

# Auction Design for Selling CO<sub>2</sub> Emission Allowances Under the Regional Greenhouse Gas Initiative

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# Regional Greenhouse Gas Initiative

- 10 Northeast States (research funded by NYSERDA)
- New “cap and trade” program for CO<sub>2</sub> starting in 2009
- All agreed to auction *at least* 25% of the allowances
- (c.f. *at most* 5% in the EU ETS, now 10%, 100% in phase 3)
- Several states (NY, MA, and four others) have said they will auction 100%
- Purpose of study is to select auction design
- RGGI may be precursor to a US national program
- As first program to auction substantial fraction of allowances, RGGI will have global impact



# Methodologies for Evaluating Auction Design Options

- Auction experiments
- Literature review
- Lessons from real world experience with allowance and other auctions



# Criteria for Evaluating Auctions

- Low administrative and transaction costs
- Fairness and transparency
- Economic efficiency
- Avoid collusion
- Reveal market prices
- Minimize price volatility
- Raise reasonable revenues
- Compatibility with electricity markets
- Liquid allowance market



# RGGI Auction Formats Considered

- **Sealed Bid Discriminatory** – high bids win and pay prices bid
- **Sealed Bid Uniform Price** – high bids win, and pay highest rejected bid
- **English Clock** – multi-round ascending prices, bidders state demand quantities, uniform price
- **Dutch** – multi-round descending price clock, with Buy Now button, discriminatory price
- **Shot Clock (Anglo-Dutch)**– ascending price clock with a final round sealed bid (discriminatory)
- **Simultaneous Multiple Round, Multiple Unit** – patterned after the FCC SMR, must raise or withdraw provisionally losing bids
- **Continuous Time Discriminatory or Uniform Price** – show provisionally winning bids at each time, high bids at closing bell become actual winners

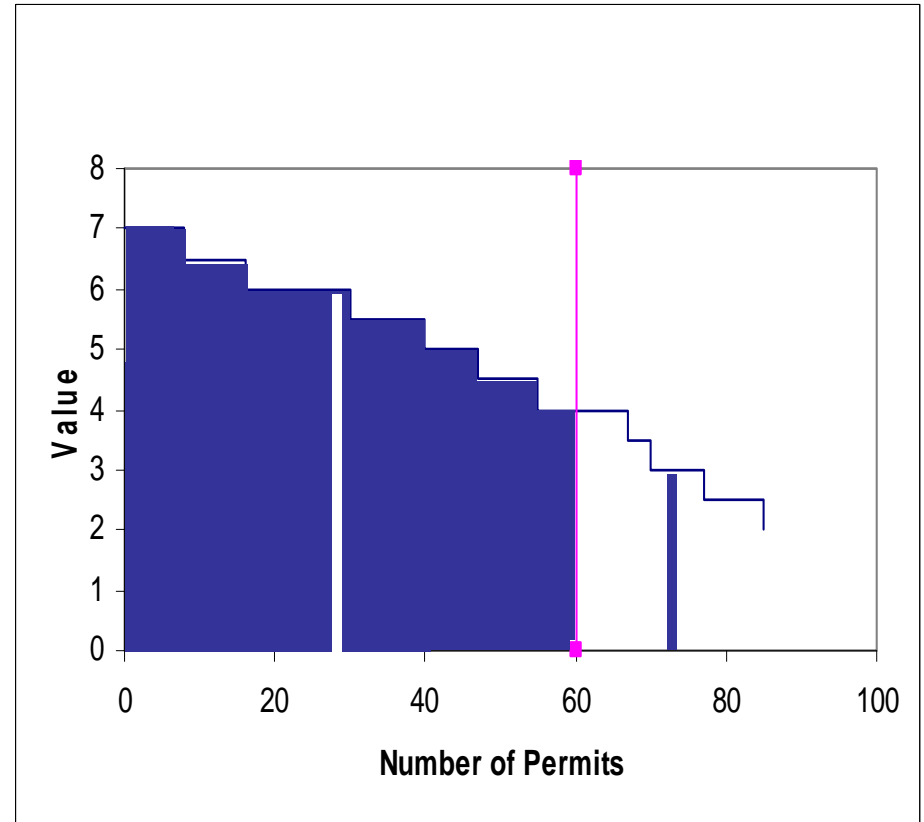
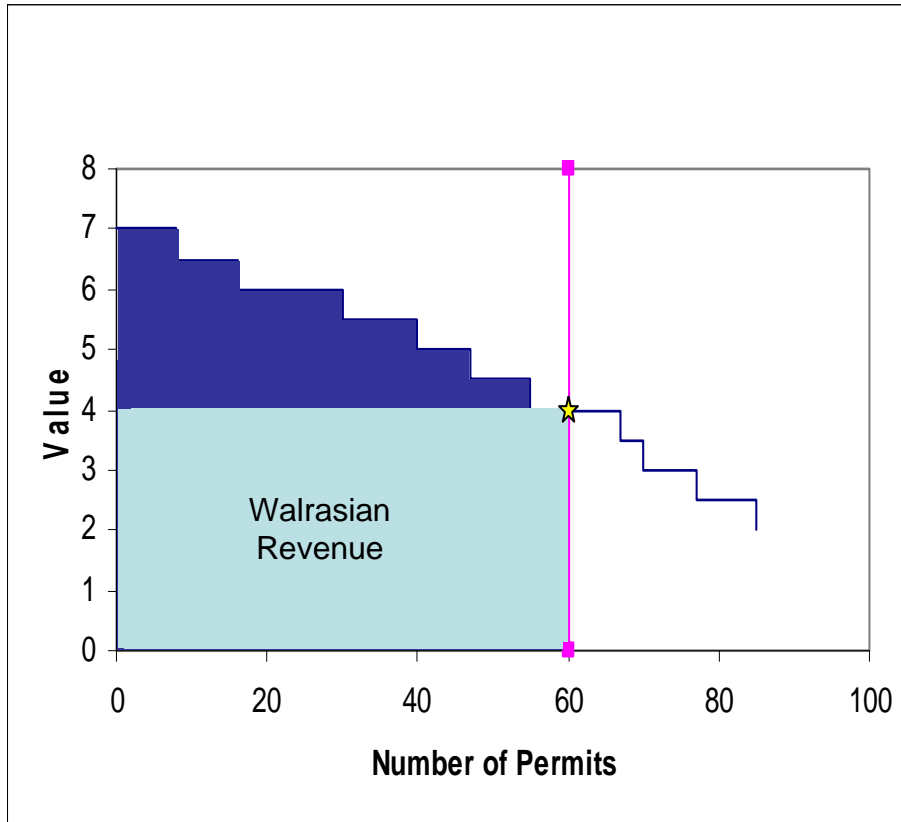


