“Access Pricing, Stranded Assets and Peak Loads”

95-11-06

Michael Crew and Paul Kleindorfer
Draft

Access Pricing, Stranded Assets and Peak Loads

Michael A. Crew¹
Paul R. Kleindorfer²

November 1, 1995

Over the last decade a number of major changes have taken place in network industries. Telecommunications, gas, postal service and, more recently, electricity are all facing increasing competition. As these industries are vertically integrated, competition may occur at any stage, but not necessarily at all stages, of the production process. Indeed, competition usually does not take place horizontally but occurs at only one stage of the production process. As these industries still have at least some vestiges of natural monopoly, the problem of pricing inputs, particularly the pricing of access to bottleneck facilities, is of major importance. While a number of approaches can be employed to deal with this problem in regulated industries, an approach called "efficient component pricing" (ECP)³ appears to be the leading contender at least in terms of practical applications. ECP has entered the realm of practice, both in the U. S. and elsewhere. Internationally, ECP has recently been given a major boost in the form of approval by the Law Lords in the case of New Zealand Telecom.⁴

¹ Professor of Economics, Graduate School of Management, Rutgers University, Newark, NJ, 07102.


³ It is also known as "the parity principle". However, we will refer to it as ECP.

⁴ While not binding on the U.S. Courts, the imprimatur of such an august form is a distinct boost to ECP's applications.
Given the growing acceptance of ECP, at least in practice, in this paper we examine the nature of ECP and assess its impact. We argue that the issue of access pricing is more complicated than envisaged by ECP, that ECP is "efficient" under a narrower set of conditions than envisaged by its proponents, and that some of the strong claims made for ECP cannot be sustained, especially in the presence of peak loads and diverse technology. This is particularly apparent in the case of the so-called "stranded investment" problem.\footnote{We will discuss the nature of the stranded investment or stranded costs problem at greater length later in the paper. For the moment we can think of stranded investments as being those inputs whose cost the incumbent cannot recover in the event of competitive entry.} We examine some alternative approaches and argue against the widespread adoption of ECP.

Section 1 examines a simple case of ECP drawing primarily from the approach taken by Baumol and Sidak (1994). The purpose of this section is to provide a brief review of ECP as a benchmark for the developments that follow. Section 2 provides a critique of ECP and a more general discussion of access pricing, including the objectives of an efficient access pricing policy. Such a pricing policy takes into consideration many issues not addressed in ECP, including peak-load effects, information asymmetries and dynamic aspects. Some of these issues are explored in Section 3 which includes a simple two-technology model which examines the implications of ECP for efficiency on competitive entry when stranded investments and peak loads are present. While this is a simple model, it does enable us to examine the problems of access pricing in conditions of disequilibrium and it shows the weakness of ECP in resolving such issues. Section 4 considers some possible applications and implications for policy. We argue that the proper approach to recovery of stranded investments will differ according to the nature of the industry. We conclude with a discussion of alternative approaches to the problem.

1. Brief Review of Efficient Component Pricing
Local telephone companies, gas companies, electric utilities and postal services possess inputs to which competitors must have access if they are to supply output to final consumers. Setting appropriate prices for such inputs is a significant problem to which ECP purports to offer a practical answer which is readily implemented in the real world. Perhaps the clearest statement of ECP is provided by Baumol and Sidak (1994). Accordingly in our review of ECP we will refer extensively to their treatment.

While we will briefly address the issue of dynamic efficiency in the context of ECP, we are going to concentrate on its static efficiency properties which also have been addressed by others.\(^6\) In simple terms the theme underlying our approach is that ECP is efficient if the status quo itself is efficient. Since the status quo is unlikely to be efficient in precisely those regulatory settings to which ECP is intended to apply, this makes it a much less valuable tool than might be understood from arguments by its proponents.

