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Integration and Independent Innovation on a Network

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Abstract

Physical telecom networks are costly and few, traditionally to the point of monopoly. Innovation thrives with many independent minds. So one might hope independent innovators, not only its proprietor M, can offer innovative services on a network, as has been true on the Internet. This issue is central in telecom policy; it also arises elsewhere, including complaints about Microsoft. I try to expound the following key points. Often an unregulated M has ex ante incentives to organize service innovation efficiently. But this incentive breaks down ex post as M can extract an independent J's quasi-rents (Farrell and Michael Katz 2000). Even ex ante, the "one monopoly rent theorem" (Ward Bowman 1957) fails when M's bottleneck access business is more regulated than its competitive services (e.g., Jean-Jacques Laffont and Jean Tirole 2000). This tempts M to sabotage J's innovations. "Quarantining" M from the service sector solves these problems, but excludes the firm with (often) the best opportunities and the strongest incentives to innovate. "Parity pricing" or ECPR (Robert Willig 1979) purports to get the best of both worlds (BoBW). But it seems so hard to implement in innovation markets that one might construe ECPR analysis as reductio ad absurdum for BoBW.

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Integration and Independent Innovation on a Network

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Physical telecom networks are costly and few, traditionally to the point of monopoly. Innovation thrives with many independent minds. So one might hope independent innovators, not only its proprietor *M*, can offer innovative services on a network, as has been true on the Internet.[1] This issue is central in telecom policy; it also arises elsewhere, including complaints about Microsoft.

If both *M* and independents innovate in services on *M*'s network, then independents depend on their (service-level) competitor. Non-economists often think *M* will always resist independents' innovation. Economists find this too pessimistic: *M* gains as well as loses when an independent innovates. Some even suggest that a simple pricing rule eliminates the problem. But I think that's too optimistic: extreme pessimism may not be warranted, but some pessimism is.

In this terse exposition of these tough issues, I try to expound the following key points. Often an unregulated *M* has *ex ante* incentives to organize service innovation efficiently. But this incentive breaks down *ex post* as *M* can extract an independent *J*'s quasi-rents (Farrell and Michael Katz 2000). Even *ex ante*, the "one monopoly rent theorem" (Ward Bowman 1957) fails when *M*'s bottleneck access business is more regulated than its competitive services (*e.g.*, Jean-Jacques Laffont and Jean Tirole 2000). This tempts *M* to sabotage *J*'s innovations. "Quarantining" *M* from the service sector solves these problems, but excludes the firm with (often) the best opportunities and the strongest incentives to innovate. "Parity pricing" or ECPR (Robert Willig 1979) purports to get the best of both worlds (BoBW). But it seems so hard to implement in innovation markets that one might construe ECPR analysis as *reductio ad absurdum* for BoBW.

I. A Simple Model[2]

A telecom system is a network, controlled by *M*, "on top of" which services are provided by *M* and/or others *J*. If he pays *M* a network subscription fee *s*, a consumer can buy services: for simplicity the model (though not all the discussion) assumes that each consumer buys just one service and that all consumers pick the same one. A consumer's payoff is $v(p,q) - s + t$, where "quasi-surplus" v increases in service quality q and decreases in service price p, while t differs across consumers. Thus subscription demand takes the form $X(v(p,q) - s)$, where X is increasing. The network costs $N(X)$.

Service providers also pay "access charges" a per customer to *M*. When each customer buys one unit of services, $v(p, q)$ takes the separable form $u(q) - p$, and we have redundant prices: (a, p, s) is equivalent to $(a+k,\ p+k,\ s-k)$.

Innovation here means improving service "quality." I discuss how institutions affect innovators' *quasi-rents* (gross of innovation costs) and how those compare to social contributions. Less ambitiously, I often discuss only how incentives with integration compare to those without.

I begin with the analytically simpler case in which *M* is excluded from the service market. This was (generally) the case with long-distance calling in the US, from the AT&T breakup in 1984 until the 1996 Telecommunications Act set conditions for Bell companies (*M*) to enter the long-distance market (as many have now done). Closer to our focus on innovation, a similar "quarantine" once applied to the "enhanced services" market: see e.g. Farrell and Philip Weiser (2002). But such quarantines are now rare.