# Performance Measures

1. **Revenue**, as a percentage of maximum if all bid value in a discriminatory auction
2. **Walrasian revenue**, what would be obtained if people bid their values in a uniform price auction (Supply = Demand), expressed as a percentage of the maximum in (1)
3. **Efficiency**: maximum efficiency would allocate units to the highest value users; actual efficiency is a percentage of this maximum



# Performance Measures: Revenue and Efficiency



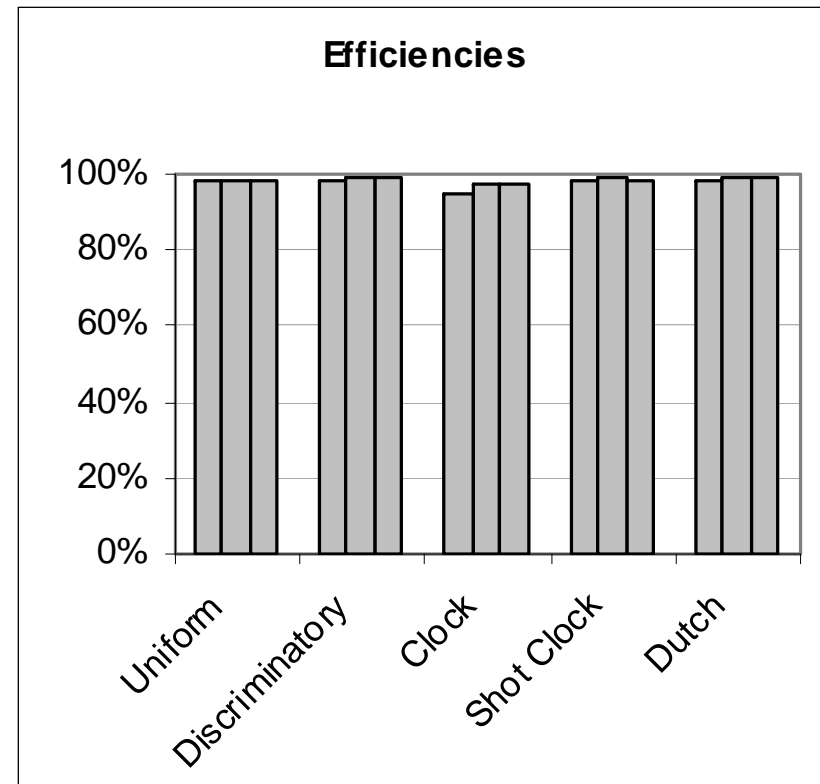
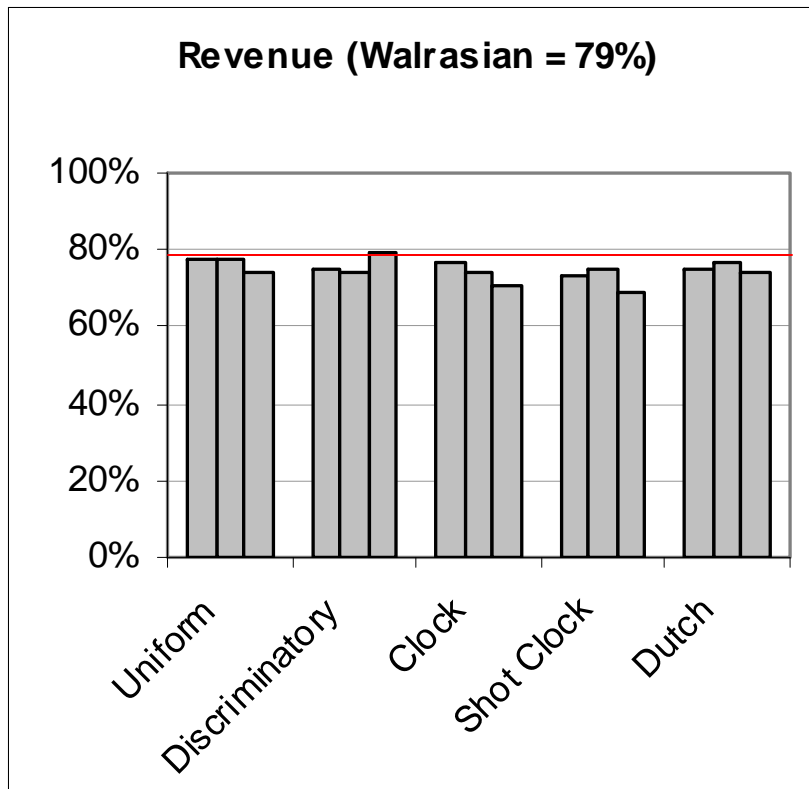
# Phase One Experiments

- I. Simple Environment
- II. Examination of revenue and efficiency in multi-unit auction





