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MARKUP PRICING FOR INTERCONNECTION: A CONCEPTUAL FRAMEWORK

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1. INTRODUCTION

Profound changes in technology and the rapid growth in telecommunications markets have created conditions in which production of most telecommunications services by competitive suppliers can now be presumed to be little, if any, more costly than monopoly production. In these circumstances, the earlier goal of regulation—to protect consumers against monopoly exploitation—should be replaced by the goal of fostering conditions favorable to competition and encouraging efficient markets. As liberalization of the telecommunications sector proceeds, regulatory involvement in telecommunications markets should be reduced to the minimum activities necessary to ensure that those markets are competitive.

The prototypical telecommunications market structure has been a vertically-integrated dominant operator (DO) that supplies a wholesale interconnection service and a variety of retail services. For the DO's retail competitors, interconnection is a bottleneck resource and decisions about pricing of interconnection, more than any other relationship between the DO and other operators, will profoundly affect the terms of telecommunications competition. Continued regulation is necessary to prevent the abuse of market power by the dominant provider and to ensure the supply of interconnection on equal terms to competitors. However, detailed regulation of interconnection pricing would require a regulator to obtain extensive amounts of market information and make judgments among competing operators.

In this paper we critically examine alternative proposals for setting interconnection prices based on markups over the long-run average incremental costs (LRAIC) of interconnection services. Our analysis concentrates on the competitive effects of markups and addresses several of the issues raised in Office of Telecommunications or Oftel (1994) and the interconnection of the dominant U.K. operator, British Telecom (BT), with its competitors. We first discuss the nature of interconnection costs and the types of cost components that could potentially justify cost markups. Then we examine the rationales advanced for alternative types of markups. This leads us to analyze the effects of various markups on the competitive performance of telecommunications markets. We conclude with recommendations.

D. Gabel et al. (eds.), *Opening Networks to Competition*

2. INTERCONNECTION COSTS

We accept LRAIC as the appropriate concept for determining the cost of interconnection services. LRAIC measures the additional cost that would be incurred, using least-cost technology and production methods, in supplying the increment in demand for interconnection services, when all other services are maintained at an unchanged volume. LRAIC can be calculated by using functional models that represent the technological components of a network and the direct costs of its resources. Modeling efforts in the U.S. and U.K. have combined an engineering specification of current technology with economic analysis of the costs of network elements to determine average incremental costs of access services and network usage. We recommend that LRAIC be calculated for each interconnection service (or a bundle of services) over its entire output.

Our approach to LRAIC is practical and is fair to the DO. LRAIC refers to the individual services demanded by the interconnecting operator. Thus, if an operator demands only a dedicated line, the relevant LRAIC would be that of a dedicated line. If the interconnecting operator needs to terminate a call via the DO's local network, the relevant LRAIC would be that of the DO's local network. In the latter case, since the network is used by both the DO and the interconnecting operator, we may interpret the total use of the network as being for interconnection, with the DO imputing interconnection to itself. Our approach to LRAIC is fair to the DO because we do not take, as the increment for calculating LRAIC, only the quantity purchased by the interconnecting operator but, rather, the service itself. In this way, fixed costs and other economies of scale in the production of a service are averaged over the entire output of that service. Similarly, common fixed costs and other economies of scope realized for bundles of services (the "local network") are "averaged" over the bundle. Thus, if one follows this approach, the common costs not captured in LRAIC of interconnection are likely to be small.[1]

An interconnection price equal to LRAIC will just recover the full additional costs of the interconnection services themselves. If interconnection were produced in a perfectly competitive market, LRAIC would become the prevailing price.[2] But when interconnection services are supplied exclusively or predominantly by the DO, additional charges may be justified—for example, to cover common costs. We critically examine these justifications later.

In providing interconnection the DO incurs several distinct types of costs. Conditioning the DO network for competition (including network security measures, numbering changes, and access switching arrangements) is a one-time general cost, and one that is not specific to either a particular competitor or a specific interconnection location. One-time costs are also incurred to establish interconnection arrangements with each interconnecting operator. These two types of non-recurring costs are efficiently recovered in one-off charges.

Variable costs of interconnection are of two types. The first is due to providing sufficient network capacity—switching, transmission, signaling, and related components—to carry the maximum traffic flows to and from the interconnecting operator. The second type of variable costs results from providing accounting, billing and other

services that are directly related to the volume of interconnected calls and vary with the number and duration of calls. In addition, provision of interconnection requires that the DO increase various overhead activities.

