CHAPTER 7

Efficient Network Access Pricing Rules for Developing and Transition Economies

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The movement for privatization, liberalization, and deregulation extends to developing and transition economies that have reconsidered the former natural monopolies for public services in telecommunications, electricity, gas, and transportation. Parts of these public firms are now viewed as potentially competitive, such as long-distance service in telecommunications and generation in electricity or gas. Other elements—for example, the transmission grid in electricity and the tracks in railways—are still considered natural monopolies and remain regulated.

Management of the interface between the competitive and regulated sectors is crucial for the success of liberalization. The conditions under which competitors can access the regulated sector, which is an essential input for their activities, determine the profitability of entry. These conditions therefore affect the level of competition in the sectors opened to competition as well as the efficient utilization of the natural monopoly elements.

Despite their vital role for the success of liberalization, there are no specific proposals for desirable access-pricing rules for developing economies. This chapter aims to start filling this gap. Some main features of developing countries might call for specific rules. Many developing countries are characterized by the high cost of public funds, poor auditing and monitoring facilities, low transaction costs of corruption, weak counterpowers, weak ability to commit, and inefficient tax systems.[1]

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[1] See Laffont (1996, 1998) for more details on characteristics of developing countries.

The Optimality of the Market Structure

The pricing of interconnection is highly dependent on the market structure. We distinguish three different situations. In case 1, there is vertical disintegration. The firm controlling the bottleneck (the natural monopoly) is not allowed to compete in the provision of services using the bottleneck as an input. In case 2, the firm controlling the bottleneck is one competitor among many providing services that use the bottleneck as an input. In case 3, competition takes place between vertically integrated firms and each firm controls a bottleneck and provides services.

Do the characteristics of developing countries favor a particular market structure? The comparison of cases 1 and 2 rests essentially on a comparison of the economies of scope that vertical integration makes possible and the problems of favoritism it raises. Since the economies of scope are likely to be independent of the characteristics of developing countries (at least for given technologies) and developing countries find it difficult to fight favoritism, there should be a bias toward vertical disintegration in these countries. However, the comparison of cases 2 and 3 rests on a comparison of the fixed costs associated with competition in the provision of the bottleneck and the gains that competition would yield.[2] This comparison is difficult in developing countries, where the high cost of public funds increases the costs of the duplication of fixed costs as well as the information rents of monopolistic provision of the bottleneck.

These comparisons are further complicated by the dynamics of the industry, which may be moving toward case 3, as in the telecommunications industry. Vertical disintegration might in fact slow down the emergence of competition among vertically integrated firms that provide both local and long-distance telephone services. Thus, vertical disintegration might be particularly inappropriate. By contrast, vertical disintegration might be strongly advised if competition in services is introduced for railway tracks, gas pipelines, or the electricity grid. Each case presents a choice between single ownership of the tracks, the pipelines, or the grid, and shared ownership of the bottleneck by the users who agree on rules for using it. The comparison is between the inefficiency of regulation and the free-rider problems of joint ownership. In a country where regulation is easily captured, joint ownership would be the more favorable scenario.

Currently, the main difference between telecommunications and the other industries is that the local network that is a bottleneck for long distance is providing a service of its own for which consumers can compete. For gas, electricity, and railways, consumers are not interested in purchasing separately the service provided by the bottleneck. And, in general, different firms will not provide the

[2] See Auriol and Laffont (1992).

piece of the pipeline, electricity grid, or track that is of interest to the consumer. An exception might occur in railways, where several firms might provide roughly equivalent itineraries. It might be more likely that a different company than the incumbent local telephone company would provide the copper fiber optic line to the consumer, and that this bottleneck would be rented to different users, including local telephone service companies.

Structural Separation and Pricing of Access to Independently Owned Infrastructure

The utility that owns the infrastructure sells wholesale services to other firms, which market final services to the consumers. Here we consider competitive and noncompetitive uses of independently owned infrastructure.

Competitive Usage

The simplest case arises when the n final services are produced by competitive industries at some constant marginal cost. It is as if the utility produced the final services itself at a unit cost equal to its own cost of providing access to the competitive downstream firms plus the latters' unit cost of producing the final services.

The Ramsey formula can be applied to the prices charged for access to the utility's infrastructure and the prices can be decentralized through a price cap on access charges. Ramsey pricing entails the following:

$$\frac{P_k - C_{Ok} - C_k}{P_k} = \frac{\lambda}{1+\lambda}\frac{1}{\hat{\eta}_k} \quad k=1,\ldots,n,$$

where P_k is the price of service k; C_k is the producer's long-run marginal cost of producing the final service, k; C_{Ok} is the long-run marginal cost of access to supply service k; $\hat{\eta}_k$ is the price superelasticity of service k and λ is the shadow price of the utility's budget constraint.