# Revenues and Efficiencies by Session “Behavioral Revenue Equivalence” at Near Walrasian Levels

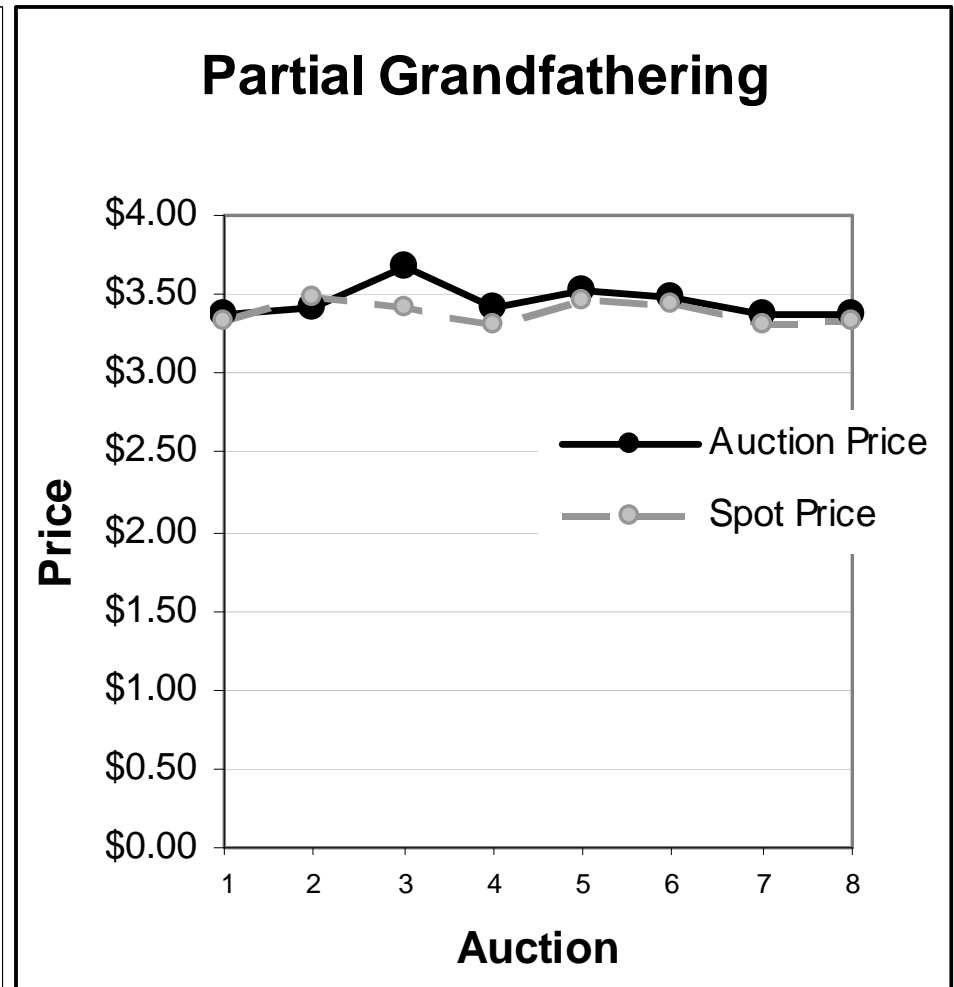
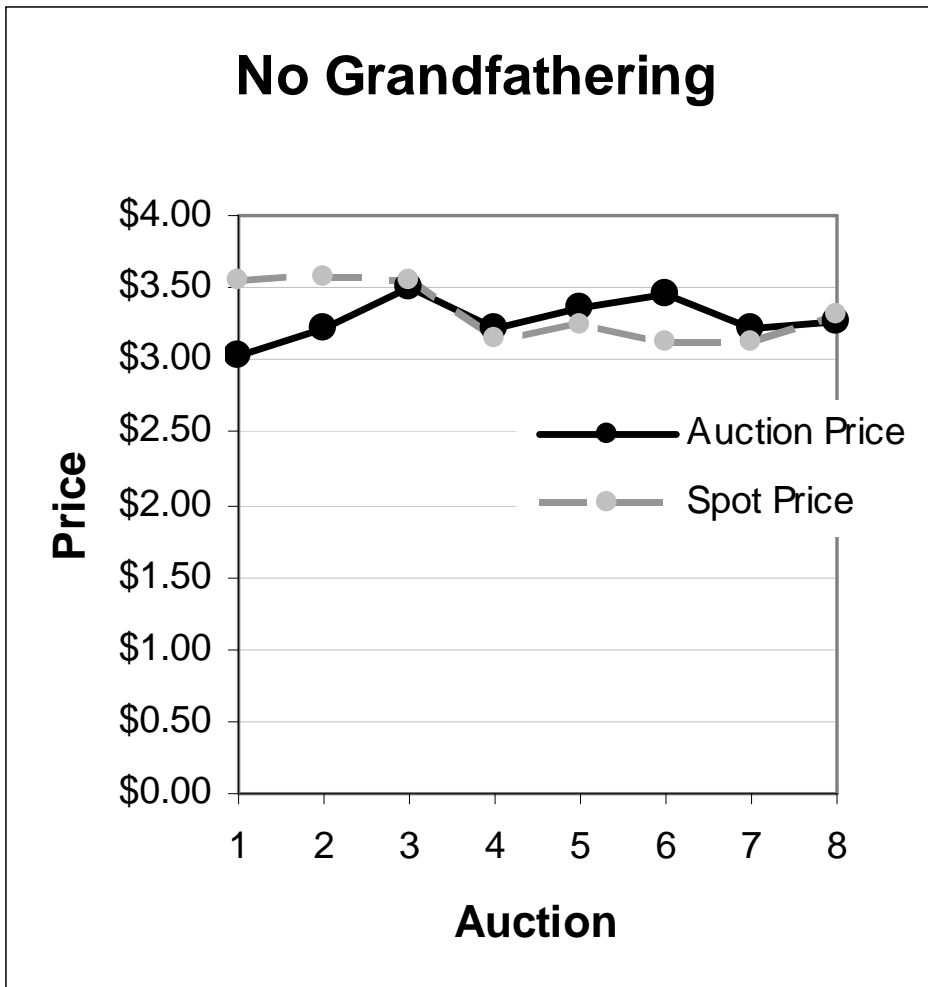