Rather than recover the various types of interconnection costs in a single per-unit charge, it is efficient to have a price structure in which the price elements correspond to the activities that are marginal. Thus, the costs of facilities that are dedicated to interconnecting one operator and do not vary with traffic volume should be recovered in one-off charges.

In addition to the direct LRAIC of producing interconnection services, the DO may incur additional costs that need to be financed. Such costs are of three types. They may, first, be caused by interconnection, for example, costs of conditioning the network for interconnection. Second, the result of interconnection may be a reduction of an original source of finance, such as revenues from retail services. Normally, services of the DO and interconnecting operators are either substitutes or complements. Except when there is no cross-elasticity between the interconnection service and the DO's other products, the sale of interconnection will change the demands for some other DO services and affect the DO's net revenue. Third, there may be no better or more adequate source of finance; a possible example is funding of Universal Service Obligations (USOs).

Calculation of LRAIC of interconnection over the entire interconnection service, including the quantity of the service used internally by the DO, will include many of the fixed costs and costs common to several interconnection components. However, there may remain some costs that are common to interconnection and one or more retail services, such as research and development expenditures for network improvements that benefit all services.

2.1 Components of Potential Cost Markups

Several quite distinct types of DO costs could, in principle, be recovered through markups of the direct incremental costs of interconnection. We first enumerate the types and their economic justifications. In a following section we will critically analyze those costs that require further discussion.

Cost inefficiencies. The DO's actual costs of supplying interconnection may exceed least-cost practice if the DO is not operating at the production-possibility frontier and efficient management could consequently supply interconnection at lower cost. Some inefficiencies are embedded in the DO's capital plant and network structure as the result of such factors as past differences between realized and forecasted demands, unanticipated technical advances, and managerial slack.

LRAIC are calculated on the basis of efficient use of current technology and plant and assume that future interconnection services will be provided efficiently. In competitive markets firms are unable to recover costs of past inefficiencies in higher prices. A regulator could review past investment decisions to determine whether costs were prudently incurred at the time they were made, and that they have not yet been recovered elsewhere. An affirmative finding could justify a markup of LRAIC. However, prudency

reviews require costly and time-consuming proceedings that should be one-time determinations, such as those leading to the conditions established at the time BT was privatized.

Historic versus current costs. The accounting charges for capital depreciation differ from the user cost of capital. These differences arise largely from changes in the costs of capital equipment over time that are not correctly captured in accounting depreciation. The differences can go in both directions. Due to rapid technical change, prices of telecommunications equipment have gone down substantially over the past few years. In contrast, the costs of building and laying cable have risen somewhat. Also, some of the older plant in the local loop is almost fully written off, while replacement costs would be substantial. It is quite likely that the various effects are offsetting, so that the difference between forward-looking and historical costs may give rise to neither a markup nor a markdown.

Economies of scope. The DO's total interconnection costs may be less than the stand-alone costs of producing the same volume of interconnection service because some resources are shared in the production of the DO's other services. While we believe that the interconnecting operator should benefit from the DO's economies of scope to the extent that they are not lost due to interconnection, the interconnecting operator may not be entitled to these benefits if it demands only a single unbundled service component or element. In this case, a markup on the LRAIC of this component may be justified for costs common to other components.

The significance of economies of scope is likely to vary with the degree of unbundling. When the interconnection service includes, for example, access to the consumer, local switching, and message transport through the initial levels of the DO network to a competitor's point of presence, common costs will be largely included in the LRAIC of the service. In contrast, if the DO provides a competitor with only a segment of local loop transport, provision of that service could share costs with other local network elements.

Economies of scale. A proportionate increase in the quantities of all DO services may cause a less-than-proportionate increase in total cost and result in some degree of systemwide economies of scale. As explained above, calculating LRAIC on a service-specific basis over the entire output of the service incorporates the product-specific economies of scale that would be observed by measuring the difference in the DO's total costs with and without interconnection. Any further economies of scale are then due to economies of scope between interconnection and other services.

Opportunity costs. When the DO sells interconnection to a competitor it may incur an opportunity cost—a reduction in the profit contribution that the DO (e.g., BT-Retail) would otherwise earn if it had to pay LRAIC for interconnection to itself. The cost components necessary to establish this follow from the DO's relevant definition of profit: revenues minus LRAIC of interconnection minus LRAIC of the other services used by the DO to deliver the replaced demand. These other services would include, but not be limited to, marketing, billing and retail bookkeeping.