We are not the first to argue that ECP does not have the efficiency properties claimed by its proponents. Others have argued at length, notably Tye (1994), that static efficiency is not necessarily the outcome of employing ECP. He argues: "There is no substitute for careful assessment of the regulatory goals and institutional circumstances on a case-by-case basis to determine the economically efficient approach for pricing competitive access" (1994, p224). While we consider the details of Tye's arguments beyond the scope of this paper, we think that his conclusion has considerable merit and we will examine ECP in the light of his conclusions. If ECP, as proposed by Baumol and Sidak, does not provide a basis for access pricing, are we left only with the case-by-case approach of Tye? While we believe that Tye is correct in his criticism of ECP, we find his position is somewhat pessimistic. However, in

---

\(^6\) We do not challenge the ostensible objective of ECP, namely to promote static efficiency in the pricing of inputs sold to competitors. It should be noted that Baumol and Sidak make no claims as to the benefits of ECP in promoting dynamic efficiency.
this paper, we do not offer the comprehensive articulation of principle that would ideally replace his case-by-case recommendation. In general, we believe that the issues of regulated competition require continuing oversight and that simple formulae, including those embodied in ECP, are not likely to provide an adequate replacement for the adversarial, if not objective, review provided by the normal regulatory process.

We will start by reviewing very briefly the approach to ECP as articulated by Baumol and Sidak. ECP is intended to address a problem where Company A supplies commodity X where X consists of two commodities y and z. Company B competes with A in the provision of z but can only produce X if he buys y from A. A has a monopoly in y. A competitive market exists in X. ECP provides a price to charge B for y so that he can supply X. Baumol and Sidak argue that ECP will result in a price that makes A indifferent between supplying X himself or having B supply it. This is achieved by charging B A's incremental cost of y plus the opportunity cost to A resulting from the sale of y. (This is the same as charging B the selling price of X less A's incremental cost of z.) Baumol and Sidak produce a very simple example which illustrates their approach clearly. Suppose the competitive price of X is $10 and A's incremental costs of y and z are $3 each, providing a net contribution of $4 from selling X. Thus, under ECP, A would charge B $7 for y (i.e. its incremental costs plus the lost contribution, making A indifferent whether or not it sells X or B does). B would be able to make a contribution from selling X only if his incremental cost of producing z is less than 3, viz. A's incremental cost of z. Thus B is only able to compete for the supply of X if he is more efficient than A in the production of z, the input they both produce. Stated very briefly this is Baumol and Sidak's argument for the efficiency of ECP.

---

7 Baumol and Sidak use an example of two railroads with one of them having a monopoly over part of the route system. The problem is what price should the rival railroad pay for use of the route where the other railroad has a monopoly.
investments". Because of the longevity of much of the investment in network industries and the long capital recovery schedules, the entry of competitors may leave some of the incumbent's existing plant underutilized and with a very much reduced prospect of recovering its capital. Paying for this stranded investment is built into existing regulated rates particularly for electric utilities. For postal service, at least in the U.S., there is much less of a problem of stranded investment. It is more of an issue of "stranded labor". The high wages paid by the U.S. Postal Service would be under obvious threat in the event of meaningful competition. ECP has been sold effectively as a relatively transparent means of not only addressing the access problem but also resolving the stranded investment problem by leading regulatory economists including Baumol and Kahn. Such considerations make ECP the leading contender as a mechanism for pricing access. It is by no means clear that this rush to embrace ECP is justified in view of some major unresolved issues in the pricing of access for which ECP offers minimal assistance. The main advantage of ECP is that it is conceptually simple and ostensibly transparent.

In this section we continue our critique of ECP plus a general discussion of the desirable features of a system of access charging. The purpose of this section is to review briefly the objectives and characteristics of an efficient access pricing system with a view to introducing our peak load pricing model developed in section 3. We will not pursue the matter at length as others, notably, Laffont and Tirole (1990a, 1990b, 1994) and Armstrong, Cowan and Vickers (1994), have examined such issues in detail.

The underlying objective of our approach to access pricing is the promotion of entry by efficient competitors. As such, it is ostensibly no different from that claimed

---

9 Stranded investment occur in some cases because of the long depreciation lives provided under cost-of-service regulation. In Crew and Kleindorfer (1992), we analyzed this problem and argued for economic or front-loaded depreciation in telecommunications.

10 See Kahn (1994) for a discussion.
We do not dispute that for this situation ECP could result in an efficient price. However, a situation like this is rare if not impossible. The market for X is assumed to be competitive but there is a monopoly in y which is an input for X. The more likely situation is that A has a monopoly on X as well as y. In these situations ECP is of little or no help. All it would achieve would be to maintain the monopoly profit on the input sold to competitors as well as on the final product. If ECP is the default option, negotiation between the parties in such situations, as Tye (1994) argues, will result in A holding up B, with ECP potentially legitimating the process of doing so. According to Tye the regulator has to offer protection to B in such a case. Each case, he argues, has to be judged on its merits and be subject to regulatory supervision. We would argue the need for some underlying principles to avoid such a case-by-case approach. However, we do agree with Tye that ECP does not provide the underlying principles required. Indeed, if the price of X were determined under regulatory supervision, as is currently the case where competitors enter the business of traditional utilities, ECP provides an opportunity for the incumbent to maintain the status quo. As such it could be potentially damaging to dynamic efficiency in that it provides comfort and encouragement to incumbents to erect barriers to competitors rather than concentrating on improving their internal efficiency.