II. No Integration

If M's prices (a, s) are fixed (perhaps by regulation), independent innovators compete in services in "the usual way." Because a affects costs and s affects market size, independents normally wish both prices were lower, but they are competitively neutral. Returns to innovation come, as usual, through *e.g.* intellectual property (perhaps only a license to litigate), first-mover advantage (limited by imitation), attracting customers from rival service providers, and bringing new customers into the market. These incentives need not be optimal, but they can be, and they are at least a helpful benchmark.

M is keen to cooperate with service innovation and competition. If v increases slightly by dv, then (holding a and s fixed) X increases by $X'(v\text{-}s)\mathrm{d}v$, so M's profits $(a{+}s)X - N(X)$ increase by $[a + s - N'(X)]X'(v - s)\mathrm{d}v$.[3] Meanwhile, innovators get a "normal" chance at a reward. (In the simplest model innovators make profits equal to their social contribution.)

If s maximized M's profits, then $X = [a + s - N'(X)]\, X'(v - s)$, so M internalizes the full increase in quasi-surplus (even though, since s is fixed, consumers also get that increase!). If v increases discretely by Δv, then at fixed s, M may gain less than $X\Delta v$ even if s was profit-maximizing. But if M can *change* s in response to Δv, it captures at least $X\Delta v$: by increasing s by Δv, it maintains X and increases its margin by Δv; if this is not M's best response then it can gain even more.

When M fully internalizes changes in quasi-surplus, its long-run interests are probably close to efficient. Yet in the short run it might be tempted to confiscate innovators' quasi-rents. Farrell and Katz (2000) discuss ways it can do so. For instance, if demand X is L-shaped, then by raising s (or a) M can force an innovator to cut its markup to zero. For more general demand, however, this will not work.

These observations imply that an unintegrated M is even willing to bear substantial costs to help downstream innovation that increases v.[4] They also quantify the vertical feed-through that spawns both the Jekyll and the Hyde of integration by M.

III. Integration

If only one firm offered services, integration between it and M would have obvious benefits. It would eliminate double-marginalization pricing; for the same reason, internalizing the vertical feed-through would make it keener to innovate.

Independents often complain about integration by M. They might whine simply because M is keener to innovate than they are, or than the independent it perhaps replaces. More legitimate complaints arise if M's integration saps independents' incentives to innovate. As I discuss below, M may sabotage independents; it may extract their ex post quasi-rents; and it may have an "unfair" advantage because (perhaps) it doesn't pay above-cost access charges.

A. *Sabotage*

By nastily manipulating the network-service interface (if allowed), or by stubbornly declining to do so, M may be able to sabotage independents' innovation. So we want M to *want* to cooperate.

As we saw above, an unintegrated M wants to cooperate. Perhaps surprisingly, so does (often) an unregulated integrated M. Since such an M fully captures any increase in quasi-surplus, its goal in the services market is to maximize $\Pi^{M}_{\text{service}} + Xv = W_{\text{service}} - \Pi^{J}$. Thus M will like innovation by an independent J unless the innovation increases independents' joint profits by more than it boosts total surplus: probably an unusual case. This is a version of Bowman's (1957) one monopoly rent theorem.[5]

Will a regulated integrated *M* cooperate or sabotage? If independent *J* innovates then (at fixed prices) *M* gains (i) *a* on the business diverted from its own services to *J*'s, and (ii) $a + s - N'(X)$ on any new subscribers (who presumably buy from *J*). It loses its margin on its lost service business. High access charges thus encourage *M* to cooperate; but they also (given *M*'s service prices) discourage an independent from innovating in order to take customers from *M*.

B. *Pushing Independents' Ex Post Quasi-Rents Upstream*

When *M* internalizes consumer quasi-surplus benefits in the service market, it will be a very aggressive competitor in that market.[6] While this behavior is highly desirable in some ways, it can confiscate independents' quasi-rents. This is much like the difference between a desirably strong competitor who simply offers good deals, and a strong reactor who offers good deals only when a rival does so.

1. <u>Pricing</u>

M may push its own rents upstream (from services to subscription); it often can also push independents' rents upstream and thereby confiscate them.

