Buyback Auctions: Possibilities

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Background

- Fisheries are subject to overfishing
  - Too many boats chasing too few fish
- It is natural to try to restrict the number of vessels.
- But there are structural problems to getting there.

Possible Policies

- Harvest restrictions, maximum total catch,…
  - Problems: capital stuffing, race to fish

- Tradeable Quota
  - Problem: transactions costs
    - Those few who want to buy a lot don't have the time or capability to locate a lot of little fishers

Australian Fishing Data: offshore

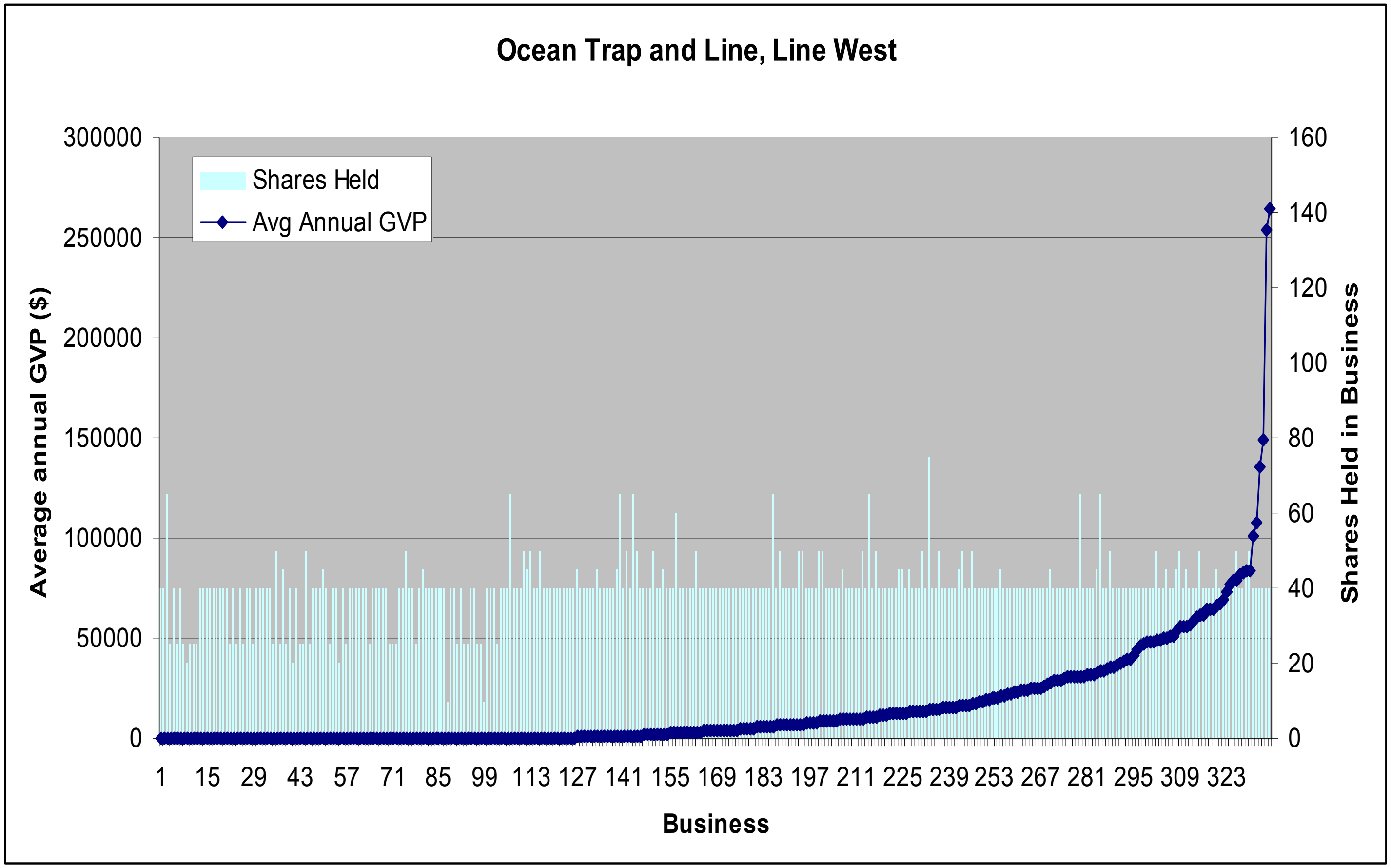


Figure 4: Relationship between numbers of shares held and average annual GVP for each of 336 OTL FBs between 2009/10 and 2010/11.

Buyback Auctions

- Buy out a sizeable portion of the fishers.

- Historically
  - Have come at a high cost
    - Government subsidies to the fishery
    - Treasury pays for past mistakes instead of the fishers themselves.
  - Have used bad auction designs.
    - Pay what bid
    - Example: In Maryland crab fishery only 34% of target was reached and spent 80% more per license than expected.

- Surely we can do better.

A Standard Model

- The fisher's incremental value of being in the fishery is $U_i\ (s, \theta_i) = \max_y\ \pi(y, s, \theta_i)$

- The stock of fish is determined by

  $$ds/dt = g(s) - \Sigma y(s, \theta_i)$$

- For this talk I assume ***a competitive fishery***.
  - $y(s, \theta_i)/k_i$ is approximately the same for all i
  - the steady state stock depends on total capacity and <u>not</u> on who wins.

    $$U_i = U_i(s(K), \theta_i)$$

- U has a private value and a common value.

Goals of a Satisfactory Buyback Policy:
For a given capacity choice K