2. Some Features of Efficient Access Pricing and ECP

The theoretical problems of access pricing, while non-trivial, pale into insignificance compared to the practical problems of access pricing. These problems are made more complicated because of the existence of a very important predicament now currently facing incumbents and regulators - the problem of so called "stranded

---

\(^3\) For an extensive discussion of such issues see Pechman (1993).
for ECP by Baumol and Sidak, namely:

"The rule always assigns the supplier's task to the firm that can do it most efficiently." (1994, p139)

While this statement may be formally correct, its value is questionable as argued, for example, by Laffont and Tirole (1994), in their essay on access pricing. Laffont and Tirole show that in the case of perfect substitutes the solution is bang bang in that if the entrant B, described in the example in section 1, can supply z for less than 3 and the incumbent has an incremental cost of 3 for supplying z then efficiency would require that the incumbent should supply only access. Similarly, if the entrant has costs in excess of 3 no access should be supplied to him. Relaxing the assumption of perfect substitutes makes the problem more complicated for a number of reasons which we will now examine along with other problems of ECP.

One of the problems ignored by ECP is asymmetric information, which is examined at length by Laffont and Tirole (1994). ECP does nothing to remedy the major information advantage of the incumbent over the entrant. Rather, it enhances the information advantages of the incumbent, as can be seen from the following:

"The efficient component pricing rule states simply that the price for an input should equal its average-incremental cost, including all pertinent incremental opportunity costs." Baumol and Sidak (1994, p118)

The price charged would include the profit foregone if the incumbent had supplied the entire product under the status quo. ECP then gives the incumbent almost carte blanche to determine the profit he receives. It provides no mechanism for countering the information asymmetries of the incumbent let alone any incentives for truthful revelation of costs which is a major issue of concern to Laffont and Tirole (1994). In the simple example of section 1 the incumbent would have every incentive to argue that his marginal costs of supplying z are very small. To give further examples, a post office could boost the price it charges for local delivery by arguing that the upstream costs, such as transportation and sorting, are very low. Similarly, an electric utility would argue that its incremental costs of generation are low in determining either the rate it pays an independent generator to buy its power or the
rate it charges an independent generator for access to its system. Resort to opportunity cost arguments along the lines of ECP does nothing to prevent the incumbent from revealing an amount that provides him with the largest expected profit.

The ECP approach has the effect of preserving the status quo in that it provides, according to Baumol and Sidak, the incumbent with the same (or larger) return whether he supplies the product or not. Moreover, arguments for it are based upon the notions of static efficiency. As such it has a minimal contribution to markets that are not in long equilibrium and is particularly unsuited to the emerging markets that are appearing in electricity, postal, gas and telecommunications. With changing technologies in both hardware and regulatory mechanisms, there has been recognition that the benefits of vigorous competition exceed the benefits provided by regulated monopoly. The problem in dynamic efficiency is that of getting from the current situation of regulated monopoly to a situation of vigorous competition. In this case policies that impede entry and innovation are going to slow, if not stall, the movement to competition.

Another difficulty about ECP as presently presented is its weakness in addressing the peak-load problem that is present in all network industries. This is a major problem as we shall see in section 3 where we develop a simple model of access pricing under peak loads. Although this model is static, it does enables us to begin to consider some of issues affecting dynamic efficiency.

