The Pricing of Inputs Sold to Competitors

William J. Baumol†
J. Gregory Sidak††

Local telephone companies have long been regulated as natural monopolies. However, technological innovation and the prospect of falling regulatory barriers to entry now expose some portions of the local exchange to competition from cable television systems, wireless telephony, and rival wireline systems. Nevertheless, it is probable that certain parts of local telephony will remain naturally monopolistic. In these cases the local exchange carrier must be permitted to sell necessary inputs to its competitors in the market for final telecommunications products at a price that reflects all its costs, including opportunity costs. The authors' analysis applies to any network industry. Thus, it is useful in antitrust analysis of essential facilities and in regulatory analysis of transportation, energy transmission, pipelines, and mail delivery.

†Director, C.V. Starr Center for Applied Economics, New York University; Professor Emeritus, Princeton University.

††Resident Scholar, American Enterprise Institute for Public Policy Research; Senior Lecturer, Yale School of Management.

This Essay draws upon WILLIAM J. BAUMOL & J. GREGORY SIDAK, TOWARD COMPETITION IN LOCAL TELEPHONY (1994). We thank the MIT Press and the American Enterprise Institute for permission to excerpt portions of the book for this Essay.

Introduction

One of the most vexing issues facing regulators of local telephone service is the pricing of access to the local loop. The pricing is particularly difficult because a local exchange carrier (LEC) supplies access to interexchange carriers (IXCs) while simultaneously competing with them in toll services within a local access and transport area (LATA).[1] Access has two significant attributes. First, access is an intermediate good; it is an input used in the supply of a final product, intraLATA toll service. Second, the LEC produces this input for use

1. For a discussion of how LATAs were created as local telephone markets by the Modification of Final Judgment (MFJ), see MICHAEL K. KELLOGG ET AL., FEDERAL TELECOMMUNICATIONS LAW 227-34 (1992).

not only by itself, but also by its rivals in the market for the final product. Pricing issues arise generically whenever a firm, X, is the only supplier of an input used both by itself and by a rival to provide some final product. If X charges its rival more for the input than it implicitly charges itself, it will have handicapped that rival's ability to compete with X, perhaps seriously. The reverse will be true if regulation forces X to charge the rival less for the input than X charges itself. This pricing problem arises not only in telecommunications regulation, but also in antitrust law[2] and in the regulation of any network industry.

This intermediate-goods pricing problem can distort the efficient division of responsibilities between the LEC and the IXCs in supplying competitive telecommunications services. An excessive price for access handicaps the IXCs in their efforts to attract a share of intraLATA service. Correspondingly, below-cost access prices handicap the LEC. Either price distortion can direct some of the business in question to an inefficient supplier. This kind of inefficiency can also be expressed in terms of the profits the LEC earns by supplying access to itself and by supplying it to the IXCs. If the LEC charges the IXCs so high a price that any sale yields a large incremental profit, but the LEC forgoes some of this profit when it uses access in its own sale of intraLATA toll services, then the LEC will have set an indefensibly low price for its final product. This constitutes a competitive impediment for the IXCs. Thus, the problem is to ensure an appropriate relationship between the profits the LEC earns from providing access to itself and those it earns from selling access to its competitors in the final-product market.

What is the proper relation between these two profit figures? The unambiguous answer we propose may appear unfamiliar and invented especially to address the pricing of intermediate inputs such as access. On the contrary, the efficient component-pricing rule that we will describe is simply another use of the incremental-cost principles that achieve economic efficiency. The role of opportunity cost is given special emphasis because of its relevance to the current issue.

Part I of this Essay briefly describes the trend toward competition in local telephony. Part II defines the relevant cost concepts necessary for analyzing optimal input pricing. Part III derives and explains the efficient component-pricing rule. Part IV discusses the relevance of the efficient component-pricing rule to specific issues posed by the emergence of competition in local telephony, giving special attention to the regulatory response to such competition in New Zealand.

2. This is the essential facilities problem. *See* United States v. Terminal R.R., 224 U.S. 383 (1912); MCI Comm. Corp. v. American Tel. & Tel. Co., 708 F.2d 1081, 1132-33 (7th Cir.), *cert. denied*, 464 U.S. 891 (1983).

I. Toward Competition in Local Telephony

There is no question that substantial competition pervades some activities of the local telephone companies. In other portions of their operations competition is weak or virtually nonexistent, although changes on the horizon suggest that it may not be absent for long. But even in the competitive portions of the LECs' operations, it is probably undesirable to let the LECs fend for themselves, because the LECs' monopoly services constitute inputs for the activities of their rivals in competitive arenas—inputs without which the rivals cannot hope to operate. The LECs' monopoly services are referred to as "bottlenecks" or "essential facilities." This means that, absent regulatory constraint, the LEC could use the monopoly services or facilities to force rivals to bend to its will or to destroy those rivals altogether. This is the fundamental complicating phenomenon hindering the deregulation of local telephone service.

Soon after the Modification of Final Judgment, it became apparent that competition would exist between the LECs and interexchange carriers such as AT&T, MCI, and Sprint. Yet, the extent to which competition between these two groups has grown was not widely foreseen.[3] The primary arena in which that competition has occurred is the transmission of messages within the LATAs. Intrastate telecommunications service does not fall under the direct jurisdiction of the Federal Communications Commission (FCC), and state regulatory agencies have not prevented the LECs from providing intraLATA long-distance services. With both LECs and IXCs participating in the lucrative intraLATA intrastate market, both groups pursued business in this arena with vigor. Competition in the local arena is now provided or threatened from a bewildering array of sources: the IXCs, overlapping LECs, resellers, cable television firms, private bypass arrangements, cellular telephone and other wireless services, and local fiber-optic networks.

Probably the most breathtaking development in this regard was the announcement in October 1993 that Bell Atlantic, one of the seven regional Bell operating companies (RBOCs), would acquire the largest cable company in the United States, Tele-Communications, Inc. (TCI)—a deal which later collapsed in February 1994.[4] Although many viewed this move as primarily a way for Bell Atlantic to enter the cable television market on a grand scale, the merger could have had even more significant implications, for it would have quickly placed Bell Atlantic in direct competition with other RBOCs for local

3. For an illuminating contemporary analysis of AT&T's possible strategic objectives in settling the divestiture suit and consenting to the MFJ, see Paul W. MacAvoy & Kenneth Robinson, *Winning by Losing: The AT&T Settlement and Its Impact on Telecommunications*, 1 YALE J. ON REG. 1 (1983).

4. *See* Dennis Kneale, *Bell Atlantic and TCI Are Poised to Shape a New Interactive World*, WALL ST. J., Oct. 14, 1993, at A1; *Bell Atlantic's Pact to Acquire TCI Collapses Amid Dispute Over Price; Cable Rate Cut by FCC Was Final Straw*, WALL ST. J., Feb. 24, 1994, at A3.

residential telephone access in scores of American cities outside Bell Atlantic's current telephone service area.

The experience of intraLATA competition is instructive for policy-makers concerned with local service competition. In that market the growth of competition posed a disturbing dilemma. The LECs argued that complete regulation as monopoly suppliers made it impossible for them to compete effectively. That is not to say that the IXCs were left free to compete without constraint. AT&T, in particular, continued to face regulatory intervention both by the FCC and by state public utility commissions. Nevertheless, in intrastate services, the LECs claimed that deregulation of their activities was trailing that of AT&T, presumably because the LECs were the residual proprietors of all the substantive bottleneck services.

The LECs do continue to possess bottleneck services, even though competition threatens to erode or even to eliminate them. The bottlenecks constitute legitimate grounds to continue regulating the LECs. The primary bottleneck is the LECs' control of the facilities used to supply access service—that is, the service that provides the connection between messages received from outside areas and the local loop to which a particular subscriber is attached. For local service, at least until recently, it generally has been deemed wasteful to include two or more rival suppliers, since that would entail duplication of facilities (the wires leading into the individual residence or business location). Moreover, it was judged that in this field a multiplicity of suppliers could not long survive, given the cost that their presence imposes and the probable inconvenience to subscribers. As a result, operation of the local loop and the provision of access to it were considered to constitute a natural monopoly from which no substantial deviation was possible.[5] The switches and other equipment used in providing access then were considered to be a bottleneck facility, because no IXC could deliver a message to the intended recipient's telephone through the local loop without purchasing the access service from the local exchange carrier.