Under competition, $P_k = a_k + C_k$, where a_k is the access price. Therefore, the induced access-pricing rule is:

$$\frac{a_k - C_{Ok}}{P_k} = \frac{\lambda}{1+\lambda}\frac{1}{\hat{\eta}_k} \quad k=1,\ldots,n.$$

Alternatively, we can define the demand for access, D_k, for service k (access k) as:

$$\tilde{D}k(a_1,....,a_n) = Dk(P_1,....P_n).$$

The price superelasticity of the demand for access k is

$$\tilde{\eta}_k = \frac{a_k}{P_k} \cdot \hat{\eta}_k.$$

We obtain a classic Ramsey type of pricing (see principle 1):

$$\frac{a_k - C_{Ok}}{a_k} = \frac{\lambda}{1+\lambda} \cdot \frac{1}{\tilde{\eta}_k} \quad k=1,...,n.$$

Principle 1. *The excess of the access price over the marginal cost of access for service k relative to the access price for k should be inversely proportional to its demand price superelasticity.*

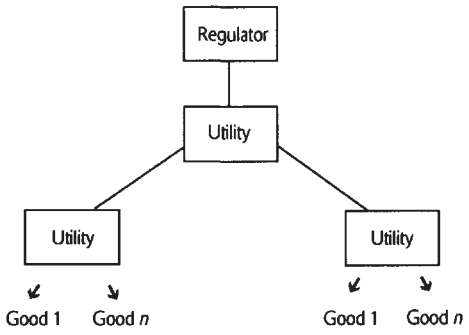
The decentralization of Ramsey pricing by price caps enables the regulator to rely on the demand information of the regulated firm (see warning 1). This is true even if we still have the difficult choice of weights in the price cap.

Warning 1. *In developing countries, for a very competitive usage of the infrastructure, Ramsey pricing of the infrastructure should be based on broad categories of usage that do not raise complex inspection issues and should be decentralized by price caps.*

Figure 7–1 illustrates the typical market structure and raises several informational issues. The demand information is naturally located with the users of the infrastructure. The utility can infer this demand information from the demand for access as long as the users report truthfully the type of final good for which they use the infrastructure. The following examples illustrate the importance of reporting truthful information.

- For railways, each shipper must specify truthfully the content of its cargoes. This additional agency problem may be a serious issue in countries where corruption impacts the inspection system, especially if there is a large number of users, as we implicitly assume in this section.
- For the Internet, pricing independent of usage is still necessary because of the technical difficulties in identifying the type of usage.
- In telecommunications, long-distance carriers that face higher access prices than local carriers may bypass their interconnection by sending traffic directly to a local carrier that benefits from lower access prices.

Figure 7-1. The Typical Utility Market Structure



- In electricity, the pricing of transmission should depend on the demand or supply elasticity at each node of the network. This creates a lot of discretion for the system operator. Therefore, pricing should be based on a single injection price and a single extraction price, that is, prices that reflect easily observable characteristics. Congestion brings the further difficulty of having to rely on nodal pricing that accounts for the externalities due to Kirchoff laws. Again, there should be a uniform price that reflects the local treatment of congestion.

There are technical limits for the best possible use of Ramsey pricing, as well as institutional limits that are needed to curb corruption activities. Laffont and Tirole (1993) show that optimal regulation may require no price discrimination and therefore may entail "political" cross subsidization. Note that decentralization is only partial in the sense that the regulator will still have to make sure that the firms use the correct classification of services into the different categories. Ramsey pricing is often criticized for its informational requirements. Note that price cap regulation does not require the regulator to know the price elasticities. It uses firms' knowledge of these elasticities. Of course, the calculation of the optimal weights in the price cap formula requires the same type of information.

The Market Power of Users

Consider the simple case in which each user is a monopoly in one independent market. The monopoly will charge a monopoly price computed according to the usual formula:

$$\frac{P_k - (a_k + C_{Ok})}{P_k} = \frac{1}{\eta_k}$$

where η_k is the price elasticity of good k. Since Ramsey pricing requires

$$\frac{p_k - C_{Ok} - C_k}{P_k} = -\frac{\lambda}{1+\lambda}\frac{1}{\eta_k},$$

the monopolistic mark-up of the user should be undone by a discount on the access price defined by:

$$\frac{a_k - C_{Ok} - C_k}{P_k} = -\frac{\lambda}{1+\lambda}\frac{1}{\eta_k}.$$

These marginal access charges can be supplemented by a fixed payment to form a two-part tariff, $a_k q_k + A_k$, where q_k is quantity and A_k is a fixed fee, and which ideally can extract the monopolist's profit (see remark 1). More generally, nonlinear pricing can be used.