3. Entry with Peak Loads and Diverse Technology

In this section, we consider a traditional 2-period peak-load model, with periods of equal length and with independent demands given by \( D_t(P_t), \ t = 1,2 \). We assume two classes of economic agents, an incumbent and entrant(s). The incumbent \( I \) operates with a technology with unit variable costs \( b_t \) and unit capacity costs \( \beta_t \).

\[^{11}\] See the deterministic peak-load pricing model in Crew and Kleindorfer (1986).
Entrants $E$ operate with a technology with unit variable costs $b_E$ and unit capacity costs $\beta_E$. We will make a number of assumptions on the relationship between incumbent and entrant cost structures and examine some of the applications for efficient access pricing. We consider three possible technological conditions under which entry could be efficient:

**Case 1: Entrant has an efficient peak technology**

\[
b_I < b_E; \quad \beta_I < \beta_E; \quad b_E + \beta_E < b_I + \beta_I \tag{1}\]

Note that if $b_E + \beta_E \geq b_I + \beta_I$, then $I$ is more efficient in expanding capacity to meet peak demand than is $E$ (i.e., providing a level of unit of output for one period). Thus, no entry would occur if the final inequality in (1) were violated.

**Case 2: Entrant has an efficient base-load technology**

\[
b_E < b_I; \quad \beta_E > \beta_I; \quad 2b_E + \beta_E < 2b_I + \beta_I \tag{2}\]

Note that if $2b_E + \beta_E \geq 2b_I + \beta_I$, then $I$ is more efficient in meeting base load demand (i.e., providing a level output for both periods) than is $E$. Since $b_E < b_I$, $2b_E + \beta_E \geq 2b_I + \beta_I$ also implies $b_E + \beta_E \geq b_I + \beta_I$ so that $I$ would also be more efficient in meeting peak demand. Clearly, if the final inequality in (2) is violated, no entry can occur.

**Case 3: Entrant has a dominating technology**

\[
b_E < b_I; \quad \beta_E < \beta_I \tag{3}\]

In this final case, we see that $E$ has a dominating technology. Clearly, $I$'s technology would not be used at all if $E$'s technology were known to be available. In the problems we examine below, however, we assume that $I$ makes capacity choices
before E's technology is available. Thus, case 3 is quite possible.

We begin our analysis by summarizing well known results for Welfare Optimal (WO) pricing. The WO solution ignores stranded investment and breakeven constraints (or assumes that these are covered via lump-sum non-distorting transfer payments to the incumbent and the entrant as necessary). Thereafter, we consider various versions of Efficient Components Pricing (ECP). Under ECP, the entrant is charged an entry fee. We show that there are several possible interpretations of ECP, some more efficient than others. There is the Stranded Ramsey Optimal or Very Efficient Components Pricing (VECP) regime, which is the welfare maximizing solution subject to the constraint of committed incumbent stranded investment and breakeven operations for both incumbent and entrant. There are a number of variations of ECP favoring the incumbent, for example, Opportunistic Efficient Components Pricing (OECP), under which the incumbent is maximizes profits in a von Stackelberg leader position recognizing the entrants decision rule for setting capacity given the ECP charge formula. A number of other intermediate ECP possibilities may be examined. The characterizing feature of all these cases is that revenues for the incumbent are collected both from customers and from the entrant via the ECP charge on entrant's capacity.

Let $P_t$, $t = 1, 2$, be the time indices for periods 1 and 2, where we take $t=1$ to be the peak period, so that demands are assumed to satisfy:

$$D_1(P) > D_2(P), \quad \forall P > 0.$$  

Let $P_t(x)$ be the inverse demand curve in period $t$ so that $D_t(P_t(x)) = x$. We assume the standard welfare function of the sum of consumer and producer surpluses (see below). The welfare-optimal solution is obtained from the following problem:
Welfare Optimal Solution (WO)

Maximize \( W(P, q_I, q_{EI}, Q_I, Q_E) = \)

\[
\sum_{t=1}^{2} \int_{0}^{D_t(P_t)} \left[ \int_{0}^{x} P_t(x) dx - b_t(q_{II} + q_{I2}) - b_{EI} q_{EI} + q_{E2} \right] - \left[ \beta_I Q_I + \beta_E Q_E \right]
\]

subject to:

\( q_I + q_{EI} = D_t(P_t), \quad t=1,2. \) (5)

\( 0 \leq q_I \leq Q_I, \quad 0 \leq q_{EI} \leq Q_{EI}, \quad t=1,2. \) (6)

where \( q_{FI} = \) output supplied by firm \( F \) in period \( t, F \in \{I, E\} \), and where \( Q_F = \) output capacity of firm \( F \).

Efficient Component Pricing

It is not entirely clear what ECP means in the peak-load problem. The interpretation we follow here is that an entry fee is exacted from the entrant on every unit of capacity built (i.e., a charge of the form \( \rho Q_E \)). But how large is the entry fee to be set? The following seem reasonable assumptions on entry and on the entry fee.

