

Auction Experiments

拍賣實驗

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Auctions (拍賣)

- You have a unique... (Liberty Times 2004/9)
- ▶ Referendum ballot 「入聯公投票」
- ▶ You want to get the most out of it
 - ▶ But you do not know where the highest buyer is
 - ▶ And you have no idea about his willingness to pay
- ▶ What would you do?
- ▶ Post a random price on the flea market,
- ▶ Bargain with Taiwan History Museum, or auction it off on eBay/Y拍?



Auctions (拍賣)

- ▶ Cannot find your trading partner
 - ▶ Because you do not know where that buyer is
- ▶ Very hard to determine the price
 - ▶ You do not know buyer's willingness to pay
- ▶ Auctions: The seller auctions off the item under a pre-set rule, and openly invite buyers to bid
- ▶ Conversely, the buyer could conduct the auction (such as procurement auctions)
 - ▶ Strictly speaking, we mean one-sided auctions

Auctions (拍賣)

- ▶ **General Principle:** Highest bidder wins
 - ▶ Payments may differ, but winner is the same
- ▶ Avoid buyers **faking** a low willingness-to-pay
 - ▶ Solve incomplete information (in bilateral trade)
- ▶ Other trading rules are also designed to solve this problem, such as:
 - ▶ Free form bargaining
 - ▶ Double auction markets
 - ▶ One-on-one bargaining

Different Market Format (不同的交易規則)

▶ Trading Rule:

▶ (交易規則)

1. Bilateral Search and Bargaining

▶ (雙邊搜尋談判)

2. Posted Offer

▶ (直接標價)

3. Auctions

▶ (拍賣)

▶ Different Auctions:

▶ (不同的拍賣)

1. 2-sided (雙邊喊價)

2. 1-sided (單邊喊價)

▶ Unit of Sale (拍賣數量)

1. Multi-unit (多單位)

▶ Uniform (統一定價)

▶ Discriminative (各自定價)

2. Single-unit (單一)

Different Market Format (不同的交易規則)

- ▶ **Open (公開喊價)**
 1. **Ascending Auction (往上喊價)**
 - English Auction (英國式拍賣)
 - Button (按鈕拍賣)
 2. **Descending Auction (往下降價)**
 - ▶ Dutch Auction (荷蘭式拍賣)
- ▶ **Closed, Sealed-bid (秘密投標)**
 1. **First Price (付最高標)**
 2. **2nd Price (第二高標)**
 - ▶ Rarely Used (較罕見):
 3. **3rd price (第三高標)**
 4. **All pay auction (全付)**

Other Auction Rules (其他特別拍賣規則例子)

- ▶ **Reserve price (底價):** Lowest acceptable price by the seller
 - ▶ **Secret reserve price:** Not announced, usually used in sealed bid auctions
- ▶ **Entry fee:** What bidders have to pay to participate
- ▶ **Tie-breaking rule:** How to decide the winner if several bidders tie

Other Auction Rules (其他特別拍賣規則例子)

- ▶ **Buy-it-now price:**
 - ▶ Price to buy the item immediately
- ▶ **Privileges:**
 - ▶ Assign favorable bidding conditions to some
- ▶ **Examples:**
 - ▶ **Priority and Handicaps:** “Disadvantaged” bidders win with priority or have bids amplified
 - ▶ **Knowing More Information:** Specialists in NYSE

Market Format vs. Environment

- ▶ Above are variation in **Market Format**
 - ▶ How to bid, who wins, who pays, what price, etc.
- ▶ Not in the **Environment**:
 - ▶ Things unchanged under different market formats
- ▶ **Characteristics** and **information** of the item for sale
- ▶ Buyer's value, seller's cost, participation cost

Environment (交易環境)

- ▶ Is the item divisible?
 - ▶ First assume the item is **Indivisible**
- ▶ **Private value**: Buyers know own willingness-to-pay, not affected by others'
 - ▶ Consumption value of food, books, iPhone 12, etc.
- ▶ **Common value**: Buyers know own estimate of value, affected by others' estimates
 - ▶ Off-shore oil tracks, antiques, etc.