That this transaction constitutes sale of a service by a monopolist to a set of purchasers who compete with one another was complication enough. This state of affairs calls for the usual restraints upon the monopoly seller to ensure that it does not exploit its customers. The situation was rendered even more complex by the competition between the LECs and the IXCs for intraLATA service to subscribers. Consequently, an LEC unconstrained by regulation is

5. Some have argued that a market structure of overlapping LECs, which existed in many American cities until roughly 1915, could or would have survived if interconnection between competing LECs had been required, if AT&T had been prevented from acquiring competitors, and if exclusive franchises had not become politically expedient. *See* KELLOGG ET AL., *supra* note 1, at 12-17. For an analysis of the effect of political constraints on this early market structure, see William P. Barnett & Glenn R. Carroll, *How Institutional Constraints Affected the Organization of Early U.S. Telephony*, 9 J. L. ECON. & ORG. 98 (1993).

in a position not only to favor one IXC over another, but more importantly to supply access to itself on terms that favor its own competitive position in the intraLATA markets. The solution to this problem requires carefully designed rules on the pricing of intermediate inputs such as access, at least until effective competition in access services becomes established.

II. Relevant Cost Concepts

In order to explain the efficient component-pricing rule, it is first necessary to clarify the meaning of several different cost concepts. These cost concepts are relevant to what we call the competitive-market model of regulation, which seeks to simulate the outcomes of a perfectly contestable market.

A. *Marginal Cost of X*

The marginal cost of X refers to the increase in the firm's total outlays resulting from a small rise in the output of X. As already noted, in perfectly competitive equilibrium the firm will always set the price of X equal to the marginal cost of X. This price will satisfy the requirements of economic efficiency if it yields revenue sufficient for continued financial solvency of the firm. But such a price will always prevent the earning of revenues sufficient for this purpose where production is characterized by scale economies.

B. *Incremental Cost of X*

Incremental cost is a generic concept referring to the addition, per unit of the additional output in question, to the firm's total cost when the output of X expands by some preselected increment. Thus, marginal cost can be approximated by incremental cost if the increment in question is small. But if the increment is large, marginal cost and incremental cost can differ substantially, because the ranges of outputs examined in the two calculations are not the same.

C. *Average-Incremental Cost for an Entire Service X (AIC_X)*

Average-incremental cost, along with marginal cost, is the concept most frequently cited in recent discussions of public-interest floors on prices. The average-incremental cost of the entire service is defined as the difference in the firm's total costs with and without service X supplied, divided by the output of X. In other words, it is the cost per unit of X that is added to the firm's total outlays as a result of its supply of the current output of X. Formally, if $x,y,z,...$

represent the outputs of the firm's various products, and TC($x,y,z,..$) is the total amount the firm must expend in producing that combination of outputs, then

$$AIC_X = [TC(x,y,z,...) - TC(0,y,z,...)]/x.$$

It is natural to consider average-incremental cost as a first cousin of the commonly used average-variable cost. Because, so far as we are aware, there is no standard definition of the latter, the differences and similarities between the two concepts cannot be conclusively determined. They can be used to mean the same thing, but there are at least three differences in the ways they are often interpreted or utilized. First, average-variable cost is used at least sometimes to refer to short-run cost, with capacity not adjusted to output volume. Average-incremental cost, on the other hand, is the lower, long-run figure obtained after plant and equipment are adjusted so as to minimize the average cost of the pertinent output. Second, average-incremental cost of a service X includes any fixed cost that must be incurred on behalf of that product alone. Professor Phillip Areeda, Langdell Professor of Law at Harvard University, has indicated that his definition of average-variable cost, which is used extensively in antitrust litigation,[6] does include such product-specific fixed costs.[7] But it is not clear that everyone who calculates average-variable cost figures performs a similar calculation. Finally, average-variable cost calculations are burdened by the baggage of past calculation practices of questionable legitimacy; average-incremental cost studies so far appear to be less burdened by these practices. Despite these possible distinctions, readers will lose little in following the logic in the remainder of our discussion if they treat average-incremental cost and average-variable cost as synonyms.

D. *Stand-Alone Cost of a Combination of Services Y,Z,... ($SAC_{YZ,...}$)*

The stand-alone cost of a combination of services is the cost that would be incurred by an efficient entrant to the industry in question if it were to decide to produce only some specified set of commodities $Y,Z,...$. That is, it is the cost to produce just those items, standing alone. The concept also applies to an entrant that decides to produce only a single commodity Y. Using the preceding notation, we can write, for the case where the entrant decides to produce $Y,Z,...$ but not X,

$$SAC_{YZ,...} = TC(0,y,z,...).$$

6. Phillip Areeda & Donald F. Turner, *Predatory Pricing and Related Practices Under Section 2 of the Sherman Act*, 88 HARV. L. REV. 697 (1975); *see* WILLIAM J. BAUMOL, SUPERFAIRNESS: APPLICATIONS AND THEORY (1986) (defining average-variable costs).

7. *See* BAUMOL, *supra* note 6, at 116 n.4, 118 n.6 (1986).

Under the competitive-market standard for regulation, marginal costs and average-incremental costs are the figures relevant for price floors, while stand-alone costs are the figures relevant for price ceilings. Moreover, as we show elsewhere, incremental cost and stand-alone cost are intimately connected, and either number can be deduced directly from the other.[8] Specifically, when the firm earns no more and no less than the competitive rate of return, if each of the firm's prices is above its average-incremental cost, then each of those prices must be below its stand-alone cost, and vice versa. This result can simplify the administration of price floors and ceilings.

III. The Efficient Component-Pricing Rule

A critical requirement for economic efficiency is that the price of any product be no lower than that product's marginal cost or its average-incremental cost. Economic analysis emphasizes that the pertinent marginal cost as well as the average-incremental cost must include all opportunity costs incurred by the supplier in providing the product. Opportunity cost refers to all potential earnings that the supplying firm forgoes, either by providing inputs of its own rather than purchasing them, or by offering services to competitors that force it to relinquish business to those rivals, and thus to forgo the profits on that lost business. In a competitive market, price always includes compensation for opportunity costs, such as the interest forgone by the firm when it supplies funds from retained earnings rather than borrowing them from a bank. The efficient component-pricing rule states simply that the price of an input should equal its average-incremental cost, including all pertinent incremental opportunity costs. That is,

optimal input price = the input's direct per-unit incremental cost + the opportunity cost to the input supplier of the sale of a unit of input.

We examine now the logic and consequences of that rule. In the following discussion, the term "direct costs" will refer to all costs that, from the point of view of the supplier firm, are not opportunity costs.

A. *The Nature of the Problem*

The literature on the economics of price regulation indicates that the pricing principle just described can guide the choice of efficient access charges.

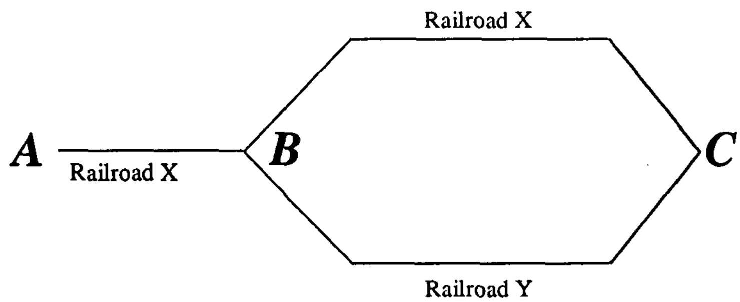
8. WILLIAM J. BAUMOL & J. GREGORY SIDAK, TOWARD COMPETITION IN LOCAL TELEPHONY 82-85 (1994).

This pricing principle—variously known as the efficient component-pricing rule, the imputation requirement, the principle of competitive equality, or the parity principle—is merely a variant of the elementary principles for efficiency in pricing that were discussed above. This rule applies to the sale of an input—a component *K* of the final product—by a supplier *X* of both the component and the final product. The purchasing firm *Y* uses the component to produce the same final product as *X* and sells that final product in competition with *X*. Here, *Y* is itself assumed to make the remaining components (other than *K*) of the final product. If *X* sells component *K* to *Y*, then *Y* is enabled to compete with *X* in selling the final product. When *X* sells component *K* to *Y*, either voluntarily or pursuant to regulatory mandate, what price should *X* charge for component *K*?