- Demand is met and breakeven operations are assured, so that (6)-(7) and the following profit restrictions hold (the reader will note the presence of the entry fee \( \rho Q_E \) in both profit functions):

\[
\Pi_I = (P_1 - b_I)q_{II} + (P_2 - b_I)q_{I2} + \rho Q_E - \beta_I Q_I \geq \Pi_{IO} \geq 0 \] (7)

\[
\Pi_E = (P_1 - b_E)q_{EI} + (P_2 - b_E)q_{E2} - \rho Q_E - \beta_E Q_E \geq 0 \] (8)
• Capacity and operating costs are minimized, implying that no excess capacity is installed (i.e., the used and useful criteria is met) and merit order dispatching of installed capacity is used.

Note that these assumptions are compatible with the standard Ramsey solution to the stranded investment problem. However, these assumptions are not sufficient to determine a unique pricing solution. Instead, a family of ECP prices result. Which feasible ECP prices will obtain will therefore depend on external factors. On one extreme, the regulators preferences could obtain and Ramsey prices could result. At the other extreme, the incumbent’s preferences could obtain and ECP pricing would maximize I’s profits. In between these extremes, there is a continuum of other possibilities, as we will show below.

WO Solutions

Based on Crew and Kleindorfer [1986, Chapter 3], Tables 1a-c summarize previous firm-peak results for the WO solutions for cases 1-3. The following are salient points about the WO solution. First, unless the cost efficiency conditions (2) and (4) are met, either the E or the I technology will be excluded from any efficient technology mix. The relevant conditions are clear from the Tables. Second, when a diverse technology is optimal, the solution entails using the more expensive variable cost plant on peak and the more expensive capital cost plant as base load. Third, we have not explicitly given the optimal outputs from each technology in each period (the \( q_p \)). These follow from the requirement in the WO solution that capacity be operated in merit order once installed.

---

\(^{12}\) Note that I may still not be minimizing total costs and may be indulging expense preferences for staff or other emoluments. This is picked up in our model by the case \( \Pi_{10} > 0 \).
ECP Solutions

The ECP solutions are sketched for Cases 1 and 2. The solutions given all assume cost minimization (given \( Q_t \)), a firm peak in period 1,\(^{13}\) and incumbent prices \( \{P_{10} \mid t = 1,2\} \) before entry set so that \( P_{10} \geq b_t, t = 1,2 \). In particular, it is assumed that \( Q_t \) satisfies \( P_{1}(Q_t) \geq b_t \) or \( D_{1}(P_{10}) = Q_t \leq D_{1}(b_t) \).

\(^{13}\) We will not be concerned here with shifting peak results. That would complicate without informing our discussion of ECP.
### Table 1a: Welfare Optimal Results for Case 1
\(b_1 < b_E; \quad \beta_1 > \beta_E; \quad b_E + \beta_E < b_1 + \beta_1\)

<table>
<thead>
<tr>
<th></th>
<th>(\beta_1 - \beta_E \geq 2(b_E - b_1))</th>
<th>((\beta_1 - \beta_E)/2 &lt; (b_E - b_1) &lt; (\beta_1 - \beta_E))</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peak Price (P_1)</td>
<td>(b_E + \beta_E)</td>
<td>(b_E + \beta_E)</td>
</tr>
<tr>
<td>Off-Peak Price (P_2)</td>
<td>(b_E)</td>
<td>(2b_1 + \beta_1 - (b_E + \beta_E))</td>
</tr>
<tr>
<td>I's Capacity (Q_I)</td>
<td>0</td>
<td>(D_2(P_2))</td>
</tr>
<tr>
<td>E's Capacity (Q_E)</td>
<td>(D_1(P_1))</td>
<td>(D_1(P_1) - D_2(P_2))</td>
</tr>
</tbody>
</table>

### Table 1b: Welfare Optimal Results for Case 2
\(b_E < b_1; \quad \beta_E > \beta_1; \quad 2b_E + \beta_E < 2b_1 + \beta_1\)