- Efficient: Remove the highest cost or least efficient vessel capacity from the industry.
  - Max $\Sigma U_i(s(K), \theta_i)x_i$ subject to $\Sigma k_i x_i = K$.
- Self-financed: No outside subsidies or taxes
  - $\Sigma\, t_i = 0$
- Voluntary: All boats, winners and losers, should be better off after the buyback than they were before.

A Simple Buy-back Auction

- <u>Uniform-price auction</u>
  - A desired capacity level is chosen, K.
  - Boats each submit a per-unit capacity bid.
  - Bids are accepted from high to low and until K* is reached.
  - The per capacity price, P*, is the highest rejected bid.
  - Winners pay P* times their capacity.

- <u>With rebate</u>
  - The total of all payments, P*K, is then redistributed to **<u>all</u>** bidders in proportion to capacity.

- Winners pay to remain in the fishery;
  losers are paid to leave the fishery.

Standard Theory

- Because of the rebate, dominant strategies do not exist.

- In a symmetric Bayes equilibrium, bids are increasing in V_i. Therefore we get E and S.
  - Also get V from the increase in profits due to the contraction in capacity.

- This requires common knowledge of information, beliefs, rationality, etc.
  - Unlikely in practice.

Behavioral Theory

- If there are a lot of fishers, then the probability that anyone is the first rejected is small.
  - The probability is O(1/N).

- Behavioral assumption:

Each fisher acts as if they will NOT be the first rejected.

- Then, if s(K) is known, each fisher has a dominant strategy.
  - Bid $U_i\ (s(K), \theta_i)$

- Get E, S, and V.
  - Don't need common knowledge of information, beliefs, rationality, etc.

Experiment 1: Parameters

- The goal:
  - Test the Behavioral Assumption
  - Evaluate the performance of the buy-back auction when S is known

