

Design Matters: Experimental Tests of California's Cap & Trade Scheme

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Markets California-style: The basics of AB 32

- Economy-wide cap once fully implemented
- Imported emissions are accounted for
- Transportation fuels covered starting in 2015
- 80 million ton reduction in CO₂e by 2020
- 62 million are achieved by “complementary measures”, i.e. regulations
- Anything those measures don’t achieve comes under the cap & trade program
- There will be many marginal costs of control!

Important market design elements

- Declining cap
- Declining free allocations except that public utilities get 100% free allocations which they ***must*** consign to auction
- Mandatory recording of ownership and of “beneficial interest” i.e. hidden ownership

More market design elements

- Three year compliance period, compliance entities must hold at least 30% of current obligation.
- Price collar: auction reserve price and price containment reserve (PCR): 7% of cap
 - More on this later

Limits on banking

- Banking is allowed but is limited
- Tight limits on ownership: holding limits
 - Fixed absolute limit only binds large participants
 - Limits relaxed for allowances in non-tradable “compliance” accounts
- Holding limits will bind PG&E, among others, very soon
- Holding limits were justified as a hedge against market manipulation

The auction

- Quarterly uniform price / sealed bid
 - Price is last accepted bid
- Reserve price:
 - \$10 rising at 5% plus the expected inflation rate
- Some must consign to the auction, others may
- Unsold allowances held until two auctions in a row close above the reserve price
 - Then sold at the next auction

Vintages

- Two auctions will be held each auction day:
 - 1. Current and past vintages
 - Including consignment allowances
 - Unsold allowances from previous auctions
 - 2. Vintage from 3 years in the future (2.5% of that year's allowance budget at each auction).
 - Unsold future vintages
- Why oh why do we still have vintages for GHGs?

Purchase and holding limits

- Bids in the auction are subject to purchase limits by auction and to aggregate holding limits
 - Any bids that would exceed either are disallowed
 - Limits apply to groups of related entities
- Auction purchase limits
 - No more than 25% of future vintage auctions
 - For current auctions:
 - 15% for covered entities and opt-ins
 - No limit for EGUs with direct allocation sale requirements
 - 4% for all others

Reserve sales

- The PCR sales are a strange mix of fixed price offer and pay-as-bid auction
 - Reserve is divided into three equal lots or tiers: \$40, \$45, and \$50 (increasing at 5% plus inflation)
 - Bidders bid amounts in each of the price tiers
 - Bids are honored by lot until that tier is exhausted
 - Pull-down rule when lower tiers not exhausted
 - Random assignment if oversubscribed
 - This is an *interesting* mechanism!

Questions we address

- Do holding limits harm market function?
 - Treatments: loose v. tight holding limits
- Does the form of reserve sale affect outcomes?
 - Treatments: California v. RGGI reserve sale
- Does the choice of 1st price or 2nd price matter?
 - A question arising from an early mistake in our specification
 - Treatments: Highest rejected bid v. lowest accepted bid

Lab setup

- U.Va. economics lab; Veconlab software
- No communication, private values
- 12 periods per session
- 12 experienced subjects, all U.Va. students
 - \$6 to show, average earnings \$57
 - $\frac{1}{2}$ hour to read instructions, one hour of trading
- Randomly assigned private costs, redrawn each period

Experimental environment

- High and low emitter roles (6 each)
 - 5 production units each, low emitters must run 3
- Half must consign all to auction, half may consign
- Declining cap with random spikes in demand for permits
 - Low-hydro years have high output price, probability: 0.3
 - Must run goes up to 4 for low and 1 for high
- Compliance check every three periods
 - Penalties 3 for 1 for each unit in deficit
- Purchase limits and holding limits
- Trading accounts and compliance accounts
- Free allocations at first but decline to zero

Decision sequence

1. Observe output price
2. Consign of permits to auction (some must, some may)
3. Observe total auction quantity at offer this period
4. May move permits from trading to compliance
5. Enter bids; limited by bid limits, maybe by holding limit
6. Observe outcome on own bids and auction closing price
7. Post limit offers to buy and/or sell in spot market
8. Decide how many units to produce
9. Observe earnings and account totals