<table>
<thead>
<tr>
<th></th>
<th>(\beta_1 - \beta_E \leq b_1 - b_E)</th>
<th>((\beta_1 - \beta_E)/2 &lt; (b_1 - b_E) &lt; (\beta_1 - \beta_E))</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peak Price (P_1)</td>
<td>(b_E + \beta_E)</td>
<td>(b_1 + \beta_1)</td>
</tr>
<tr>
<td>Off-Peak Price (P_2)</td>
<td>(b_E)</td>
<td>(2b_E + \beta_E - (b_1 + \beta_1))</td>
</tr>
<tr>
<td>I's Capacity (Q_I)</td>
<td>0</td>
<td>(D_1(P_1) - D_2(P_2))</td>
</tr>
<tr>
<td>E's Capacity (Q_E)</td>
<td>(D_1(P_1))</td>
<td>(D_2(P_2))</td>
</tr>
</tbody>
</table>

### Table 1c: Welfare Optimal Results for Case 3
\(b_E < b_1\) and \(\beta_E < \beta_1\)

<table>
<thead>
<tr>
<th></th>
<th>(b_E + \beta_E)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peak Price (P_1)</td>
<td>(b_E + \beta_E)</td>
</tr>
<tr>
<td>Off-Peak Price (P_2)</td>
<td>(b_E)</td>
</tr>
<tr>
<td>I's Capacity (Q_I)</td>
<td>0</td>
</tr>
<tr>
<td>E's Capacity (Q_E)</td>
<td>(D_1(P_1))</td>
</tr>
</tbody>
</table>
Case 1: ECP When Entrant Has an Efficient Peak Technology

Based on the conditions of full capacity utilization and merit order dispatching, we obtain the following conditions characterizing breakeven operations (see (8)-(9) above) for Case 1. Note that these conditions assume capacity will be fully utilized in the peak period and that \( Q_I \) will be utilized before \( Q_E \) in the peak period.

\[
(P_1 - b_I)Q_I + (P_2 - b_I)\text{Min}[D_2(P_2), Q_I] + \rho Q_E - \beta_E Q_I \geq \Pi_{\text{\text{II}}} \tag{9}
\]

\[
(P_1 - b_E)Q_E + (P_2 - b_E)[D_2(P_2) - Q_I] - \rho Q_E - \beta_E Q_E \geq 0. \tag{10}
\]

\[
(P_1 - b_E - \beta_E - \rho)Q_E = 0 \tag{11}
\]

where, for any real number \( x \), \( x^* = \text{Max}[x, 0] \). From (10)-(12) we obtain the following characterizing equations for the ECP regime for Case 1:

\[
\Pi_f(P_1, P_2, Q_E, Q_P) = \Pi_{\text{\text{II}}} \tag{12}
\]

\[
P_1 = b_E + \beta_E + \rho \tag{13}
\]

\[
Q_I + Q_E = D_1(P_1) \tag{14}
\]

We note that these conditions (13)-(15) determine a family of ECP prices since there are four variables to be determined \((P_1, P_2, Q_E, Y)\) and only three characterizing equations. To these three, we add a fourth equation as follows:

\[
\rho Q_E = K \geq 0, \tag{15}
\]

where \( K \) is the total dollar payment to be collected by means of the entry fee.

As \( K \) varies in (15), the family of feasible ECP regimes is determined. We
show this in the accompanying Figure 1. There we show two corresponding loci, one for required profit level $\Pi_{10} = \Pi'$ and one for $\Pi_{10} = \Pi''$, where $\Pi'' > \Pi'$. As expected, the higher profit requirement drives prices up, but it also reduces the capacity $Q_e$ of entrants. In particular, if the incumbent can specify any profit level he likes, then the potential clearly exists to drive $Q_e$ to 0.

One other point to be noted in Figure 1 is the presence of iso-consumer surplus contours. These are drawn as dashed lines in Figure 1. The point of tangency to the iso-profit contour is of course the Ramsey solution for that level of profits. We refer to this as the Very Efficient Component Pricing Regime (VECP). This can be contrasted to the Opportunistic Efficient Component Pricing Regime (OECP) which obtains when the incumbent can announce any profit level he likes. In particular, if $\Pi'$ is the maximum profit obtainable under any feasible ECP regime, then the OECP is as shown. This Figure represents the basic logic which characterizes Efficient Component Pricing:

- ECP determines under peak-load conditions a family of pricing regimes, even when there is no information asymmetry and $\Pi_{10}$ is known with certainty;
- When there is information asymmetry and the incumbent can announce a higher profit requirement, this will suppress entry;
- When the incumbent has complete freedom to announce any price he likes, then the ECP regime can be used to both thwart entry and maximize profits.