Because *M* captures upstream any increases in quasi-surplus *v*, Farrell and Katz (2000) show that *M* gains by pricing a successful service at production cost and taking all its rents upstream.[7] By contrast, independents price successful innovations well above cost. Thus a successful *M* prices lower than a similarly situated independent.

In the simplest models this does not affect independents' incentives to innovate, because the difference arises only when *M* leads in quality. But in general *M*'s low price may force successful independents to cut theirs; that raises quasi-surplus, and hence *M*'s profits. An integrated *M* can thus confiscate innovators' ex post quasi-rents; Farrell and Katz (2000) argue that this confiscation technique may well work better than manipulating (*a, s*) or threatening to withdraw cooperation, techniques available to *M* whether integrated or not.

2. <u>Catch-Up Innovation, Imitation, Litigation</u>

When product-market competition is fierce enough, an independent will perceive little private gain from catch-up innovation, imperfectly inventing around another firm's patents, or imitation. Thus a firm that makes a technological advance will keep its lead until it can profitably be leapfrogged.

An integrated *M*, however, gains (upstream) from the pecuniary effect (Farrell and Katz 2000) of a catch-up innovation that makes a leader lower its price; or from imperfectly imitating. Similarly, because *M* captures increases in quasi-surplus, it will leapfrog a successful independent faster than would another independent. Finally, *M* may profitably challenge an independent's patent, even where another independent would not.[8]

In short, its upstream interests make *M* a more aggressive service-market competitor than an independent: in its own willingness to innovate, but also in its propensity to imitate, invent around, litigate against, and cut prices against, a successful independent innovator. So first-mover advantage, differentiation, and intellectual property reward independent innovators less when *M* is integrated.

C. *Above-Cost Access Charges and Level Playing Fields*

Non-economists often worry that *M* pays only *N*'(*X*) for access, while independents pay *a*. Economists note that if *M* lures customers from independents by offering better services, then it gives up *a* in access charges on each such customer, so its opportunity cost is *a* (and since that customer subscribes anyway, *N*'(*X*) and *s* are irrelevant). But, to the extent that an innovation attracts *new* customers onto the network, an independent pays *a* per new customer (besides service costs and revenues) while *M* pays *N*'(*X*) – *s*.[9]

Thus, in mature networks or for modest innovations (*X* won't change much), *M* effectively pays roughly *a* in access charges: a "level playing field."[10] But when a big innovation will significantly boost *X*, and $a + s >> N'(X)$, it follows that *M* has more incentive to innovate than independents. It is less clear at this level whether, given *a*, *M*'s integration inefficiently saps independents' incentives or merely introduces one player with better incentives.

IV. Efficient Component Pricing

Economists have asked whether access charges can yield the best of both worlds (BoBW): *M* can integrate and yet preserve its incentive to cooperate and independents' efficient incentives to innovate. In their usual formulation, ECPR access charges (Willig 1979; Laffont and Tirole 2000) are calculated, starting from fixed (presumably regulated) service prices for *M*, so as to compensate *M* for lost business when an independent attracts customers away. In the simplest models, an independent can (barely) compensate *M*, (barely) attract consumers, and become residual claimant of its innovation's contribution to total surplus. ECPR access pricing thus rewards productively efficient entry or independent innovation, and also (at least weakly) makes *M* willing to cooperate.[11]

Might ECPR be the key to BoBW? Others have criticized ECPR on various grounds;[12] here I argue that it is exceptionally hard to implement in an innovation market.

For instance, why is ECPR a *rule*, rather than just a Coase-theorem *prediction* that efficient innovations will be adopted and *M* compensated? Flexible access charges might help *M* confiscate quasi-rents, but a more standard concern is that without the rule *M* might refuse to subcontract to a more efficient *J*, presumably because of effects on competition: e.g., *J* might (Netscape-Oedipally) turn on *M* and support a rival network. So one must exclude the effects of future increases in competition in *M*'s "lost profits" for ECPR. But now we lose ECPR's nicest property: *M* will after all want to sabotage *J*.

Meanwhile, telecommunications firms value customer relationships; this value *should* count in *M*'s lost profits when a rival takes the customer. (Otherwise, *M* again wants to sabotage, and inefficient rivals will try to take the customer.) ECPR must thus include one large, intangible, unverifiable number, while rigorously excluding another.