Pricing interconnection to recover the DO's foregone profit contribution has been called the Baumol-Willig rule (Baumol, 1983; Willig, 1979) or the efficient component

pricing rule (ECPR). To make this calculation the LRAIC for each of the DO's relevant retail services must be determined. A large fraction of costs is likely to be customer-specific, another large fraction capacity- and call-related, whereas the revenue lost will be per minute and customer-specific. Thus, the opportunity cost will be a blend of costs per minute, costs per customer and capacity costs—and correct implementation of ECPR is going to be highly complex! Moreover, using the ECPR will interfere with pricing interconnection on a capacity basis, because a large part of the opportunity costs is on a per-minute basis.

Universal service obligation (USO) costs. USOs provided by the DO impose a cost burden of serving certain retail customers. If USOs are to be financed by a surcharge on interconnection services, the largest part of USO costs would have to be borne by the DO itself and would therefore lead to markups in the DO's retail prices. Thus, under the ECPR the USO costs would automatically be recovered in the calculated interconnection price. Recovering USO costs through markups on interconnection increases incentives to bypass the DO network and shift usage to suppliers that do not participate in financing USOs.

Access deficit costs (ADCs). Pricing restrictions on the DO's retail services constrain the DO to set prices for retail access services (line rentals, local switched services) below the level a maximizing operator would set if subject only to an overall price constraint. Calculation of ADCs should acknowledge that the reason for granting ADCs is the pricing constraint placed on BT for connection and rental charges. In strictly economic terms, the ADC should be the shadow value of that constraint—the increased profit that would be realized by removing this constraint and otherwise maintaining the overall price cap. If BT is actually not much constrained by the limits on residential tariffs and on business connection and rental tariffs, the shadow value of the constraint is small, certainly much smaller than the access deficit as currently calculated.

2.2 Types of Markups

Constant markups increase all interconnection service prices by the same absolute amount per unit of service.

Proportional markups increase each interconnection service price by the same percentage of the LRAIC of that service.

Ramsey markups increase interconnection service prices by varying amounts so that total demand for the retail service is curtailed by the same percentage in every market. Ramsey pricing requires information on the elasticities of demand for both the DO's final and interconnection services.

A *minimum proportional markup* on LRAIC has been suggested in the Wissenschaftliches Institut für Kommunikationsdienste/European American Center for Policy Analysis (WIK/EAC, 1994) report to the European Commission. It is the minimum factor by which all DO service prices must be proportionally marked up in order to recover costs in excess of LRAIC. It differs in three important ways from the equal markup suggested by Oftel.

First, the minimum proportional markup is calculated by applying common costs or other justified markup items proportionally to all of the DO's systems business. The systems business includes two types of services:

- services for which the DO has to impute interconnection charges to itself. These services are offered as interconnection services to others and are used as inputs to the DO's own retail services.
- other services for which the DO usually would not impute interconnection charges. These services are not available to interconnecting operators and include, in particular, value-added services to final consumers on top of interconnection services. They also include customer connection and the exchange line rental.

Under a minimum proportional markup all of these services are treated equally because they tend to share the same common costs and, therefore, should all contribute to these costs. Some additional DO activities, such as equipment manufacturing and sales of foreign subsidiaries, may also share some common costs with systems business, but the sharing is likely to be negligible in terms of overall numbers.

The magnitude of the equal markup as proposed by Oftel and the minimum proportional markup would be quite similar if the DO had to impute interconnection charges to all of its retail services, but that does not appear to be the procedure envisioned by the consultative document. In order to calculate the minimum proportional markup one would need either the LRAIC of all systems services or the total costs of producing the systems services.

Second, the DO is not limited by the minimum proportional markup from setting higher prices for its retail services, to the extent they are supported by the market and not otherwise constrained by regulation.

Third, the minimum proportional markup serves as an upper bound. The DO may set individual interconnection charges with a lower markup, as we discuss below, but that would not entitle it to a higher than minimum proportional markup for any other interconnection services.

Because the inverse of the elasticity of demand for interconnection services appears in the Ramsey pricing formula, the proposed upper bound for the markup of LRAIC corresponds to a lower bound on the elasticity. The reasoning is that the (super-) elasticity for interconnection services is likely to be higher than the weighted average of the demand elasticities in all the dominant operator's markets. This would be because of bypass opportunities and because entrants seem to target the more elastic market segments.[3] As an upper bound the minimum proportional markup enables the dominant operator to set a lower markup in order to forestall bypass or duplicate networks, or if the elasticity for interconnection services turns out to be very high for other reasons.

The *ECPR* increases each interconnection service price so as to just offset the loss of profit contribution that results from demand that is shifted to retail competitors.

Entry assistance pricing establishes varying markups according to an entrant's market share or other metric of competitive performance.

