

Auction Experiments

(拍賣實驗)

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Auctions (拍賣)

- ▶ You have a unique... (Liberty Times 2009/4/9)
- ▶ Referendum ballot (入聯公投票)
- ▶ You want to get the most out of it
 - ▶ But do not know where the highest buyer is
 - ▶ And have no idea about his/her WTP
- ▶ 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/露天/shopee?



Auctions (拍賣)

- ▶ Cannot find your trading partner
 - ▶ Since you do not know where that buyer is
- ▶ Very hard to determine the price
 - ▶ You do not know buyer's WTP
- ▶ **Auctions:**
 - ▶ Seller auctions off the item under pre-set rules and openly invites buyers to bid
 - ▶ Buyer could also conduct the auction (such as procurement auctions)
 - ▶ Here, 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 WTP
 - ▶ Solve incomplete information@bilateral trade
- ▶ Other trading rules designed to solve this:
 1. Pitt Market (with Free Form Bargaining)
 2. Double Auction Markets (1,2 are N-on-N)
 3. 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. Second Price

(第二高標)

▶ Rarely Used: (較罕見)

3. Third 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/have bids amplified
 - ▶ **Know More Information:** Specialists in NYSE

Market Format vs. Environment

- ▶ Above are variation in **Market Format**
 - ▶ How to bid, who wins, who pays, what price
- ▶ Not in the **Environment**:
 - ▶ Things unchanged under different market formats
 1. Characteristics and information of the item for sale
 2. 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 value (WTP), not affected by others'
 - ▶ Consumption value of food, books, iPhone,...
- ▶ **Common Value:** Buyers know estimate of own value (dep. on 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**

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

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

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

Auction Theory Prediction (Vickrey, 1961)

1. Descending **Dutch** = **First Price Auction**
2. Ascending **English** = **Second Price**
 - ▶ Strategic Equivalence: Value/risk-free
3. **Revenue Equivalence Theorem:**
 - ▶ **Any** auction yields the same average revenue under IPV, risk neutral buyers 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 = First Price Auction**
 - ▶ Econ. Intuition: risk losing vs. pay more
 - ▶ **Experiments**: Dutch revenue 5% less
 - ▶ Coppinger et al. (EI 1980), Cox et al. (bk ch 1982)
 - ▶ **Behavioral Game Theory**:
 - ▶ Short time frame (seconds/minutes) lead buyers to update $E[\text{Others}' V]$ (too fast)
 - ▶ Cox et al. (1982, JEBO1983): Not because buyers love to wait

Auction Theory vs. Experimental Results

2. Ascending **English** = **Second Price**

- ▶ Econ. Intuition: bid own V is dominant
 - ▶ Strategic Equivalence: Value/Risk-free
 - ▶ But weird equilibria exist: I bid 10^{12} , you bid 0
- ▶ **Experiments**: English results match theory
 - ▶ Second price revenue 11% higher (overbid)
- ▶ **Behavioral Game Theory**: Can't learn since mistakes are rarely punished
 - ▶ Kagel et al. (ECMA87'), Harstad & Rothkopf (MS00')

Auction Theory vs. Experimental Results

3. Revenue Equivalence Theorem:

- ▶ Any auction yields same average revenue if IPV, RN buyers, highest wins/lowest earns 0
- ▶ Experiments:
 - ▶ First/second price (numerical bids) get higher revenue than Dutch/English (on/off)
 - ▶ Behavioral Game Theory: Kagel (hdbk95')
 - ▶ 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 V)

▶ 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, Dutch/first price yield higher variance
 - ▶ Uncertain number of opponents (with known distribution) has similar effect...

Risk Aversion: Theory vs. Experiment

2. Uncertain number of bidders:

- ▶ Assume risk averse buyers with IPV, revenue is higher if buyers do not know actually # of bidders (vs. known) in Dutch/first price
- ▶ **Experiments:**
 - ▶ Revenue is higher if # 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 estimates of their V (affected by others' information)
- ▶ **Pure Common Value**: Buyers have same V
 - ▶ Offshore oil drilling rights, TSMC stock option
- ▶ Could have **Winner's Curse (WC)**:
 - ▶ No realizing that others' estimates are lower than you if you win
- ▶ Rational buyers do not have WC
 - ▶ They correctly update estimates downwards

Common Value: Theory vs. Experiment

- ▶ **Value Discovery**: When buyers have CV and information is disperse enough,
 - ▶ Price \rightarrow true V as $\#$ of bidders \rightarrow infinity
- ▶ **Experiments**: Inexperience bidders exhibit winner's curse under first/second price
- ▶ Learning (to avoid WC) 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 WC
 - ▶ 「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 WC 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 V 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

- ▶ **Experiments:** Revealing seller information increases price under **Affiliated PV**
 - ▶ But only by 30% of what theory predicts (usually not significantly greater than 0)
 - ▶ Kagel et al. (ECMA 1987)
- ▶ **Field:** 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