Access Pricing, Bypass, and Universal Service

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This paper discusses the interaction between competition and price regulation in telecommunications markets. First, we discuss how to achieve efficient entry when an incumbent's regulated retail prices are out of line with its costs. Second, the analysis is extended to the case where entrants need to purchase network services from the incumbent. Except in the extreme case where entrants have no alternative but to use the incumbent's network to provide their own services, I argue that (i) retail instruments should be used to combat retail-level distortions such as universal service obligations, and (ii) network access charges should be equal to the incumbent's cost of access (excluding "opportunity costs") in order to achieve productive efficiency.

I. Competition and Universal Service: (How) Do They Mix?

Telecommunications firms are often required to offer retail tariffs that depart significantly from their underlying costs.[1] Just one example of this practice is a requirement to offer geographically uniform retail tariffs, even though the cost of network provision varies in different regions. These cross-subsidies lead to difficulties with laissez-faire entry, and there will tend to be "too much" entry in artificially profitable segments and "too little" in the loss-making markets. In addition, there is the funding problem: if entry eliminates profits from hitherto profitable markets, then the incumbent may be unable to continue financing its loss-making operations. Because of these problems, it has often been felt that competition and universal service requirements do not mix well. Since they have nothing to do with the presence of essential facilities, for maximum clarity I discuss these issues in this section assuming that entrants do not need access to the incumbent's network to provide services.

Consider a specific subscriber group which is offered a retail package by the incumbent, denoted M, that may be out of line with M's costs. For simplicity, assume that all subscribers within this group are homogeneous, and that they have inelastic demands for service so long as they obtain nonnegative net utility. Suppose M incurs a total cost C per subscriber and generates gross utility U per subscriber. The price for M's service is mandated to be P per subscriber (this price being determined by a process outside the model). A subscriber's net utility is therefore $U - P$. Suppose that there is a potential entrant, E, who can supply a service that costs c per subscriber and generates gross utility of u per subscriber. Welfare per subscriber, as measured by the sum of consumer utility and profits, is equal to $u - c$ if E serves subscribers, and $U - C$ if M retains the market. Therefore, successful entry is socially desirable if

$$C \geq c + [U - u].$$

Given M's price, E can attract subscribers provided its own price p satisfies $u - p \geq U - P$. Entry will occur whenever the maximum price that can be charged by E covers its costs, that is, when

$$P \geq c + [U - u]. \tag{1}$$

Whenever $P \neq C$, therefore, private and social incentives for entry differ. There are two kinds of market failure, depending on whether the sector is profitable or loss-making for M. First, suppose that the sector is required to be profitable, so that $P > C$.

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[1] This paper does not discuss *why* such cross-subsidies are so prevalent. See Jean-Jacques Laffont and Jean Tirole (2000 Ch. 6) and Michael Riordan (2001) for discussion of this topic.

If

$$P \geq c + [U - u] \geq C$$

entry occurs when it is socially undesirable. In this case entry can profitably take place even when E has higher costs or lower service quality than M.

Alternatively, if $P < C$, then when

$$P \leq c + [U - u] \leq C$$

it is socially desirable for entry to take place, and yet it is not privately profitable.

In theory it is a straightforward matter to correct this divergence between the private and social incentives for entry. The incumbent is implicitly paying an "output tax" of

$$t = P - C \tag{2}$$

per subscriber, which is positive or negaxtive depending on the form of regulation, and efficiency is ensured provided the entrant is also required to pay this tax. With this tax, E will find it profitable to attract a subscriber provided that

$$u - c - t \geq U - P$$

(i.e., whenever $u - c \geq U - C$ as claimed). Notice that this output tax (2) is equal to M's lost profit, or "opportunity cost," when it loses a subscriber. From a simple efficiency point of view it makes little difference whether the proceeds from this output tax are paid directly to M, to the public purse, or into an industry fund. However, if the incumbent has historically been using the proceeds from a profitable sector to finance other loss-making activities, then if the entrant pays the tax to the incumbent, the latter will not face funding problems should entry occur.

While it may seem a little abstract to use these kinds of output taxes to correct for allocative inefficiencies in the incumbent's tariff, these can sometimes be implemented in a simple and nondiscriminatory way via a well designed "universal service" fund. This procedure can be illustrated by means of a basic example, summarized in Table 1.

TABLE 1—GIVING CORRECT ENTRY INCENTIVES VIA A UNIVERSAL SERVICE FUND

	Urban	Rural
Number of subscribers	20 million	10 million
M's cost per subscriber	\$50	\$200
M's price per subscriber	\$100	\$100
M's overall profit for each type	\$1 billion profit	\$1 billion loss
E's contribution to fund	\$50	−\$100

Note: One billion = 10^9.

The incumbent offers a retail service to two groups of subscribers, a high-cost rural group and a low-cost urban group. Universal service obligations require that the incumbent offers service to both groups at the same price, \$100, and the firm makes a profit from urban subscribers that covers the loss from rural subscribers.