2.3 Rationale for Alternative Cost Markups

Ramsey pricing is designed to maximize economic efficiency for a vertically-integrated DO in a regulated retail market which produces under some economies of scale and scope and is required to raise all of its revenues through sales (i.e., there are no external subsidies). In this case the DO has to raise revenues beyond LRAIC to cover its total costs, and it should spread this revenue-raising activity over all its outputs. Optimal (economically efficient) pricing requires retail markups on the LRAIC of retail services.[4] It also requires wholesale markups on the LRAIC of interconnection services. The rationale for Ramsey pricing is that all services contribute to a predetermined financial goal in such a way that the allocative distortion is minimized. For the purposes of Ramsey pricing, markups on an intermediate output (interconnection) can be seen as a substitute for (higher) markups on a final output, and the optimal pricing relationship between interconnection and the final output is similar to that between other substitute goods or services.

The *ECPR* would set markups on the LRAIC of interconnection that would recover the opportunity costs of the demand shifted from the DO to the interconnecting operator. The proponents' (Baumol, 1983; Baumol and Sidak, 1994; Willig, 1979) argument for this rule is that it would make the dominant operator whole. Thus, the DO would realize the same profit as under continued monopoly provision, and, if one accepts its proponents' view that ECPR is compatible with competition, the DO would have no incentive to behave in an anticompetitive fashion. Furthermore, the efficiency of the ECPR would be achieved because demand substitution would occur precisely when the interconnecting operator is more efficient than the DO in providing its part of the service. Lastly, the ECPR would allow the regulator to implement his preferred pricing in the retail market.

There are two versions of the ECPR. The simple version, most commonly prescribed, takes the DO's markup in the retail market as the opportunity cost component of the efficient component price. The sophisticated version also takes into account the demand relationship between the DO's and the interconnector's retail outputs and the competitive relationship of the suppliers.

The actual efficiency of the simple ECPR rests on several important assumptions: 1) that the DO's retail prices are efficient; 2) that retail service offered by interconnectors is a perfect substitute for the DO's retail service and is produced in fixed proportion to the interconnection service; and 3) that the retail market is characterized by Bertrand pricing. The first assumption is required because the ECPR does not change the retail prices. Hence, it can only lead to an efficient outcome if the DO starts out with efficient prices. The second assumption is required because otherwise the DO would not lose the same amount of retail service that it provides as interconnection service and thus the retail markup would not be the opportunity cost of the interconnection service. The third assumption is required because otherwise the profit contribution lost by providing interconnection instead of the retail service would differ from the retail markup. If all three assumptions were satisfied, Ramsey pricing and the ECPR would be equivalent. In fact, none of these assumptions is likely to obtain in the telecommunications markets.

First, the DO's retail tariffs are very unlikely to be efficient. Indeed, one of the main objectives of competition is to provide consumers with more efficient price options. Thus, the ECPR, as it is usually proposed, starts from the wrong side. If the regulator cannot simultaneously optimize both interconnection and retail tariffs, he should start out determining optimal interconnection charges first and then let the market determine retail tariffs (possibly with price caps for the DO). The rationale here is that the natural monopoly property has shrunk to the interconnection bottleneck.

Second, the retail services offered by interconnectors are not perfect substitutes for the services offered by the DO. Some of them are complements; others are imperfect substitutes. This is already indicated by the fact that interconnecting operators can almost never charge the same prices for similar services as the DO. If cable TV operators or Mercury underprice BT by 20 percent and still do not have to ration their supply, their services cannot be perfect substitutes for those offered by BT. As a result, efficient interconnection charges should be substantially below the simple ECPR values.

Third, classical Bertrand pricing is unlikely to prevail. Interconnecting operators compete with the DO in capacity and pricing, so that Cournot pricing is most likely to result. Again, as a result, efficient interconnection charges should be below the simple ECPR. In today's market circumstances the adjustments to the ECPR that would be required to yield efficient pricing of components would result in lower interconnection charges than those calculated by the simple rule, and would make the telecommunications retail market more competitive.

3. INFORMATION REQUIREMENTS

Obtaining satisfactory evidence to establish and quantify any of the potential components of cost markups will require significant investment of time and resources by both the firms and the regulator. There should be a strong presumption that a candidate markup component be material—large enough to imply a significant minimum proportional markup. All of the types of markups require data on LRAIC of the components of interconnection services. They also require demand elasticities for these services so that equilibrium quantities, and from them total markup revenue, can be calculated. To the extent that economies of scale and scope, historic inefficiencies, access deficits and USOs are to be included in markups, data on these costs are also required for any type of markup.

Absolute and *proportional* markups require no further information. However, ECPR markups and Ramsey markups have substantially similar requirements for additional information.