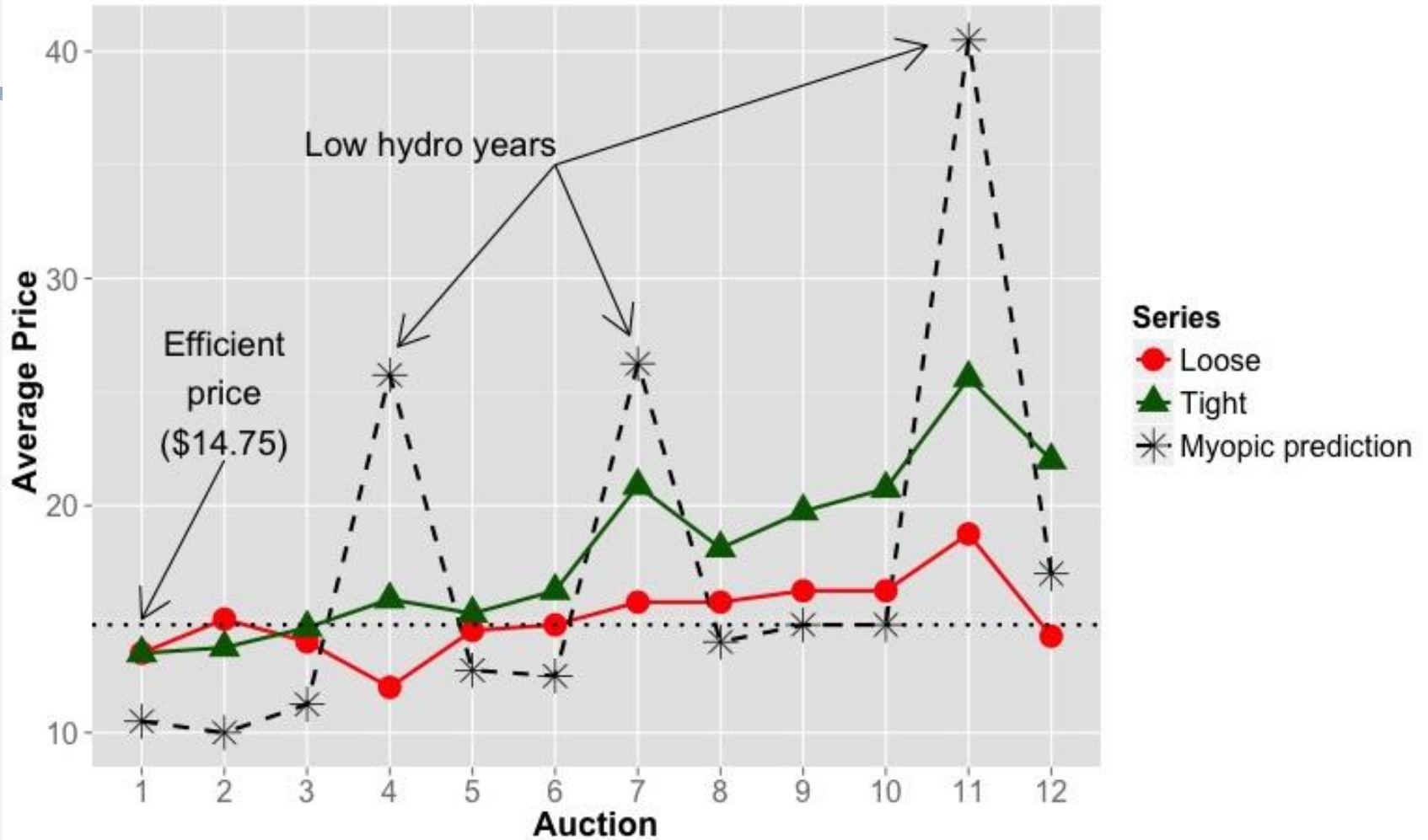
Non-parametric tests

Wilcoxon tests			
	Efficiency	Liquidity	Price variability
Loose/Tight Holding Limits	w=26, p=0.055*	W = 32, p-value = 0.002***	W = 1, p-value = 0.0081***
Post auction/In auction sale	W=19, p=0.683	W = 23, p-value = 0.283	W = 8, p-value = 0.214
1st price/2nd price	W=16, p=0.818	W = 19, p-value = 0.937	W = 15, p-value = 0.699
N = 12			