We will use an example from rail transportation, rather than telecommunications, to answer this pricing question. In our experience, the logic of the issue seems to be grasped more easily with the aid of the rail analogy. As will be shown, however, regulators already have applied this logic to telecommunications markets. Consider then two railroads, *X* and *Y*, that operate along parallel routes from an intermediate point *B* to a destination point *C*, as illustrated in Figure 1. Railroad *X* owns the only tracks extending from the origin point *A* to the intermediate point *B*. In this case, the final product is transportation all the way from *A* to *C*. Competing railroad *Y*, also a proprietor of tracks from *B* to *C*, can be expected in these circumstances to apply to railroad *X* for interconnection from *A* to *B*, seeking to rent trackage rights along that route from its rival. If the transaction is completed, *Y* (like *X*) will be able to ship all the way from *A* to *C*; in regulatory parlance, *X* then is called the landlord railroad and *Y* is called the tenant. Regulators commonly have been requested by prospective tenants to force a landlord to grant them trackage rights. For obvious reasons, the regulatory agency usually has been asked to set the rental fee as well.

The sale of access by an LEC to an IXC that is a horizontal competitor of the LEC in the market for intraLATA toll services is precisely analogous to the grant of trackage rights by the landlord to the tenant railroad. Access is an input to the final product, interexchange telecommunication, and is not essentially different from the purchase of any other intermediate input. Setting a price for access to the local loop in telecommunications is, therefore, precisely analogous to setting the rental fee for trackage rights. More generally, the pricing of access is analogous to pricing any product component in comparable circumstances.

Figure 1



The Trackage-Rights Pricing Problem

The efficient component-pricing rule has already advanced from theory to practice in the United States and abroad. The Interstate Commerce Commission (ICC) has applied the rule in several railroad rate cases.[9] In October 1989, the California Public Utilities Commission embraced the rule in its reform of regulation of LECs.[10] More recently, the High Court of New Zealand adopted—and the Court of Appeal of New Zealand subsequently rejected—the rule in antitrust litigation between Clear Communication, Ltd. and the former government telephone monopoly, Telecom Corporation of New Zealand, Ltd.[11]

B. *The Traditional Regulatory Approach to Rental Fee Determination*

9. For example, see the quartet of cases known as *Compensation I* through *IV*, St. Louis S.W. Ry.—Trackage Rights over Missouri Pac. R.R.—Kansas City to St. Louis, 1 I.C.C.2d 776 (1984), 4 I.C.C.2d 668 (1987), 5 I.C.C.2d 525 (1989), 8 I.C.C.2d 80 (1991).

10. Alternative Regulatory Framework for Local Exchange Carriers, Invest. No. 87-11-033, 33 C.P.U.C.2d 43, 107 P.U.R.4th 1 (1989).

11. Clear Communications, Ltd. v. Telecom Corp. of New Zealand, CP590/91, slip op. (H.C. Dec. 22, 1992) (available at the Yale Law Library), *rev'd*, C.A. 25-93, slip op. (C.A. Dec. 17, 1993) (available at the Yale Law Library).

Until recently, regulators have often approached the rental-fee decision in the manner suggested by the following example. Let the direct average-incremental cost incurred by landlord *X* as a result of *Y*'s use of its track be AIC dollars per train. This is the additional cost per train incurred by the landlord railroad—including track wear and tear, additional planning, and administrative cost—as a result of the tenant's use of the landlord's tracks. Suppose that because of economies of scale, total revenues must exceed the sum of the incremental costs of the two types of traffic if *X* is to break even. Suppose further that, in the absence of trackage rights, the traffic from *A* to *C* had yielded *X* a net contribution toward the shortfall (that is, total incremental revenue minus incremental cost) of *T*, and assume that contribution *T* equals $90 million per year. Finally, suppose that, after granting trackage rights, *X* is expected to retain two-thirds of the traffic from *A* to *C*, with the remaining traffic going to *Y*.

Assuming freight rates for shipments from *A* to *C* are fixed, regulators generally have determined the proper rental fee for the trackage rights to consist of (1) a charge per train of railroad *Y* set equal to the (direct) average-incremental cost to *X* of handling *Y*'s train, and (2) a supplement designed to leave *X* with exactly two-thirds of the $90 million contribution that the traffic formerly provided. Under this regulatory rule, in other words, the landlord is granted its pro rata share of the contribution, in this case corresponding to its two-thirds expected share of the total traffic. This regulatory rule, however, violates economic efficiency. As will now be shown, it fails to compensate railroad *X* adequately for its common fixed costs; thus, the rule distorts the efficient division of responsibilities between *X* and *Y* in supplying transport over the competitive segment *BC*.

C. *The Efficient Component-Pricing Principle as a Requirement of Economic Efficiency: What Is the Efficiency Issue?*

The efficient pricing principle for product components is not only required by the competitive-market standard for defensible behavior by an allegedly dominant firm. It is also a necessary condition for economic efficiency, and hence for promoting the public interest. That is, product-component prices that do not follow this principle create an incentive for inefficiency whose costs consumers have to pay.

Another example demonstrates the nature of the efficiency issue. Consider a pharmaceutical manufacturer *X* that is the sole supplier of a medical ingredient *A* on which it holds a patent. The final product may require other medical ingredients, capsule cases, packaging, and marketing services, all of which firm *X* also can provide, although it is not the only enterprise that can do so. Economic efficiency requires that capsule cases,. packaging, retail marketing services, and so on, each be supplied by those firms that can most efficiently produce the goods and services—that is, by means that minimize the costs of the labor, fuel, raw materials, and other inputs used in producing the components. The choice is often interpreted as a make-or-buy decision on the part of firm *X*, the supplier of patent-protected component *A*. Firm *X* should make the capsule cases, the packaging, and so on only if it is the most efficient supplier of these items. Otherwise, public interest dictates that firm *X* buy those components from a rival supplier who can provide them more efficiently.

Whether firm *X* will make the efficient choice voluntarily depends on the relative price of the competing suppliers of the capsule cases (and the other product inputs). If their price when offered by a rival supplier is lower than the cost at which firm *X* can make capsule cases for itself, *X* will be motivated to purchase the cases rather than produce them. Efficiency in pricing requires that the capsules are priced so that *X* will find it profitable to select the more efficient provider to manufacture the capsules. *X* should supply the capsules itself if and only if it is the more efficient supplier. In telecommunications services, the analogous problem is to price access so that the job of carrying intraLATA traffic goes to the more efficient of the competing carriers.

D. *Efficiency of the Component-Pricing Rule and the Competitive-Market Model*

In brief, the optimal component-pricing rule asserts that the rent that tenant railroad *Y* should pay per train is the entire average-incremental cost incurred by each train traversing landlord railroad *X*'s route *AB*, including any incremental opportunity cost that the passage of *Y*'s train imposes on *X*. Expressed in this way, the rule is entirely familiar to economists, and its logic will be virtually self-evident to them, except for its focus on average-incremental cost rather than marginal cost.

The efficiency of this optimal component-pricing rule is confirmed indirectly by the fact that it yields a price level set in precisely the same way it would be in a perfectly competitive or a perfectly contestable market. To see this, imagine a set of landlords competing to rent retail space to tenants. Suppose further, as is often true, that if no suitable tenant can be found, the space can be used for the landlord's own profitable retailing establishment. No landlord who can use the property in this way will rent it to anyone for less than the direct incremental cost of the tenant's occupation of the property plus the opportunity cost to the landlord of the rental arrangement. If the landlord can earn $90,000 by using the property, the tenant will be required to make good the $90,000 that is forgone by renting the property. The same argument applies whether the opportunity cost is incurred because landlord and tenant compete for space or because they compete for customers.

Consequently, even in the most competitive of markets, no landlord will rent for less than the fee determined under the efficient component-pricing rule. Moreover, if competition abounds—that is, if a profusion of alternative properties are available to the tenant on comparable terms—the tenant will pay no more than the efficient component price. In practice, of course, the tenant can be expected to spend slightly more than that, in order to induce the landlord to rent rather than use the property himself.

Since, in the absence of externalities, it is expected that competitive prices will be consistent with economic efficiency, the preceding argument establishes a presumption that the component-pricing rule is indeed optimal. This is also made clear by our railroad example, which will now be used to show how the optimal input price is calculated.

Recall from Figure 1 that in our illustration only railroad X offers transportation from A to B (route AB) and then to C (route BXC). Its competitor, railroad Y, also offers transportation from B to C (route BYC) and it wishes to serve shippers from A as well by renting trackage rights along X's route AB. By obtaining interconnection over route AB, railroad Y will be able to offer shippers seamless transportation service from A to C, which is our illustrative final product. Suppose the competitive price to shippers for transport from A to C is \$10 per ton, and X's incremental cost along each of its two route segments, AB and BXC, is \$3 per ton. Thus, on its carriage of shipments from A to C, landlord X earns a net contribution toward its common fixed costs equal to the final-product price minus its two incremental costs—that is,

$$X\text{'s earned contribution} = \$10 - \$3 - \$3 = \$4$$

for every ton of freight X carries over the full route from A to C.