Ramsey markups require estimates of marginal cost or LRAIC for all retail (as well as interconnection) services, and both own-price and cross-price elasticities of demand for those services. These values pertain to the equilibrium DO quantities after market entry by interconnecting competitors.

Sophisticated *ECPR* markups require almost the same information as Ramsey prices (except that cost and demand data on services that are independent of the interconnection

service are not needed). In addition, it is necessary to establish that the demand in question would be lost by the DO. This means that cross-elasticities of retail demand between the DO and the interconnector have to be determined, as well as the competitive relationship between the rivals.

Laffont and Tirole (1994) have recently observed that a partial price cap (on retail services only) combined with the ECPR will induce the DO to overprice its competitive service and underprice monopoly services. As a result, adding the ECPR to current price caps will systematically bias prices against competition and will tend to perpetuate existing rate imbalances.

As a practical alternative to the extensive information requirements of Ramsey pricing, Laffont and Tirole suggest that a *global price cap* be used to constrain the DO's pricing of both retail and interconnection services. Under a global price cap, the DO would be free to vary both interconnection and retail service prices so long as it did not exceed a regulated maximum average price. In the absence of strategic considerations the DO might then have an incentive to restructure its overall prices in the direction of Ramsey prices. The rationale for this conjecture is based on a similar rationale for a tendency toward Ramsey pricing under monopoly price caps.[5] But pricing interconnection under a global price cap does not eliminate the opportunity for strategic behavior with adverse competitive effects. Under a price cap without constraints on individual service prices, the DO is free to increase prices in the interconnection and monopoly service markets and use the revenues to cross-subsidize its competitive retail service, incurring only small net reductions in profit. If this leads to the exit of competitors, the DO could reap higher net profits from increased prices and a jump in sales in the formerly competitive retail markets even if other prices have to be decreased to compensate. To control such potentially predatory behavior in the US, separate price caps were implemented for several distinct baskets of services, and within a basket maximum annual adjustment bands were established to constrain price changes for individual services.

4. COMPETITIVE EFFECTS

Markups of LRAIC will affect the nature and degree of competition in telecommunications markets. The various types of markups will have significantly different effects on competition in the retail and the wholesale markets. A pricing system that successfully encourages competition will treat all actual and potential participants equally and will protect against abuses of market power by the dominant firm. In practice, the information necessary to successfully implement some types of markups is either unobtainable or available only at considerable cost; as a result, regulatory policies must be based on partial information. In these instances, and when the weight of available evidence does not strongly weigh in favor of one pricing system, we suggest selection of the markup regime that encourages entry and additional competition and minimizes the risk of discrimination by the DO.

Retail market effects. We can think of several regimes when it comes to the effects of interconnection pricing on the retail market. The first regime is the one where the DO's retail prices are taken as given through regulation. This is the most common model for the ECPR. Under this regime, the predominant function of competition is to reduce costs of the value added by the retail service over the interconnection service. Price effects here are likely only if the cost reduction is substantial.

Under the second regime, the DO is permitted some pricing flexibility through retail price caps, but is constrained overall in its retail price level. Here, competition can have the effect of lowering costs and prices but it may also have the effect of increasing prices that are not subject to competition. The latter can happen because price decreases for one services can be traded off against price increases for another service. Price caps with full price flexibility for all retail services may therefore have undesirable consequences. Removing this flexibility moves one back toward the first regime.

The third regime allows the DO to price freely in retail markets where it faces competition and regulates only the prices of monopolistic retail services. If an interconnection regime exists that eliminates barriers to entry in the retail market then this is a desirable regime because it could lead to efficient prices and cost minimization on the value-added of the retail service over the interconnection service. We therefore want to focus our analysis of competitive effects of interconnection markups on this third regime.

Generally, if there are interconnection markups, the marginal costs of the retail services provided by the interconnecting operators are increased by the amount of these markups. To the extent that the DO's and the competitors' retail services are substitutes, selling one unit of retail service forgoes receiving the markup on some amount of interconnection. Thus, the DO's opportunity costs of its retail service are increased as well. In that sense markups need not change the relative positions of competitors in the retail markets.

The effect on retail prices of markups on interconnection prices depends on: 1) the demand relationships between the retail services offered by the DO and the interconnector(s); 2) the technological relationship between interconnection and the retail service(s) (whether fixed or variable proportions), and 3) on the nature of competition in the retail market. We cannot here deal with all possible combinations. Rather, we pick a few that appear to have empirical importance. In particular, we concentrate on the fixed-proportions case because that strengthens the bottleneck aspect. Also, we assume that there are no capacity constraints.

