On the Merits of Endogenous Access Pricing

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- Typically, *ex ante* regulatory directives are used to ensure downstream competitors' access to the upstream facility.
- Downstream competitors pay a regulated access price that is based on service volume.

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- Competitors pay the access price to the vertically integrated incumbent.

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- Many economists argue that access / access pricing discourages the vertically integrated incumbent from investing on infrastructure.
- There are controversy regarding the 'under investment' result.
- Recent work shows that if investment on infrastructure increases downstream demand, then the vertically integrated incumbent may overinvest on infrastructure, relative to a monopolist that is not required to provide access to the competitors.

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- It may be possible for the incumbent to increase its profit by increasing unnecessary spending on infrastructure.

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- If yes, then how to prevent the unnecessary spending on infrastructure.
- We show that the traditional access pricing (**exogenous access pricing**) indeed encourages the incumbent to spend unnecessarily on infrastructure.
- We show that an alternative endogenous access pricing (**endogenous access pricing**) that prevents unnecessary spending by the incumbent.

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- The incumbent prefers a higher access price, whereas the rivals prefer a lower access price.
- Exogenous access cost pricing may give rise to an (artificial) cost advantage for the incumbent firm that owns the infrastructure.

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- The access price determination mechanism and a tentative access price can be announced *ex-ante*, with the understanding that the firms may have to pay more or receive money back *ex-post* according to the access price determination mechanism.
- A simple option of adjusting the access price *ex-post* transforms an exogenous access pricing regime to an endogenous access pricing regime.

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- Endogenous access pricing fully neutralizes the artificial cost advantage that is otherwise enjoyed by the incumbent firm due to the wedge between the access price and the upstream marginal cost.
- The aggregate quantity and the consumer surplus under endogenous access pricing are equal to or larger than those under exogenous access pricing.
- If the entrants are no less efficient than the incumbent, then the welfare under endogenous access pricing is equal to or larger than the welfare under exogenous access pricing.

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- By inflating its infrastructure cost, the VIP can force its competitors to pay a higher access price and may gain a strategic advantage over its rivals.
- We show that under exogenous access pricing, we identify conditions such that the potential strategic advantage of higher upstream costs can outweigh the direct burden of higher operating costs, and the VIP's profit can increase as its upstream production costs rise.
- Under endogenous access pricing, the potential strategic advantage of higher upstream costs can never outweigh the direct burden of higher operating costs, and the VIP's profit always decreases as its upstream production costs rise.

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- We abstract from retail production costs other than the cost of acquiring the essential input from the VIP.
- The unit cost of acquiring the input is simply the regulated access price, w, that is charged for the input.

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- Therefore, cost inflation provides no direct value to the VIP (X - inefficiency).

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- For analytic simplicity, we assume that additional cost inflation would be detected with sufficiently high probability and penalized sufficiently severely that the VIP never increases F above $\overline{F}$.
- To ensure that industry operation is potentially profitable, $\underline{F}$ is assumed to be less than the maximum variable profit that can be secured in the industry.

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- Under endogenous access pricing (ENAP), the regulator announces that the access price will be $w(Q) = \frac{F}{Q}$, where Q is the level of industry output that ultimately arises.
- Therefore, under ENAP, each producer realizes that an increase in its retail output will cause the access price that ultimately prevails to decline, *ceteris paribus*.

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- Formally, the VIP's profit is:

$$\pi_0(q_0, q_1, ..., q_N, w, F) = P(Q)\, q_0 + w \sum_{i=1}^{N} q_i - F\,. \tag{1}$$

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- The corresponding profit (π_i) of retail rival $i \in \{1, ..., N\}$ is the product of the rival's retail output (q_i) and its profit margin ($P(Q) - w$). Formally:

$$\pi_i(q_0, q_1, ..., q_N, w) = [\,P(Q) - w\,]\, q_i \quad \text{for } i \in \{1, ..., N\}\,. \tag{2}$$

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- Fourth, the VIP and its N retail rivals choose their outputs simultaneously and independently.
- Finally, the market clearing price is determined, the firms sell their outputs at this price, and the N retail rivals deliver the required access payments to the VIP.

Outcomes with Endogenous Access Pricing

- If the VIP attempt to raise its rivals' unit cost of retail production by artificially inflating its fixed cost of production, the VIP effectively raises its own operating cost symmetrically.

Theorem

Suppose $P''(Q) \leq 0$ *and* $P'''(Q)$ *is negative or sufficiently small in absolute value for all* $Q \geq 0$. *Then the VIP always operates with the cost-minimizing technology under ENAP, i.e.,* $\widetilde{F}^* = \underline{F}$.

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- As a result, the VIP generally will refrain from such cost inflation under ENAP, as Theorem 1 reports.

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- An increase in F increases the rivals' marginal cost of production and thereby induces them to reduce their output.
- The output reduction raises the market-clearing retail price, which enhances the VIP's profit, *ceteris paribus*.
- When the inverse demand curve is concave, successive reduction in rival output produce successively smaller increases in the market price, generating diminishing increases in the VIP's profit.