# Phase Two Experiments

- I. Richer environment: spot markets, compliance penalties, partial grandfathering etc.
- II. Explicit collusion (with spot markets and banking)
- III. Loose cap (without spot markets)
- IV. Price discovery with uncertainty about demand conditions (without spot markets)



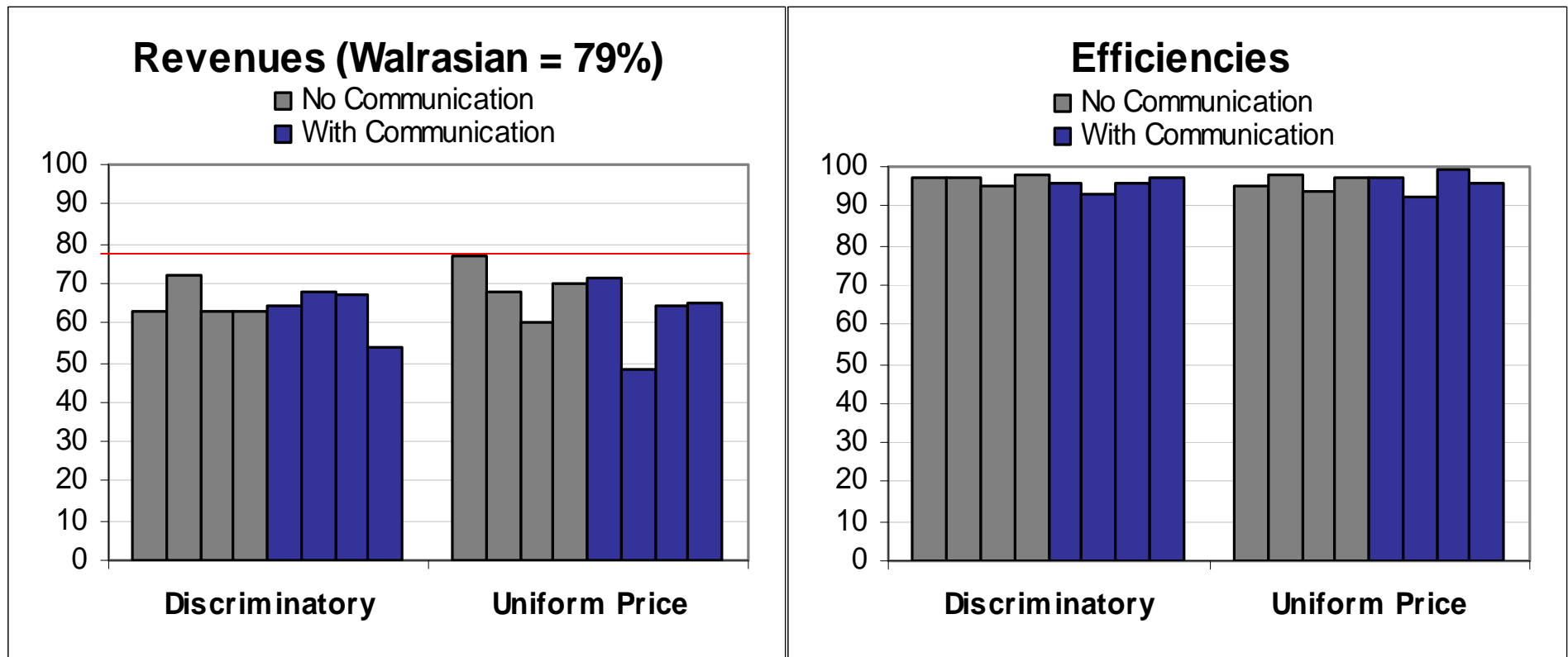
# Uniform Price Auctions with Spot Markets and Partial Grandfathering