Or suppose that *J* innovates, and later, at time *T*, *M* introduces a similar service, claiming that it had been in the works already. How should access charges account for substitution between these services? If *M* really would have introduced its service at *T* anyway, then ECPR says that after *T*, *J* should compensate *M* (*sic*) for the business that *J* retains after *M*'s imitation! Otherwise *M* would want to sabotage *J*, and *J* would have excess incentives to pre-empt *M*'s impending innovation. Yet *J* will hardly innovate if the rule lets *M* claim much of the quasi-rents from *J*'s innovation by imitating it and saying "We were going to do that."

Where these effects loom large, regulators can't even approximate the ECPR that has the nice properties. If *a* exceeds ECPR, it deters efficient (even productively efficient) entry and innovation. If *a* is below ECPR, *M* wants to sabotage. Because some of *M*'s concerns don't count for ECPR, and because it's hard to attract consumers without "over"-compensating them, one could easily make both errors simultaneously.

Thus ECPR does *not* neatly resolve the thorny problem of whether and how to let *M* integrate into services innovation. ECPR is one necessary (not sufficient) condition for BoBW, and one that almost surely fails even if policy focuses on meeting it; so BoBW is a pipe dream. The nicest solution would be real competition among more than a couple of networks. If that is not forthcoming (networks are costly), the issues sketched here present very hard problems for policy, and for business practice.

V. Can We Learn From Unregulated Cases?

Regulators can sometimes learn from how unregulated firms manage analogies to the regulatory problem. Unregulated firms often try to avoid "competing with customers," but not always. Microsoft produces both the dominant PC operating system and also applications software that competes against independents' applications. It neither prices applications at cost nor charges access fees to complementors (as ECPR would presumably prescribe). Independent innovation continues, though some claim it is sapped by Microsoft's presence. Similarly, Annabelle Gawer and Rebecca Henderson (2003) study Intel's relationship with complementor/competitors. Managers they interviewed "talked continually about the need to reassure third parties that Intel was not going to compete `too aggressively' in the market for complements."

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[1] Many minds could work for M, but might not be independent.

[2] This model is from Farrell and Katz (2000), which treats rent extraction and sabotage in more depth than here, but does not discuss ECPR or (mostly) access charges.

[3] Even if (a, s) is regulated so that $(a + s)X = N(X)$, M gains if network provision involves economies of scale, so that $N'(X) < N(x)/X$.

[4] In Farrell and Katz' (2000) undifferentiated Bertrand model, only drastic or catch-up innovation increases v; realistically, almost any real innovation does so.

[5] Farrell and Weiser (2002) describe exceptions to this "theorem," or "internalization of complementary efficiencies" (ICE) principle.

[6] M's interest in quasi-surplus as well as service-level profits might make it behave like a government agency that needn't turn a profit. I suspect that those who worry about government competing against private enterprise mostly don't worry about vertical integration by private monopolists, and vice versa.

[7] ECPR (see below) essentially models M as doing this, by imputing a value of a that would only then explain its pricing.

[8] M could also demand a license in return for access to the network. Then M can imitate, seemingly dissipating innovation rents but in fact shifting them upstream. There are similar strategies without integration.

[9] Not *N*'(*X*), because here it is new customers rather than (say) "new minutes" for existing customers in long-distance. If *M*'s network budget is balanced, so $a + s = N(X)/X$, then $N'(X) - s = a - [N(X)/X - N'(X)]$, so the effective discount on access charges is the degree of economies of scale in network costs. If *M* makes a network profit then the discount is greater.

[10] This assumes *M* understands the opportunity-cost argument (even many economists don't). If not, or if *M* economically doesn't pay *a*, I doubt that *rules* can make *M* act as if it did. Regulators sometimes ask *M* to show, by accounting, that a service could be profitable if it *did* pay *a*. Such "imputation" seems especially inapt when service is innovation-intensive, so that many services will fail and the "hits" can generate big profits (but even they may require penetration pricing).

[11] Standard ECPR overcompensates *M* through profits from increased subscriptions – though this effect vanishes if consumers get no additional quasi-surplus.

[12] Nicholas Economides and Lawrence White (1995) stress that productively inefficient entry can be economically efficient.