**Case 2: ECP When Entrant Has an Efficient Base-Load Technology**

A similar analysis obtains for Case 2. We do not provide the details here, but the characterizing equations are given below. Note that in Case 2 the efficient technology to use first (once installed) is the entrants' technology. This explains the

---

14 To avoid myriad special cases, we have assumed in Figure 1 that the incumbent has installed at least enough capacity to meet off-peak demand, i.e. $D_2(P_2) \leq Q_1$, leading to obvious simplifications in (9)-(10).
difference between (16)-(18) and (9)-(11).

\[(P_1 - b_I)Q_I + (P_2 - b_E)[D_2(P_2) - Q_E] + \rho Q_E - \beta E I I_{\pi 0} \]  
\[(P_1 - b_E)Q_E + (P_2 - b_E)\text{Min}\{D_2(P_2), Q_E\} - \rho Q_E - \beta E Q_E \geq 0.\]  
\[(P_1 + P_2 - 2b_E - \beta E - \rho)Q_E = 0\]  

Again, from (16)-(18), we obtain the following characterizing equations which determine the family of ECP regimes for any specified required profit level \(\Pi_{\pi 0}\) for the incumbent.

\[\Pi_{\pi}(P_1, P_2, Q_E, Q_E, \rho) = \Pi_{\pi 0}\]  
\[P_1 + P_2 = 2b_E + \beta E + \rho\]  
\[Q_I + Q_E = D_1(P_1)\]  
\[\rho Q_E = K \geq 0\]

where different ECP regimes result as \(K\) varies. A similar graphical analysis to Figure 1 shows that as the required profit level increases for \(I\) the level of entry decreases and price levels increase. Solutions for VECP and OECP are derived similarly to those for Figure 1.

4. Concluding Discussion on the Role of ECP in Access Pricing

Others have argued that ECP suffers from both theoretical (for example, Laffont and Tirole 1994) or practical (Tye 1994) problems. We would concur with these conclusions and add our own arguments based upon the model developed here that ECP is likely to be counterproductive when it comes to resolving the practical
problems of access pricing currently faced by network industries. As demonstrated in our model, the problems of access pricing are considerable in situations not involving long-run equilibrium. ECP requires not only competition in the final market, as admitted by Baumol and Sidak (1994), but it also requires long run equilibrium, a point Baumol and Sidak apparently overlooked. Since stranded investment by its very nature involves disequilibrium it is hard to see what role ECP can play given the current stranded-investment problems of network industries. Add to this when we examine a simple model of stranded investment with peak loads the ECP solution does not even provide a unique solution let alone being obvious or transparent, thereby losing its major claim to practical application.

While we have argued strongly that ECP is almost valueless or even potentially damaging in the solutions it purports to provide to current access pricing problems, we admit that we do not yet have a clear alternative approach to resolving the issue. Our approach does lead us to the following preliminary conclusions:

1. We do not believe that ECP provides a solution to the problem of pricing access under conditions that are interesting in practice and it has little or no role in the presence of stranded investment.

2. In view of the vagueness of ECP it provides the opportunity to favor the incumbent at the expense of entrants. As such it can be damaging to dynamic efficiency and the transition to an efficient industry structure.

While we do not have an obviously implementable solution to replace ECP - given the complexity of the problem this is not surprising! - we do suggest the development of a framework to address such problems. We argue for viewing the current problem as being resolved within a bargaining framework. This framework would start with a clean slate in contrast to ECP which implies that the entrant has the obligation to the incumbent of covering the latter's opportunity costs (including profits foregone) of the sales displaced. The "clean-slate" approach has many
advantages over ECP. The model developed above throws some light on the efficiency losses of using ECP in cases where stranded investment is involved. ECP, with its emphasis on the status quo, fails to provide incentives for dynamic efficiency. At least with the clean-slate approach such considerations could be considered rather than automatically foreclosed. Needless to say, additional research seems warranted on the development of dynamic models and access pricing methods which emphasize the adjustment process from the current state of disequilibrium to a state efficient equilibrium.
References


Kleindorfer, P. R., Testimony on behalf of the U.S. Postal Service [1987].


Figure 1. Feasible ECP Regimes

\((P_1', P_2', Q_{E'}, \rho)\)