Consider first the case of perfect substitutes and Bertrand competition. This is the case under which the simple ECPR would be optimal if we had started with given retail service prices. Instead, we want to start with a given interconnection price and trace the effect of a markup (in a comparative statics sense) of this price on retail price(s). If Bertrand competition (or perfect competition) obtains and if there were active interconnectors before the increase, the resulting increase in the retail price will equal the increase in interconnection price. The reason is that, under Bertrand competition, price equals marginal costs and the marginal costs of all firms in the market (including the DO's opportunity costs of the retail service) have increased by the amount of the increase in the

interconnection price. Thus, for any given interconnection price, Bertrand competition assures a competitive retail price. As long as the DO sells in the retail market, under Bertrand retail price competition the interconnection price will *look like* the simple efficient component price, although it has been chosen arbitrarily.

Next, suppose that interconnecting operators form a competitive fringe and the DO is dominant in the retail market. In this case the interconnectors will price at marginal costs while the DO will price like a monopolist on its residual demand curve. This situation can only prevail if the interconnectors' costs on their value-added portion are higher than the corresponding incremental costs of the DO and if the interconnectors have an upward-sloping supply curve. As a result the DO will absorb some of the interconnection price increase and the increase in retail price will be less. In other words, the DO will have an additional markup on the retail price and this markup will shrink with increases in the interconnection price. The same will hold under Cournot or Stackelberg competition where the retail price increase will again be less than the increase in the interconnection price markup.[6]

In cases in which the retail outputs are imperfect substitutes, we usually expect the same general pattern of effects from interconnection price changes on retail prices to emerge as under the non-Bertrand cases. In terms of competitive positions, we will have two offsetting effects for imperfect substitutes. The DO's opportunity costs for its retail service(s) will increase less than the increase in the interconnection price markup, because it does not automatically lose a unit of retail sales for every sold unit of interconnection; and the nondominant operators will be able to increase their retail prices relative to those of the DO without losing all customers. As a result of those two effects increases in retail service prices will again be less than increases in interconnection prices. A particularly important case of imperfect substitutes is that the DO's retail services hold advantages of name recognition and perceived quality so that the DO can price its retail service(s) higher than the interconnectors without losing substantial sales.

All cases except homogeneous Bertrand competition have in common that the DO has a markup on its retail service(s) in addition to any markup on interconnection services and that the retail markup is a *decreasing* function of the interconnection markup. Thus, for all these cases interconnection markups below the simple ECPR would be called for. However, if the production of the retail (value-added) services occurs at constant returns and there is free entry into the retail service market, competition for the market will drive the retail price down to marginal cost—the interconnection price plus the marginal cost of producing the value-added service. Thus, the outcome under Cournot competition will be equivalent to Bertrand competition, due to the entry of new firms.

The preceding analysis assumes that the DO does not care whether it earns the same profit from interconnection services or from retail services—in the extreme, this assumption means that the DO would be willing to lose all its retail business to interconnecting operators if they are more efficient. The assumption is unrealistic for two reasons. First, over time the DO would lose its goodwill in the retail market, goodwill that may be quite valuable to the extent that the retail market is not homogeneous. Second, the DO would lose its yardstick for establishing the interconnection price markup. If the DO

does care more about sales in the retail market than in the wholesale market, it will use the markup in the wholesale market to disadvantage its competitors in the retail market. The markup in the wholesale market then provides a price cushion for the DO's retail services.

Goodwill (and other) advantages that the DO has over competitors may enable the DO (a) to shoulder burdens that would come naturally from competition and (b) to behave anticompetitively. The DO can sustain a price difference between its retail services and those offered by nondominant operators. The fact that for some time DOs are able to maintain a price premium means that the ECPR will not produce the efficient outcome.

Therefore, the markup on interconnection charges need not mirror the dominant firm's markup on retail services. A lower markup on interconnection services should not be seen as financial assistance to interconnecting operators (i.e., they still pay more than the LRAIC of interconnection). Rather, it would compensate for advantages that the DO has, and it would be a tool for the regulator to reduce retail tariffs.

The drawback of *constant absolute markups* is that the interconnection services with small values will carry very large percentage markups, raising the cost of entry and impeding competition. When quantities of interconnection services can be measured in more than one way, absolute markups are not uniquely defined, leading to discrimination among entrants.

