“It is hard to find a more controversial issue in industrial policy than that concerning the terms on which entrants can gain access to an incumbent firm’s network.”

1. This paper reviews the theory and practice of access price regulation with an eye on the impact of access price regulation on downstream competition. The paper presents, first, the framework within which the classic access regulation problem arises; second, the principles governing the determination of access prices; third, the application of these principles in a few different industries in OECD countries.

2. The key ideas that this paper seeks to emphasise are the following:

- Access pricing (at least in the “classic” vertically-integrated natural monopoly or “essential facility” problem) is closely related to the problem of efficient pricing of the outputs of a multi-product monopolist. The same theories and principles that apply to the optimal regulation of a multi-product monopolist can be applied to the regulation of access prices. The primary difference is that forms of price discrimination which may be feasible at the level of final prices may not be feasible at the level of access prices and this can be important for downstream competition.

- There is a wide range of forms of access pricing. The most appropriate form in any given context depends very closely on what objectives are sought and what instruments are available to achieve those objectives. Where there are fewer instruments than objectives, access pricing may need to make trade-offs between the objectives. It is very important to specify clearly at all times what assumptions are being made about the objectives being pursued and the instruments available.

- In the simplest cases (with no fixed costs or access deficit to be recovered) all prices (including prices for access services) should be set according to marginal cost. Where some prices for some services must be distorted away from marginal cost, economic theory shows that welfare-maximising prices for all related services should also be distorted. In particular, since the services of downstream rivals are often close substitutes for the incumbents’ final services, if the prices of the incumbent’s final services are distorted away from cost, the prices of access services to rivals should also be distorted in a similar manner. The relationship between the final prices and access prices is given by a formula which is a generalisation of the Efficient Component Pricing Rule.

- Where it is necessary to recover fixed costs or an “access deficit”, the incumbent’s final prices and access prices must be raised above marginal cost. The appropriate mark-up over marginal cost is given

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1 Armstrong (2001), page 36.
by the well-known formula for Ramsey pricing. This formula can be expressed as the generalised ECPR rule plus a Ramsey mark-up.

- In all of the above cases, the assumption of perfect competition downstream and the assumption of social-welfare maximising pricing ensures efficient entry decisions downstream. Where there is also a possibility of entry into or bypass of the non-competitive facility, the presence of access prices above stand-alone cost or below incremental cost induces inefficient entry or bypass. If this entry cannot be prevented through entry controls, additional instruments are needed. For example a mechanism might be established which taxes/subsidies the final services (akin to a universal service funding mechanism). In the presence of such a mechanism, access prices should be adjusted to lie between incremental cost and stand-alone cost and taxes and subsidies used to correct final prices to their efficient levels.

- As a general rule, any price discrimination which is present in final prices should be reflected in access prices and vice versa. Where it is not possible to price discriminate in the same way in access prices as in final prices, there may be a trade-off between efficiency and downstream competition. The promotion of competition downstream may require forcing the integrated incumbent to behave as though it were vertically separated (and therefore to not price discriminate). This forces a loss of efficiency, but benefits downstream competition. Conversely, if, in order to promote efficiency, the downstream firm is allowed to make use of its own cost and demand information to price discriminate, downstream competition will suffer.
Part I: The Basic Framework

3. The classic access or “essential facility” problem involves, at a minimum, the following three ingredients:

   (a) An industry with at least two (strongly) complementary activities; ②

   (b) At least one of those activities must, for reasons of regulation, natural monopoly or network externalities, not be able to support competition; (this activity will almost always be subject to regulation to control its market power)

   (c) The other activity must be able to support competition.

4. One of the reasons that the analysis of access problems can be confusing is that they arise in industries with complementary components – components which are, in fact, always purchased together. There is often, at first, something counter-intuitive about distinguishing between two activities which are always purchased together. It is as though we are distinguishing between the production of “left shoes” and the production of “right shoes” when almost all consumers always buy shoes as a pair. But, despite this counter-intuitiveness, this is exactly the situation that we are discussing – if the production of right shoes was non-competitive, while the production of left shoes was competitive we would potentially have a classic access problem.

5. I have used the word “complementary” here, rather than the phrase “vertically-related”, which is also used in this context. In fact, two activities which are complementary, can be said to be vertically related. (Similarly, two activities which are substitutes can be said to be horizontally related). However, the term “vertically related” raises the question of what is upstream and what is downstream. While we can define upstream and downstream relatively easily in the case of say, natural gas networks, this expression makes much less sense in the case of, say, local telephone networks. In order to make a local telephone call you need the services of both the originating local loop and the terminating local loop. So these two local loops are complementary. While it might be possible to define upstream and downstream on a call-by-call basis (and even then it is dubious), in the case of two way networks such as telecommunications, it does not make sense to talk about upstream and downstream facilities on a consistent basis.

The Classic “One-Way” Access Problem

6. The classic “one-way” access problem arises when firms in the competitive activity must buy inputs from firms in the non-competitive activity but not vice-versa. This can be represented diagrammatically as follows:

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② Two activities are complementary if consumers need to purchase the services of both activities in order to have the service that they desire – for example, natural gas at a well-head is of no use to a factory without a pipeline to transport it, so natural gas production and transmission are complementary activities.
7. It is useful to observe at this point that the incentive on the integrated firm to restrict competition in the competitive activity depends on the nature of the regulation of final prices relative to access prices.

8. Suppose that the access prices are tightly regulated while the final prices are not (or are less so). In this context, the incumbent has a clear incentive to vertically-integrate into and restrict competition in the competitive activity – by doing so it may be able to raise the price of the competitive activity to recapture some of the monopoly rents that it loses to regulation of the non-competitive activity. This is the “classic” access problem.

9. Now consider what happens if we simply switch the assumptions about what part of the industry is regulated. Suppose now that it is the competitive activity of the integrated firm which is tightly regulated (so that the integrated firm cannot earn any monopoly rent on this activity), while the non-competitive activity is not regulated at all. In this context, it is clear that the incumbent firm has an incentive to withdraw from the competitive activity, and to only provide access services to other companies.

10. This might seem like a theoretical point, but cases like this have arisen in practice. In the US natural gas industry, for example, in the early 1980s, most pipelines delivered a bundled product of gas plus transportation. The price of this bundled product was regulated. The US regulator, FERC, was also seeking to induce pipelines to offer an unbundled transportation-only service. Normally we might predict that pipelines would resist offering the unbundled access service – as doing so increases competition in the downstream market where it might be earning some rents. But, when prices for gas at the well-head increased significantly in the early 1980s, most pipelines were making a loss on their sales of the bundled gas-plus-transportation service, so they voluntarily opted instead to offer transportation-only service, as a way of restoring their revenues. A similar effect also arose in the UK. In Russia, when the monopoly long-distance company was forced to provide international calls below international settlement rates it actively sought to provide international leased lines instead.

11. As we will see later, one of the arguments for regulating access prices through a price cap that includes both access prices and final prices is precisely that it provides the same “weight” of regulation on both access prices and final prices, neither causing the monopolist to unduly resist granting access or inefficiently pushing it to withdraw from providing final services. Laffont and Tirole (1996) write “An access rule can only be discussed in the context of an overall regulatory scheme, as its implications depend

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3 Of course, in the past all it may have succeeded in doing is have the regulation extended to the competitive activity as well, but given that we assuming that the government wishes to remove regulation and introduce competition in the competitive activity, we will put to one side this possibility.
strongly on how final prices are determined” and “A discussion of an access rule without reference to the rest of the regulatory environment has limited interest. The quality of an access pricing rule depends on the determination of prices for final products”.

The “Two-Way” Access Problem

12. In certain two-way networks, such as telecommunications, railways or even airline networks, the need for access is reciprocal – each firm needs inputs provided by another. This can be illustrated as follows:

**Figure 2: Reciprocal Interconnection in Two-Way Networks**

13. These networks often have the characteristic known as “network externality” or “demand-side economies of scale”. That is, it is often the case that the value of the network depends, in part, upon the number of other people you can call, the number of websites you can reach or the number of other places you can get to. In some cases, these effects can be so important that, in the absence of specific regulation, a single firm would emerge supplying the entire market.

14. In the “two-way” access context, these network effects can give rise an incentive to interconnect, even in the absence of regulation. For the remainder of this paper I will focus on the classic “one-way” access problem.

15. A recent paper (writing in the context of the telecommunications industry) made the following claims. We will seek to test these claims against economic theory over the course of the subsequent paragraphs:

“The level of interconnection charges determines the structure of the telecommunications market. If interconnection charges are too high, it will discourage companies to enter into the telecommunications market. … It is critical to ensure cost-oriented interconnection charges in order to ensure effective competition. In this context, it is essential that interconnection charges should be calculated on the basis of forward-looking incremental costs, which are incurred for interconnection services. … Interconnection charges should not include an access deficit contribution or universal service contribution. If there is any economic loss due to the provision of universal service this should be compensated separately through, for example, a competitively neutral funding mechanism”.

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Part II: Principles Governing Access Prices

16. Let’s turn now to review the economic theory governing access pricing. The focus here on access pricing is not intended to imply that other aspects of the problem of regulating access do not matter. Price is just one component of the access regulation problem – indeed, it is impossible to successfully regulate price without also regulating quality. There may be myriad aspects of quality which need to be regulated to ensure effective access, including the timeliness of information, timeliness is response to access requests, flexibility about how and where access is provided and so on.

17. There are strong similarities between the problem of access regulation and the problem of efficient regulation of the prices of a natural monopoly. Indeed, with certain caveats, the regulation of access prices is closely related to the problem of the regulation of the prices of a natural monopoly. The primary difference between regulating access prices and regulating the prices of a natural monopoly is that access services are not consumed by final customers but are an input for a downstream competitive market. As a result, a regulator fixing access prices needs, in addition to the standard concerns, to pay attention to the effect of the access prices on downstream competition. In particular, the extent of price discrimination which is possible at the final price level may be greater or less than the extent of price discrimination possible at the access price level.

18. As is well known from the theory of the regulation of a natural monopoly, a key issue is the number of objectives that must be achieved and the instruments available for achieving those objectives. If the number of objectives is larger than the number of instruments it may not be possible to simultaneously achieve all the government’s possible public policy objectives. It may be necessary to make trade-offs between those objectives. Laffont and Tirole write:

“As the number of market imperfections grows, the access pricing rule is bound to respond to an increasing number of concerns, ceteris paribus, and more instruments are needed if access prices are not to arbitrate inefficiently among conflicting goals. The access price … becomes a ‘jack of all trades and master of none.’”

