Price-Cap Regulation of Firms That Supply Their Rivals

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Disclaimer

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**Partially Integrated Market**: A market where a firm must purchase an input from its (vertically-integrated) rival in order to compete

**Two-Stage Partial Integration**
Examples of Partial-Integration Settings

- **Moresi and Schwartz (2017):** Qualcomm (smartphone chips), Samsung (smartphones), Comcast-NBCU (programming)

- **Business Data Services:** Supplying rivals in a price-capped market (this paper)

- **Network Neutrality:** Supplying rivals when discrimination is prohibited (Koning and Yankelevich, 2016)
Existing Results in Partial-Integration Settings

- **Arya, Mittendorf, and Sappington (2008):** Standard comparisons (Singh and Vives, 1984) regarding prices, profits, and welfare levels between Bertrand and Cournot competition are reversed.

- **Moresi and Schwartz (2017):** The integrated firm typically wants to induce expansion by its rival given linear input pricing (under both Cournot and Bertrand competition downstream).

- **Reisinger and Tarantino (2015):** Given monopoly producer and two retailers, vertical merger with less efficient retailer can lead to below-cost pricing of input and be welfare-enhancing.

- **Mandy, Mayo, and Sappington (2016):** Vertically-integrated provider will look to raise cost of industry leader under Cournot competition, industry follower under Bertrand competition.
What We Do (And Don’t Do) in This Paper

**Do**: highlight effects of price-cap regulation of a vertically-integrated firm that supplies an input to a rival retailer

- In short run, price caps benefit consumers by preventing price-increasing retail competition without making foreclosure more likely.

- In long run, price caps are likely to strengthen incumbent’s cost-reduction incentive but also are likely to weaken entrant’s self-provision incentive.

**Don’t**: provide specific recommendations to regulators of such markets
What Are Business Data Services?

**Business Data Services (BDS):** Dedicated high-capacity connections used by businesses and institutions to transmit their voice and data traffic

- Point-to-point circuits ("dedicated")
- Non-switched
What Are Business Data Services Used For?

- Traditionally: carrying concentrated voice traffic from large business to toll carrier
- Business intranets
- Backhaul for cell towers
- Wholesale access for CLECs (focus of this paper)
BDS Competition and Regulation

What do U.S. markets for BDS look like?

- Incumbent local exchange carriers (ILECs) sell to downstream private and public enterprises as well as to competitive local exchange carriers (CLECs).
- Recent entry by cable companies
- Regulation varies throughout the U.S.
How is BDS regulated in the U.S.?

- Prior to the 1990s: “cost-plus” system using projected costs and demand for access.

- In 1990, the FCC announced that it would regulate “dominant” LECs based on price caps (“RPI-X”).

- Roughly speaking, ILECs capped at same rate(s) in retail and wholesale markets. This framework avoids margin squeezes (see Jullien, Rey, and Saavedra 2014).
Questions about regulation in partially integrated markets:

1. **Short-run**: How do price caps affect market outcomes?

2. **Long-run**: How do price caps affect investment incentives?

Theory is general, but analysis and interpretation motivated by BDS application.
Model Setup (Firms)

- An ILEC ("(I)ncumbent") and CLEC ("(E)ntrant") compete to sell BDS to downstream buyers.

- The CLEC must purchase wholesale access from the ILEC to resell it downstream.

- ILEC has no cost of upstream access, but each firm faces downstream (retail) cost $c_i$, $i \in \{I, E\}$.

- ILEC sets a price, $w$, per “unit” of access.
BDS Model

Model Setup (Demand)

Linear demand with (exogenously) differentiated products:

- **Inverse Demand**: $p_i = \alpha - q_i - \beta q_j$ where $\alpha > 0$, $\beta \in (0, 1)$.
  - $\beta$: degree of product homogeneity

- **Implied Demand**: $q_i(p_i, p_j) = \frac{\alpha}{1+\beta} - \frac{p_i - \beta p_j}{1-\beta^2}$.

- **“Value Margin”**: Let $\alpha_i \equiv \alpha - c_i$.
  - $\alpha_i$ decreasing in $c_i$: will sometimes interpret $\alpha_I$ and $\alpha_E$ as providers’ relative “efficiency levels.”
Model Setup (Firm Profits)

- **ILEC Profit**: \( \pi_I = \underbrace{w q_E}_{\text{upstream profit}} + \underbrace{(p_I - c_I) q_I}_{\text{downstream profit}} \).