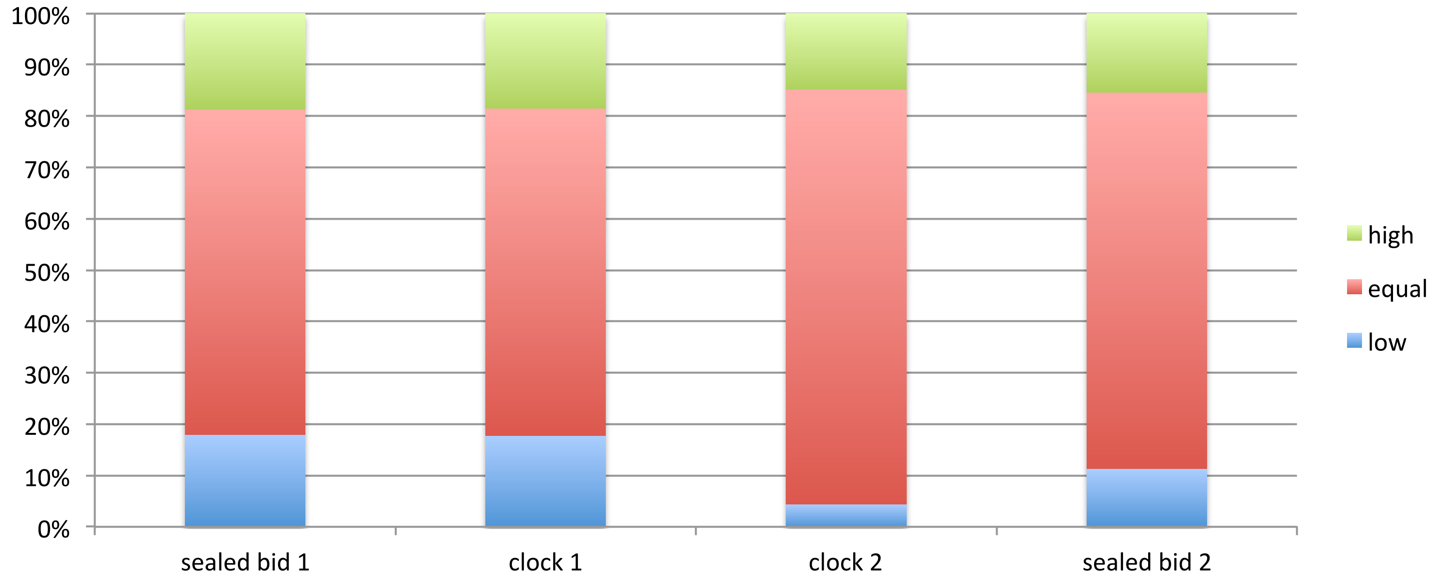
- Values randomly drawn
  - Private values:
    - v in [50,550] then V in [v-50,v+50].
    - Signal = V, Value = V
  - This is common knowledge.

Experiment: Auction Designs

- Sealed bid:

- Clock auction:
  - Price increases by 5 each x seconds.
  - Bidders must choose to stay in any round. If no choice then drop out (with no re-entry).
  - Auction stops when remaining number is less than or equal to K.
    - If too many drop in last round, then winners chosen randomly from that group.