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- Assumption 1. $P(Q) = a - bQ$, where $a > 0$ and $b > 0$ are parameters.

Outcomes With Exogenous Access Pricing

- We employ backward induction to determine the equilibrium outcomes under EXAP in this setting.

Lemma

Suppose Assumption 1 holds. Then given access price $\widehat{w}$*, the equilibrium output of the VIP under EXAP is* $\widehat{q}_0^* = \frac{a+\widehat{w}N}{b[N+2]}$*. The equilibrium output of each of the* N *rivals under EXAP is* $\widehat{q}_i^* = \frac{a-2\widehat{w}}{b[N+2]}$ *for* $i = 1, ..., N$*.*

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- Lemma 4 specifies the VIP's profit under EXAP as a function of F.

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Suppose Assumption 1 holds. Then when the VIP's fixed cost is F, the access price that will be set under EXAP is

$$\widehat{w}(F) = \frac{1}{2N}\left[a(N+1) - \sqrt{\widehat{G}(F)}\right] \text{ where}$$

$$\widehat{G}(F) \equiv a^2[N+1]^2 - 4bFN[N+2].$$

Lemma

Suppose Assumption 1 holds. Then for a given fixed cost, F, the VIP's equilibrium profit under EXAP is:

$$\widehat{\pi}_0^*(F) = \frac{1}{4bN^2[N+2]^2}\left\{2aN[N+4]\sqrt{\widehat{G}(F)} + 4bFN^2[N+4][N+2\right.$$

$$\left. - 2a^2N\left[N^2+3N+4\right]\right\} - F.$$

Outcomes With Exogenous Access Pricing

It can be verified that $\widehat{\pi}_0^{*\prime}(F) \gtreqless 0$ as $F \lesseqgtr \frac{3\,a^2[N-2]}{16\,b\,N}$. Therefore, the VIP's profit-maximizing fixed cost under EXAP, $\widehat{F}^*$, is as specified in Theorem 5 below.

Theorem

Suppose Assumption 1 holds. Then the VIP operates with the cost-minimizing technology under EXAP if it faces fewer than three retail rivals (i.e., $\widehat{F}^* = \underline{F}$ if $N < 3$). In contrast, if the VIP faces three or more rivals and $\underline{F}$ is sufficiently small (e.g., $\underline{F} < \frac{a^2}{16\,b}$), then the VIP will set $\widehat{F}^* = \min\left\{\frac{3\,a^2[N-2]}{16\,b\,N}, \overline{F}\right\} > \underline{F}$ under EXAP.

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- The conclusions in Theorem 5 reflect the following considerations.

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- Under EXAP, the VIP's rivals incur marginal cost $\widehat{w} > 0$, whereas the VIP's marginal cost of retail output is 0.
- Therefore, the VIP's marginal cost advantage increases as F, and thus $\widehat{w}$, increases.
- This increased cost advantage increases the VIP's share of retail output and thus the VIP's profit, *ceteris paribus*.

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- In contrast, when the VIP faces many retail rivals, the cost advantage it secures from increasing F is relatively valuable and the fraction of the increase in F it bears is relatively small.
- Consequently, the VIP may find it profitable to increase F above its minimum feasible level, $\underline{F}$.

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- Endogenous access pricing (ENAP) can provide stronger incentives for upstream cost minimization than exogenous access pricing (EXAP).
- ENAP enhances the VIP's incentive to reduce its upstream operating cost because it effectively induces the VIP to perceive the same marginal cost of production that its retail rivals face.
- Consequently, upstream cost increases do not endow the VIP with the same competitive advantage under ENAP that they provide under EXAP.

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- In principle, a regulator might attempt to limit a firm's incentive to inflate its production cost under EXAP by linking the established access price to an estimate of the firm's minimum feasible operating cost ($\underline{F}$) rather than to the firm's observed cost (F).

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- However, it can be difficult to derive an accurate estimate of $\underline{F}$ in practice.
- Our findings suggest that ENAP may be an attractive alternative to EXAP quite generally, but particularly when it is difficult to derive precise estimates of the VIP's minimum possible operating cost.

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- More general results can be derived. For instance, Theorem 1 (which states that the VIP will not intentionally inflate its production costs under ENAP) continues to hold in many settings where the VIP and its rivals operate with positive marginal production costs.
- Furthermore, although the exact conditions under which the VIP will inflate its fixed cost of production under EXAP are more complex when industry suppliers incur positive marginal production costs, these conditions reflect the basic message of Theorem 5. In particular, the VIP often will set F above $\underline{F}$ when it faces many retail rivals, but will tend to set $F = \underline{F}$ when it faces few rivals.

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- This finding implies that the VIP typically will not raise F above $\underline{F}$ under ENAP if doing so risks a financial penalty.
- In contrast, the VIP often will continue to increase F above $\underline{F}$ under EXAP when doing so risks financial penalty, provided the expected penalty is not too pronounced.

Thank you!
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