In a competitive market, what will railroad X charge railroad Y for permitting the latter to haul a ton of freight over X's route AB? Assume for simpler exposition that each ton of freight carried from B to C by Y means that one less ton is transported by X. Then, even if there are other railroads in positions similar to X, none will rent Y their tracks unless Y pays them enough to compensate for the cost of the lost profit that Y's interconnection will impose on them. This cost includes the direct incremental cost—wear and tear of X's tracks, fuel if X is required to supply the engine, and so on—a sum that we take to be \$3 in our example. But full compensation for interconnection also requires that Y pay for the incremental opportunity cost its traffic imposes upon X—that is, the loss of \$4 of net contribution toward common fixed costs that X incurs for every ton of business that Y diverts from X by using X's tracks. Thus, the competitive-market standard requires that the price of trackage rights (or, more generally, of interconnection) must also satisfy the efficient component-pricing rule. In our example, the direct per-unit incremental cost to railroad X of permitting use of its route *AB* is \$3 per ton. Railroad *X*'s per-unit opportunity cost is its loss of \$4 per ton of net contribution toward its common fixed costs. Thus, the efficient component price for granting railroad *Y* interconnection over route *AB* is \$7 per ton—the price that would emerge in a competitive market.

E. *Direct Discussion of the Role of Component Pricing in Promoting Efficiency*

The component-pricing principle has a critical role in promoting economic efficiency. Continuing with our railroad example, it will now be demonstrated that if the price of the component provided by landlord railroad *X* is set according to this pricing rule, then the two participating railroads will face incentives that automatically assign the business over route *AB* to the supplier who can provide it with the least use of fuel, labor, and other valuable inputs. But if the rental payment for the landlord's component—in this case, *X*'s tracks over route *AB*—is set at a price below that required by the efficient component-pricing principle, the requirements of economic efficiency will be violated. Economic efficiency requires that the competitive segment of the service be performed only by efficient suppliers—that is, by those suppliers whose incremental costs incurred to supply the service are the lowest available. In order to realize this goal, it must be possible for the more efficient suppliers to make a net profit when they offer the final product for a price that yields no such gain to less efficient suppliers. This condition must hold whether the more efficient supplier happens to be the landlord or the tenant.

We first will demonstrate the basic efficiency result using our hypothetical numerical example, and then we will show how to generalize it, indicating that the result is valid always, not only when the pertinent numbers happen in reality to match those in our illustration. First, however, we must recall that even if every one of a firm's services is sold at a price equal to its average-incremental cost, the firm's total revenues may not cover its total costs. Consequently, it is normal and not anticompetitive for a firm to price some or all of its products to provide not only the required profit component of incremental cost, but also some contribution toward recovery of common fixed costs that do not enter the incremental costs of the individual products. The appropriate and viable size of the contribution of a particular product depends in part upon demand conditions for that product; the contribution does not follow any standard markup rule or any arbitrary cost-allocation procedure. Any service whose price exceeds its per-unit incremental cost provides such a contribution in addition to the profit required on the incremental investment contained in the incremental cost.

With all this in mind, consider again our numerical example encompassing railroads *X* and *Y*. Suppose that the final product in question, transport from

A to *C*, is sold to shippers at a price of \$10 per ton—a price deemed competitive and thus above the incremental-cost floor. We have already assumed that landlord railroad *X* incurs an incremental cost for transport from *A* to *B* (which we will call IC_{AB}) that equals \$3 per ton, and an incremental cost for transport from *B* to *C* (which we will call IC_{BXC}) that also equals \$3 per ton. We saw that these incremental costs leave a net contribution toward common fixed costs of \$4 per ton (that is, \$10 − \$3 − \$3) from each unit of final product sold. We also saw that the efficient component-pricing principle requires that the landlord railroad *X* offer interconnection over route *AB* to tenant railroad *Y* at a price equal to IC_{AB} plus *X*'s opportunity cost (that is, \$3 + \$4 = \$7). At that price, the tenant's gross earnings per unit of final product amount to \$3. This represents the \$10 final-product price minus the \$7 fee that the tenant pays to the landlord for interconnection over route *AB*. But to determine *Y*'s net earnings we must also subtract from this sum the incremental cost tenant railroad *Y* incurs when it transports a ton of freight over its own route segment to complete the trip from *A* to *C*. There are three possibilities:

> *Case I:* If tenant railroad *Y* is the less efficient supplier of the remainder of the final product (transport from *B* to *C*), so that its incremental cost (say, \$4) exceeds the \$3 incremental cost of landlord railroad *X* for transport from *B* to *C*, then *Y* will lose money if it attempts to provide the final product. Here, the \$10 price for the final product must be exceeded by the \$11 sum of the efficient component price (\$7) plus *Y*'s incremental cost of completing the final product (\$4). So, *Y* will be kept out—not by an improper price, but because of its own inefficiency. This is the outcome required by the public interest.
>
> *Case II:* If the incremental cost of providing transport from *B* to *C* is the same for both railroads (\$3), then the two firms are equally efficient suppliers of transport from *B* to *C*. It does not matter to society which railroad provides the service. Moreover, the tenant will experience no gain and no loss by providing the service, since its profit in excess of incremental capital cost = price − trackage fee − *Y*'s incremental cost over route *BC* = \$10 − \$7 − \$3 = \$0, so that the tenant, offered only a return equal to its capital cost, will be indifferent with respect to providing transport.
>
> *Case III:* In the third case, the tenant is the more efficient supplier of transport from *B* to *C* with an incremental cost of, say, \$2. *Y* can then undercut slightly *X*'s final-product price (\$10) and make an additional profit for itself while still covering both the efficient

> component price that it must pay to X (\$7) and its own incremental cost of completing the final product (which is less than \$3). For example, Y can sell the final product for \$9.75 per unit, making a profit of \$0.75 per unit over the cost of capital (that is, \$9.75 – \$7 – \$2). The landlord will have no incentive to retain for itself the transportation business from B to C. It could do so only by matching the tenant's \$9.75 price. However, at any price below \$10 the landlord would be accepting a contribution less than the contribution (\$4) that it can obtain through the efficient component prices it charges Y for Y's provision of transport from B to C.

In Case III above, the landlord is said to have chosen to "buy" rather than "make" the B-to-C transportation component of the final product. This result shows how the efficient component-pricing rule achieves the principle of indifference. That is, the rule sets the landlord's component price at an amount which includes all the landlord's costs, so that the landlord is indifferent as to whether that particular transportation service is provided by itself or a rival, since all the landlord's costs are covered one way or the other. The rule thus ensures that the task of providing transport from B to C is performed by the firm that can do it more efficiently.

This result will be different if regulation forces the landlord to offer transport from A to B at a price below the efficient component price. If regulation permitted X, for example, to charge at most \$5.50 for transport from A to B (rather than the \$7 price permitted under the efficient component-pricing rule), then the tenant's gross earnings—that is, its final-product price (\$10) minus the rental price (\$5.50)—would be \$4.50, or \$1.50 above X's incremental cost of providing transport from B to C. Even if Y's incremental cost of providing transport from B to C were \$4, making it a less efficient supplier of the competitive transportation service than X, Y could still enter the arena and earn a contribution from its inefficient activity, for its per-unit profit would then be \$10 – \$5.50 – \$4 = \$0.50. The less efficient supplier is able to earn this profit because the imposition of the \$5.50 price offers the tenant a subsidy from the landlord of \$1.50 for every unit of service the tenant elects to provide. Moreover, that subsidy is, in effect, obtainable by the tenant on demand, because the \$5.50 price is imposed by regulatory authority.

The connection between the efficient component-pricing rule and allocative efficiency should now be clear: the rule ensures proper pricing and efficiency in the competitive segment of the rail route, just as it will ensure this outcome in the local telecommunications loop. It only remains to be shown that the efficiency result is not unique to the numbers we happened to select for our illustration, but rather has general applicability. To demonstrate this, we now substitute algebraic symbols for the preceding numbers.