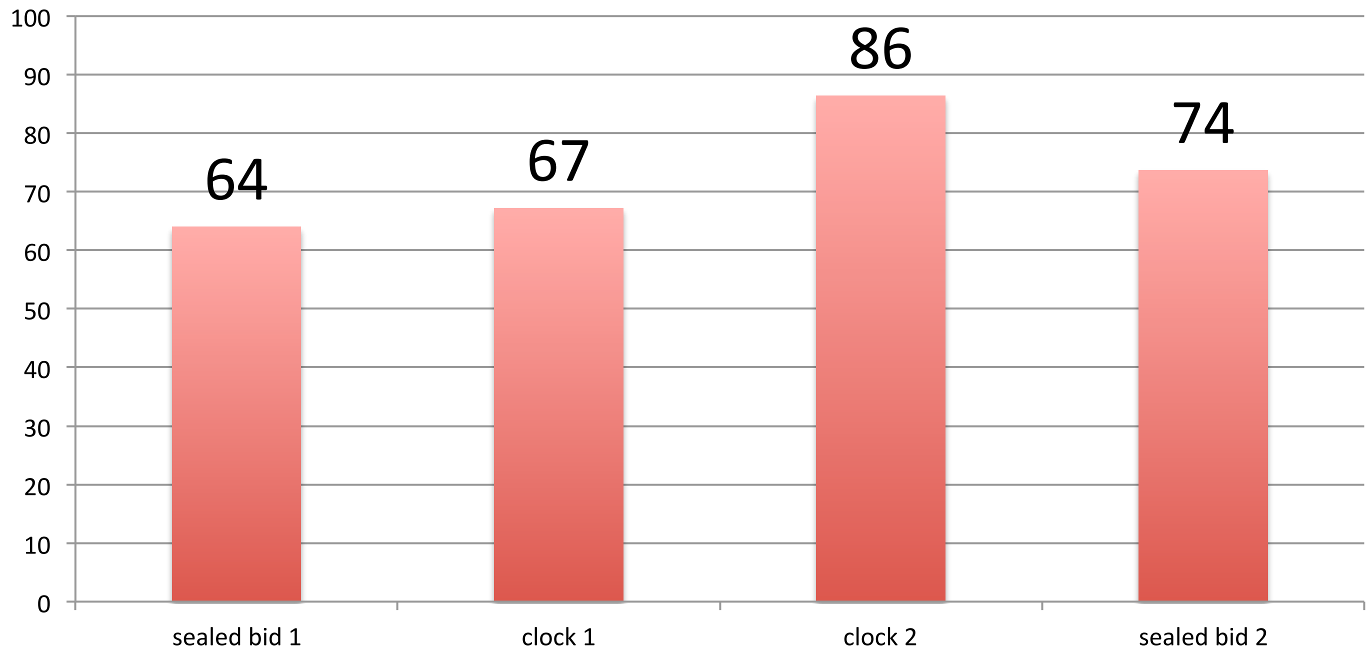
What about behavioral assumption?



- Reasonably good
  - 70% equal (b-v≤15), 17% over, 13% under.
- There is some evidence of learning.
  - Last period: 77% equal, 15% over, 8% under.
- Clock is not different than sealed bid.

Efficiency Results

Efficiency = (subject payoffs – random)/(max possible – random)



- These numbers are fairly high.
  - Prob {effic. of a random allocation < 86%} = .985
  - Prob {effic of random < 64%} = .885
- Some evidence of learning.

What if fish stocks are uncertain?

- The model: private signals about common value

  $U_i\ (s(K) + \varepsilon, \theta_i)$ and

  $(\varepsilon, \eta_1, \ldots, \eta_N)$ have density $h(\eta_1|\varepsilon) \ldots h(\eta_N|\varepsilon) h^*(\varepsilon)$

- i's bid now depends on θ_i and η_i.

- High cost and optimism will outbid low cost and pessimism.
  - Animal spirits can destroy efficiency