19. There are different ways to specify the possible objectives. Here is one possible formulation:

(a) First, we want to induce the efficient use of the non-competitive facility (which may involve removing any monopoly rents);

(b) Second, we want to induce the efficient provision, maintenance of and investment in the non-competitive facility;

(c) Third, we want to ensure a combination of product variety and quality of the non-competitive facility that best meets the demands of consumers and downstream users;

(d) Fourth, there may be other objectives such as the desire to preserve universal service or geographically-averaged pricing; and

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5 IDEI (1997), page 107.
(e) Last, and this is particularly important in the context of access price regulation, we want to preserve and promote competition in related competitive markets where possible.

20. We will particularly focus on trade-offs with the last objective – when does the pursuit of other objectives come into conflict with the objective of promoting competition in a related market?

21. The specific objectives that we will focus on in this paper and the instruments that we will consider for achieving those objectives are set out in Table 1. The more objectives that must be pursued simultaneously and the fewer the available instruments for achieving those objectives, the more trade-offs must be taken into account in setting access prices and the less efficient the result is likely to be. On the other hand, the fewer the objectives and the more the instruments, the more likely that trade-offs can be avoided and the first-best outcome can be obtained.

Table 1: Objectives and Instruments for Achieving Those Objectives Considered in this Paper

<table>
<thead>
<tr>
<th>Objectives</th>
<th>Instruments</th>
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<tbody>
<tr>
<td>Recovery of fixed costs (or deficit due to non-commercial service obligations)</td>
<td>Access prices which discriminate according to the final use to which the access service is put (third-degree price discrimination)</td>
</tr>
<tr>
<td>Efficient (social-welfare maximising) pricing of final goods and services</td>
<td>Two-part or non-linear access pricing (second-degree price discrimination)</td>
</tr>
<tr>
<td>Efficient entry into the non-competitive activity (avoidance of inefficient bypass)</td>
<td>Taxes or subsidies on final services (perhaps in the form of a non-commercial service fund)</td>
</tr>
<tr>
<td>Pricing of certain goods and services distorted to reflect other public policy objectives</td>
<td>Controls on entry in the non-competitive activity</td>
</tr>
<tr>
<td>Effective competition downstream</td>
<td>Controls on the behaviour of the integrated firm which make it behave as though it faces the same access prices which it offers to its rivals</td>
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<td></td>
<td>Lump-sum (non-distortionary) taxes</td>
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22. We will focus on the classic one-way access problem with a monopolist who produces many different products or services. Some of the products of the monopolist are sold directly to downstream users and other products are sold into a downstream competitive industry, which in turn transforms the monopolist’s inputs into final products which are then sold to downstream users. Some or all of the products sold by rivals may compete with final products sold by the monopolist. This is illustrated in the following diagram:

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7 Strictly speaking, competition is not an end in itself but a mechanism for achieving the desired outcomes. We could express the last objective as the pursuit of the other objectives in the competitive activity (promotion of efficiency in the provision and use of the competitive service and the promotion of the efficient product variety and quality). For shorthand, I consider it easier to use the term the promotion of competition.
23. For simplicity we will assume fixed proportions – one unit of access is necessary to produce one unit of final product. We will also assume that the downstream sector is perfectly competitive. In what follows we will seek to determine the most efficient (i.e., welfare maximising) set of access and final prices of the integrated monopolist, under various assumptions and constraints.

24. Note that the assumption of perfect competition implies that there is no problem of inefficient entry downstream among the rival firms. (An inefficient firm would not be able to survive in the market). In addition, we will see that, in the case when the downstream product of the rivals is a perfect substitute for a final product of the incumbent, the assumption of efficient pricing will ensure that entry will only occur downstream when the entrants are lower cost than the incumbents own downstream facility. In other words, in what follows efficient entry downstream will always be assured.

Marginal Cost Pricing

25. As is well-known, in the absence of increasing returns to scale and no prices are distorted away from marginal cost (so there are no fixed costs or access deficit to be covered) efficient pricing requires setting marginal prices equal to marginal cost. This can be achieved with simple linear pricing, requiring no additional instruments.

26. This can be expressed as \( p_2 = c_2 + \hat{c}_2 \) and \( a = p_1 - \hat{c}_1 = c_1 \) where \( p_1 \) and \( p_2 \) are the entrants’ and the incumbent’s final prices respectively, \( c_1 \) and \( c_2 \) are the marginal costs of providing a unit of access to the incumbent and the entrants and \( \hat{c}_1 \) and \( \hat{c}_2 \) are the marginal costs of transforming a unit of access to a unit of final good for the entrants and the incumbent, respectively. Finally, \( a = p_1 - \hat{c}_1 \) is the access price.

Non-Commercial Service Obligations and the ECPR

27. It is common, however, in regulated industries for some prices to be distorted away from marginal cost in order to pursue other public policy objectives.

28. For the moment, let’s assume that there are no fixed costs which need to be recovered through access prices and we will continue to assume that we are pursuing the objective of efficient pricing. If one price is distorted above or below cost – what implication does this have for the other prices? It is straightforward to verify that if the price of good 2, say, is distorted away from cost then it may be necessary to distort price of any other good \( i \) away from cost. In fact, if the price of good 2 is distorted, then the prices of the other goods must be distorted according to the formula:

\[ a = p_1 - \hat{c}_1 \] is the access price.

\[ \text{Pricing at marginal cost also induces efficient entry decisions upstream (i.e., “bypass”).} \]
\[ p_i - c_i - \hat{c}_i = \sigma_{ii}(p_i - c_i - \hat{c}_i) \]

29. Where \( \sigma_{ii} \) is known as the displacement ratio. \( \sigma_{ii} \) is zero for goods that are independent and \( \sigma_{ii} = 1 \) for goods that are perfect substitutes. So, if the service provided by rivals is a substitute for the final service provided by the integrated firm, then if the final price is held below cost, the access price should be also. This is not the case, for example, in certain access services in telecommunications. For example, the access prices for unbundled local loops (which are cost-based) are above retail prices in many countries.

30. This expression can be re-written:

\[ a = c_2 + \sigma_{2i}(p_i - c_i - \hat{c}_i) \]

31. In other words, the access price should be equal to the cost of providing access to the downstream rival plus the degree of distortion in the final prices of the integrated firm multiplied by the displacement ratio. In the case when the final good of the incumbent and the rivals are perfect substitutes and the marginal cost of providing access to the entrant is the same as the marginal cost of providing access to the incumbent, this reduces to \( a = p_i - \hat{c}_i \), i.e., the access price is just the final price less the incumbent’s cost of producing the downstream service.

32. The expression above can be taken to be a formulation of the ECPR rule. In other words, the ECPR rule arises in this context as a necessary component of efficient pricing when one or more prices are distorted away from their underlying cost.

33. At this point it is useful to ask the question how the level of the access price might affect downstream competition. This is important because there are many industries where either access or final prices are not directly related to underlying costs. In particular, geographic averaging is common. In the postal sector, for example, geographical averaging is practically universal. This implies that the prices for some services will be below cost and the prices for other services will be above cost. Does this have an impact on competition?

34. The formula above allows us to answer this question. When any price (whether it is an access price or a final price) is distorted away from marginal cost, competition will not be affected provided prices for substitute products are distorted in the same way, according to the expression above.

35. There are two extreme cases that are worth considering. The first is the case where access is used to produce a final service which does not compete with any product of the incumbent. In this case the level of access has very little impact on downstream competition. A change in the price of access is no different from a change in the price of any other input, such as oil. The second case is the case where access is used to produce a service which is a perfect substitute for a final service of the incumbent. In this case, competition will not be affected provided the price of the corresponding final service is adjusted according to the ECPR rule above. In particular, in the case where the incumbent’s service and the rivals’ service is a perfect substitute, (and the entrants are no less efficient than the incumbent) controls on the final price of the incumbent can be removed – this price can be determined by market forces. In this case the level of the access price is translated directly into a corresponding final price. The level of the access price has no direct impact on downstream competition. In particular, access prices may be above or below cost in order to satisfy non-commercial service objectives, with no impact on downstream competition.

\[ \text{Higher final prices will, in turn, reduce the size of the downstream market which may indirectly limit the number of competitors in that market if there are any fixed costs of entry.} \]
36. We will see shortly that there are important cases when it is not possible to adjust for final prices and access prices to be adjusted independently to have the relationship in the formula above, in which case downstream competition can and usually will be directly affected.

37. Up to this point we have ignored the possibility of entry into the non-competitive activity. But, in some context, there is a real possibility of entry and that entry may undermine productive efficiency. The need to control entry upstream adds another objective to our access problem. If we do not also add another instrument for achieving this objective we will inevitably need to trade-off this objective with the other objectives. There are two possible instruments that are relevant: a prohibition on entry in the non-competitive activity (as is common in the postal sector), or through a system of taxes and subsidies on the final services (perhaps through the creation of a separate funding mechanism for the non-commercial services).

38. In the context we are considering here (i.e. where there are no fixed costs to be recovered and no access deficit) the objectives of efficient pricing and efficient entry can be met by setting access prices equal to cost (inducing efficient entry decisions) and simultaneously imposing a tax (or subsidy) on final prices equal to the displacement ratio times the extent of the price distortion.

\[ t = \sigma \left( p_1 - c_1 - \hat{c}_1 \right) \]

39. This could be achieved through a universal service fund or some other industry tax and subsidy.

**Ramsey Prices**

40. In the presence of fixed costs or an access deficit due to non-commercial service obligations and assuming linear pricing, if all prices were set equal to marginal cost, the monopolist would not be able to cover the costs of the natural monopoly facility.

41. Suppose then that we insist that prices must recover sufficient revenue to allow the non-competitive activity to cover its costs and then ask what linear prices best achieve the first objective – that is, the least distortion of the use of the facility. This is the classic problem addressed by Ramsey (1927) and Boiteux (1956). The resulting prices, known as Ramsey prices, are well known and have the characteristic that goods with less elastic demand tend to have a higher price-cost margin than goods with more elastic demand.