F. *Formal Discussion of the Rule's Efficiency*

The formal discussion that follows proves the general efficiency of the component-pricing rule and provides additional insight into its workings. In algebraic terms, the rule indicates that the appropriate per-train payment by the tenant railroad Y (the purchaser of access) is AIC, the per-unit incremental cost (excluding opportunity cost), plus T/M, where T is the total contribution to common fixed costs that X earned from the traffic over route AC before granting trackage rights, and M is the total number of trains of both railroads together going from A to C. First, we prove that pricing according to the rule leaves the landlord indifferent between granting the trackage rights to the tenant and using the tracks for itself. Under the rule, the landlord railroad X will receive from Y, for Y's traffic consisting of N trains, a total payment equal to

$$(N)(\text{AIC}) + NT/M. \tag{1}$$

This gives X a contribution to profit equal to

$$(N)(\text{AIC}) + NT/M - \text{the cost to } X \text{ of } Y\text{'s traffic over } AB =$$

$$(N)(\text{AIC}) + NT/M - (N)(\text{AIC}) = NT/M. \tag{2}$$

NT/M is the contribution X receives from Y's traffic. The contribution that X will receive from the $(M - N)$ trains of its own that continue to traverse the route after the grant of trackage rights will equal the number of its trains, $(M - N)$, multiplied by the contribution per train

$$(M - N)\, T/M = T - NT/M. \tag{3}$$

Therefore, the landlord's gain from the combined traffic, after expending $(N)(\text{AIC})$ on Y's trains in the manner expressed in Equation (2), will be the sum of the contribution from Y's traffic given by Equation (2) and the contribution from its own traffic, Equation (3). That is,

$$(NT/M) + T - NT/M = T. \tag{4}$$

In other words, under the optimal component-pricing rule, the landlord will gain the same total contribution T whether or not it grants the traffic rights, and despite the fact that the landlord now operates fewer trains of its own.[12] This outcome differs from the traditional regulatory arrangement, which assigns both X and Y a share of T prorated in proportion to their respective shares, $(M - N)$ and N, of the total traffic M.

We now see how this result relates to the issue of efficiency. Let AIC_X or AIC_Y be the per-train incremental cost if this competitive B-to-C portion of the transportation service is performed by X or Y, respectively. Then it will be more efficient for landlord railroad X to transport the freight if $\text{AIC}_X < \text{AIC}_Y$, and it will be more efficient for tenant railroad Y to do so if the inequality is reversed.[13]

To prove that the component-pricing rule automatically apportions the task to the more efficient carrier, we first provide an explicit expression for the contribution T of the total traffic over route AC. For this purpose, let P represent the price that shippers pay to transport a trainload of freight over the entire route AC. Then, in the absence of its grant of trackage rights to Y, X obtains from its train traffic M the following contribution

$$T = M(P - \text{AIC} - \text{AIC}_X), \tag{5}$$

where AIC is, as before, the incremental cost of taking a train over the noncompetitive route segment AB, and AIC_X is X's incremental cost of carrying the train the remainder of route BXC. Now, if Y acquires trackage rights and sends N trains from A to C, Y will earn a profit equal to its total revenue PN, minus its optimal input-price payment given by Equation (1), minus $(N)(\text{AIC}_Y)$, the incremental cost incurred by carrying the N trains over its own route BYC. That is,

$$Y\text{'s profit} = N(P - \text{AIC} - T/M - \text{AIC}_Y), \tag{6}$$

12. The efficient component-pricing rule may appear, therefore, to conflict with the result contributed by Peter Diamond and John Mirrlees, who assert that in a Ramsey solution it is inefficient for the price of any intermediate good to include any markup over marginal cost. Peter A. Diamond & John A. Mirrlees, *Optimal Taxation and Public Production, II: Tax Rules*, 61 AM. ECON. REV. 261 (1971). There is no such conflict here, however, since true marginal cost must include all of the (social) marginal opportunity cost. The contribution derived from the tenant by the landlord is simply part of the landlord's opportunity cost incurred in providing trackage space to the tenant; the contribution entails no Ramsey markup over that marginal cost. It should be noted, incidentally, that as is usual in discussions of Ramsey analysis, Diamond and Mirrlees do not consider cases of scale economies, so that the allocation of production among firms entails an interior maximum in the determination of which MC rather than AIC plays the key cost role.

13. It is easy to extend the analysis to the case where efficiency requires each railroad to carry part of the traffic, apportioned so that $\text{MC}_X = \text{MC}_Y$, where MC_X is the marginal cost to railroad X of carrying an additional unit (carload or ton) of freight over route segment BC.

or, substituting the value of T/M obtainable from Equation (5),

$$Y\text{'s profit} = N(P - \text{AIC} - P + \text{AIC} + \text{AIC}_X - \text{AIC}_Y)$$

$$= N(\text{AIC}_X - \text{AIC}_Y). \tag{7}$$

Thus, Y will profit by renting the trackage rights from X if and only if Y is the more efficient carrier, $\text{AIC}_Y < \text{AIC}_X$. Indeed, Y's profit will then equal the net resources that society saves by use of Y rather than X. Equation (7) also shows that, when the pricing of the trackage rights follows the efficient component-pricing rule, Y will lose money by acquiring those rights if it is the less efficient carrier. In sum, the rent-setting rule presented in Equation (1) optimally allocates the traffic between X and Y.[14] The same logic applies without modification to the pricing of access to the local telecommunications loop.

IV. The Efficient Component-Pricing Rule Applied to Telecommunications

The efficient component-pricing rule is applicable to a number of current and prospective regulatory and antitrust controversies in telecommunications. We now discuss some generic problems that are likely to be encountered in applying the rule to telecommunications situations, and we examine several specific cases in which the rule has been or is likely to be applied. Many of these problems were confronted in the pathbreaking antitrust case, *Clear Communications, Ltd. v. Telecom Corporation of New Zealand, Ltd.*[15] We believe the New Zealand experience will have considerable relevance to the American telecommunications arena as head-to-head competition between local exchange carriers emerges, particularly following the merger of Bell Atlantic and TCI. We therefore begin with a discussion of the New Zealand telecommunications arena.

14. Those who consider it inequitable for the landlord to be paid the full opportunity cost of its rental have referred to such pricing as a "perfect price squeeze." *See, e.g.*, WILLIAM B. TYE, THE THEORY OF CONTESTABLE MARKETS: APPLICATIONS TO REGULATORY AND ANTITRUST PROBLEMS IN THE RAIL INDUSTRY 65-69 (1990). Equation (7) shows, however, that the efficient component-pricing rule gives the tenant all the fruits of whatever superiority in efficiency it may provide.

15. Clear Communications, Ltd. v. Telecom Corp. of New Zealand, CP590/91, slip op. (H.C. Dec. 22, 1992) (available at the Yale Law Library) [hereinafter *Clear v. Telecom*], *rev'd*, C.A. 25-93, slip op. (C.A. Dec. 17, 1993) (available at the Yale Law Library). For an insightful discussion of the case written by Telecom's barrister in the litigation, see James Farmer, *Transformation from Protected Monopoly to Competition: The New Zealand Experiment*, 1 COMPETITION & CONSUMER L.J. 1 (1993).

A. *Competition in Local Telephony in New Zealand*

Telecom Corporation of New Zealand (Telecom) is the privatized descendant of the former telecommunications branch of the New Zealand Post Office. In September 1990, the New Zealand government sold Telecom to a consortium that included two American RBOCs, Bell Atlantic and Ameritech.[16] Unlike the American telephone market, where the RBOCs provide local exchange services but are prohibited from providing interLATA long-distance services, New Zealand has adopted no such restrictions. Telecom provides both local exchange and interexchange service throughout New Zealand. Until April 1, 1989, Telecom enjoyed a statutory monopoly in the provision of telecommunication network services. Since then, all telecommunications markets in New Zealand have been open to competition.[17] Telecom, however, still remains subject to certain regulations.

Telecom's articles of association provide for one "Kiwi Share," which is held by the Minister of Finance on behalf of the Crown.[18] The Kiwi Share creates a contract between the Kiwi Shareholder and Telecom whereby the latter is obligated to provide residential telephone service on specified (subsidized) terms, subject to the constraint that Telecom achieve overall profitability.[19] This duty to subsidize residential service is known as the Kiwi Share Obligation, or KSO. Under this subsidy arrangement, Telecom may not impose per-call charges on residential subscribers or increase their basic rental fee faster than increases in the cost-of-living index.[20]

In August 1990, a new company, later renamed Clear Communications, Ltd. (Clear), was formed to compete against Telecom. Clear was also a joint venture between New Zealand investors and two formidable telecommunications firms from North America—MCI Communications Corporation and BCE Incorporated, the holding company for the Bell Canada Group.[21] By October 1990, Clear had secured the requisite order under New Zealand law recognizing the firm as a network operator entitled to negotiate for interconnection to the public switching telecommunications network (PSTN) owned by Telecom.

Clear made impressive inroads against Telecom, capturing more than ten percent of toll revenues in New Zealand in less than eighteen months.[22] Clear began by offering bypass of toll services provided by Telecom. Soon after, it

16. *Clear v. Telecom*, slip op. at 4.

17. *Id.* at 5.