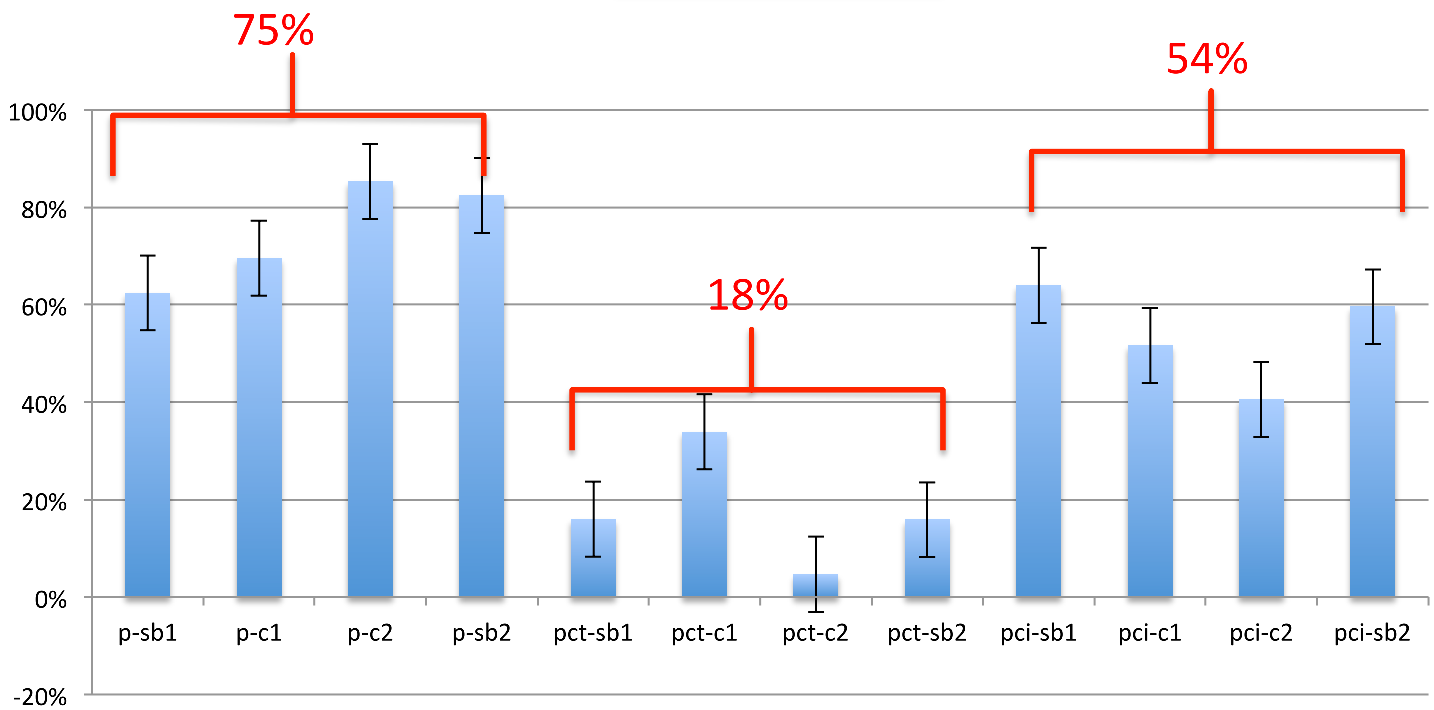
Experiments with private + common value

(See, also, Goeree & Offerman 2005)

- Tight information:
  - Value = V_i + c, Common value is c, Signals are V_i and C_i.
  - v in [50, 550], V_i in [v-50,v+50].
  - c in [750,2550], C_i in [c-50,c+50].
- Imprecise information:
  - Value = V_i + c, Common value is c, Signals are V_i and C_i.
  - v in [50, 550], V_i in [v-50,v+50].
  - c in [750,2550], C_i in [c-150,c+150]. (c is common)
- This is common knowledge.

Efficiency Results

Efficiency = (subject payoffs – random)/(max possible – random)



- The looser the information, the lower the efficiency.
  - Prob{effic of random < 75%} = .925
  - Prob{effic of random < 18%} = .66
- Clock doesn't seem to matter.
- Experience doesn't seem to matter.

Findings of Experiments

- The simple uniform-price, buyback auction is <u>satisfactory</u> if there are <u>only private values</u>.
  - High efficiency, balanced, and voluntary
- The simple uniform-price, buyback auction is <u>NOT satisfactory</u> if there are private and <u>common values</u>.
  - Balanced but low efficiency and possibly not voluntary
- Open question:

  Can we design a mechanism to homogenize expectations about the common value?

Information Aggregation Mechanisms

- We consider two very different IAMs.
  - Prediction Markets and Prediction Polls.

- IAMs generate a succession of actions, trades, bets, etc. that allow each agent to update their beliefs, conditioning on the information provided by others' actions, such that in equilibrium, all agents beliefs are exactly the full information posterior.

Prediction Market

- The design
  - Create an asset that will pay αS per unit where α is a fixed parameter and S is the stock of fish that actually occurs after contraction.
  - Give everyone an equal initial allocation of the asset.
  - Let them trade.