As discussed above, a laissez-faire approach toward entry will likely lead to (i) inefficient entry into the artificially profitable urban sector, (ii) too little efficient entry into the rural sector, and (iii) funding difficulties for the incumbent in the event of cream-skimming urban entry. To counter these problems, suppose the regulator sets up a fund containing \$1 billion (10^9) to finance rural service provision. The source of this fund is the profit generated in the urban sector, and any firm (entrants and the incumbent) must pay \$50 (M's profit margin in this sector) into this fund for each urban subscriber it serves. In return, any firm that operates in the rural sector receives a subsidy from the fund equal to \$100 (M's per-subscriber loss in that sector) for each subscriber served. Provided the number of subscribers in the two groups remains unchanged with entry, such a fund is self-financing, and widespread entry does not undermine the ability of the incumbent to serve the loss-making market. More important from an economic efficiency point of view is the feature that the contribution scheme ensures that in each sector the entrant has to pay the output tax (2), which gives it the correct entry incentives. Therefore, the most efficient firm succeeds in each sector.[2]

[2] Clearly, in implementation, great care must be taken to ensure that entrants cannot "bypass" the output tax, for instance, by providing a similar (but not identical) service.

II. Network Access Pricing

Here I extend the framework to allow for the entrant's need for network access. Specifically, there is a vertically integrated supplier M and a potential entrant E which may need access to the network of M in order to be able to compete with M at the retail level. Firm M incurs the cost C_1 per unit for providing its end-to-end retail service, and the cost C_2 for providing a unit of network services to E. M's retail service generates gross utility U per unit, and it must charge the retail price P. In addition, M levies the per-unit access charge a for its network services supplied to E. I first discuss the case where the entrant requires precisely one unit of access per unit of its final service and then turn to the case where the entrant can "bypass" M's network.

A. *No Bypass of the Incumbent's Facilities*

First I assume that bypass of M's network is not feasible, and so E needs one unit of access for each unit of its retail service.[3] E's service generates gross utility u per unit. Total surplus is higher when the entrant supplies the market if $u - [c + C_2] \geq U - C_1$, that is, whenever

$$C_1 - C_2 \geq c + [U - u].$$

Similarly to (1), there will be entry with the access charge a provided that the margin $P - a$ satisfies

$$P - a \geq c + [U - u].$$

Therefore, entry incentives coincide with overall welfare provided that $P - a = C_1 - C_2$, or

$$a = C_2 + [P - C_1]. \tag{3}$$

This formula is an instance of the famous "efficient component-pricing rule" (ECPR) for pricing network access (see section 2.1 of Armstrong [2001] for further discussion and references). This rule states that the access charge should be equal to the sum of the cost of providing access, C_2, and the optimal output tax as in (2) above, which is $P - C_1$. Since E is assumed to be unable to substitute away from M's network services, one might just as well levy the "output tax" (which is required to correct for M's retail pricing distortions) on E's *inputs,* which is what this policy entails.

TABLE 2—THE OPTIMALITY OF THE ECPR WITH NO BYPASS

	Urban	Rural
M's total cost per subscriber	\$50	\$200
Retail cost per subscriber	\$20	\$20
Network cost per subscriber	\$30	\$180
M's retail price for service	\$100	\$100
M's network access charge	\$80	\$80

This ECPR policy can be illustrated in an extension of the above example, summarized in Table 2. Here there are two components needed to provide a final service: a network element and a retail element. The incumbent is assumed to incur the same retail cost for all subscribers, but its network cost differs across the two subscriber groups. The entrant is reliant on the incumbent's network for its retail service.

Then, (3) implies that the correct network-access charge is \$80 for each subscriber, which in this case is the geographically averaged network cost. With this access charge, entry will be profitable only if the entrant has a lower retail cost than the incumbent's (or provides a better service). This policy is superior to a cost-based access charging policy, which would require charging for urban access at \$30 and for rural access at \$180. For instance, with an urban access charge of \$30 the entrant could have a retail cost as high as \$70 (compared to the incumbent's retail cost of \$20) and still find entry profitable.

B. *Allowing for Bypass of the Incumbent's Facilities*

Suppose next that E can provide its own network services.[4] When it does so, it incurs

[3] William Baumol (1999) provides a similar analysis to that in this section.

