

# Auction Experiments 拍賣實驗

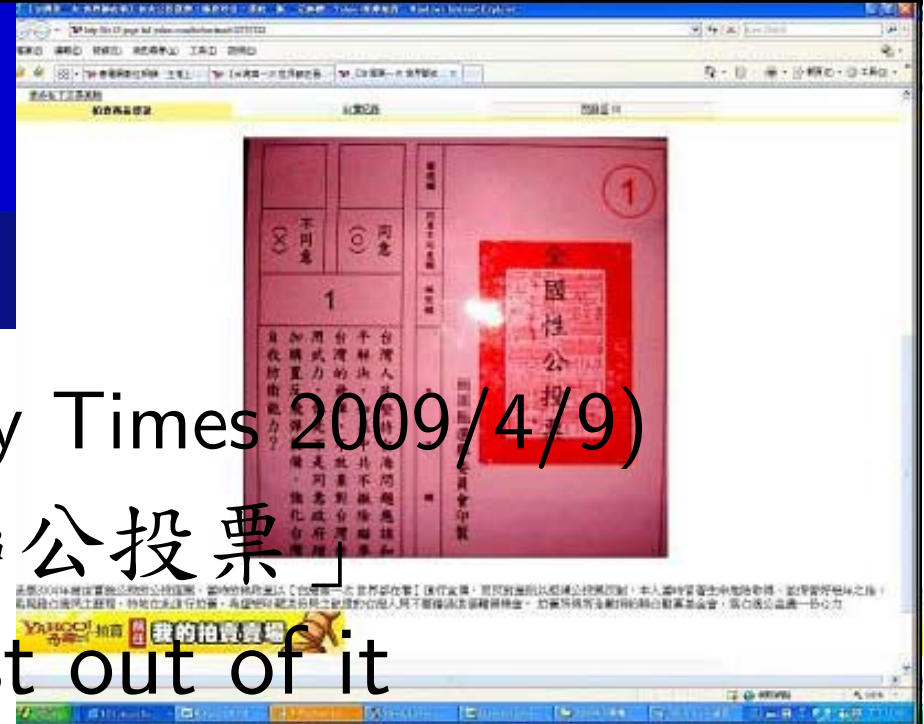
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12/26/2012

(Lecture 10, Micro Theory I)

# 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 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 Rule: Highest bidder is the winner
  - 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 (賣家的最低接受價格)
  - Secret reserve price (秘密底價) : Not announced, usually used in sealed bid auctions (事先不會公佈，通常在秘密投標使用)
- **Entry fee (參加費)** : What bidders have to pay to participate (參與投標需付出的費用)
- **Tie-breaking rule (打破平手)** : How to decide the winner if several tie (平手如何決定贏家)

# Market Format vs. Environment

- Above are variation in **Market Format** (上述都是拍賣規則上的變化)
  - How to bid, who wins, who pays, what price, etc. (如何投標、誰得標、誰付錢、價格如何決定等)
- Not in the **Environment** (跟交易環境不同):
  - Things unchanged under different market formats (在不同拍賣規則下均不變的因素)
- Characteristics and information of the item for sale (標的物的性質、各方關於標的物的資訊)
- Buyer's value, seller's cost, participation cost (買方願付價格、賣方成本、參與成本)



## Other Auction Rules (其他特別拍賣規則例子)

- **Buy-it-now price (直接購買價)** : Price to buy the item immediately (直接買下的價錢)
- **Privileges (特權)** : Assign favorable bidding conditions to some (部分買家有優惠競標條件)
  - Priority (優先決標) and Handicaps (折扣) : “Disadvantaged” bidders win with priority or have bids amplified (政府給弱勢團體優先決標權或將所投的標放大、給予折扣)
  - Knowing More Information (知道更多資訊) : Specialists in NYSE (紐約股市的交易員)

## Environment (交易環境)

- Is the item divisible? (標的物能否分割?)
  - First assume the item is **indivisible**
  - (先假設標的物為單一不可分割)
- **Private value (各自知道價值)**: Buyers know own willingness-to-pay, not affected by others' (買方知道自己的願付價格，不受他人願付價格影響)
- **Common value (共同價值)**: Buyers know own estimate of value, affected by others' estimates (買方估計標的物價值，且可能受別人資訊影響)

## Environment (交易環境)

- Are buyer values **independent** (買家價值獨立)?
- Is seller cost also independent?
  - 賣家成本是否也跟買家價值獨立?
- Buyers only know distribution of others' value or cost (買家只知道別人的價值(或成本)的分佈)
- Buyer's utility function (買家的效用函數):
$$u = (V(v_i, v_{-i}) - P_w) \cdot \Pr(\text{win}) - P_l \cdot \Pr(\text{lose})$$
- Assume risk neutral buyers (假設買家風險中立)

## Environment (交易環境)

- Simplest Assumption (最簡單的假設) : **IPV**  
**Independent Private Value** 獨立各自知道價值

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

- Classics in auction theory (拍賣理論經典文獻)
  - Vickrey (JF 1961)
  - Milgrom and Weber (Econometrica 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% lower
    - Coppinger et al. (EI 1980), Cox et al. (book chap 1982)
  - **Behavioral Game Theory**: Short time frame in the lab (seconds/minutes) lead buyers to update expectations of others'  $V$  (too fast)
    - Cox et al. 82', (JEBO 1983): 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 one's value is dominant
    - Still exist weird equilibria: I bid 1 trillion, you bid 0
  - **Experiments**: English results match theory; overbid in second price (revenue 11% higher)
    - Need extensive learning to learn to play equilibrium
  - **Behavioral Game Theory**: Can't learn since mistake rarely punished
    - Kagel et al. (ECMA 87'), Harstad & Rothkopf (MS 00')

# Auction Theory vs. Experimental Results

3. **Revenue Equivalence Theorem:** Assume 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:** Buyers focus on price with numerical bids, but focus on profit when deciding to drop out—Kagel (handbook 95’)



# Auction Theory vs. Experimental Results

4. **Competition is good (競爭都是好的)**: More buyers increases average revenue (增加買家人數會增加平均收益)
- **Experiments (實驗結果)**: In first price, more buyers increases bids (在付最高標拍賣中，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 one's 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...

# Effect of Risk Aversion: 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  $\uparrow$  if  $\#$  of bidder 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 an estimate 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 enough disperse,
  - Price  $\rightarrow$  “true value” as “# of bidders”  $\rightarrow$  infinity
- **Experiments**: Under first/second price, inexperienced bidders exhibit winner’s curse
- 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)** is the intermediate case between IPV and CV
  - Expect others' values higher if own value is high
- 1. Under affiliated value, revenue ranking is:  
English  $>$  second price  $>$  first price = Dutch
- 2. Under affiliated value, 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. (Econometrica 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**)
- [http://www.econ.ohio-state.edu/kagel/Auctions\\_Handbook\\_vol2.pdf](http://www.econ.ohio-state.edu/kagel/Auctions_Handbook_vol2.pdf)
- **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)
- Bajari and Hortacru (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): Use lab experiments to test revenue equivalence for all-pay auction; 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 exp.?
- 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