42. This can be expressed as follows (see the Appendix):

\[ a = p_1 - \hat{c}_1 = c_1 + \frac{\lambda}{1 + \frac{\lambda}{\hat{\eta}} p_1} \]

43. Which is identical to the following:

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10 Strictly speaking what is relevant is not the “own price” elasticity of demand of the service but the “superelasticity” of demand which depends on the effect of the price change on the demand of other services as well. It is worthwhile recalling that Ramsey prices may not exist – that is, the distortion required in pricing above marginal cost may not yield sufficient revenue to cover the costs of the monopoly facility even if the facility is socially beneficial (in the sense that consumer surplus exceeds the total cost of providing the facility with marginal cost pricing). If a set of prices exist which allow the monopolist to cover its costs exists then the facility must be socially beneficial, but the reverse is not true (especially in the case of linear pricing). In this context, if the facility is to be provided at all there must be an external source of funds.
\[ a = p_1 - \hat{c}_1 = c_1 + \sigma(p_2 - c_2 - \hat{c}_2) + \frac{\lambda}{1 + \lambda} \eta_i \]

44. Which of these equations is more useful depends on whether the exists a final service which is a close substitute for the access service. If there is a final service which is a close substitute for the access service, then the second equation gives the access price in relation to the final price.

45. These formulae imply that if the incumbent provides a number of different services and if the price must be marked up above marginal cost on any one of those services with elastic demand, then the mark-ups should vary, with mark-ups higher on less elastic services. Where prices must be distorted away from marginal cost, it is essential to take into account demand-side factors. New entrants in the competitive activity often argue that access prices should be “cost based” or “cost-oriented” (as in the paragraph cited above) but where access and final prices must be raised to recover other funds, then access and final prices should not be purely “cost based”.

46. There are several points related to the use of Ramsey prices which are worth recalling here (these are demonstrated in the appendix). The first is to recall that since we are discussing a multi-product monopolist the relevant elasticities are not just the own-price elasticity but the “super-elasticity” which takes into account the effect of the access prices on the demand for the other services of the monopolist. Another useful point is to note that when the incumbent firm benefits from captive customers, the final price for its service should be higher than for the rival’s service. The reasoning is as follows. If the incumbent firm faces captive customers who do not switch to the new entrants (e.g., due to brand loyalty, name recognition or switching costs) the firm faces a lower elasticity of demand for its own final services (due to the brand loyalty, etc.) than for its access services. If the downstream activity is not perfectly competitive, the access prices should be reduced to offset the mark-up above marginal cost that arises in an imperfectly competitive industry.

47. It is sometimes objected that taking into account demand-side factors requires too much information and is impractical. This objection is addressed later in this discussion.

**Peak Load Pricing**

48. In many industries, services can be differentiated according to the time at which the service is provided. In other words, it is possible to set different prices (with different price-cost margins) for services provided at different times. If services at different times have a different elasticity of demand, then if prices must be above marginal cost, the application of Ramsey principles implies that prices should be different at different times according to the elasticity of demand.

49. In addition, in many industries the capacity of the non-competitive facility is limited and this capacity limit is reached at certain times. In economic terms, the marginal cost of providing an additional service at peak times may be significantly higher than the marginal cost of providing service at off-peak times.

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11 With the elasticity measured according to the “superelasticity” of the service.
12 In this context a “non-discrimination” rule that requires that all purchases of access pay the same price for the same service makes no economic sense.
13 Another result is that when the downstream activity is not perfectly competitive, the access prices should be reduced to offset the mark-up above marginal cost that arises in an imperfectly competitive industry.
14 Laffont and Tirole (1996) write: “Optimal access prices are likely to be too complex an object for regulators to have the required information to implement them directly. They depend on fine information about marginal cost of access, required mark-ups, elasticities and cross-elasticities of demand and the intensity of competition in the intermediate and final segment”.
times. In this context, Ramsey pricing would require that prices should be higher at peak times. Indeed, prices at peak times should be high enough to clear the market, to eliminate any excess demand.

50. It may be the case that the mark-ups on the prices for peak-time service are sufficiently high as to allow the prices of off-peak services to be reduced to marginal cost. In this case, the first two objectives above can be simultaneously achieved, without the need for trade-offs. More generally, some mark-up above marginal cost may be required at off-peak times.

51. Put into the language of access pricing, this implies that if the capacity of the non-competitive activity is exhausted at certain periods, access prices should be higher in those periods so as to efficiently ration the quantity of access demanded in those peak periods. Any resulting revenue collected should be used to lower access and final prices towards marginal cost in off-peak periods.

52. Although regulation usually involves fixing prices and allowing quantities to adjust to clear the market, during peak periods (since capacity is fixed in the short run) it often makes more sense to fix the quantity available and allow prices to adjust to clear the market. This might mean, for example, holding an auction to determine the market-clearing prices for the available capacity. This is not always feasible (due to market power problems), but where it is feasible it may be preferable. It is common, for example, to ration access to capacity-constrained airports through the allocation of take-off and landing slots, which may be traded in the market to determine the market-clearing price. Access to natural gas pipeline capacity is also freely traded in the US.

Third-Degree Price Discrimination

53. If we allow price-discrimination, we may be able to do even better than with simple Ramsey prices. In some cases Third-degree price discrimination might be possible – in other words, it might be possible to divide consumers into groups, selling at different prices to different groups of consumers. By raising the price to consumers with inelastic demand the regulator may then be able to reduce the total distortion by lowering prices to consumers with elastic demand. Of course, it must be possible to prevent resale amongst downstream customers.

54. In other words, where the regulator is able to distinguish different classes of customers with different elasticities of demand and where resale can be prevented, then, if prices must be above marginal cost to fund fixed costs, the regulator should set different prices for different classes of customer, with prices higher above marginal cost for customers with more inelastic demand. Since the demand of downstream customers depends, in part, on the use to which the access service is put, this means that if access prices must be raised above marginal cost, access prices should (whenever it is feasible) differ according to the different final use of the access service. To price discriminate in this way the monopolist must be able to observe the final use to which the access service is put (or equivalently, the class of demand of the customer to which the final service is sold).

55. It is clear that differences in access prices will usually be reflected in differences in final prices, but is the reverse true? Is it the case that all third-degree price discrimination which can be observed in final prices should be reflected in access prices?

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15 Allowing an unregulated monopolist to price discriminate between customer classes has ambiguous welfare implications. See, for example, Varian (1989) or Katz (1987). Here, however, we are considering the pricing decisions of a monopolist regulated by a benign social planner. In this context, price discrimination is always welfare enhancing.
56. When third-degree price discrimination is practiced at the final price level but is not feasible (or is not used) at the access price level there is a trade-off between downstream competition and efficiency.

57. This can be illustrated with the following example. Suppose that a rail company serves a number of classes of final customers, with different elasticities of demand. The integrated company may have the ability to charge different prices to each class of customer, as the principles above would require. Suppose, however, that the track infrastructure company cannot observe the demand of the passenger and freight services carried in trains operated by rival train-operating companies. In this case rival train-operating company would face a simple linear price of access to the track infrastructure, independent of the class of final customer served.

58. If price discrimination is possible, it is efficient to set different price in different downstream markets, and with higher prices in markets with less elastic demand. At the same time, a single linear access price must be set for all downstream competitors, whatever the market they serve. The level of this access price determines which of the downstream markets it is profitable for downstream competitors to enter. The lower the access price, the larger the share of the total market for which the rivals can successfully compete. This competition may drive down the final price in these markets which, in turn, force final prices to be raised (to recover fixed costs) in the remaining non-contested markets.

59. On the other hand, policy-makers could insist that the integrated company behave as though it faces the same cost structure as other companies, by prohibiting price discrimination in final prices (or, at least, no more differentiation in final prices than exists in access prices). Prohibiting price discrimination would facilitate competition downstream, but at the cost of efficiency and the incentives for provision of the track infrastructure. Final prices will fall for inelastic customers and rise for elastic customers, (relative to the situation in which discrimination is allowed) reducing overall efficiency. In addition, the resulting drop in demand by elastic customers will lead to a drop in revenues to cover fixed costs, leading to a further rise in the track access price and a further drop in customers. In some cases it may not be feasible to recover revenue sufficient to cover the fixed cost of the track infrastructure without some form of price discrimination between customers. Preventing price discrimination in such a context, for the sake of competition, may put in jeopardy the provision of the track infrastructure at all.

60. To summarise, when price discrimination is allowed in final prices efficiency is enhanced, but where that discrimination is not allowed (or is not feasible) in access prices for services that are substitutes, downstream competition may be limited - the range of downstream markets in which the downstream rivals can compete is restricted to only those customers with lower elasticities. The scope for competition can be enhanced by forcing the integrated incumbent to behave as though it faced the same access prices, but at the cost of lower efficiency and introducing difficulties in covering the fixed costs.

Second-Degree Price Discrimination – Two-part tariffs and Non-Linear tariffs

61. In some cases, second-degree price discrimination might be possible – in other words, it might be possible to sell different units at different prices to the same consumers. In particular it might be possible for the monopolist to use a non-linear pricing scheme such as a two-part tariff – with a high fixed price and a low marginal price. Second-degree price-discrimination is only possible where it is possible to both meter consumption and prevent resale amongst downstream consumers.

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16 The classic example of this is the case of ALCOA which had a near monopoly in aluminium production in the US. Unable to price discriminate at the level of aluminium ingots, it integrated into the manufacture of aluminium products with high elasticity, selling ingots at a higher price to firms producing aluminium products with a lower elasticity of demand.
62. If the marginal price is set at marginal cost and the fixed component of the price is not so high as to prevent downstream consumers from consuming at all, the efficient outcome can be achieved. More generally, raising the fixed part of the two-part tariff may force some consumers (especially smaller consumers) to leave the market entirely. This can be partly addressed by offering a non-linear tariff which, for small quantities offers a price structure close to simple linear pricing but, for large quantities is closer to a two-part tariff with the marginal price close to marginal cost.

63. The implications for access pricing are that \textit{if access or final prices must be raised above marginal cost, then access or final prices should include a non-linear component (i.e., a two-part or multi-part tariff) whenever that is feasible.}

64. In the natural gas sector, for example, access to the transmission network usually has a two part form, with virtually all of the charges in the fixed (non-traffic sensitive) component. In the rail sector, as well, it is common for access to the rail infrastructure to have such a two-part structure. This is particularly the case in the UK. In the telecommunications industry, also, two-part charges are common at the retail level (but not so much at the access level). Mobile operators, in particular, have finely developed menus of pricing options.

65. As before, though, it is important to pay attention to the relative structure of prices at the access level and the final level. Where the integrated firm uses a two-part pricing structure downstream, but offers (or is required to offer) only a simple linear access price, there may arise again a trade-off between downstream competition and efficiency.