[4] Laffont and Tirole (2000 pp. 118–19) discuss the benefits of imposing output taxes on entrants and note that their use would imply that cost-based access charges are optimal.

total costs $\hat{C}_1$ per unit for its end-to-end retail service, and this service generates gross utility $\hat{u}$ per unit. (Utility $\hat{u}$ may differ from u if using M's network degrades or enhances E's service compared to its stand-alone service.) In sum, welfare per unit with the three possible entry strategies is given by

$$(4)\quad W = \begin{cases} \hat{u} - \hat{C}_1 & \text{with stand-alone entry} \\ u - [c + C_2] & \text{with entry via } M\text{'s network} \\ U - C_1 & \text{with no entry.} \end{cases}$$

Which regulatory regime ensures that the maximum value of welfare in (4) is achieved? Since the relationship between E's inputs and outputs is now not fixed, the regulator should ideally use both an access charge and an output tax to attain desirable outcomes.[5] Specifically, suppose that E must pay the tax t per unit of its output and the charge a for each unit of M's network services. With these two charges, E's profit per unit of output when it uses M's network is $P + [u - U] - [t + a + c]$. On the other hand, if E bypasses M's network, it can make a profit of $P + [\hat{u} - U] - [t + \hat{C}_1]$. Therefore, given that E enters, it will choose to use M's network if

$$a \leq [u - \hat{u}] + [\hat{C}_1 - c].$$

Given that entry occurs, (4) implies that welfare is higher when E uses M's network if

$$C_2 \leq [u - \hat{u}] + [\hat{C}_1 - c].$$

Therefore, given that entry takes place, private and social incentives for using M's network are brought into line by choosing $a = C_2$. Making the network access charge equal to the cost of providing access gives the entrant the correct "make-or-buy" incentives for its network provision.[6]

Turning to the choice for t, following the analysis in Section I, the ideal output tax is given by $t = P - C_1$ per unit as in (2) above. With these choices for a and t, one sees that E's profits per unit with each of its three options for entry are:

$$E\text{'s profit} = \begin{cases} [\hat{u} - U] + [C_1 - \hat{C}_1] & \text{with stand-alone entry} \\ [u - U] + [C_1 - c - C_2] & \text{with entry via } M\text{'s network} \\ 0 & \text{with no entry.} \end{cases}$$

Comparing these profits with (4), one can see that E's incentives are now in line with welfare: the entrant will enter when it is optimal to do so, and will choose to use M's network when it is efficient for it to do so.[7] Other policies will cause various kinds of inefficiencies. For instance, if E can use M's network at cost, then it will face the correct make-or-buy incentives conditional on entry, but not the correct incentives to enter. Alternatively, if the ECPR (3) were imposed, then E might build its own infrastructure even if it were more efficient for it to use M's.[8]

They suggest that the use of these kinds of taxes is "politically unlikely" but go on to suggest that these taxes could be repackaged as a tax on the whole industry to make them seem less discriminatory. Since this is the approach taken here, this section of my paper is best seen as expanding on this earlier suggestion.

[5] See Armstrong (2001 [section 2.4.2]) for a discussion of the case where the access charge is the *only* instrument available. In this case, since the access charge has to perform two tasks, a compromise must be made, and a degree of productive inefficiency results.

[6] Several writers loyal to the ECPR approach have suggested that the ECPR is necessary for productive efficiency (see e.g., Baumol et al., 1997). When bypass is possible, however, it is usually necessary to price access at cost to ensure productive efficiency at the network level.

[7] This insight, that when bypass is possible the regulator with enough instruments at its disposal should price the input at marginal cost, is well-known in the vertical-control literature. See Tirole (1988 pp. 179–81) for an account of how an (unregulated) upstream monopoly offers its input at marginal cost when it has suitable additional instruments for controlling downstream competition.

[8] This policy is somewhat related to the "M-ECPR" proposal as outlined in J. Gregory Sidak and Daniel Spulber (1997 Ch. 9). Those authors suggest that the entrant should be charged an amount up to its *own* cost of providing network services for the use of the incumbent's network and that an "end-user charge" should be imposed to prevent cream-skimming entry. One advantage, however, of basing access charges on the incumbent's cost is that it decentralizes the decision about the desirability of entry to the (perhaps better-informed) entrant, and knowledge of the entrant's technology is not required.

TABLE 3—GIVING CORRECT ENTRY AND MAKE-OR-BUY INCENTIVES

	Urban	Rural
M's total cost per subscriber	\$50	\$200
Retail cost per subscriber	\$20	\$20
Network cost per subscriber	\$30	\$180
M's retail price for service	\$100	\$100
E's contribution to fund	\$50	−\$100
M's network access charge	\$30	\$180

The output-tax element of this regime can again be implemented by means of an industry fund, as described in Table 3.

Here, there is a universal service fund that operates just as in Table 1: any firm providing service to an urban subscriber must contribute \$50 to this fund, and any firm offering service to a rural subscriber can receive \$100 from the fund. In addition to these contributions, the entrant can gain access to the incumbent's network at actual cost (not averaged cost as in Table 2). Notice that if the entrant chooses to enter via the incumbent's network its total payment is \$80 per subscriber in each group, just as in Table 2. However, the advantage of splitting the ECPR charge into two parts (a cost-based access charge together with an output tax) is that when network bypass is a possibility it is undesirable to make network access charges deviate from the incumbent's network costs.

Thus, where possible, retail instruments (perhaps in the form of a carefully designed universal service fund) should be used to combat retail-level distortions such as mandated tariffs that involve cross-subsidies. Wholesale instruments should then be used to combat potential productive inefficiencies, in this case the productive inefficiency caused by pricing access other than at cost.

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