18. *Id.* at 26-27.

19. *Id.* at 27-28.

20. Farmer, *supra* note 15, at 16.

21. *Clear v. Telecom*, slip op. at 4-5. As part of the subsequent agreement between MCI and British Telecom (BT) to form a global strategic alliance, MCI sold its stake in Clear to BT. *See* Grahame Lynch, *MCI to Sell Clear Stake to BT in Global Alliance Deal*, EXCHANGE, June 18, 1993, *available in* LEXIS, Allnews Library, ZPC1 file.

22. Farmer, *supra* note 15, at 16.

began to compete in the provision of local telephone service to business customers in New Zealand's largest cities—Auckland, Wellington, and Christchurch.[23] Unlike Telecom, however, Clear did not have a Kiwi Share Obligation to provide subsidized residential service. A dispute then arose over whether the interconnection fee that Telecom proposed to charge Clear should include a contribution to Telecom's cost of providing this residential subsidy.

When Clear's negotiations with Telecom to interconnect Clear's proposed "Gateway" service to the PSTN broke down, Clear sued Telecom under New Zealand's antitrust statute, section 36 of the Commerce Act of 1986.[24] Clear argued that Telecom had violated section 36 in three principal respects: (1) by taking five months to respond to Clear's interconnection proposal; (2) by requiring anyone calling a Clear Gateway subscriber from the PSTN first to dial a three-digit access code, "023," which would not be necessary to call Telecom subscribers; and, most importantly in the view of the trial court, (3) by "charging too much for interconnection."[25]

The trial judge, Judge Ellis of the Wellington Registry of the High Court of New Zealand, recognized that the case presented an issue of first impression. How should access prices be set among overlapping local exchange carriers? The question had simply not arisen in the modern experience of telecommunications regulation because either technology or government monopoly had always precluded competition in local telephony. Judge Ellis wrote:

> The history of the negotiations and this dispute we will soon relate shows the polarisation of the parties on matters of economic principle. There are no guidelines for the parties provided by legislation or regulation. The mechanisms of negotiation have failed and only the strictures of the Commerce Act can advance the matter. After the parties reached deadlock in August 1991, Telecom decided to seek assistance from overseas economists with experience in the field where dominant firms are obliged to make their facilities available to would be competitors. However there were no identical situations that have exposed solutions. This is the first time that such

23. *Clear v. Telecom*, slip op. at 6.

24. *Id*. Section 36(1) of the Commerce Act provides:

> No person who has a dominant position in a market shall use that position for the purpose of (a) Restricting the entry of any person into that or any other market; or (b) Preventing or deterring any person from engaging in competitive conduct in that or in any other market; or (c) Eliminating any person from that or any other market.

Commerce Act, 1986, No. 5, § 36, 1986 N.Z. Stat. 71, 95.

25. *Clear v. Telecom*, slip op. at 8-9.

> a problem has fallen to be determined by a Court governed only by the general provisions of a competition statute.[26]

Much of the complexity of the pricing problem derived from the reciprocal need for access to the facilities of each firm in a network industry:

> In order to be able to offer a local service Clear needs to provide line access for each customer to its own switch, and a trunk from that to Telecom's switches. It needs to give customers the ability to make and receive calls not only within its own network but also to and from Telecom's PSTN. Clear must have an ubiquitous service, just as Telecom has now. Indeed once Clear has interconnected, Telecom will need access to Clear's network for it to continue to provide a ubiquitous service.[27]

To effect this interconnection, Clear proposed "first that there would be no number access code to get into or out of the two networks and second there would be no charge by either for access to the other's network, except to balance the volume of calls."[28] Telecom objected to this proposal, and Clear and Telecom's months of negotiations over mutually agreeable terms proved fruitless. Telecom then retained economists, including one of the authors, to recommend an efficient pricing regime. On the basis of those recommendations, Telecom's final offer to Clear and Clear's response to it, as summarized by Judge Ellis, were the following:

> Telecom now accepts that:
>
> > (1) As regards the access charge, Telecom will be entitled to the equivalent of a monthly line rental at business rates less any saving in its average incremental cost because Clear puts in the equivalent of the loop to Telecom's switch. This is known as the access levy which is foregone;
> >
> > (2) As regards the traffic charge, in respect of a call into the Clear network, it claims to be entitled to be paid that part of Telecom's cost saved by Clear carrying the call part of the way. Conversely it is entitled to charge Clear for the whole of calls entering the Telecom network at its

26. *Id.* at 10-11.
27. *Id.* at 13.
28. *Id.* at 30.

> business rates less that part of Telecom's cost saved by Clear carrying the call part of the way.
>
> (3) Telecom claims that Clear should meet the cost of the link constructed by Telecom between the Clear and the Telecom switches ("the bridge") at Telecom's incremental cost.
>
> Telecom accepts the necessary periodic adjustments. It accepts that when Clear's local network is "big enough" there will be reciprocity in the access levy to each competitor's network.

> This is intended to be an application of the Baumol-Willig model [for efficient component-pricing] . . . . Clear does not accept the model but we understand agrees with the consequences of its adoption. Clear's final position is that there should be no access levy; the KSO [to provide subsidized residential service] should be borne by Telecom alone; the cost of the bridge should be shared equally; and there should be either a free exchange of calls or alternatively a settlements regime.[29]

The above statement reflects the parties' final positions when Judge Ellis considered whether Telecom's behavior constituted an anticompetitive use of a dominant market position.

After a lengthy analysis of the efficient component-pricing rule and Clear's criticisms lodged against it, Judge Ellis embraced the rule as the appropriate legal standard to guide the pricing obligations imposed on a monopolist that sells inputs to competitors. He wrote that "failure to use a pricing rule that charges for access to Telecom's network, that charges for the incremental cost imposed on Telecom, that shares the KSO would . . . foster the development of uneconomic bypass and the proliferation of uneconomic operators."[30] He elaborated:

> In the end it is our judgment that implementation of the Rule is more likely than the alternative to improve efficient competition in New Zealand telecommunications. In that case, Telecom cannot be said to be using its position of dominance for the purpose of preventing or deterring Clear from engaging in competitive conduct

29. *Id.* at 49-50. Professor Robert D. Willig was co-author, with one of the authors, of the economists' affidavit mentioned by Judge Ellis. Dr. Alfred E. Kahn submitted complementary expert testimony describing the "principle of competitive parity." *Id.* at 69-70.

30. *Id.* at 95.

> in the New Zealand telecommunications market. If the defendant's conduct is more likely than not, in light of the available alternatives, to improve competition, the defendant cannot be said to be in breach of the purpose requirements of [section] 36. There is an improvement in competition when there is an enhancement of an efficient competitive process.[31]

Consequently, Judge Ellis held that "Telecom was up until its final stance at trial in breach of [section] 36 in that it asked too much for connection to the local loop." Having concluded this, the New Zealand court accepted the efficient component-pricing rule as the correct antitrust standard for assessing the legality of the pricing of inputs sold to competitors.[32]

The Court of Appeal of New Zealand, however, reversed the judgment of the High Court on the grounds that it would violate section 36 of the Commerce Act for Telecom to include its forgone monopoly profit in the opportunity-cost component of the access charge paid by Clear. Justice Gault of the Court of Appeals wrote:

> The reason I have rejected the opportunity cost method of pricing in the circumstances of this case is that it does not exclude monopoly profits. That reason does not dictate that no access charge could be levied to recover a contribution to the claimed cross-subsidy [for residential customers] or otherwise to contribute to the fixed costs of the Telecom network.[33]

This conclusion is placed in context when read alongside the observation of Justice Cooke in his concurring opinion:

> It is important, I think, to appreciate that the theory [of efficient component pricing] has been developed primarily for a country of regulated markets where prices for ultimate consumers may be controlled by regulatory agencies. That is not the present situation in New Zealand: the system is one of "light-handed" regulation, the Commerce Act and competition being relied upon to provide built-in safeguards against consumer exploitation.[34]

---

31. *Id.* at 95-96.
32. *Id.* at 100.
33. Clear Communications, Ltd. v. Telecom Corp. of New Zealand, C.A. 25-93, slip op. at 42 (C.A. Dec. 17, 1993) (Gault, J.).
34. *Id.* at 4 (Cooke, J.).

Given these circumstances, we must sympathize with the reasoning of the Court of Appeal. As we explain elsewhere, the efficient component-pricing rule plays its full beneficial role only when adopted as part of a set of complementary rules designed to promote consumer welfare.[35] One such rule is that a monopolist should not be permitted to charge a price for a final product sold to consumers that is higher than the price that would attract an efficient entrant into that market—a price equal to the stand-alone cost of producing that final product.[36] But, as Justice Cooke noted, no such price ceiling exists under the current laws and regulations of New Zealand. It is therefore understandable that the Court of Appeal ordered Clear and Telecom to renew negotiations to set an access price that excluded any monopoly profit forgone by Telecom.