66. The problem here is that the analysis of downstream competition is complicated because there is no simple economic model of competition with two-part tariffs. We can, however, make a few simple points. The first is that if the entrants are restricted to only use a linear price downstream then they will always be undercut by the incumbent. The linear price of the entrants will always be above the true marginal cost, which can be exploited by the incumbent using a two-part pricing structure. Restricting the entrants to use a linear price will eliminate competition.

67. But why should the entrants be restricted to a linear price – why couldn’t they respond with a two-part or non-linear price of their own? Suppose the incumbent uses a two-part tariff downstream, but only offers a simple linear access price. What is the appropriate level of the access price in this case? If we assume that the entrants’ and the incumbents final services are perfect substitutes, then we can use the principle that the contribution to the fixed costs from the incumbent’s final services and the entrants’ services should be the same. This can be assured with an access price given by the ECPR price (the final price less the incumbent’s costs in the downstream activity) plus the average fixed price (i.e., the fixed part of the two-part tariff, divided by the quantity consumed at those prices). With this price the entrants will be able to match the prices offered by the incumbent.

68. But, intuitively, it seems unlikely that this would be the end of the story. It seems likely that the remaining difference in the marginal cost faced by the entrants and the incumbent would be reflected in downstream competition. Entrants would want to exploit their higher marginal cost, perhaps by focusing on serving low-volume customers, while the incumbent served high-volume customers. In other words, as before, we see that a failure to price-discriminate at the access level has the effect of limiting the scope for competition downstream.

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\textsuperscript{17} One consequence of the very high fixed component in the charging structure is that the income of the track company – Railtrack – is very nearly fixed, whatever actions it takes. As a result, it has very little incentive to ensure that trains run on time, or that trains run at all – it gets the same income regardless of what happens on its track!
69. As an aside, this discussion has implications for the theory of whether to enforce structural separation on regulated firms subject to access regulation. This discussion suggests that where more price-discrimination is possible in final prices than access prices, there can be a trade-off between competition and efficiency. Where competition is a high priority, the promotion of competition will require that the integrated firm be forced to behave as though it were not integrated. In other words, the benefits of integration will be lost whether or not the firm is integrated. Given the greatly enhanced regulatory difficulties associated with forcing an integrated firm to behave as though it was separated, this analysis suggests that where competition is a high priority, serious consideration should be given to structural separation. On the other hand, where efficiency is given relatively higher importance than downstream competition, vertical integration could be preserved, with potentially limited resulting downstream competition.

Non-linear Prices and Competition Downstream

70. We have just discussed the case where non-linear access pricing was possible in final prices but not in access prices. What about the reverse case - what if non-linear pricing is possible at the access level, but not in final prices?

71. In this case, the use of non-linear pricing at the access level might threaten competition in the competitive activity. Access prices are typically an important cost component in the downstream activity. Access prices which are structured as a two-part tariff with a high fixed cost and a low marginal cost introduce a degree of increasing returns to scale in the downstream activity. When the downstream activity uses simple linear prices, this two-part cost structure can limit the number of firms that can be sustained in the competitive activity in equilibrium.

72. When the fixed component is small, the presence of two-part tariffs may not matter much for competition. Product differentiation downstream might be sufficient to allow a sufficient number of distinct downstream firms to survive in equilibrium. However, if the fixed component is large enough, or if the product differentiation downstream is very limited, the number of firms that may be able to co-exist in the competitive component may be strictly limited. Indeed, in the limit the use of two-part tariffs may turn the competitive activity into a natural monopoly activity! In other words, although the use of two-part tariffs may facilitate the achievement of the first two objectives, there is a potential for it to conflict with the competition objective. As an illustration, the following box describes a situation that arose in the telecommunications market in Finland.

Two-Part Pricing in Finland Telecommunications

In Finland, when the legislator mandated unbundling of network elements, telecom operators responded by raising their fees 50-300%. Operator price lists contained volume discounts of up to 30% but the size of the volume discounts made it virtually impossible for anyone but the incumbent itself to benefit from the rebates. This practice was challenged by the Finnish Competition Authority and eventually dropped.

73. This problem can be resolved in some cases by setting a limit on the quantity of access that the downstream firm can purchase, and by making the size of that quantity proportional to the fixed cost component of the two-part tariff. In this case, the downstream industry faces constant returns to scale (although, of course, the downstream cost curves would be U-shaped in the “short run”) and competition is possible.

74. For example, suppose that non-competitive activity has a fixed cost of 100, a marginal cost of 1 and a capacity of 200. Assume the downstream activity has a marginal cost of zero and all the downstream services are perfect substitutes. A two-part tariff with a marginal cost of 1 and any fixed cost above zero
will lead to a single firm downstream – as that firm will be able to serve the downstream market more cheaply than any combination of firms. Assuming that market demand at a price of 1.5 is 200. Suppose instead that the access capacity is now limited, and downstream firms can purchase this capacity at a price of 0.5 per unit of capacity. In this case an arbitrary number of downstream firms can compete. Each can choose its capacity C and pay an access price with a fixed component 0.5 C and a marginal cost of 1. Since each firm will exhaust its capacity, it will charge a price of \((C+0.5C)/C = 1.5\). In effect the non-competitive activity has been converted into a number of smaller firms identical in every respect except scale.\(^{18}\)

75. In summary, where two-part tariffs are used at the access pricing, but are not feasible at the final price level, consideration should be given to the impact on downstream competition, and in particular, consideration should be given to ensuring that the capacity to which the downstream firms have access is limited and is made proportional (or less than proportional) to the fixed component of the tariff.

76. Non-linear access prices are common in natural gas and in the airport industry – as I have already mentioned, in the natural gas industry transmission tariffs often have a high fixed component and a very low variable component – the size of the fixed component is proportional to the maximum capacity (rate of flow of gas) that can be demanded at one time. In the US, these rights to a share of the total pipeline capacity can be traded on the Internet, so that the price for the total available capacity is a market-clearing price. We can make an analogy to the airport industry – where take-off and landing slots are a right to use a share of the total airport capacity. In essence, this approach divides up the natural monopoly facility into a number of smaller parts – and the users of those parts can compete with each other.

77. It is not entirely clear to me why these approaches are not more used in other industries. In telecommunications, for example, why are interconnection charges not based primarily on the capacity of the interconnection link, with a low or zero marginal charge for a call? A recent OECD paper on interconnection charges in telecommunications made this comment:

“In relation to cost-orientation principles, new entrants are arguing that the current per-minute based interconnection charges should be replaced by capacity-based interconnection charges related to the capacity of the facilities used to provide terminating service. According to the capacity based interconnection charging system, new entrants are charged by their contribution to peak demand in the network which really determines the capacity of networks. Up until now, there is no Member country which uses a capacity based interconnection charging system”\(^{19}\).

78. In 1995, Mercury in the UK proposed the use of a capacity-based charging system for the UK telecommunications industry, as discussed in the next box.

<table>
<thead>
<tr>
<th>Capacity-Based Charging for Telecommunications: Proposal of Mercury(^{20})</th>
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</table>
| In 1995 Mercury (a new entrant operator in the UK telecommunications market) proposed the setting of interconnection charges on the basis of a two-part tariff, with fixed costs proportional to the level of pre-booked capacity and zero marginal costs (up to the capacity limit).

Mercury argue as follows: “British Telecom plans and dimensions its network to permit customers to make |

\(^{18}\) In the case of multiple products, the same principles apply. Assume that we know the quantities that will be consumed given the efficient structure of final prices. Then, the two-part tariff is chosen with marginal access prices equal to marginal costs. The payment of a share \(x\) of the total fixed costs entitles the downstream firm to a share \(x\) of the total quantities. The downstream firm can then set its final prices using Ramsey principles.

\(^{19}\) OECD (2001b), page 22.

\(^{20}\) This information is drawn from a Touche Ross report, “Capacity Based Charging for Interconnect and Effective Competition”, March 1995.
calls when they want to, rather than queuing for a free line or waiting for a less busy period. Aggregating the demands of all the customers gives a period of the day when there will be the highest demand: they busy period. It is for this period that BT has to plan and dimension and put in place adequate capacity, hence it is in this period that BT incurs the vast majority of its network costs.

Interconnecting operators add to BT’s demands on its network and cause BT to incur costs. Following the logic of the previous paragraph, the costs they incur are, on the whole, to put in place more capacity in the busy period. The interconnecting operator should pay for this hence the interconnection cost structure should be based on a charge for the capacity required by that operator in the busy period”.

Under Mercury’s proposal, interconnecting operators would book capacity at “charging points” along a notional path between the points of entry to and the points of exit from the rival operator’s network. These charge points would include different types of switch and inter-switch transmission. The unit capacity charges for each of these charge points would be determined annually in advance. The interconnecting operator’s capacity payments for each charge point would be the unit capacity charge for the charge point multiplied by the amount of capacity at that charge point booked at the peak time by the operator. The network would be monitored in real time to determine actual usage levels and to determine whether actual usage levels exceed the pre-booked capacity.

If operators exceed their pre-booked capacity they could either lose the remaining calls, or be forced to pay financial penalties. At the time of writing (1995) Mercury believed that the level of monitoring required to determine in real time, levels of traffic flows due to individual operators was not possible. Mercury discuss the problem of over-booking by large incumbent operators (who have an incentive to book all available capacity to keep it out of the hands of rivals. Finally, Mercury discuss the administrative burden involved. The point out that a cable operator which interconnects with British Telecom at a single point would need to make up to 1200 capacity bookings (one for each terminating exchange) for each hour of the day for the forthcoming 12 months. For a national network operator the task would be even greater. Mercury points out, however, that under the existing (pence per minute) charging system, it already provides quarterly busy hour erlang and call-attempt forecasts by number group to BT.

Mercury conclude that capacity based charging has the key advantage of allowing competing operators to break away from the structure of BT’s retail tariffs and pence per minute charging is not preferable to capacity based charging on any of the other criteria.

79. It is also worth noting access prices can, under certain circumstances enhance downstream competition. For example, some countries choose to adopt a form of geographically-averaged pricing for natural gas transmission networks. Although geographically-averaged pricing (also known as “postage stamp pricing”) has certain drawbacks, it has the effect of enhancing competition between natural gas producers or electricity generators – by essentially eliminating the transportation cost component, the size of the geographic market of each producer is enlarged, enhancing competition in these competitive markets.