- **CLEC Profit**: \( \pi_E = (p_E - w - c_E) q_E \).
**Model Setup (Game)**

**Game**: Stage 1: ILEC sets \( w \). Stage 2: Differentiated Bertrand competition. **Solution Concept**: SPNE

Two-Stage Game

![Diagram](image-url)
Model Setup (No Exclusion)

- **Arya, Mittendorf, and Sappington (2008):** Foreclosure $\iff \alpha_E/\alpha_I \leq \beta$

- **Assumption:** $\alpha_E/\alpha_I > \beta$.
  - Entrant is not too inefficient relative to incumbent.
  - Products are sufficiently differentiated.
Proposition 1

Suppose that $\alpha_E/\alpha_I > \beta$. Then:

1. Price-increasing competition always occurs.
2. Total welfare can fall (i.e., entry may be inefficient).
3. Consumer welfare can fall, even under efficient entry.
No Regulation

Price-increasing competition:

- Chen and Riordan (2008) show that price-increasing competition can occur even without partial integration: entry may lead to steeper residual demand curve for incumbent.

- Our (linear-demand) framework: price-increasing competition does not occur without partial integration.

- Higher $w$ forces CLEC to raise its retail price.

- Prices are strategic complements: ILEC thus raises its retail price too.

- Higher $w$ also raises ILEC’s profits from each unit of CLEC’s retail sales.
No Regulation

Welfare Comparison:

Entry raises $CS$ and $W$

Entry lowers $CS$ but raises $W$

Entry lowers $CS$ and $W$

Foreclosure
Consider common price cap on wholesale access and retail service:

- \( p_I \leq c_I \).
- \( w \leq c_I \).

**Note:**
- ILEC’s wholesale and retail prices capped at marginal cost.
- CLEC’s retail price is not (explicitly) capped.
- Capping \( w \) but not \( p_E \) allays margin-squeeze concerns.
Lemma 1

1. In equilibrium, \( w \geq 0 \).

2. In equilibrium, \( p_I(w) \geq c_I \) whenever \( q_I(w) > 0 \).

3. \( q_I(w) > 0 \) holds for all \( w \geq 0 \) if \( \alpha_I > \alpha_E \) (ILEC more efficient) or \( \beta \) low enough (sufficient product differentiation).
Market participation under price caps:
Proposition 2(a)

Suppose that a regulator caps the ILEC retail and wholesale prices at $c_I$ (the “efficient cap”). If foreclosure would not have occurred absent the price cap, then it will not occur with the price cap.

When its retail price is capped at $c_I$, a monopolist ILEC does not make any profit. By permitting entry, the ILEC can at least profit via the wholesale market.
Proposition 2(b)

Suppose that the regulator caps the ILEC’s retail and wholesale prices at $c_I$, and that $\alpha_E/\alpha_I > \beta$. Then both firms and consumers are better off under duopoly competition between the ILEC and CLEC than under a price-capped monopoly.

In the regulatory regime, price-increasing competition is averted so that consumers are no worse off than under monopoly. Moreover, entry benefits both the ILEC (which earns upstream profit) and (by revealed preference) the CLEC.
Why Price Caps?

“[B]y establishing limits on prices carriers can charge for their service, and placing downward pressure on those limits or ‘caps,’ we create a regulatory environment that requires carriers to become more productive.” (FCC 1990 Price-Cap Order)

“[C]arriers that can substantially increase their productivity can earn and retain profits at reasonable levels above those we allow for rate of return carriers.” (FCC 1990 Price-Cap Order)

**Question**: Does model predict that price caps strengthen cost-reduction incentives?
Investment Stage

- Append to original game a preliminary stage in which ILEC invests in cost reduction.

- **Investment Cost**: \( \kappa(k) \) where \( k \in [0, 1) \).

- ILEC marginal cost becomes \( (1 - k)c_i \).

- Suppose \( \kappa(0) = 0, \lim_{k \downarrow 0} \kappa'(k) = 0, \lim_{k \uparrow 1} \kappa(k) = \infty, \kappa', \kappa'' > 0, \kappa''' \geq 0 \).