The input-pricing problem addressed in *Clear v. Telecom* is likely to arise in the United States in a number of telecommunications situations. The intraLATA market is one arena that we have already mentioned. Another is the local exchange itself, access to which will be sought by competing access providers and even overlapping local exchange carriers (fashioned perhaps from cable television systems, as the failed merger of Bell Atlantic and TCI would have done). The program-access provisions of the Cable Television Consumer Protection and Competition Act of 1992, which require vertically integrated cable operators to make programming available on a nondiscriminatory basis to other multichannel video distributors, also invite use of the efficient-component pricing rule.[37]

B. *Controversial Components of Opportunity Cost*

1. *Loss of Monopoly Markup*

The decision of the Court of Appeal of New Zealand illustrates a frequent objection to the efficient component-pricing rule. The complaint is that the rule is a means of ensuring that the landlord can continue receiving any monopoly profits it has been able to earn on the final product. Suppose that, in the absence of the tenant, the landlord has monopoly power in the final-product market and earns a high rate of profit on sales. If, by supplying the input to the tenant, the landlord permits the tenant to take away some of those profitable sales, then the monopoly profit on those forgone final-product sales is indeed an opportunity cost to the landlord. According to the efficient component-pricing rule, the tenant should be required to compensate the landlord for that

35. BAUMOL & SIDAK, *supra* note 8, at 140-41.

36. *Id.* at 77-85.

37. Pub. L. No. 102-385, § 19, 106 Stat. 1460, 1494-97 (1992) (codified at 47 U.S.C. § 548); *see also* Implementation of Sections 12 and 19 of the Cable Television Consumer Protection and Competition Act of 1992, First Report and Order, MM Dkt. No. 92-265, 8 F.C.C. Rec. 3359 (1993).

loss. This ensures the monopoly earnings of the landlord. It also undercuts the tenant's power to introduce effective competition into the final-product market and, thereby, its ability to reduce prices to their competitive levels.

All this is true, but the villain is not the efficient component-pricing rule. The real problem is that the landlord has been permitted to charge monopoly prices for the final product in the first place. Had the ceiling upon final-product prices been based on stand-alone cost, which as we explain elsewhere it should be,[38] the landlord could never have earned a monopoly profit in this regulatory scenario. The error, therefore, is the failure to impose the stand-alone cost ceiling on the final-product price, not the use of the efficient component-pricing rule.

2. *Special-Service Obligations*

A related issue arises when a regulated firm has special-service obligations imposed upon it. Examples include arrangements in which the input supplier is also forced to serve as the "carrier of last resort," or when, as in the case of *Clear v. Telecom,* the carrier is required to supply services to residential customers at rates that it claims to be insufficient to cover the pertinent incremental costs. These obligations are appropriately treated as sources of common fixed costs for the firm; the costs must be covered legitimately by the firm's prices and be taken into account in calculating its stand-alone cost ceilings.

In such a situation, the hypothetical entrant, whose costs constitute the stand-alone cost ceiling, should have imposed upon it the same special-service obligations as those borne by the incumbent. To do otherwise is to condemn the regulated firm to operating losses. In any competitive market equilibrium where costs are imposed by fiat upon all firms and prospective entrants, prices will have to cover those costs in addition to any other costs of the efficient suppliers. In that case, the opportunity cost of supplying an input to a competitor must also include any forgone contribution to coverage of the costs of special-service obligations imposed by regulators. If those costs are imposed on only one firm, with current rivals and entrants exempted, a special handicap is clearly borne by that firm and competition will prevent it from recovering those costs.

38. BAUMOL & SIDAK, *supra* note 8, at 77-85.

C. *Network Externalities and Demand Complementarities*

The preceding discussion should not be interpreted to imply that when access provided by an LEC to an IXC leads to the sale of an additional *X* message minutes of business by the IXC along a given intraLATA route, the result will necessarily be an equal loss of business by the LEC. For simplicity of exposition, we have used in the preceding text the case of the zero-sum game—whatever business an entrant gains is business lost by the incumbent. In practice, markets do not necessarily work that way. Entrants are known to beat the bushes for customers who were not previous users of the product in question. Moreover, there is evidence indicating that the two-way nature of telecommunications produces a beneficial network externality: an individual consumer's demand for use of the network increases with the number of other users on the network.[39] Thus, if the entrant brings in some new customers, it can also stimulate additional demand for the incumbent's services. In addition to the network externalities, the LEC's supply of access to a competitor might stimulate demand for the LEC's final product if there is complementarity of the two demands associated with the volume of traffic. For example, more household traffic can stimulate business telephone usage.[40]

Thus, an entering IXC is likely to devote effort to expanding the market, using the access to serve at least some new business that entails no reduction in LEC volume, and may even bring a bit of additional traffic to the LEC. In that case, the pertinent opportunity cost to the LEC of the supply of access will be lower than if the added IXC volume is added directly and fully at the expense of LEC sales. The pertinent opportunity cost figure is the contribution actually forgone by the LEC, not the contribution it would have lost if all of the IXC's gain had come at the LEC's expense.

D. *Explicit Access Charges to the IXC and Implicit Access Charges of the LEC to Itself*

The efficient component-pricing rule has two important applications to the regulation of local telephone service. First, it tells us what price is appropriate for the LEC to charge the IXCs for access service. More generally, it indicates

39. *See, e.g.*, BRIDGER M. MITCHELL & INGO VOGELSANG, TELECOMMUNICATIONS PRICING: THEORY AND PRACTICE 11 (1991); JEAN TIROLE, THE THEORY OF INDUSTRIAL ORGANIZATIONS 405 (1988). Usually, we think of the network externality in telecommunications accruing when another access line or another node (exchange) is added to the network. "When a new node is added, the externality is reflected in the number of calls made between any existing nodes and the new node (not an increase in the calls between existing nodes)." MITCHELL & VOGELSANG, *supra*, at 11.

40. For a thorough theoretical and empirical discussion of such complementarity effects in telecommunications demand, see LESTER D. TAYLOR, TELECOMMUNICATIONS DEMAND IN THEORY AND PRACTICE 23-24, 221-40 (1994).

the price that any other competitor of the LEC should pay to obtain access to the local loop. Second, the analysis underlying the rule indicates how the LEC should price the final product, intraLATA toll service, when selling that product to consumers. As we see next, the LEC's production of that service also entails an opportunity cost for itself. Hence, the price of that final product must at least equal its average-incremental cost, including the pertinent opportunity cost.

The opportunity cost to the LEC of the LEC's own final-product sales is determined by the price the LEC charges IXCs for access—a price governed by the efficient component-pricing rule. The LEC, in effect, must choose between supplying access to the final consumer directly or selling the access to an IXC, which would provide the final product—intraLATA toll service—to that same consumer. Either action requires that the other sale be forgone. The sale of the final product by the LEC to a telecommunications consumer enables the LEC to supply the final product—but it could otherwise have been provided by an IXC, which would have had to purchase access service from the LEC. Thus, the sale of the final product by the LEC entails a forgone access profit. The magnitude of this forgone profit, or opportunity cost, is determined by the price of the sale of access to the IXC, as governed by the efficient component-pricing rule. But, we have proved earlier in this Essay that when the access price follows the efficient component-pricing rule, the LEC must receive exactly the same profit, whether it uses the access service itself or sells it to an IXC. That is the parity principle that enables the more efficient supplier to win out.

The objective of the efficient component-pricing rule is, as the commonly used cliché describes, to ensure a "level playing field" for the competitive efforts of the IXCs and the LEC. When access, priced by the rule, is used by either an LEC or an IXC to provide the final product to consumers, it will still be possible for one of the suppliers to undercut the final-product price of the other, but only if that supplier is the more efficient provider. This is because the more efficient supplier will incur lower direct incremental costs, even though its final-product prices are not allowed to contribute less profit to the supply of access. By ensuring that the implicit price of access by the LEC to itself and the explicit price to the IXC are the same, the playing field in the sale of final-product telecommunications services is truly level.

