BIDDING UNDER A PRICE CAP
EVIDENCE FROM AN ELECTRICITY MARKET EXPERIMENT

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INTRODUCTION

Policymakers' concern:
creating incentives for adequate investment
but nevertheless also requiring low, non-volatile prices

One answer: price-cap regulation
**STYLIZED FACTS**

**Price cap in California**
- 9 July 2002: CAISO cuts its price cap by 40% but on 11 July 2002 FERC returned to the region-wide cap

> “the caps could cause severe supply disruptions…We act now because we cannot expose customers in California and other Western states to the risks of a low price cap.” FERC, July 2012

**Public Utility Commission in Texas: double the price cap between 2012-2015**
- “the market needs higher prices to guarantee there is enough electricity during peak periods” Donna Nelson, Agency’s chairwoman, Public Utility Commission of Texas Oct. 2012, Reuter

**Cap energy bills until January 2017 in UK:**
> “I am in favor of competition, I’m in favor of markets, but they have got to be effective markets and it’s got to be effective competition” Opposition Labor party’s plan

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**INTRODUCTION**

**Policymakers’ concern:**
creating incentives for adequate investment
but nevertheless also requiring low, non-volatile prices

**One answer:** price-cap regulation

**One problem:** setting a price cap has (at least) two countervailing effects on consumer welfare

(i) For given capacities and demand, price cap reduces equilibrium/market prices

(ii) A lower price cap reduces incentives to expand capacity, increasing the likelihood of demand rationing
**THIS PAPER**

How price cap affects market competition?

**Focus:** Wholesale electricity market

Bid based market: market participants submit willingness-to-sell curve to market operator [multi-unit uniform price auction]

**Experimental approach:**

(i) Market demand, Market structure, Firm-levels costs given
(ii) Strategic interaction between firms are observed under different price caps and different demand levels

**Main results**

(i) Price cap regulation has an impact not only on market prices but also on market performance and bidding behavior
(ii) Higher price cap creates higher productive inefficiency but triggers more aggressive bidding behavior

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Experimental Design_Timing

Uncertainty Demand

Stage 1
Capacity choices

Periods

\[ s = 0 \quad s = 1 \quad s = 2 \quad s = 3 \quad s = 4 \quad s = 5 \quad s = 6 \]

LOW \quad LOW \quad LOW \quad LOW \quad LOW \quad HIGH \quad HIGH

Stage 2
Supply function competition
(price, quantity)

Demand is realized

Subjects in the role of firms; 4 firms per market, capacity choice + price choice

Demand is perfectly price-inelastic but fluctuates. Low \((D=6,7,8)\) and High \((D=23,24,25)\)

Two cap levels: LowCap (=15) and HighCap (=30)
STAGE 1 : CAPACITY CHOICE

Simultaneously capacity choice under demand uncertainty
Capacity: up to 9 units, Fixed cost for each unit: 7 + Increasing MC: 1 unit costs 1.00; 2 units cost 2.00 etc.

- Total Capacity Market is revealed at the end of the round
**Stage 2: Price Choice**

For each PERIOD, demand is realized, Low (D=6,7,8) and High (D=23,24,25)

In addition to the fixed cost of 7, subjects pay a production costs for all units that are dispatched (not for the other units)

- Unit 1 (if dispatched), costs 1, the second unit (if dispatched) costs 2, the third unit (if dispatched) costs 3, and so on.

The exact number of units that will be dispatched (sold) is revealed in end of the period.
END OF THE PERIOD: MARKET PRICE AND EARNINGS

– Market supply function: computer ranks bids from the lowest to the highest
– Period’s Market price: intersection of market supply function with inelastic demand
– Screen’s summary of the period
Subjects supply less in LOWCAP (5/6 units) than in HIGHCAP (6/7 units)
Overinvestment in HighCap & Allocative efficiency in LowCap
PRODUCTIVE INEFFICIENCIES - LOW DEMAND = 7,8,9

Inefficiency measured by the additional costs incurred

- difference between total production costs and lowest possible total production costs (given market & period)

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<th>LOWCAP</th>
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Productive inefficiencies- High demand= 23,24,25

Inefficiency measured by the additional costs incurred

Larger productive inefficiency in HIGHCAP & High Demand
Subjects charge marginal cost with Low Demand, irrespective of the price cap level.
MARKET PRICE BY HIGH DEMAND

LOWCAP

HIGHCAP

With “very high demand” (all capacities are needed), always price cap.

With “high demand” (at least two pivotal bidders), always price cap with LOWCAP but not with HIGHTCAP.
**Individual Bidding Behavior**

**A “Representative” Bidding Curve**

**Dependent var.:** Price Bid for each capacity unit, relative to Price Cap

**Independent variables**

OLS regression controlling for the identity of the participant, the market, the demand level, market excess capacity (if any) and relative distance from previous bid Price

**Focus**

- High demand where price cap is theoretically expected
- Coordination problem: each pivotal generator is better off when another pivotal generator offers the price cap.
- Different estimation for subjects with large and small pivotal power, measured by Residual Supply Index = (K - ki) / D
Relative Distance of a estimated price Bid from the price cap:
if 1 => price bid equals price cap

Pivotal bidders with the largest residual demand are setting the price cap
BIDDING CURVE AND PRICE CAP_SMALL PIVOTAL POWER

Relative Distance of a estimated Price Bid from the price cap:
if 1 => price bid equals price cap

High Demand & at least two Pivotal bidders

High Cap Small RD
Low Cap Small RD
Bidding curve and Price Cap_large Pivotal Power

Relative Distance of a Price Bid from the price cap: if 1 => bid = price cap

High Demand & at least two Pivotal bidders

Bidder with large pivotal power are (relatively) more competitive with HIGHCAP
CONCLUSION

Main Findings Price cap regulation has an impact not only on market prices but also on market performance and bidding behaviour

1. Higher price cap implies higher market price and more productive inefficiency
2. Price cap, for similar market conditions, is reached more often with relatively low price cap level.

Policy implication
an increase in price cap does not fully translate into a one to one increase in market prices

=> Increasing price cap may be a relatively good policy measure in case of capacity shortage
THANK YOU

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