Proportional markups. If relative markups were the same for all interconnection services, the DO would maintain different markups for different retail services only if constrained by the regulator or if the competitive and demand conditions differed across these retail services. If the regulator held prices for certain retail services below the cost-covering level for nondominant operators, such operators would not enter these markets. Instead, entrants would favor markets where the DO's retail markup exceeds the proportional markup on interconnection prices. An effect of this pattern of market entry (and the expansion of existing non-DOs) is that the DO would be forced to move toward more equal markups for all its services (and to induce the regulator to relax pricing constraints). Thus, proportional markups on interconnection services would carry with them some tendency for a general restructuring of retail prices. However, one should not overestimate this tendency. In the past, non-DOs in the U.K. have faced interconnection markups that did not correspond to the DO's retail markups. This has brought with it significant but not revolutionary retail pricing responses by the DO.

Service-specific markups that vary with the retail service produced by the interconnecting operator can be implemented in such a way that they leave the current retail price structure intact (ECPR). Since such different markups clearly involve price discrimination, they are feasible only to the extent that the conditions for price discrimination are met. In particular, there should be no possibility for arbitrage, so that a nondominant operator in a low markup service should be unable to sell a part of its service (including the interconnection part) to another operator as an input to a service that would otherwise carry a high markup. To enforce service-specific markups the dominant operator or regulator would have to track all interconnecting calls—something that has proved to be expensive, cumbersome and conducive to cheating in the U.S. (the minutes-of-use tracking of interstate vs. intrastate calls). The inefficiencies created by use

restrictions and use discrimination (on leased lines, voice vs. data, etc.) are legion and have severely hampered competition.

The ECPR ties interconnection markups directly to the DO's retail price structure. This substantially curtails the possibilities for price competition by new entrants. Under constant or proportional markups, there is much greater opportunity for competitors to introduce discounting and bundling packages.

Operator-specific markups, with differences based on market share, date of market entry, or type of retail service, act as handicaps in the competitive arena. The U.K. waiver process on ADCs has stipulated that waivers shall not be granted beyond certain market shares (because firms with higher market shares do not seem to need such waivers). However, fully efficient interconnection pricing may suggest that markups should be lowered, the higher the nondominant operator's market share (high shares signaling lower costs of operation, something that should be rewarded). These opposing arguments may signify that markups should be made independent of market shares.

In summary, the type of markup used will have far-reaching effects on the competitiveness of telecommunications markets. Minimum proportional markups provide a practical method of recovering suitably-justified common costs that limit the opportunity of the DO to exercise market power against competitors. Operator-specific markups involve the regulator in handicapping individual competitors. Of the markup alternatives, ECPR most strongly reinforces the status quo, fully protecting the DO from profit reductions due to new competition.

5. RECOMMENDATIONS

We conclude that public policy decisions about interconnection prices should be designed both to induce retail prices that will increase efficiency and to enhance competition in the telecommunications market. The present structure of retail tariffs in the U.K. and a number of other countries is far from efficient and competitors face a vertically integrated operator that is dominant in all markets. Ramsey prices, which would be fully efficient given the requirement that the DO cover costs from sales, would be much more substantially cost-based and would reflect demand elasticities in each market. In contrast, the ECPR would preserve the current, highly inefficient retail prices and establish interconnection prices that impede competition. Minimum proportional markups of LRAIC, which can be viewed as a compromise in approach between Ramsey prices and the ECPR, move toward more efficient prices and encourage competition.

In the context of the consultative document, our analysis leads to the following recommendations:

1. The regulatory process that will set the framework for interconnection pricing should evaluate proposed markups against a standard of promoting economic efficiency and enabling wider competition. The principal thrust of public policy should be to rely on market competition to increase the efficiency of telecommunications markets. Once

markets are opened to entry, other telecommunications operators require interconnection with the dominant operator in order to compete. Prices for interconnection that exceed incremental cost, and retail price structures that do not reflect the imputed costs of interconnection services, sacrifice market efficiency for the purpose of raising funds for the operator which supplies interconnection. To evaluate whether significant common costs, universal service obligations, or other factors justify prices above average incremental costs, the regulator should require a demonstration supported by detailed, substantive evidence. A positive finding should then be weighed against an analysis of the consequent competitive effects in the interconnection and final markets. Only after a clear justification of added costs, a determination that the costs are not more efficiently recovered by other means, and a finding that increased prices do not substantially impair competition should the regulator provide for markups above LRAIC.

2. The structure of interconnection charges should reflect the types of interconnection costs incurred by the DO. Specific costs of facilities dedicated to a single operator should be recovered in fixed or other non-usage-related charges. Network capacity costs should be recovered through capacity pricing or possibly a suitably designed form of peak-load pricing that accurately reflects capacity costs under competitive conditions.