Use of the optimal component-pricing rule has sometimes been complicated in practice. Institutional arrangements can create an artificial asymmetry between the contribution forgone by the supplier of the inputs when it sacrifices sales of the final product and the contribution forgone when it sacrifices sales of the input for the final product. In one case, the local telephone company is constrained, by a combination of past practice and regulation, to use one set of facilities, *A*, in supplying access to the interexchange carriers, and another set of facilities, *B*, in supplying interconnection for its own toll calls into the local loop. Under current pricing arrangements, the LEC receives a larger contribution from a message using *B* than from one employing *A*. Consequently, the opportunity cost when the LEC provides interconnection to itself instead of an IXC is different from the opportunity cost incurred when the LEC supplies interconnection to the IXC rather than itself. In this case, the supply of interconnection for an IXC call, which is presumed to deprive the local exchange carrier of the final-product business, entails a larger opportunity cost than does the opposite process—namely, the use of the facilities by the LEC to provide the final product to its own customers.

The danger with asymmetries of opportunity costs is that the LEC may try to bias market conditions in its own favor, charging the IXC more for interconnection to the local loop than it implicitly charges itself for the same service. The problem lies not in recognizing the appropriate role of opportunity cost in pricing, but in developing a pricing arrangement that yields different profits to two different processes for supplying the same service. Clearly, that outcome violates the dictates of the competitive-market standard, which would soon bring profits from the use of the *A* access facilities into line with those from the *B* interconnection facilities. In a fully competitive market, either entry would quickly erode the profits from the more lucrative facilities toward the level of profits offered by the other facilities, or the less profitable facilities would soon be abandoned.

Thus, where this situation of asymmetric opportunity costs arises, the regulator should require, or at least provide, strong incentives for equalization of the contributions offered by the two sets of facilities. This problem is no reason to abandon the efficient component-pricing rule or to acquiesce to biasing input pricing in favor of one party.

E. *Marginal and Inframarginal Opportunity Cost*

Opportunity costs can involve subtle but important technical complications in certain situations. For instance, total opportunity costs, even though substantial, can be close to zero at the margin. However, in other instances, the marginal opportunity cost of the sale or lease of some good or service can clearly be positive if the item is limited in supply or entails some fixed capacity, so that the more the seller supplies to others, the less it has available for its own use.

A firm that lets others use a bridge whose capacity was already fully employed to transport its own products obviously is apt to incur an opportunity cost even when it permits just one additional person to cross. But if an LEC can easily expand the facilities it uses to provide access, then its sale of access to others is not affected by any such capacity limitation. In general, if a product supplier can expand capacity and is prepared to do so until the marginal profit of further additions to capacity is zero, then no corresponding marginal opportunity cost in the sale of the product will arise from a resulting unavailability of capacity to the seller.

The same can be true of an opportunity cost that arises when the recipient of access (or some other input) uses it to take profitable business away from the input supplier. If a firm is a profit-maximizer, then each of its activities will be carried to the point where it yields zero economic profit at the margin. Thus, the opportunity cost of losing the marginal unit of any product of one of its activities can be expected to disappear. This observation has been used to argue that while price floors for final products as well as the optimal input prices should all include opportunity costs, if any, in practice this can often be ignored because marginal opportunity costs are frequently zero.

This argument is misleading, however, because it fails to consider the pertinent margin. If the price of access is set so low that an IXC can take away a high proportion of the sales of intraLATA long-distance service by the LEC, then much more than the zero-profit marginal unit of the LEC's original sales volume will be lost. That is, the IXC is virtually certain to wrest away a substantial increment of the LEC's business, not just a single marginal unit. Then, the remaining business will likely entail more than a zero marginal profit, because output will have been cut from the precompetition profit-maximizing level. Hence, a substantial opportunity cost can be borne by the LEC on the margin if, having permitted substantial incursions into its business by an IXC, it permits the IXC to sell still another unit of the product at the new output level.

Scale economies present yet another reason why the opportunity cost incurred by supplying access to a rival cannot be ignored. These costs can substantially affect the efficient price for use of that input. As has been shown, where production of the particular commodity is characterized by scale economies, average-incremental cost replaces marginal cost as the pertinent standard for final-product prices consistent with efficiency in production. Efficiency in production then requires that where the product is characterized by declining average-incremental cost, the price must be set no lower than average-incremental cost.

The role of average-incremental cost in regulating the price of a homogeneous service is pertinent to the issue just discussed—the role of opportunity cost in determining the efficient price. We have just noted that sometimes, particularly when opportunity cost is not created by capacity limitations, marginal opportunity cost can be driven to zero. This is possible when the supplier of the facility can expand capacity to the point that enables him to use as much as he wants for his own purposes and to sell or lease as much capacity to others as he desires. But in such a case, even though marginal opportunity cost may be zero because capacity will be expanded by a profit-maximizing firm to the point where the enterprise gains nothing by adding yet another unit, it does not follow that the opportunity cost on inframarginal units of capacity will also be zero. If inframarginal units do yield positive benefits to the owner when used for his own purposes, and if some substantial proportion of that capacity is nevertheless rented or sold to someone else, then that transaction will clearly entail a nonzero opportunity cost—the sum of the forgone inframarginal benefits. That is, the average-incremental opportunity cost will be positive; the efficient price, which should at least equal AIC, must cover the nonzero opportunity-cost component as well.

F. *Entry by Efficient Rivals*

A final word is necessary on the pertinence of the efficient component-pricing rule to the opportunity for entry. In a competitive market, an incumbent will levy an access charge on a new entrant that will cover both the direct incremental cost of providing the access and its opportunity cost. As we have seen, the latter represents the contribution of the access-using service either toward meeting a shortfall in the price of another service or toward recovery of the common fixed costs of supplying some or all of the incumbent's services. An access charge large enough for these purposes may at first glance seem to constitute an inappropriate competitive disadvantage to the entrant, since it requires the entrant to make such a contribution even though the incumbent may not be performing these activities efficiently, and the entrant itself may have to undertake similar activities to support its own services. Closer inspection, however, confirms that these impressions are mistaken.

As has been shown, the efficient component-pricing rule offers the prospect of success to entrants who can add efficiency to the supply of the final product, while it ensures that inefficient entrants are not made profitable by an implicit cross-subsidy extracted from the incumbent. An entrant may have to replicate some of the incumbent's activities or facilities, and the costs of such duplication can render an entrant unprofitable. But if that is the case under efficient component-pricing, then the requisite replication of costs correspondingly renders the entry inefficient and, ultimately, harmful to consumers and to society. This is exactly what occurs in an ideally competitive or contestable market. After all, one of the chief benefits of competitive markets is their intolerance of inefficient supply arrangements. Input pricing that discourages inefficient entry cannot be said to constitute an undue competitive disadvantage, any more than the efficient workings of competitive markets can be labeled anticompetitive, even if they lead to the demise of less efficient firms.

Conclusion

As technological innovation and regulatory reform cause entry barriers to fall in the telecommunications industry, competing firms are seeking to interconnect to the telecommunications network at a greater number of locations than in the past. At each such interconnection, an access price will have to be determined. To borrow a current metaphor, the challenge for public policy is to set the socially optimal toll for any given on-ramp or interchange along the interstate highway system. Furthermore, because the telecommunications network—unlike the interstate highway system—is unlikely to be publicly owned, regulators must ensure that access prices enable the incumbent firm to remain financially solvent. The price of access, in other words, must cover not only the incumbent's incremental cost of providing access, but also the opportunity cost that such provision of access implies for the incumbent's ability to cover its common fixed costs, including its regulatory obligations to provide universal service. We have proposed here a solution for the regulators and legislators who have just begun to confront these questions.

In this Essay, we have described the efficient component-pricing rule for the pricing of access or any other input used both by the input producer and by competitors in supplying final products. Using a railroad analogy, we showed how the optimal rental fee for access to a monopolist's tracks is the sum of the direct incremental cost of permitting the tenant railroad to use the tracks and the opportunity cost to the landlord railroad of supplying this downstream competitor with access to those tracks. The trackage-rights problem is perfectly analogous to the LEC's supply of access to IXCs, and to myriad situations in network industries in which one firm produces an intermediate good—access to the network—that constitutes a necessary input for its competitors in the market for the final product sold to consumers.

The efficient component-pricing rule is applicable generally. The rule always assigns the supplier's task to the firm that can do it most efficiently. A price lower than one set in accordance with the rule—as seems often to have happened under regulatory decisions on the division of profit between the input producer and the final-product supplier—always constitutes an interfirm cross-subsidy and so invites the assumption of the supplier's role by a firm that is not the most efficient provider. This result should not come as a surprise. It is well known that economic forces set component prices in competitive markets in this way, and competitive market prices are generally those necessary to achieve economic efficiency. Thus, our efficiency result also follows immediately through this indirect route, using the competitive-market standard as the guide to efficient pricing.