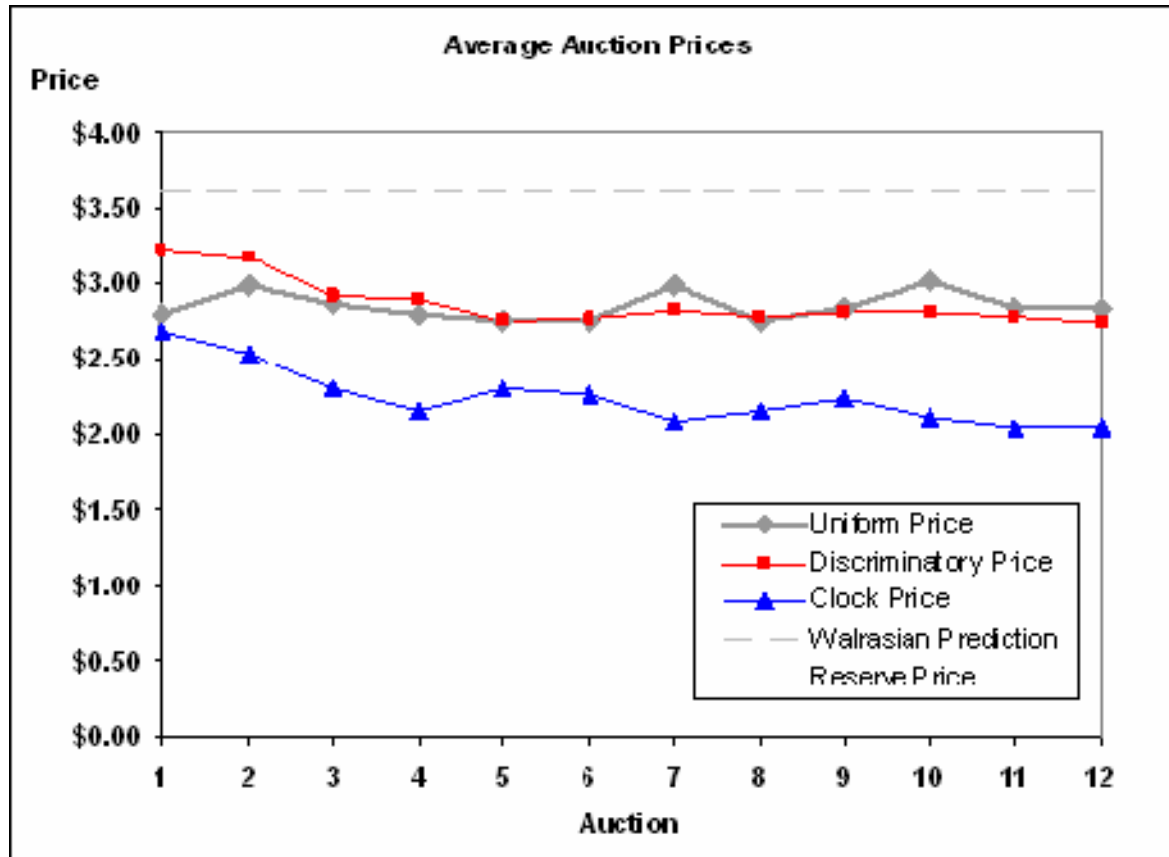
# Collusion: Uniform Vs. Discriminatory

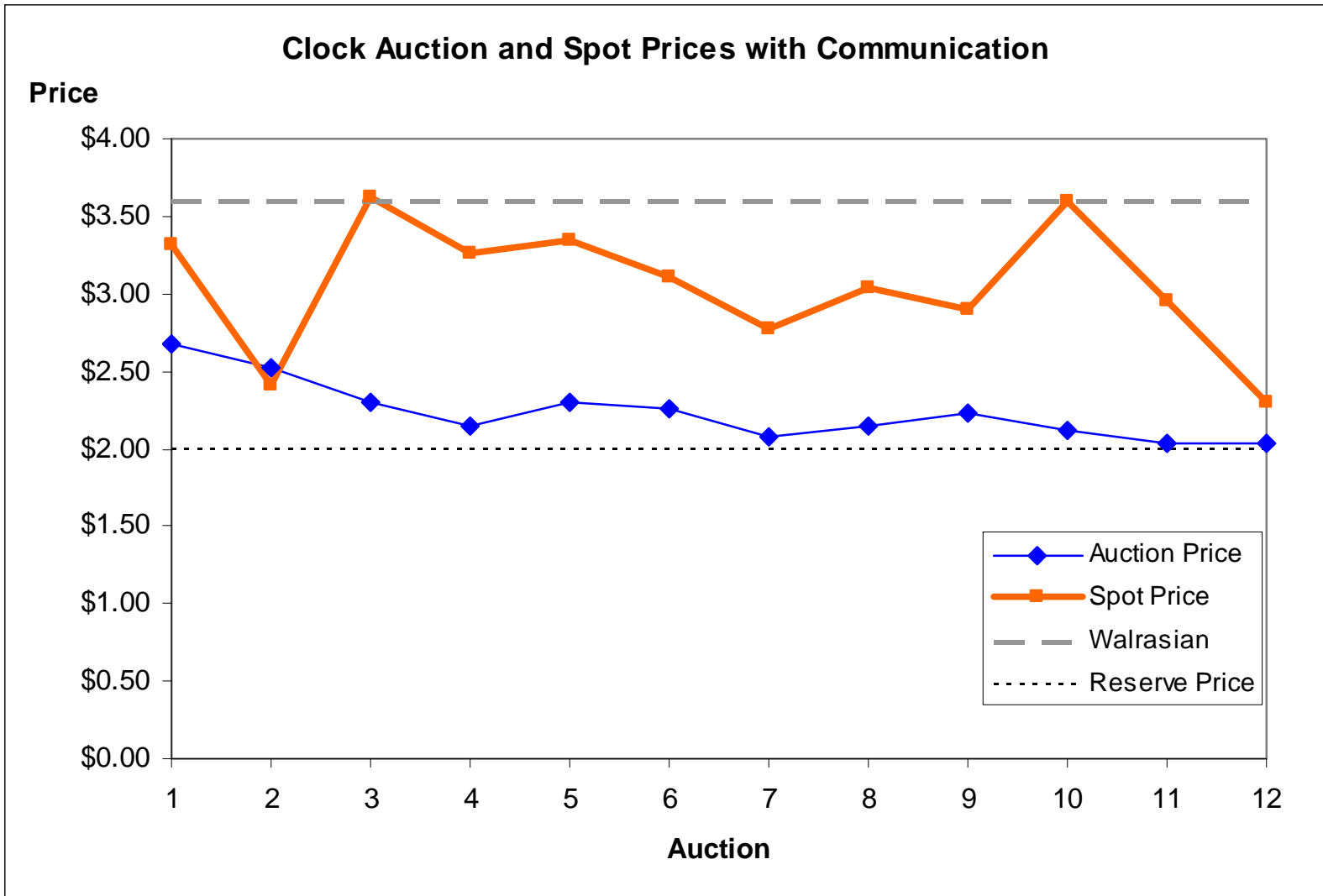
Without communication: with only 6 bidders, revenues below the Walrasian predictions of 79%

Explicit Collusion: communication has little effect for both formats, some groups collude successfully, others don't