Environment (交易環境)

- ▶ Are **buyer values** **independent**?
- ▶ Is **seller cost** also independent?
- ▶ Buyers only know distribution of others' value or cost
- ▶ Buyer's utility function

$$u = (V(v_i, v_{-i}) - P_w) \cdot \Pr(\text{win}) - P_l \cdot \Pr(\text{lose})$$

- ▶ Assume risk neutral buyers

Environment (交易環境)

- ▶ Simplest Assumption: **IPV Independent Private Value**

$$u = (v_i - P_w) \cdot \Pr(\text{win})$$

- ▶ Classics in auction theory:
 - ▶ Vickrey (JF 1961)
 - ▶ Milgrom and Weber (ECMA 1982)

Auction Theory Prediction (Vickrey, 1961)

1. Descending **Dutch** equivalent to **first price**
2. Ascending **English** equivalent to **second price**
 - ▶ **Strategic Equivalence**: Value, risk attitude free
3. **Revenue Equivalence Theorem**:
 - ▶ For risk neutral buyers with IPV, the above four auction formats yield the same revenue (when highest value buyer wins and lowest type earns zero)
4. **Competition is good**: More buyers increases average revenue

Auction Theory vs. Experimental Results

1. Descending **Dutch** equivalent to **first price**
 - ▶ (Strategic Equivalence: Value, risk attitude free)
 - ▶ Economic Intuition: risk losing vs. pay more
 - ▶ **Experiments**: Dutch auction revenue 5% less
 - ▶ Coppinger et al. (EI 1980), Cox et al. (book chap 1982)
 - ▶ **Behavioral Game Theory**:
 - ▶ Short time frame (seconds/minutes) lead buyers to update expectations of others' V (too fast)
 - ▶ Cox et al. 82', (JEBO 83'):
 - ▶ Not because buyers love to wait

Auction Theory vs. Experimental Results

2. Ascending **English** equivalent to **second price**
 - ▶ (Strategic Equivalence: Value, risk attitude free)
 - ▶ Economic Intuition: bid own value is dominant
 - ▶ But weird equilibria persists: I bid 10^{12} , you bid 0
 - ▶ **Experiments**: English results match theory; overbid in second price (revenue 11% higher)
 - ▶ Need extensive learning to converge to equilibrium
 - ▶ **Behavioral Game Theory**: Can't learn since mistakes are rarely punished
 - ▶ Kagel et al. (ECMA 87'), Harstad & Rothkopf (MS 00')

Auction Theory vs. Experimental Results

3. Revenue Equivalence Theorem:

- ▶ If buyers are risk neutral with IPV, sellers in the above four auction formats earn same revenue (in the “efficient” equilibrium and lowest type earns 0)
- ▶ Experiments:
 - ▶ First/second price (numerical bids) get higher revenue than Dutch/English (on/off)
- ▶ Behavioral Game Theory: Kagel (hdbk 95’)
 - ▶ Buyers focus on price with numerical bids, but focus on profit when deciding to drop out

Auction Theory vs. Experimental Results

4. **Competition is good**: More buyers increases average revenue
 - ▶ **競爭都是好的**: 增加買家人數會增加平均收益
 - ▶ **Experiments**: more buyers increases bids in first price
 - ▶ **實驗結果**: 付最高標拍賣中，買家人數越多，買家投標金額均上升
 - ▶ Cox et al. (JRU 1988), Kagel and Levin (EJ 1993)
 - ▶ **No difference in second price (bid own value)**
 - ▶ **第二高標拍賣沒差**，因為大家標自己的價值

Auction Theory: Effect of Risk Aversion

1. **Dutch/first price**: Assume risk averse buyers, but still IPV , Dutch/first price yield higher revenue than second price
 - ▶ **Economic Intuition**: Risk averse buyers fear not winning and bid higher
 - ▶ Note: Revenue equivalence is on average revenue, Dutch/first price yield higher variance
 - ▶ Uncertain number of opponents (with known distribution) has similar effect...

Risk Aversion Effect: Theory vs. Experiment

2. **Uncertain number of bidders:** Assume risk averse buyers, but still IPV, revenue is higher when buyers do not know actually number of bidders (vs. known) in Dutch/first price.
 - ▶ **Experiments:** Revenue is higher if number of bidder is hidden
 - ▶ Dyer et al. (RAND 1989)
 - ▶ Can we predict bidding behavior if we measure buyer's risk preferences? Maybe...

