$$\texttt{sold}_i = \begin{cases} 1, & \text{if } \texttt{sold}_i^* > 0 \\ 0, & \text{if } \texttt{sold}_i^* \leq 0 \end{cases}$$

- Probit model:

$$\Pr[\texttt{sold}_i = 1 \mid X] = \Phi\left(\texttt{sold}_i^* - \mu_i\right) \qquad (\chi^2 = 36.97)$$

Model

Probit

- Specifications about the previous slide:
  - Sloan was the omitted artist.
  - Chalk was the omitted medium.
  - Time dummies were grouped (1987-1991; 1992-1996; 1997-2000; 2001-2004; 2005-2008). 1987-1991 was the omitted period.
  - The NBER defines the recessions that took place during: June 1990-March 1991, March 2001-November 2001 and December 2007-December 2008.
- If the predicted value for the ith painting from the probit equation is z_i, then the inverse Mills ratio (r_i) is:

$$r_i = \frac{f(z_i)}{1 - F(z_i)}$$

Model

Probit

- Including this term to the pricing equation:

$$p_i = \theta\,(\bar{p}_i)^{\lambda}\,\mathrm{e}^{\psi r_i + \varepsilon_i}, \quad \forall i \in \mathcal{N}$$

- With $\ln(\cdot)$:

$$\ln(p_i) = \ln(\theta) + \lambda \ln(\bar{p}_i) + \psi r_i + \varepsilon_i$$

- Hypothesis tests:

$$H_0^{(\theta)} : \theta = 1 \qquad H_0^{(\lambda)} : \lambda = 1$$

Results

Table: OLS to test if the estimated price is unbiased

	Hammer Price	Premium Price
$\ln(\theta)$	0.1824	0.2286
	(2.604)	(2.925)
λ	1.0426	1.0271
	(64.61)	(66.38)
ψ	-0.5774	-0.3385
	(-3.219)	(-2.039)
n	422	422
F	10.83	8.79
R^2	0.912	0.922

t statistics in parenthesis with robust standard errors.

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Tests for HP:

$$\hat{\theta} = e^{0.1824} = 1.2$$

$$s.e.(\hat{\lambda}) = \frac{1.0426}{64.61} = 0.0161$$

$$t = \frac{1.0426-1}{0.0161} = 2.64$$

Tests for PP:

$$\hat{\theta} = e^{0.2286} = 1.2568$$

$$s.e.(\hat{\lambda}) = \frac{1.0271}{66.38} = 0.0155$$

$$t = \frac{1.0426-1}{0.0155} = 1.74$$

Another Result

- Remember the price equation:

$$\ln(p_i) = \ln(\theta) + \lambda \ln(\bar{p}_i) + \psi r_i + \varepsilon_i$$

- The disturbance term for p_i is lognormally distributed, so, $\bar{p}$ should also be considered to be lognormally distributed.
- Let $\bar{p}$ be defined by the following equation:

$$\ln(\bar{p}) = \frac{\ln(U) + \ln(L)}{2}$$

Table: OLS using the geometric mean for $\bar{p}$

	Hammer Price
$\ln(\theta)$	0.2528
	(2.88)
λ	1.041
	(64.53)
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	(-3.189)
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t statistics in parenthesis with robust standard errors.

Tests for HP:

$\hat{\theta} = 1.288$

$s.e.(\hat{\lambda}) = 0.161$

$t = 2.565$

TEC

Outline

Conclusion

- The study reveals that auction houses consistently underestimate the hammer price for the works by The Eight, and this underestimate becomes greater with the value of the piece.
- Maybe Sothebby's and Christie's does not compete on buyers' premia.
- Sellers becomes more ready to sell when "surprised" by higher prices.
- Buyers are more "activated" to bid when they think a "bargain" will be arriving at auction.