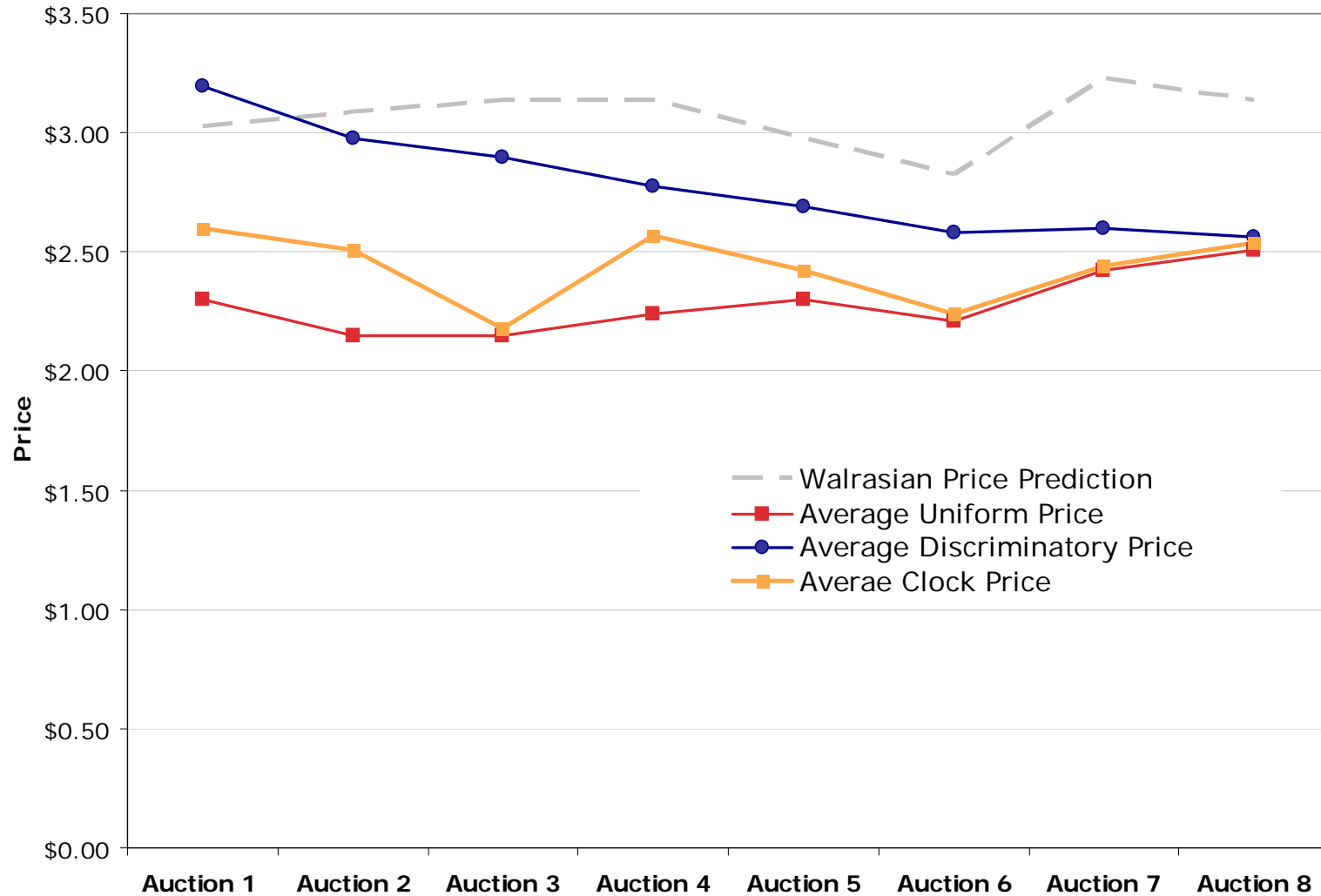
# Effects of Collusion





# Average Prices with Loose Cap

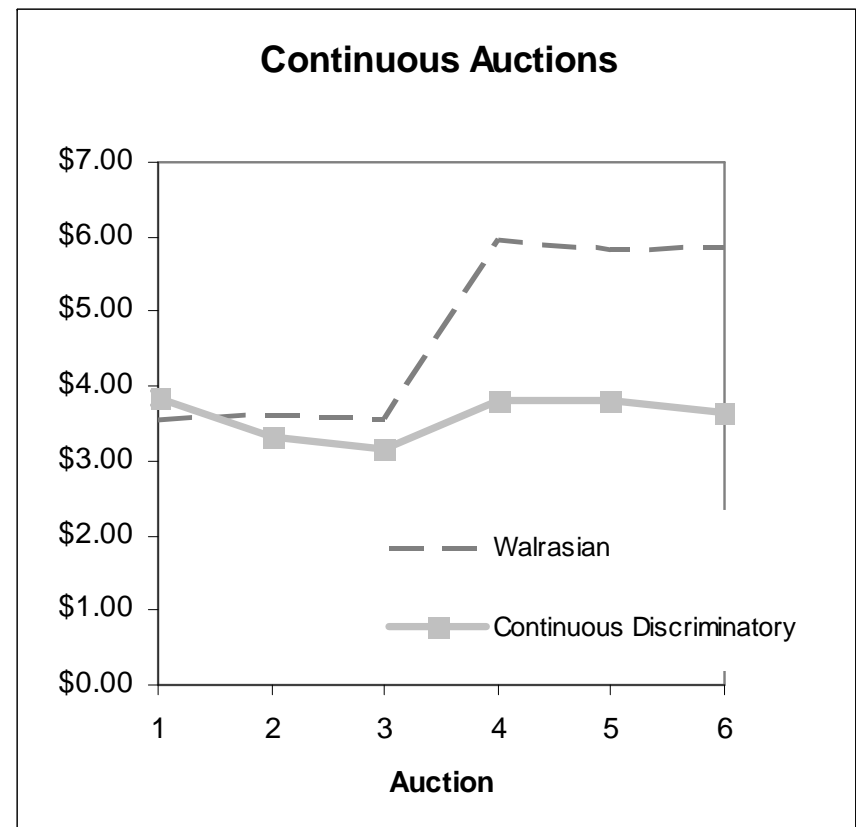
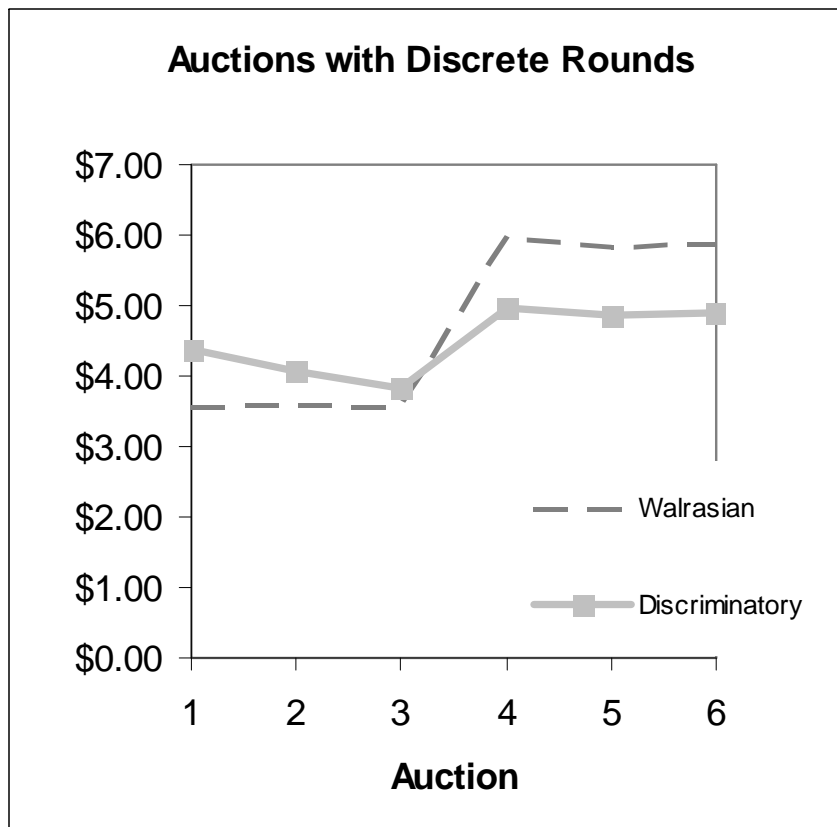
Average Price Paid Per Permit