Auction Theory: Common Value

- ▶ **Common Value:** Buyers know only estimates of their values (affected by others' information)
- ▶ **Pure Common Value:** Same value for all buyers
 - ▶ Off shore oil drilling rights, TSMC stock options,...
- ▶ Could have **Winner's Curse:**
 - ▶ No realizing that others' estimates are lower than you if you win
- ▶ Rational buyers do not have winner's curse
 - ▶ They correctly update their estimates downwards

Common Value: Theory vs. Experiment

- ▶ **Value Discovery**: When buyers have CV and information is disperse enough,
 - ▶ Price \rightarrow “true value” as “# of bidders” \rightarrow infinity
- ▶ **Experiments**: Under first/second price, inexperience bidders exhibit winner’s curse
- ▶ Learning (to avoid Winner’s Curse) is slow
- ▶ Smaller effect in English auctions
 - ▶ Kagel and Levine (AER 1986, EJ 1989)

Common Value: Theory vs. Experiment

- ▶ **Extensions (延伸實驗):**
- ▶ “Allow buyers to **decide whether to participate**” decreases Winner’s Curse
 - ▶ 「允許買家先決定是否參與」會降低贏家魔咒
 - ▶ Cox and Smith (mimeo 1992)
- ▶ **Professionals (專業人士):** Procurement contractors also exhibit Winner’s Curse in the lab
 - ▶ 專門承作土木工程的包商在實驗室裡也有贏家魔咒
 - ▶ Kagel and Levine (book 1992)

Auction Theory: Affiliated Value

- ▶ **Affiliated Value (AV)** (英雄所見略同):
Intermediate case between IPV and CV
 - ▶ Expect others' values higher if own value is high
- ▶ Under Affiliated Value,
 1. Revenue ranking is:
 - ▶ English $>$ second price $>$ first price = Dutch
 2. Can increase revenue by announcing own information or estimate
 - ▶ Milgrom and Weber (1982)

Affiliated Value: Experiment vs. Field Data

- ▶ **Experiments:** Under **Affiliated Private Value**, revealing seller's information increases price
- ▶ But only by 30% of what theory predicts (usually not significantly greater than 0)
 - ▶ Kagel et al. (ECMA 1987)
- ▶ **Field Data:** Already confirm theory regarding:
 - ▶ Buyers with higher WTP bid higher
 - ▶ Revenue increases as # of buyers increases
 - ▶ Under CV, better informed buyers earn more

Conclusion and Discussion

- ▶ These are **classical** results
 - ▶ more on-going (see auction chapter of **Handbook of Experimental Economics, Vol.2**)
- ▶ **Online Auctions**
 - ▶ Lucking-Reiley (1999): Test revenue equivalence theorem with internet (news group) field experiments
 - ▶ Roth and Ockenfels (2002): Explain last minute bidding on eBay with fixed ending rule (compared to Amazon's going-going-gone)
 - ▶ Bajari and Hortacu (2003): Use eBay coin auctions to study winner's curse under CV
 - ▶ More recently: Price effect of seller's reputation...

Conclusion and Discussion

- ▶ Other lab experiment development:
- ▶ All pay auctions (全付拍賣):
- ▶ Noussair and Silver (GEB 2006):
 - ▶ Test revenue equivalence for all-pay auction (in lab)
 - ▶ find bidders exhibit extreme winner's curse and bid way too high (sellers earn very high revenue)

Conclusion and Discussion

- ▶ **Auction with resale (拍賣後交易):**
- ▶ Latest auction theory deals with resale
 - ▶ Haile (2002) - US forest timber auctions
 - ▶ Lab experiment?
- ▶ **Spectrum auction design (手機執照拍賣設計):**
 - ▶ Milgrom/McAfee design FCC spectrum auction
 - ▶ Binmore/Klemperer design British 3G auction
 - ▶ Holt/Goeree design “paper-and-pencil” package bidding auction for FCC’s crown jewel “700Hz”
 - ▶ Google bid up to get **open access**, in lieu of g-phone