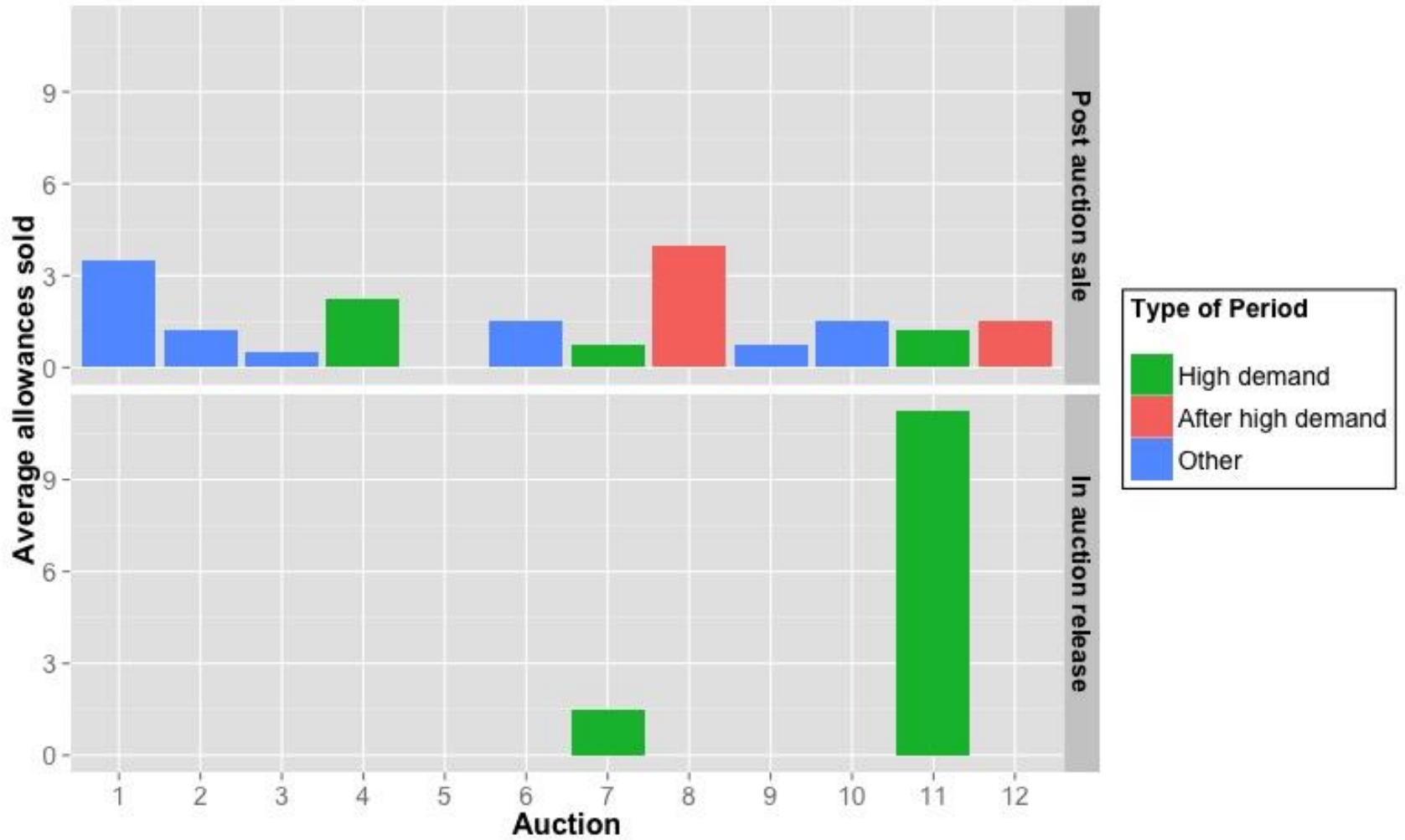
Regression results (naïve)

	Sessions	Auctions
N	12	144
Efficiency		
Tight holding limit	-7.16**	-7.72***
In auction sale	3.83	3.40***
1st price	3.67	2.72**
Intercept	87.7***	89.2***
Liquidity		
Tight holding limit	21.35***	28.6***
In auction sale	-1.2	-8.16
1st price	2.78	-1.69
Intercept	4.98	6.96
Price variability		
Tight holding limit	21.35***	28.6***
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Average Auction Price by Holding Limit