3. The burden of proof of justifying markup amounts in addition to current LRAIC should be on the dominant operator. The DO, which benefits from an information asymmetry vis-à-vis both the regulator and competitor, has a lower cost of supporting a claim for cost markups than a competitor which seeks to challenge a claim. Indeed, only the DO may have access to the requisite data. The operator should be required to support claims of common costs or differences from current LRAIC with a "bottoms-up" analysis and to demonstrate that these costs are not recovered in the prices of other services. A showing of a significant magnitude of costs would be required.

4. ADCs should be phased out. The economic measure of an access deficit is the extent to which pricing constraints limit the DO's profits to less than it could earn within an overall price cap. Any deficit in excess of this value should be eliminated immediately. Any remaining deficit is a temporary cost burden of the DO that will vanish as rate rebalancing proceeds. In the U.K. the DO has already had 10 years to adjust rate structures to meet competition. If the burden were judged to unduly handicap the DO in competition with interconnecting rivals, the preferred relief would be more rapid adjustment of retail rates.

5. USOs should not be financed through markups on interconnection charges. Traffic that bypasses the DO's network would not contribute to USOs financed from markups on interconnection charges, although it may benefit from universal service. Also, in the long run it may be possible to eliminate the whole markup issue altogether if it were not for USOs. Funding of USOs should be based on sector-wide sources of revenue to avoid biasing competition in specific markets.

6. When justified by significant economies of scale or scope, minimum proportional markups calculated on a base of all of the DO's systems business should provide an upper bound for the prices of all interconnection services. Lower interconnection rates are consistent with competition, provided they are reached through arms-length negotiations and are not less than LRAIC. To ensure that the DO does not obtain unfair advantage, it should not impute lower interconnection rates to itself than the most favorable rates offered to a competing operator for significant volumes of service. In practice, the regulator could restrict imputation to the DO of rates based on the average of interconnection rates purchased in the market. A lower imputed rate (but not less than the most favorable market rate) could be justified on a showing by the DO that the benchmark rate is generally available and used at significant volumes. A lower imputed rate would not, however, permit the DO to raise other interconnection rates above the levels determined by the minimum proportional markup.

In a competitive market for interconnection services (and based on competitive markets for retail services) there would be either no markups or markups that would likely be quite the opposite of what ADCs are now. These markups would depend on market demand elasticities and the type and intensity of competition, information that is hardly available *ex ante*. Constant or proportional markups would create the least distortion for competition among nondominant operators and between the DO and nondominant operators across all markets. As a consequence, minimum proportional markups are the best we can do to move in the direction of competitive markets.

7. Regulators should not differentiate markups by operator (or service provider). There should be no waivers for new entrants or small firms. There should be no discrimination in the interconnection market. Entry assistance is not necessary because there is a sufficient number of entrants and markups are likely to be much smaller than current ADCs. In fact, some new entrants provide new services that actually increase total usage of the DO's telecommunications network. But it is almost impossible for a regulator to make such an assessment. Operators, however, should be allowed to negotiate lower markups. The DO, in imputing interconnecting charges to its own retail services, should be limited to terms no more favorable than those negotiated by any interconnector.

The regulator is unable to assess the efficiency of a new operator, so that by giving an operator entry assistance in the form of waivers the regulator may end up assisting the wrong firms. The *market* assists the most efficient firms as long as they are nondominant (whereas a dominant firm can behave anticompetitively and therefore could also succeed even when it is not the most efficient). In contrast to our recommendation, one could argue that the first U.K. entrants (Mercury, the mobile operators, and new entrants since 1991) have benefited from ADC waivers, and, consequently, that new entrants should have the same advantage. But this argument would be tantamount to saying that a change in the situation does not allow for a change in policy.

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NOTES

1. At the same time, unbundling of interconnection services raises issues of allocating costs that are common to the original bundles. Thus, unbundling can add to the markup problem.

2. We are not concerned here with the possibility that, under competition, the interconnection charges may actually vanish. This can happen if inbound and outbound traffic flows are almost equal and transactions costs of pricing interconnection are sufficiently high. However, such a situation would not be perfectly competitive.

3. A further motivation for the suggested minimum proportional markup is that it puts pressure on dominant operators and national regulators to rebalance the retail tariffs in favor of higher prices for local calls, rental and connection.

4. Strictly speaking, Ramsey markups are calculated from marginal costs rather than LRAIC. For practical reasons, we suggest that an implementation of Ramsey markups for interconnection would be based on LRAIC, and for simplicity our discussion makes this assumption.

5. This rationale is based on the mechanism described in Vogelsang and Finsinger (1979).

6. Note that under the assumption of demand homogeneity—except for the Bertrand case—the persistence of a dominant operator presupposes that this operator has lower costs than the nondominant operators.