- Assume \( c_E < \alpha(1 - \beta) \): CLEC never foreclosed.

- Further assume \( \alpha(2 - \beta - \beta^2) > c_i(4 - \beta^2) - c_E\beta \): ILEC’s retail price cap binds.
Investment

Proposition 3

Consider the augmented game with a stage for ILEC investment. A price-capped ILEC will typically invest more in cost reduction than an unregulated ILEC would.
For unregulated ILEC, efficiency gain leads to rise in upstream price, drop in downstream price.

Hence Proposition 3 may be surprising:

- Price-capped ILEC may be unable to raise upstream price by as much as unregulated ILEC would.
- By assumption, downstream price cap binds regardless of investment level, so price-capped ILEC won’t reduce its downstream price (hence may not be able to increase retail demand as much as unregulated ILEC).

Proposition 3 says that price-capped ILEC’s increased pressure to boost margins more than compensates for above effects.
Do Price Caps Encourage Facilities-Based Entry?

“Our focus should be furthering the public interest in next-generation broadband deployment, not advancing the private interests of particular competitors. And our framework should be one that promotes competitive entry, not punishes it.” (Then-Commissioner Pai, in dissent to BDS Order adopted on Apr. 28, 2016)
Investment Stage (CLEC)

Consider a preliminary stage in which CLEC pays a fixed cost to invest in own facilities (effectively to reduce $w$ to zero).

**Proposition 4**

*Consider the augmented game with a stage for CLEC investment. The range of fixed-cost structures that lead to CLEC investment is broader without price-cap regulation unless $\alpha_E$ and $\beta$ are sufficiently high.*
Investment (CLEC)

- **X**: Difference in CLEC’s profit between $w = 0$ and $w = w^*$ cases, assuming ILEC is unregulated.

- **Y**: Difference in CLEC’s profit between $w = 0$ and $w = w^*$ cases, assuming ILEC faces binding retail price cap and slack wholesale price cap.

- **Z**: Difference in CLEC’s profit between $w = 0$ and $w = w^* = c_I$ cases, assuming ILEC faces binding retail and wholesale price caps.
Investment (CLEC)

- **X**: CLEC’s self-provision incentive when ILEC is unregulated.
- **Y**: CLEC’s self-provision incentive when ILEC faces binding retail price cap and slack wholesale price cap.
- **Z**: CLEC’s self-provision incentive when ILEC faces binding retail and wholesale price caps.

**Exercise**: compare both **Y** and **Z** to **X**.

At $\alpha_E = \alpha I \beta$, $Z < Y < X$.

$max\{Y, Z\} < X$ appears to hold except for very large $\alpha_E$ and high $\beta$. 
Entrant Investment With and Without Regulation:

\[ Y - X \text{ increasing in } \alpha_E \]

\[ Y - X \text{ decreasing in } \alpha_E \]

\[ \frac{\alpha_E}{\alpha_I} \]
Proposition 4 Discussion

- CLEC is “more likely” to invest when ILEC is price-capped if introducing price caps increases CLEC’s gain from self-provisioning versus purchasing wholesale access.

- Gain from self-provisioning is lower when wholesale price is capped.

- However, when ILEC’s retail price is capped, ILEC charges same retail price regardless of CLEC’s actions. → CLEC has easier time stealing retail business—hence may have greater payoff from self-provisioning—when ILEC is price-capped.

- Effect of wholesale price cap typically dominates.
Takeaways

1. Without regulation, entry based on wholesale access may raise prices and hence reduce consumer—and even total—welfare.

2. Price caps prevent price-increasing competition without encouraging foreclosure.

3. Price caps encourage incumbents to invest in cost reduction.

4. Price caps typically discourage entrants from self-provisioning.
Open Questions

- More general demand functions (Aguelakakis and Yankelevich, 2016; Moresi and Schwartz, 2017)
- Endogenous level of product differentiation ($\beta$) tied to CLEC cost ($c_E$)
- Richer model of input-price-setting (e.g., bargaining, second-degree price discrimination with heterogeneous CLECs)
- More granular model of self-provisioning
- “Optimal” price caps according to regulator’s objective