# Price Discovery: Demand Shift

## **Discriminatory** Tracks Badly

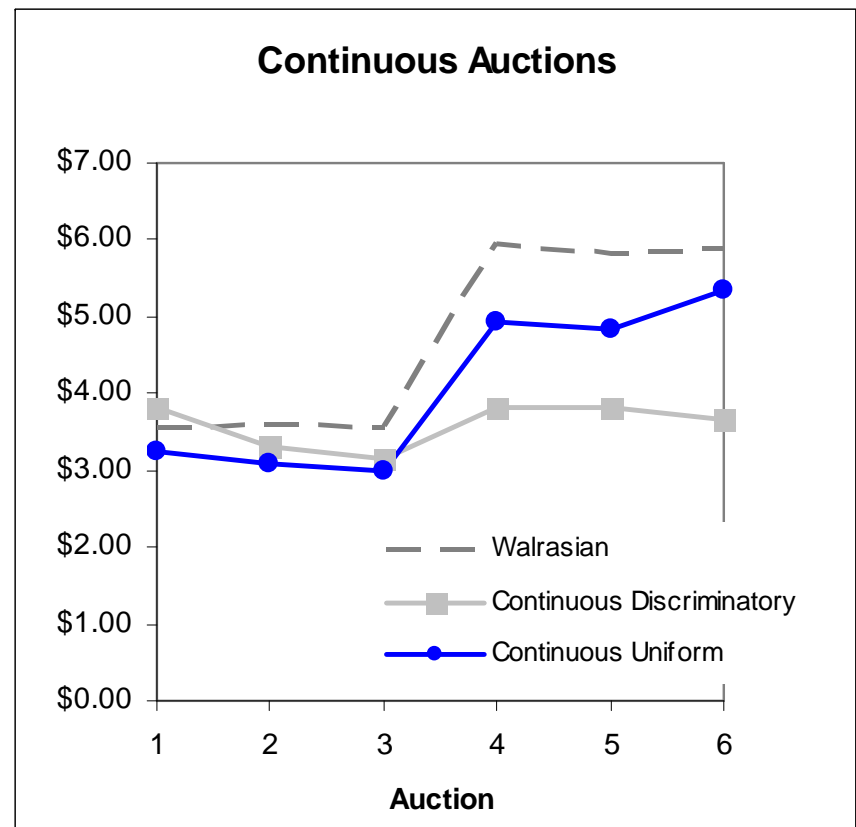
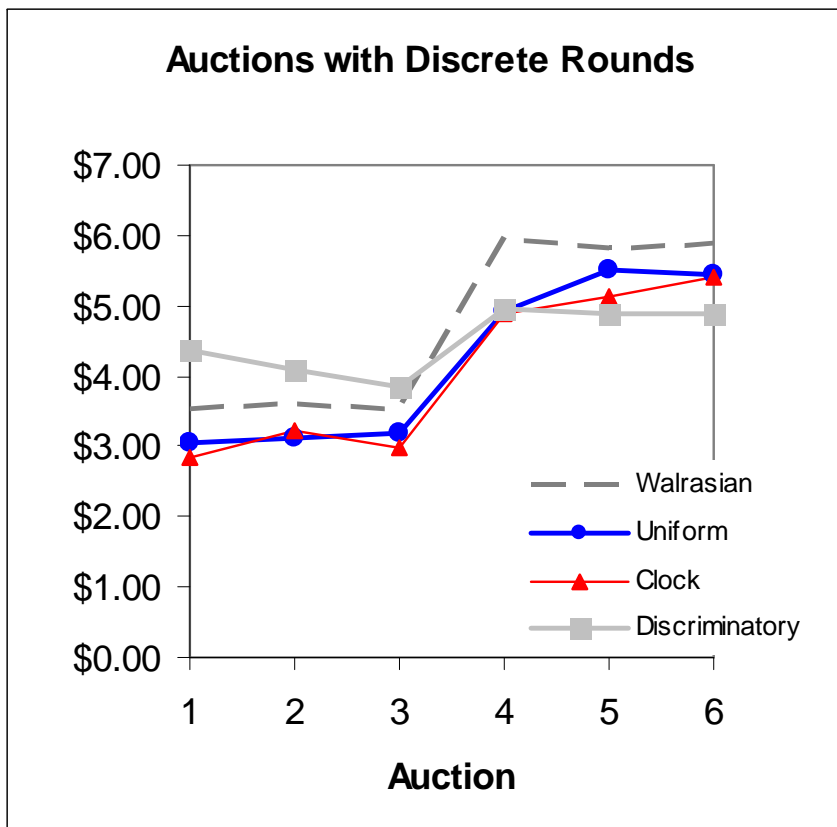
(sniping and tacit collusion)