Ramsey Pricing With Entry

80. Now consider the effect of allowing for the possibility of entry upstream (also known as bypass).

81. The efficient setting of prices according to the principles which we have set out above may require that the prices for certain services be set above stand-alone cost. For example, if a natural monopoly produces two products, one of which has inelastic demand and the other has perfectly elastic demand. Ramsey pricing would require that the service with elastic demand be priced at marginal cost, while all of
the fixed costs of the firm should be recovered through the prices of the inelastic service. If there are any fixed costs associated with the provision of the elastic service, this will mean that the charges for the inelastic service must exceed its stand-alone cost. In other words, if prices are set efficiently according to Ramsey principles there can be incentives for bypass even in the absence of any non-commercial service obligations.

82. Earlier we saw that the problem of inducing efficient entry could be solved through the use of a tax/subsidy mechanism such as a universal service fund. The price of access is then set at cost and the universal service fund is used to distort final prices to achieve whatever other objectives are required.

83. If there are fixed costs which must be covered through final prices and access prices, the same analysis applies, but in this case, rivals are only inefficiently induced to entry upstream when the revenue from certain access services exceeds stand-alone cost. Correspondingly, rivals are only inefficiently deterred from entry when the revenue from certain access services is less than incremental cost. In other words, there is a range over which access prices can vary without fear of inefficient entry. When certain access prices must be outside this range (perhaps due to the presence of non-commercial obligations which force the revenue from some services to be below incremental cost), then there is a risk of inefficient entry decisions. As before, this can be addressed through a separate tax and subsidy mechanism, which taxes those final services for which the corresponding access services would otherwise yield revenue above stand-alone cost and subsidises those services for which the corresponding access services would otherwise yield revenue below incremental cost.

84. In other words, arguments for the use of incremental cost cannot be based solely on considerations of promoting efficient use of the non-competitive facility or the effect on competition downstream. Rather, they are based primarily on preventing inefficient entry upstream. Where other mechanisms exist for preventing inefficient entry upstream, such as an outright prohibition on entry, the efficient outcome could often be achieved more simply by basing access prices on marginal cost.

85. In other markets an outright prohibition on entry will not be possible, such as those markets in which it is not possible to distinguish clearly between the non-competitive and competitive activities. In these markets, a prohibition on new entry would involve drawing an arbitrary boundary around the non-competitive activity, which may include some competitive activities or exclude non-competitive activities, especially if the boundary remains static over time. Rather than risk introducing another regulatory distortion by inappropriately limiting new entry, it may be preferable to place upper and lower bounds on access prices, so that access prices lie between incremental cost and stand-alone cost, and to use taxes and subsidies to adjust final prices back to their efficient levels.

86. Where taxes and subsidies of this kind are not possible, access prices must arbitrate between the competing objectives of efficient pricing and efficient entry. As a general rule, this will lead to access prices being lowered when they are above stand-alone cost and raised when they are below incremental cost, with the degree of adjustment depending on the responsiveness to entry to slight changes in the access prices.

Price Caps: The Exercise of Discretion and Limits to that Discretion

87. So far we have focused on regulating individual access prices. Some of the mechanisms that we have discussed involve gathering a substantial amount of information about the characteristics of both cost and demand. In many circumstances the regulated firm will have better information than the regulator about costs and demand. An important issue in the theory of regulation of a multi-product monopolist is the question whether it is possible to allow the regulated firm some discretion in the setting of its prices, to
allow it to exploit that additional information, without either capturing monopoly rents or acting anti-competitively.

88. The most common form of discretion is to allow the firm to adjust its prices subject to a simple linear constraint – known as a price cap.

89. It is possible to demonstrate that even if the regulator has no knowledge of the costs and demands of individual services, then (provided the firm has this information) if the firm has flexibility to set its prices within a simple linear constraint and if the weights in the linear constraint are set correctly (in proportion to the quantities demanded at the resulting prices) then the resulting prices are just the efficient Ramsey prices. In other words, by allowing the regulated firm discretion to set its prices subject to a simple linear constraint, then the efficient outcome can be achieved even when the regulator has very limited information about cost and demand.

90. Is it the case that allowing the firm some discretion in setting its prices is always desirable? Armstrong and Vickers (2000) analyse this problem and come to the conclusion that some form of discretion is desirable when there is uncertainty over cost, but not necessarily when there is uncertainty over demand. The problem is that the regulated firm likes to charge higher prices in larger markets, whereas Ramsey pricing may demand lower prices in those markets if the elasticity is higher.

91. What does this imply for access pricing? Well, subject to the caveats just mentioned, serious consideration should be given to granting the regulated firm some discretion in the setting of its access prices. In particular, consideration should be given to not regulating individual access prices, but merely regulating an overall basket of access prices. Indeed, this basket of prices could also include the prices of the final products of the regulated firm. Laffont and Tirole (1994, 1996) have proposed the use of what they call a “global price cap” which is essentially a cap on a basket of prices including both the final prices and the access prices of the firm.

92. The essence of the proposal is that access services should be treated like final services and included within the overall cap on the firms prices. The weights used in the computation of the price cap should be exogenously determined and proportional to the forecasted quantities of the associated goods.

93. They argue as follows:

“A global price cap includes both access charges and final good prices. By decentralising price decisions, including those relative to access, a global price cap implements the optimal Ramsey price structure (that is, the prices that minimise the social cost of charging prices differing from the services’ marginal costs in order to cover the firm’s fixed costs) conditional on the firm’s knowledge about its demand and cost structures and does not require the regulator to measure marginal costs or estimate demand elasticities.

The key insight is that the inclusion of access prices in the price cap re-establishes the symmetry between access goods and final goods, and partly reconciles the firm with the existence of competition. The firm is led to view its competitors’ output as an output of its own, that it partly produces (in the bottleneck segment) and partly outsources (in the competitive segment) if it is efficient to do so.

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21 Allowing some discretion to the firm may also reduce welfare depending on how the firm is regulated. Although, if the weights in the price cap are set optimally, the efficient outcome can result, if the weights are set in some other way (for example, if they are set so that the firm faces a cap on its average revenue), then it the firm may have an incentive to price discriminate in a way which reduces overall welfare. See Vickers (1997), page 22.

Laffont and Tirole emphasise that access and final prices should be regulated symmetrically. “The very debate about access pricing reflects the general view that intermediate and final goods are to be treated asymmetrically. A global price cap denies the specificity of access goods.” One of the benefits of treating access and final prices symmetrically is that it eliminates the incentive to restrict or deny access. Earlier we saw that when access prices are regulated more strictly than final prices, the regulated firm has a strong incentive to deny access. On the other hand, we saw that when final prices were regulated more strictly than access prices there was an incentive to withdraw from the downstream activity and focus on providing access. The global price cap, by treating access and final prices symmetrically neither pushes the incumbent to restrict access nor to withdraw from the downstream activity.

Given that the global price cap yields Ramsey prices we can recall the earlier results. In particular when the cost of providing access does not depend on who uses that access, when the network operator and its rivals are equally efficient on the competitive segment and when all firms face the same downstream demand, then a firm facing a global price cap will choose prices which satisfy the ECPR.

Laffont and Tirole acknowledge that there are circumstances under which the incumbent might have an incentive to exercise its discretion under the global price cap to force out entrants. To address this concern, they propose combining the global cap with an additional constraint that prevents the incumbent from setting its final prices too low relative to the access prices – specifically they propose using the ECPR as a price floor for final prices to prevent the incumbent engaging in predatory pricing.

Note that where the control of entry is important it will generally not be possible to use a price-cap of this form (as the access prices will typically be distorted away from the underlying cost and may exceed stand-alone cost or be lower than incremental cost). However, it is conceivable that it might be possible to set the access prices equal to marginal cost and to establish a tax/subsidy mechanism (as described earlier) and then to decentralise the decisions as to the levels of tax/subsidy on each product.

**Incentives for Cost Minimisation**

Up until this point we have assumed that the costs of the incumbent firm are fixed. In practice, these costs depend on the efforts of the incumbent to reduce costs to a minimum. These efforts are not typically observable. Another possible objective for access pricing policy is therefore to create incentives for cost minimisation while not giving up excessive rents to the incumbent.

Laffont and Tirole (1994) show that the access pricing and incentives issues can, under certain conditions be separated. In other words, it is possible to set the access prices according to the principles set out above, while using other tools to address cost-minimisation incentives. In particular, the most important tool that regulators have to address incentives is the share of the benefits from cost reductions that the incumbent is allowed to capture. At one extreme, the regulator could insist that all of these benefits be passed on to consumers through lower prices. Regulated prices which track closely the costs of the regulated firm provide relatively weak incentives for efficiency. At the other extreme the regulator might allow the incumbent firm to keep all of the benefits of cost reduction, providing strong incentives for cost efficiency.

Laffont and Tirole also argue that where there are other distortions in the market, the access price may also be pressed into service in the pursuit of correction of these other distortions. This might involve further trade-offs against the objectives listed above. For example, if there is imperfect competition downstream, so that downstream prices are marked-up above marginal cost (including the access price), this distortion may be reduced by lowering the access price (at the cost of raising some other final prices). The access price might also be lowered to subsidise entry (when there is a fixed cost of entry and the social benefits of entry exceed the private benefits).
100. In practice, this comes down to questions such as the nature of the formula which fixes overall prices, the extent to which the regulated firm is allowed to pass on certain costs and the lag between the resetting of price-adjustment formulas. These issues go beyond the scope of this paper. Access policy makers should nevertheless consider the question of incentives for efficiency, how price-adjustment formulas will be fixed and the delays between adjusting these formulas.