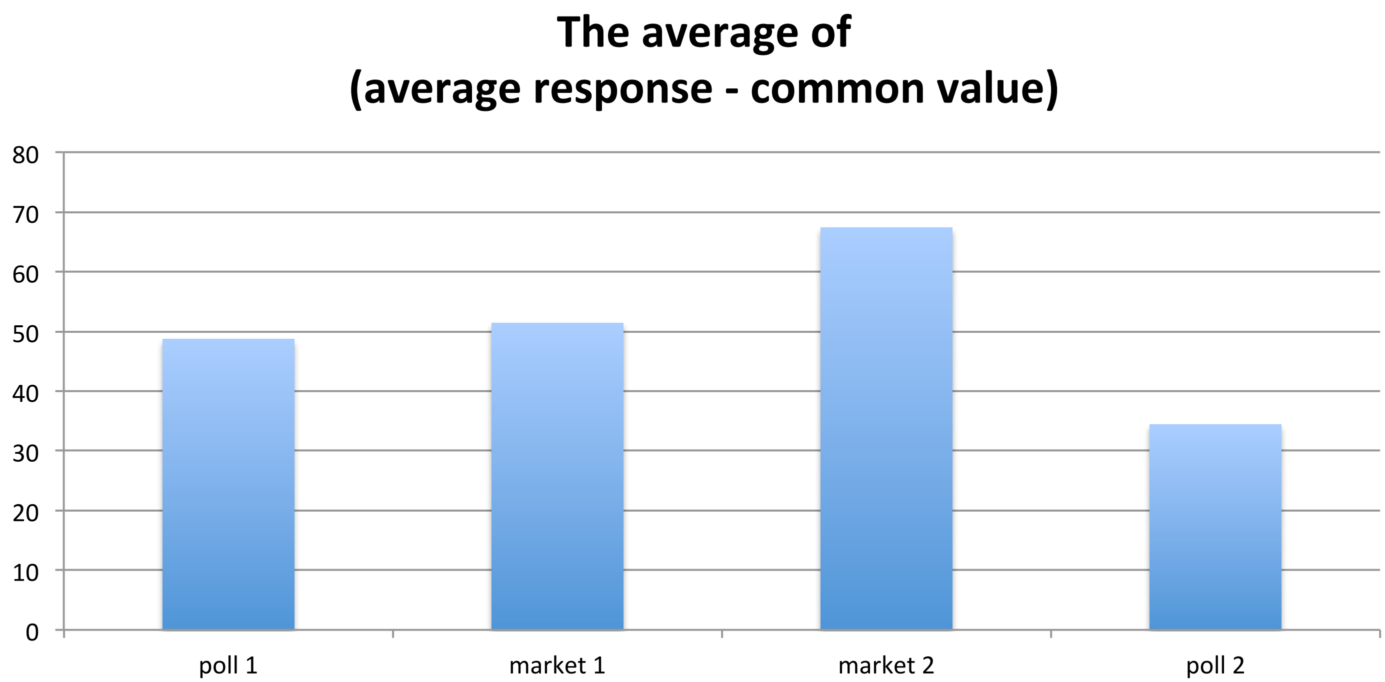
- The theory
  - A risk neutral trader will buy if $p < \alpha\, E(S \mid \text{beliefs})$ and sell if $p > \alpha\, E(S \mid \text{beliefs})$.
  - In equilibrium $p = \alpha E(S \mid \text{full information beliefs})$ and everyone's beliefs = the full information beliefs.

Prediction Poll

- The design
  - Everyone submits a "prediction" about the stock.
  - The submissions are averaged and reported.
  - Everyone submits a new "prediction."
  - And so on.
  - Everyone is paid $A – B (M\text{-}S)^2$ where A and B are parameters, M is the final average reported and S is the actual stock that occurs after contraction.