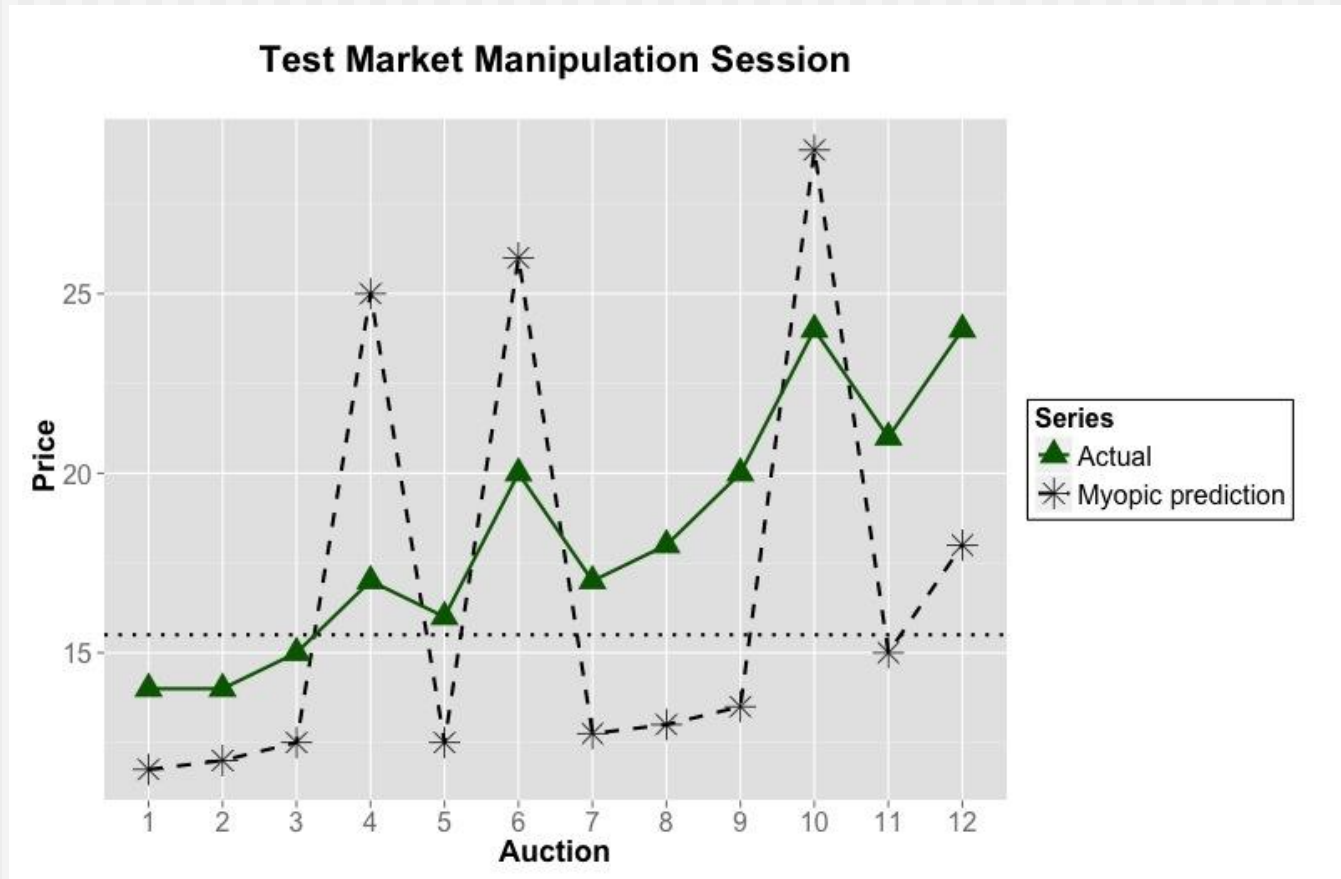
Allowances Purchased in PCR Sale



Next step

- What we have not shown is that California's current cap is set at a damaging level.
 - Not really a question for the lab
- What we wish to show next is that there are cheaper, more market-friendly ways of limiting market manipulation by a large holder of allowances.
- We can generate market manipulation in the lab
 - But to do so, without a derivatives market requires extreme measures
 - Two players with large free allocations and low must-serve requirements

Test Manipulation Session



The policy cycle: a parable

- Concerns over price volatility =>
- 3-year compliance periods =>
- Concerns over “hold-up” manipulation =>
- Need to limit ownership =>
- High price variability (and low liquidity)
 - So we end up with the worst of both worlds
- We can break this cycle with effective design
 - Price collar with hard floor and cap (and cap adjustment?)
 - Increased auction frequency
 - Other ideas?

- Thank you