Summary

101. The following table summarises some of the key conclusions of this paper:
Table 2: Summary of Some Key Results

<table>
<thead>
<tr>
<th>When the objectives are:</th>
<th>And the instruments available are:</th>
<th>Prices should be set as follows</th>
</tr>
</thead>
<tbody>
<tr>
<td>Efficient pricing&lt;br&gt;(no need to recover fixed costs)&lt;br&gt;(no other distortions to pricing) and with or without need to control entry / bypass</td>
<td>(no special instruments)</td>
<td>Marginal cost pricing: Final prices and access prices set equal to marginal cost: $p_2 = c_2 + \hat{c}_2, a = c_2$</td>
</tr>
<tr>
<td>Efficient pricing&lt;br&gt;Recovery of fixed costs&lt;br&gt;(no other distortions to pricing)&lt;br&gt;(no need to control entry/bypass)</td>
<td>Lump-sum taxes</td>
<td>Marginal cost pricing</td>
</tr>
<tr>
<td>(no special instruments)</td>
<td>Prices must trade-off the efficiency objective and the cost-recovery objective. The result is Ramsey pricing: $p_2 = c_2 + \hat{c}_2 + \frac{\lambda}{1 + \lambda} \tilde{p}_2$ (possibly achieved through the decentralising the price-setting decisions to the regulated firm subject to a global price-cap).</td>
<td></td>
</tr>
<tr>
<td>Two-part / non-linear pricing&lt;br&gt;Discrimination between customer classes</td>
<td>Ramsey pricing may be able to achieve the efficient outcome in which prices are set at marginal cost for elastic services</td>
<td></td>
</tr>
<tr>
<td>Taxes and subsidies&lt;br&gt;(universal service fund)</td>
<td>Final prices should be set according to Ramsey pricing – access prices can be fixed independently of final prices</td>
<td></td>
</tr>
<tr>
<td>Efficient pricing&lt;br&gt;Distortions to pricing which are either revenue neutral or revenue-enhancing&lt;br&gt;(no need to recover fixed costs)&lt;br&gt;(no need to control entry)</td>
<td>(no special instruments)</td>
<td>Prices which are related to the distorted price (including the related access service) should be distorted as well, according to the general ECPR formula: $a = c_2 + \sigma_{21} (p_1 - c_1 - \hat{c}_1)$</td>
</tr>
<tr>
<td>Taxes and subsidies&lt;br&gt;(universal service fund)</td>
<td>Final prices which are related to the distorted price should be distorted as well $p_2 = c_2 + \hat{c}<em>2 + \sigma</em>{21} (p_1 - c_1 - \hat{c}_1)$ Access prices can set independently of final prices</td>
<td></td>
</tr>
<tr>
<td>Efficient pricing&lt;br&gt;Distortions to pricing which lower revenue overall&lt;br&gt;(no need to recover fixed costs)&lt;br&gt;(no need to control entry)</td>
<td>Lump-sum taxes</td>
<td>same as above</td>
</tr>
<tr>
<td>(no special instruments)</td>
<td>Prices are given by an expression which includes a Ramsey mark-up:</td>
<td></td>
</tr>
</tbody>
</table>
\[ p_2 = c_2 + \hat{c}_2 + \sigma_{21} (p_1 - c_1 - \hat{c}_1) + \frac{\lambda}{1 + \lambda \eta_2} p_2 \]

<table>
<thead>
<tr>
<th>Efficient pricing</th>
<th>Taxes and subsidies (universal service fund)</th>
<th>Access prices should be set equal to cost. Final prices should be adjusted through taxes to satisfy the equation above.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distortions to pricing (whether they lower or raise revenue)</td>
<td>(no special instruments)</td>
<td>Access prices must trade-off efficiency objective and entry objective.</td>
</tr>
<tr>
<td>Efficient entry (no need to recover fixed costs)</td>
<td></td>
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<table>
<thead>
<tr>
<th>Efficient pricing</th>
<th>Taxes and subsidies (universal service fund)</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Recovery of fixed costs</td>
<td></td>
<td></td>
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<tr>
<td>Efficient entry with or without distortions to pricing</td>
<td></td>
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</tbody>
</table>
Part III: Access Pricing in Practice

102. In the light of the above theory, what do we observe in practice in access pricing?

Telecommunications

103. In telecommunications, the “essential facility” is primarily the service of call termination (possibly including call termination on mobile networks when those subscribers are not simultaneously connected to another network) and sometimes the service of call origination. Access pricing is therefore primarily a question of regulating the charge for call termination on fixed or mobile networks.

104. Table 2 in the appendix, drawn from OECD (2001), sets out the broad position of a number of countries in regard to telecommunications interconnection policy. As a broad summary:

- There is virtually universal acknowledgement of the idea that charges must be “cost-based”. In most cases this means long-run incremental cost (sometimes plus a mark-up). The notion of marginal cost pricing is largely absent.
- Charges are typically on the basis of a simple linear, per minute charge. Two-part charges (e.g., different charges for call setup/duration, per call charges or capacity-based charges) seem rare.
- Charges are typically not differentiated according to the elasticity of demand of the calling party – i.e., there is typically no differentiation between business/residential or between customers, but there may be differentiation between termination charges for calls originating from fixed lines and from mobile services.
- Generally speaking, cross-subsidies and funding of universal service goals are not pursued through access prices.
- In the case of interconnection of two local companies, bill-and-keep is sometimes applied.

105. In the light of the above discussion, the use of incremental cost as a price floor makes some sense, given that the boundary between the non-competitive and competitive activities are difficult to define and are evolving in the light of changes in technology. However, this typically implies raising prices above marginal cost, introducing an efficiency loss and potentially creating a competitive advantage for the incumbent. In particular, new entrant companies will be vulnerable to pricing strategies under which incumbents exploit their lower marginal costs, unless incumbents can be effectively forced to behave as though they implicitly face a higher marginal cost. There seems to be substantial scope for moving towards greater use of two-part tariff schemes (as appears to be common in the Internet industry), with the cost of the fixed component proportional to the “capacity” of the service to which the new entrant has access.

Railways

106. In the rail industry, access regulation is primarily a matter of ensuring access by a train operator to track infrastructure which it does not own. In the EU there is typically an attempt to separate rail infrastructure from train operating companies. In the US, Canada and Mexico rail companies are almost always integrated and typically negotiate access on a reciprocal, bilateral basis. Information on the
regulation of access to track infrastructure is available from NERA (1998), Cole and Holvad (2000), ECMT (1998). See also Table 1 in the Appendix. As a broad summary:

- There is wide variation in the extent to which infrastructure charges cover the total costs of the rail infrastructure. While there is full cost recovery in the UK, and some attempt is made to cover some costs in some European countries, in other European countries there is little or no attempt at covering other than marginal costs.

- Many countries use two part charges (although none to the extent of the UK). Some others use variable charges which are raised significantly above marginal cost.

- There is typically relatively little variation in charges according to the demand elasticity of the service.

107. From the perspective of competition, pricing at marginal cost greatly simplifies the task of promoting competition as it eliminates the need for access prices to take into account demand-side information. Indeed the observed lack of variation in charges according to demand-side information may be consistent with marginal cost pricing. Many countries however insist on some cost recovery through access charges. For these countries, there does not seem to be sufficient variation in access charges according to the precise elasticity demand of the downstream customers served. Most countries that use two-part charges have a relatively modest fixed component. For these countries the consequences for downstream competition may be limited, but for the case of the UK, given the magnitude of the fixed charges, it would be surprising if these charges did not have an impact on downstream competition. It would be interesting to determine whether the fixed component of the track access charges in the UK give the train operating company the right to a fixed share of the capacity of a section of the track network.

108. A new track pricing system has been implemented in Germany from the start of 1999, as described in the attached box.

<table>
<thead>
<tr>
<th>Deutsche Bahn track access charges</th>
</tr>
</thead>
<tbody>
<tr>
<td>Under a pricing system introduced in 1998, the track access charges for the DB network have the following characteristics. First, they are differentiated according to the category of the lines (6 categories, reflecting maximum speeds, location of the lines, importance of the lines in terms of traffic) into traffic categories (3 categories: long-distance passenger, local passenger traffic and freight traffic) and line load factors (3 categories). The access prices have a two part structure. Users must purchase a network card whose price depends on the category of the lines and the number of line kilometres to which the user wishes to have access. This card must be purchased every year. In addition, there is a fee per train kilometre. In addition, route users who perform only relatively few train kilometres per year must pay a variable charge which depends only on the train kilometres, the respective network category and the load factor of the lines on which the trains are operated. These charges are considerably higher than the variable price component of the two-part tariff in the previous paragraph.</td>
</tr>
</tbody>
</table>

**Natural Gas**

109. In the natural gas and electricity industry, access issues include important questions about access to the transmission and distribution networks. These networks have natural monopoly elements.

---

110. In natural gas the structure and capacity of a transmission/distribution network depends on the physical location of gas producers and gas consumers and on the volumes of gas demanded. The costs of building and operating a gas pipeline network are largely fixed, with only a small element of the total cost dependent on the volumes of gas transported over the network. Therefore it makes sense to charge for natural gas transportation on the basis of a two-part tariff, with a fixed component proportional to the capacity available to the shipper at peak times.

111. This basic principle is complicated, however, by the fact that the capacity available at any one time depends on the direction of flows in the network. A flow of gas from A to B can be offset by a flow of gas in the opposite direction – from B to A.

112. In practice, natural gas transmission tariffs typically include a substantial fixed component. As one example, the following box highlights the charging structure for British Gas in 1993/94. In North America, 90-95% of the total costs of a pipeline are recovered through fixed (“capacity”) charges.

<table>
<thead>
<tr>
<th>British Gas Charging Formula 1993/94</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total charge is the sum of capacity charges and variable charges for each part of the network. On the national transmission system the fixed charge is 2.058+0.0183D pence per peak day kilowatt-hour per annum, where D is the effective distance covered in the national transmission system. The variable charge is (1003+7.25D)x 10^-5 pence per kilowatt-hour. The effective distance is capped at 692 km with charges over this charged at 25% of the per-km rate. “Backhaul” flows are charged at only 50% of the per-km rate.</td>
</tr>
<tr>
<td>On the regional transmission system, the fixed charge is 1.096+0.0779R pence per peak day kilowatt-hour per annum, where R is the distance covered in the regional transmission system. The variable charge is (666+47.5R)x 10^-5 pence per kilowatt-hour. In the Medium Pressure Distribution system there is a flat fixed charge of 4.983 pence per peak day kilowatt-hour per annum and a flat variable charge of 0.0286 pence per kilowatt-hour. In the Low Pressure Distribution system there is a flat fixed charge of 3.615 pence per peak day kilowatt-hour per annum and a flat variable charge of 0.0190 pence per kilowatt-hour.</td>
</tr>
</tbody>
</table>