# Price Discovery: Demand Shift

**Uniform** and **Clock** Track Better  
(some tacit collusion observed)



# Recommendations

Format and Timing

Reserve Prices

Participation

Information, Monitoring and Evaluation



# Recommendations: Format and Timing

- Joint and uniform auction for allowances from all states.
- Sealed bid, uniform price auction
- Separate auctions for allowances from different years (vintages)
- Quarterly auctions
- Minimum lot size of 1000 allowances
- Auction future vintages in advance



# Addressing Substitutability Between Allowance Vintages

1. Bidders Express Preferences for Trading Between Vintages (ex: a linear substitution algorithm) (Cramton comment)
2. Allowances for Both Vintages are Sold in a “Combined Vintage Auction” with single price bids (RFF/UVA)
  - A Combination of These Two Proposals (ex: NYISO suggestion)



# Recommendations: Reserve Price

- Reserve price at each auction
- No allowances sold at prices below reserve price
- Unsold allowances rolled into contingency reserve or sold in next auction



# Recommendations: Participation

- Auction open to all financially qualified bidders
- Single bidder's purchases limited to 33% of auction total volume
- Accepted bid is a binding contract



# Recommendations: Information, Monitoring and Evaluation

- Announce clearing price, identity of winners and, (only if necessary) quantity they won
- Do not announce *any* bids, nor the identity of losing bidders
- Require disclosure of party benefiting from allowance purchases but do not make this public
- Coordinate with existing efforts by federal and state agencies
- Ongoing evaluation of auction performance



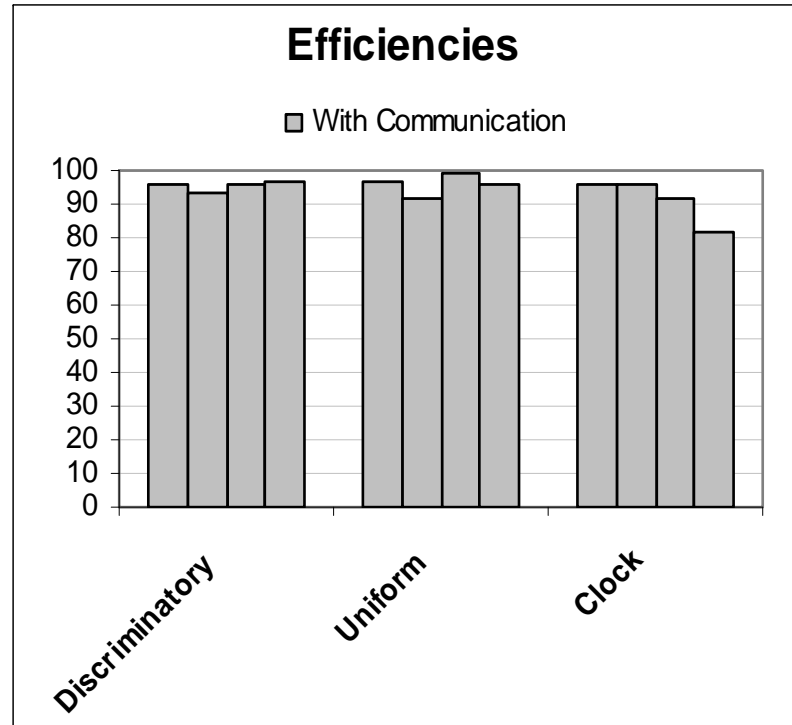
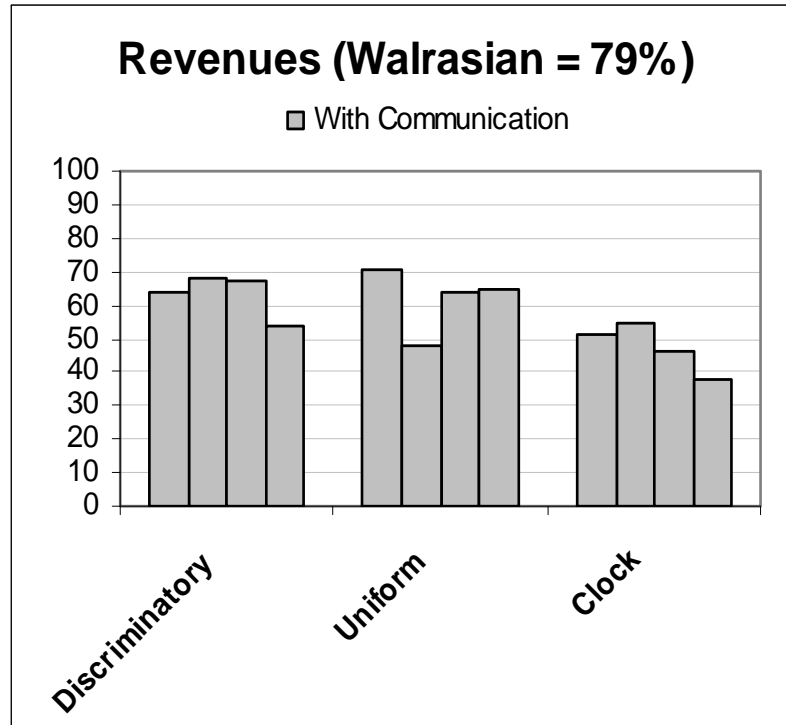
# For a Copy of Study

- Go to <http://www.coopercenter.org/econ/index.php> or
- [http://www.rggi.org/docs/rggi\\_auction\\_final.pdf](http://www.rggi.org/docs/rggi_auction_final.pdf)





# Collusion Results



# Clock With Demand Information