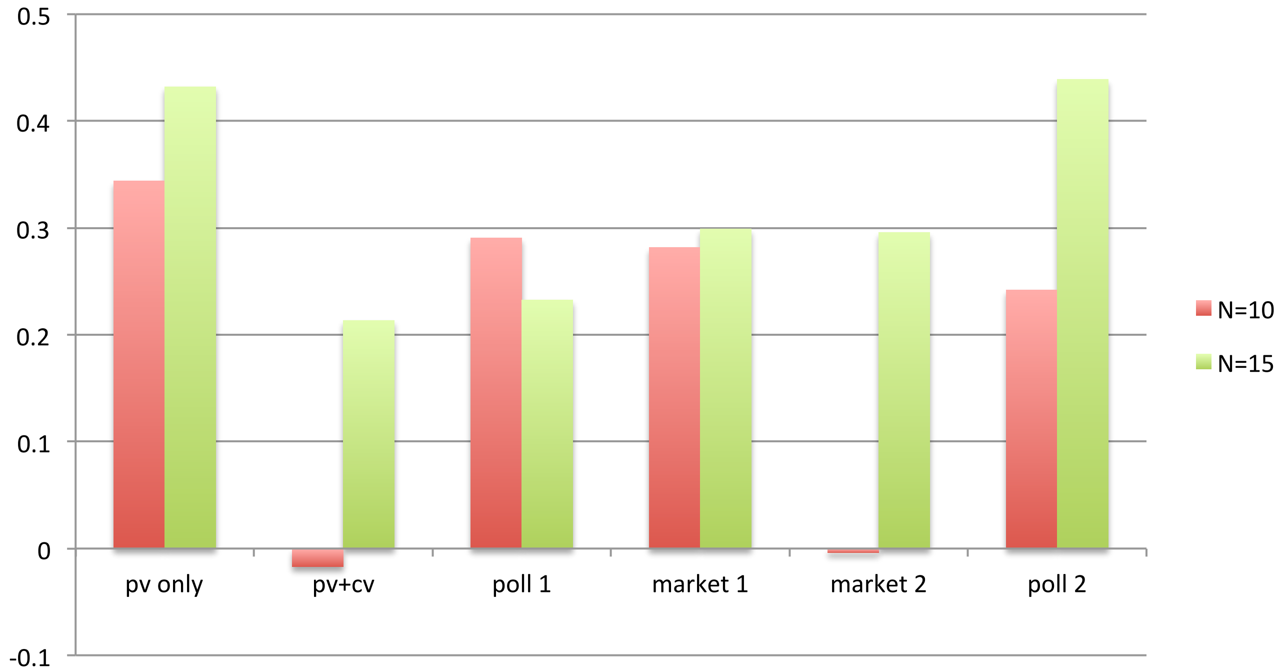
- The theory
  - A risk neutral responder will report E(S| beliefs) and update those beliefs on the basis of the reported averages.
  - The final average is E(S| full information beliefs) and everyone's beliefs = the full information beliefs.

Accuracy Results



- Average response – common value significantly less than the signal variance of 150.
- Poll a little better than market: less than 50!
- Some evidence of learning with poll but not market.

Efficiency Results: (gains over random)



- Efficiencies higher with N = 15.
- Both market and poll improve on auction only.
- Poll attains the level of efficiency achieved in a private values environment.

What is possible with a buyback auction

- In a private values only environment,
  - The behavioral assumption is approximately valid.
    - Conjecture: Even better as N increases.
  - The simple buyback auction yields high efficiencies.
    - The clock is a little better than the sealed bid.

- In environments with both private and common values,
  - The simple buyback auction does not yield high efficiencies.
  - The looser the information, the lower the efficiencies.

What is possible with a buyback auction and IAM.

- Preceding the buyback auction with a prediction market or poll will improve efficiency.
  - The prediction doesn't have to be right, just agreed on.

- The prediction poll allows the buyback auction with rebate to attain high levels of efficiencies.

Questions?