---

26 See IEA (1994)
### Appendix A:

**Table 1: Summary of Arrangements for Charging for Rail Infrastructure**

<table>
<thead>
<tr>
<th>Country</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Austria</td>
<td>The body SCHIG has responsibility for financial new and replacement investment in rail infrastructure and collecting infrastructure charges. System of fixed and variable charges (no fixed charges for secondary or narrow-gauge track). Infrastructure charges cover only 40% of investment expenditure. Fixed charges cover 8% of total infrastructure charges in 1998 (down from 27% in 1997). The elimination of fixed charges in 1999 is under discussion.</td>
</tr>
<tr>
<td>Belgium</td>
<td>Infrastructure charges plus government lump sum payment cover investment costs. Infrastructure charges based on variable charges. The charging system starts with a common reference price per train-km (close to marginal cost) multiplied by coefficients related to the commercial value of the track, the technical characteristics of the track, the train weight, the priority of the service and the likely degree of congestion.</td>
</tr>
<tr>
<td>Denmark</td>
<td>Danish National Railway Agency is responsible for infrastructure provision, financed by state funds, less infrastructure charges. There is a system of fixed and variable charges. Fixed charges are low.</td>
</tr>
<tr>
<td>Finland</td>
<td>System of variable charges only, based on gross tonne km, with differences for freight and passengers. For freight there is also a non-distance related charge, equivalent to the heavy vehicle tax.</td>
</tr>
<tr>
<td>France</td>
<td>For about 95% of the network, charges are very low. Substantially higher charges apply to high-speed and suburban routes. Total charges recover about 25% of infrastructure costs. For suburban and high-speed lines there is a monthly fixed charge, a usage charge and a reservation charge (which varies between peak and off-peak). For other lines there is only a usage charge.</td>
</tr>
<tr>
<td>Germany</td>
<td>Only variable charges. Infrastructure charges recover all maintenance and operations costs. Charges per train-km vary according to the type of route, the quality of the route, the type of train (including several distinctions between passenger and freight). These variable charges are relatively high.</td>
</tr>
<tr>
<td>Greece</td>
<td>No rail infrastructure charges (and no rail competition, either?)</td>
</tr>
<tr>
<td>Ireland</td>
<td>No system of infrastructure charges and no rail competition.</td>
</tr>
<tr>
<td>Italy</td>
<td>Ministry of Transport publishes access charges which apply to all train operators. From 2001 subsidies to infrastructure charges are intended to be eliminated.</td>
</tr>
<tr>
<td>Luxembourg</td>
<td>No infrastructure charges yet.</td>
</tr>
<tr>
<td>Netherlands</td>
<td>All infrastructure charges have been set at zero until 2000, with the exception of freight freeways (variable charge per train km only). All rail infrastructure costs are funded by state contributions.</td>
</tr>
<tr>
<td>Portugal</td>
<td>Rail infrastructure charges not yet introduced. Charges will eventually cover all of REFER’s operating costs, though no time frame has been set.</td>
</tr>
<tr>
<td>Spain</td>
<td>No firm proposals for infrastructure charges yet.</td>
</tr>
<tr>
<td>Sweden</td>
<td>Long history of infrastructure charges (since 1989). Infrastructure charges include a fixed charge per axle per year, which varies between rolling stock and intended to mirror road vehicle taxation. Variable charges, reflecting marginal costs, traffic control charges on the basis of train-kms. Total infrastructure charges in 1996 covered maintenance costs and about one seventh of total costs. Fixed charges will be eliminated.</td>
</tr>
<tr>
<td>UK</td>
<td>For the passenger franchises, very large fixed charges and low variable charges. The fixed charges provide about 85% of Railtrack’s total income and cover about 90% of its total costs. There is also a detailed performance incentive regime. For other services (freight services and non-franchised passenger services, including extra services by the franchisees) track access charges are negotiated, with recourse to the Rail Regulator in the event of disagreement.</td>
</tr>
</tbody>
</table>

Source: NERA (1998)
<table>
<thead>
<tr>
<th>Country</th>
<th>Services subject to special regulations</th>
<th>Regulations on Interconnection service charges which are subject to special regulations</th>
<th>Disclosure of standard interconnection offer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Australia</td>
<td>Mandatory access requirements on services through declaration following industry self-regulatory processes or an ACCC inquiry</td>
<td>In case of arbitration, the ACCC has foreshadowed the use of TSLRIC, however, the ACCC reserves the right not to apply TSLRIC.</td>
<td>No. Approved (by ACCC) interconnection agreements are publicly available.</td>
</tr>
<tr>
<td>Austria</td>
<td>Telekom Austria AG and Mobilkom Austria AG interconnection services</td>
<td>Need to be cost oriented. LRIC accounting methodology is applied.</td>
<td>Yes</td>
</tr>
<tr>
<td>Belgium</td>
<td>Belgacom’s fixed interconnection services</td>
<td>Need to be cost oriented.</td>
<td>Yes</td>
</tr>
<tr>
<td>Canada</td>
<td>Interconnection rates are approved by the CRTC</td>
<td>Need to be cost oriented. Interconnection charges are generally based on long run incremental costs plus 25% mark-up. Within exchange local traffic is inter-exchanged on a bill and keep basis. (In terms of local interconnection, CLECs have co-carrier status in relation to the ILECs.)</td>
<td>Yes</td>
</tr>
<tr>
<td>Czech Republic</td>
<td>Ceský Telecom’s fixed interconnection services</td>
<td>Need to be cost oriented.</td>
<td>Yes</td>
</tr>
<tr>
<td>Denmark</td>
<td>Tele Denmark’s fixed interconnection services</td>
<td>Need to be cost oriented. Currently FDC accounting methodology is used with consideration of a best practice assessment. LRAIC accounting methodology will be introduced by the end of 2002.</td>
<td>Yes</td>
</tr>
<tr>
<td>Finland</td>
<td>Sonera’s and the Finnet Group’s fixed interconnection services</td>
<td>Need to be cost oriented. Interconnection charges are basically determined by commercial negotiation between the interested parties. Only when the interested parties fail to reach an agreement, the operators with significant market power have to prove cost orientation of their interconnection charges.</td>
<td>Yes</td>
</tr>
<tr>
<td>Country</td>
<td>Services subject to special regulations</td>
<td>Regulations on Interconnection service charges which are subject to special regulations</td>
<td>Disclosure of standard interconnection offer</td>
</tr>
<tr>
<td>-----------</td>
<td>--------------------------------------------------------------------------------------------------------</td>
<td>------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>---------------------------------------------</td>
</tr>
<tr>
<td>France</td>
<td>France Telecom’s fixed and France Telecom’s and SFR’s mobile interconnection services</td>
<td>Need to be cost oriented. Currently a FDC accounting methodology is used.</td>
<td>Yes</td>
</tr>
<tr>
<td>Germany</td>
<td>Deutsche Telecom’s fixed interconnection services</td>
<td>Need to be cost-oriented. Distance sensitive interconnection charges.</td>
<td>Yes</td>
</tr>
<tr>
<td>Greece</td>
<td>OTE’s fixed interconnection services</td>
<td>Need to be cost-oriented.</td>
<td>Yes</td>
</tr>
<tr>
<td>Hungary</td>
<td>Matav’s fixed interconnection services</td>
<td>No cost-orientation is required. Interconnection charges are determined by agreement between the Minister of Transport, Telecommunications and Water Management and the Minister of Finance.</td>
<td>No</td>
</tr>
<tr>
<td>Ireland</td>
<td>Eircom’s fixed interconnection services</td>
<td>Need to be cost-oriented. The interconnection charges for 2000 will be calculated on the basis of Eircom’s network costs using a bottom-up LRIC model.</td>
<td>Yes</td>
</tr>
<tr>
<td>Italy</td>
<td>Telecom Italia’s fixed interconnection services</td>
<td>Need to be cost-oriented.</td>
<td>Yes</td>
</tr>
<tr>
<td>Japan</td>
<td>NTT’s fixed interconnection services</td>
<td>Need to be cost-oriented. Currently a FDC accounting methodology is used. MPT had a plan to submit a bill in 2000 to introduce a LRIC accounting methodology.</td>
<td>Yes</td>
</tr>
<tr>
<td>Korea</td>
<td>Korea Telecom’s fixed interconnection services, SK Telecom’s mobile interconnection services</td>
<td>Needs to be cost-oriented. Currently a FDC accounting methodology is used.</td>
<td>No</td>
</tr>
<tr>
<td>Luxembourg</td>
<td>P&amp;T Luxembourg’s fixed interconnection services</td>
<td>Need to be cost-oriented.</td>
<td>Yes</td>
</tr>
<tr>
<td>Mexico</td>
<td>Telmex’s fixed interconnection services</td>
<td>Need to be cost-oriented. The bill and keep methodology is applied to interconnection between Telmex and other local network providers.</td>
<td></td>
</tr>
<tr>
<td>Netherlands</td>
<td>KPN’s fixed interconnection services</td>
<td>Need to be cost-oriented. A modified EDC (Embedded Direct Cost) accounting system, mainly based on historical cost but including forward looking cost elements, is used.</td>
<td>Yes</td>
</tr>
<tr>
<td>New Zealand</td>
<td>No service</td>
<td>No sector specific requirement.</td>
<td>No</td>
</tr>
<tr>
<td>Norway</td>
<td>Telenor’s fixed voice interconnection services</td>
<td>Need to be cost oriented. A FDC model is used.</td>
<td>Yes</td>
</tr>
<tr>
<td>Poland</td>
<td>TPSA’s fixed interconnection services</td>
<td>Need to be cost oriented. The incumbent is obliged to justify the proposed accounting rates and the calculation methodology. TPSA’s standard offer is published after the Ministry’s assessment.</td>
<td></td>
</tr>
<tr>
<td>Portugal</td>
<td>PT’s fixed interconnection services, and TMN’s and Telecel’s mobile interconnection services</td>
<td>Need to be cost-oriented.</td>
<td>Yes (PT)</td>
</tr>
<tr>
<td>Country</td>
<td>Services subject to special regulations</td>
<td>Regulations on Interconnection service charges which are subject to special regulations</td>
<td>Disclosure of standard interconnection offer</td>
</tr>
<tr>
<td>-----------</td>
<td>-----------------------------------------</td>
<td>--------------------------------------------------------------------------------------</td>
<td>---------------------------------------------</td>
</tr>
<tr>
<td>Spain</td>
<td>Telefonica’s fixed interconnection services</td>
<td>Needs to be cost oriented. CMT uses LRAIC to determine interconnection charges.</td>
<td>Yes</td>
</tr>
<tr>
<td>Sweden</td>
<td>Telia’s fixed interconnection services</td>
<td>Needs to be cost oriented.</td>
<td>Yes</td>
</tr>
<tr>
<td>Switzerland</td>
<td>All operators (fixed and mobile) with a dominant position in the interconnection market are required to adhere to principles of cost-orientation, transparency and non-discrimination.</td>
<td>Needs to be cost oriented. LRIC is used to the calculation of the interconnection tariffs.</td>
<td>Yes</td>
</tr>
<tr>
<td>Turkey</td>
<td>No</td>
<td>-</td>
<td>No</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>British Telecom’s interconnection services which are deemed not competitive in the marketplace. Vodafone’s and BT Cellnet’s mobile interconnection services</td>
<td>Needs to be cost oriented. Price-caps are imposed on BT’s non competitive interconnection services.</td>
<td>Yes</td>
</tr>
<tr>
<td>United States</td>
<td>LEC’s inter-LATA interstate access charges are subject to the jurisdiction of the FCC and are set forth in tariffs filed with the FCC. LEC’s inter-LAT intrastate access charges are set by the state commission. Local interconnection charges are set through commercial negotiation under pricing guidelines established by state commissions.</td>
<td>Needs to be cost based. Inter-LATA interstate access charges are subject to a price cap regime. Inter-LATA intrastate access charges are subject to price caps or rate-of-return regulation. Local interconnection charges are, in most cases, set by TSLRIC.</td>
<td>Yes</td>
</tr>
</tbody>
</table>

*Note:* The second column ("Services subject to special regulations") presents services which are currently subject to special interconnection regulations. Thus, the list of regulated services can be increased or decreased by regulators’ designation of SMP operators.

*Source:* OECD.
### Table 1: Regulatory reform in the electricity supply industry as of 1998

<table>
<thead>
<tr>
<th>Country</th>
<th>Liberalisation</th>
<th>Third Party Access</th>
<th>Electricity Market</th>
<th>Transmission Price Regulation</th>
<th>Consumer Choice Thresholds *</th>
</tr>
</thead>
<tbody>
<tr>
<td>Belgium</td>
<td>none</td>
<td>none</td>
<td>none</td>
<td>cost-based</td>
<td>distribution: 1 MW</td>
</tr>
<tr>
<td>Canada</td>
<td>none</td>
<td>none</td>
<td>Alberta Pool (1996)</td>
<td>cost-based</td>
<td>no choice</td>
</tr>
<tr>
<td>Denmark</td>
<td>Amendment to Danish Electricity Supply Act (1996, implemented 1998)</td>
<td>regulated TPA</td>
<td>none</td>
<td>cost-based</td>
<td>no choice</td>
</tr>
<tr>
<td>France</td>
<td>none</td>
<td>none</td>
<td>none</td>
<td>cost-based</td>
<td>no choice</td>
</tr>
<tr>
<td>Germany</td>
<td>Act on the Supply of Electricity and Gas (1998)</td>
<td>negotiated TPA</td>
<td>none</td>
<td>cost-based</td>
<td>1998 0 KW</td>
</tr>
<tr>
<td>Greece</td>
<td>none</td>
<td>none</td>
<td>none</td>
<td>-</td>
<td>no choice</td>
</tr>
<tr>
<td>Ireland</td>
<td>none</td>
<td>none</td>
<td>none</td>
<td>-</td>
<td>no choice</td>
</tr>
<tr>
<td>Italy</td>
<td>none</td>
<td>none</td>
<td>none</td>
<td>price cap</td>
<td>no choice</td>
</tr>
<tr>
<td>Netherlands</td>
<td>The Electricity Act (1989)</td>
<td>none</td>
<td>none</td>
<td>none</td>
<td>no choice</td>
</tr>
<tr>
<td>Portugal</td>
<td>none</td>
<td>none</td>
<td>none</td>
<td>cost-based</td>
<td>1998 1 GW</td>
</tr>
</tbody>
</table>


Sources: See Section 3.3 in main text
Appendix B:

Suppose we have a vertically-integrated natural monopoly which produces two services – an access service, which we will label “1” and a final service, which we will label “2”. The access service is sold to a competitive industry which converts it to a final product.

Assume that the marginal cost of producing the access service is \( c_1 \) when the access service is sold to downstream rivals and \( c_2 \) when sold internally to the integrated firm. The marginal cost of the downstream activity of the integrated firm is \( \hat{c}_2 \) and the marginal cost of the rivals in the competitive activity is \( \hat{c}_1 \).

The price of the rivals downstream final service is \( p_1 \) and the price of the integrated firm’s final service is \( p_2 \). The access price is \( a = p_1 - \hat{c}_1 \). Demand for rivals’ final services given the final prices is \( D_1(p_1, p_2) \). Finally, demand for the incumbent’s final services is given by \( D_2(p_1, p_2) \).

Consider first the problem of maximising social welfare given by producer surplus (industry profit) and consumer surplus. This expression is:

\[
\sum_i (p_i - c_i - \hat{c}_i)D_i(p_1, p_2) + CS(p_1, p_2)
\]

The first-order conditions are:

\[
\sum_i (p_i - c_i - \hat{c}_i)\frac{\partial D_i}{\partial p_j} = 0
\]

Where \( \frac{\partial D_i}{\partial p_j} \). In the absence of any other constraints, social welfare is maximised by marginal cost pricing \( p_1 = c_1 - \hat{c}_1, p_2 = c_2 - \hat{c}_2, a = p_1 - \hat{c}_1 = c_1 \). Now, if for some reason \( p_2 \) is constrained to be different from cost then the first order condition for \( p_1 \) gives:

\[
p_1 = c_1 + \hat{c}_1 + \sigma(p_2 - c_2 - \hat{c}_2)
\]

Where \( \sigma = -D_{21}/D_{11} \). So, \( a = p_1 - \hat{c}_1 = c_1 + \sigma(p_2 - c_2 - \hat{c}_2) \). I.e., the access price is the marginal cost of access plus a correction reflecting the distortion in the other price.

Suppose now that the access prices must produce enough funds to cover the fixed costs of the access service. In this case the problem is one of maximising social welfare subject to producer surplus being non-negative. Solving the lagrangian for this problem gives:

\[
p_1 = c_1 + \hat{c}_1 + \frac{\lambda}{1 + \lambda} \left( D_{11}D_{22} - D_{12}D_{21} \right)
\]

\[
p_2 = c_2 + \hat{c}_2 + \frac{\lambda}{1 + \lambda} \left( D_{21}D_{12} - D_{11}D_{22} \right)
\]

It is possible to write this as:

\[
a = p_1 - \hat{c}_1 = c_1 + \sigma(p_2 - c_2 - \hat{c}_2) + \frac{\lambda}{1 + \lambda} \frac{D_1}{D_{11}}
\]

In other words, as before the access price is corrected for the distortion in the other price, plus a correction corresponding to its own-price elasticity of demand.
When demands are independent \( D_{21} = 0, D_{12} = 0 \), this reduces to:

\[
p_1 = c_1 + \hat{c}_1 + \frac{\lambda_{D_1}}{1 - \lambda} D_{11}, \quad p_2 = c_2 + \hat{c}_2 + \frac{\lambda_{D_2}}{1 - \lambda} D_{22}
\]

Which is just the standard Ramsey pricing formulas, based on own-price elasticity.

Now, suppose demand is linear and given by the following equations: \( D_1 = A_1 - bp_1 + dp_2 \) and \( D_2 = A_2 + dp_1 - bp_2 \) where \( b > 0, d > 0 \) and \( b > d \). In this case we can subtract the two equations above to give:

\[
(p_1 - p_2) - (c_1 + \hat{c}_1 - c_2 - \hat{c}_2) = \frac{\lambda}{1 - \lambda} \frac{1}{(b - d)} \left((p_1 - p_2)(b + d) - (A_1 - A_2)\right)
\]

\[
\Rightarrow (p_1 - p_2)(1 - \alpha(b+d)) = (c_1 + \hat{c}_1 - c_2 - \hat{c}_2) - \alpha(A_1 - A_2)
\]

where \( \alpha = \frac{\lambda}{1 - \lambda}(b - d) \) and \( \alpha < 0 \) and \( (1 - \alpha(b+d)) > 0 \).

Now, if demand is perfectly symmetric \( (A_1 = A_2) \) and the cost of supplying access is the same whether it is to the incumbent or to the rivals \( (c_1 = c_2) \), then the access price given by:

\[
a = p_1 - \hat{c}_1 = p_2 - \hat{c}_2 + \beta(\hat{c}_1 - \hat{c}_2) \text{ where } \beta < 0
\]

In other words, if the costs of downstream rivals and the integrated firm are the same in the downstream activity \( (\hat{c}_1 = \hat{c}_2) \) then the access price is equal to the “implicit access price” (the price the integrated firm pays to itself to provide the access service) \( a = p_1 - \hat{c}_1 = p_2 - \hat{c}_2 \).

More generally, if the downstream rivals have higher costs than the integrated firm, \( (\hat{c}_1 > \hat{c}_2) \) the access price is lower than the “implicit access price”: \( a = p_1 - \hat{c}_1 < p_2 - \hat{c}_2 \).

Finally, if the costs of the downstream rivals and the integrated firm are the same, but the integrated firm has some captive customers \( (A_1 < A_2) \) then, from the equation above, \( p_1 < p_2 \), so, again, the access price is lower than the “implicit access price”: \( a = p_1 - \hat{c}_1 < p_2 - \hat{c}_2 \).

Consider now the effect of a price cap. Suppose that the monopolist can choose prices subject to the cap \( w_1 p_1 + w_2 p_2 \leq \bar{P} \). Maximising profits subject to this constraint gives:

\[
p_1 = c_1 + \hat{c}_1 + \frac{(\hat{\lambda} w_1 D_1) D_{22} - (\hat{\lambda} w_2 - D_2) D_{21}}{(D_{11} D_{22} - D_{12} D_{21})}
\]

\[
p_2 = c_2 + \hat{c}_2 + \frac{(\hat{\lambda} w_2 - D_2) D_{11} - (\hat{\lambda} w_1 - D_1) D_{12}}{(D_{11} D_{22} - D_{12} D_{21})}
\]

Clearly if we choose the weights to be proportional to the quantity demanded at the efficient prices \( (w_1 = k D_1 \text{ and } w_2 = k D_2) \) then we have the same equation as before:
\[ p_1 = c_1 + \hat{c}_1 + (\lambda k - 1) \frac{(D_1 D_{22} - D_2 D_{21})}{(D_1 D_{22} - D_{12} D_{21})} \]
\[ p_2 = c_2 + \hat{c}_2 + (\lambda k - 1) \frac{(D_2 D_{11} - D_1 D_{12})}{(D_{11} D_{22} - D_{12} D_{21})} \]

In other words, when the weights in the price cap are chosen proportional to the quantity demanded at the efficient (Ramsey) prices, the monopolist will choose the efficient Ramsey prices. This implies (as derived earlier) that in the case when the demands are independent, the prices are the simple Ramsey prices based on own-price elasticity. In the case when demand is symmetric the prices satisfy the ECPR.
References:


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