> ***Remark 1.*** *For competitive usage of the infrastructure, two-part tariffs cannot be used because competition would drive prices to marginal cost and bankrupt users.*

> ***Principle 2.*** *With market power of users, the marginal access charges should subsidize access; users' excess profits should be recovered by fixed charges and more generally by nonlinear pricing.*

Principle 2 requires a lot of knowledge from the regulator and raises issues of favoritism in price discrimination. In the absence of long-term contracts, there is potential for expropriation of some large users' investments. Warning 2 addresses the complexity and potential discretion involved in countries with little technical expertise and low transaction costs of collusion. For example, the control of a user's monopoly power could be undertaken by the regulatory agency or by an appropriate policy of marginal subsidization cum profit tax. The regulator could use a simple price cap regulation. The regulator really needs more instruments, but in general is not given tax instruments and can only very imperfectly achieve multiple objectives with the single instrument of access prices.

> ***Warning 2.*** *In developing countries, the regulator should not attempt to undo the monopoly power of the infrastructure users. Alternative policies should be used to foster competitive use of the infrastructure.*

Additional Problems with Ramsey Pricing

One problem with Ramsey pricing is regulatory capture. That is, when the regulator designs the tariffs, the discretion surrounding the determination of

elasticities raises the problem of capture (when a price cap is used the problem is transferred to the choice of weights). Warning 3 addresses this problem. In practice, the choice of a good starting point is difficult and is generally based on past prices. Expert benchmarking is crucial for the success of developing countries in this task.

> ***Warning 3.*** *A nondiscretionary method for choosing weights in the price cap should be selected (for example, last year's quantities and an exogenous change in the level).*

Another problem with Ramsey pricing is the risk of expropriation. The best and simplest way to strike a balance between rent extraction and incentives for cost minimization is to use price cap regulation with reviews. However, in countries with little credibility, regulation of the rate of return might offer a more reassuring environment. First, in addition to the traditional problems of rate-of-return regulation, the specificities of developing countries (for example, lack of reliable accounting and lack of regulatory expertise) favor price cap regulation. The drawback of giving up too much rent is weakened by the urgent need to attract capital. Second, rate-of-return regulation does not necessarily represent a more effective commitment to fair treatment when the government has little credibility to fulfill its promises.

One-Way Access with Vertical Integration

We consider the case of a vertically integrated utility (the incumbent) that provides access to the infrastructure and that also sells a service using the infrastructure. The problem is to price access for other providers of services using the infrastructure. A situation of noncompetitive entry would require regulation of prices of services. Here we consider the pricing situation when competitive users with constant marginal cost provide a service that is not provided by the incumbent (case a) and when they provide a service that is a close substitute for the service provided by the incumbent (case b).

Let good 1 refer to the service offered by the incumbent with the long-run marginal cost of access for good 1 denoted by C_{01} and the long-run marginal cost of producing good 1 denoted by C_1. Let good 2 refer to the service offered by the competitors with the long-run marginal cost of access for good 2 denoted by C_{02} and the long-run marginal cost of production denoted by C_2. There is no fixed cost in the production of services.

Let a be the access price to be charged to competitors. Ramsey pricing of access leads to:

$$a = C_{O2} + \frac{\lambda}{1+\lambda} \frac{P_2}{\hat{\eta}_2}$$

with $P_2 = a + C_2$ from perfect competition. Alternatively we can write:

$$a = C_{O2} + \delta\left[p_1 - C_{O1} - C_1\right] + \frac{\lambda}{1+\lambda}\,\frac{P_2}{\eta_2}. \tag{1}$$

$\delta = (\partial q_1 / \partial P_2) / (\partial q_2 / \partial P_2)$, where q_1 and q_2 are the retail sales of goods 1 and 2, respectively, δ is the displacement ratio (the change in the incumbent's retail sales divided by the change in its sales to rivals as the access price varies).

In case a, competitors provide new products that the incumbent does not (or cannot) provide. That is, $\delta \approx 0$. For example, the mobile phone industry illustrates this case when the incumbent provides local and long-distance services by fixed link (δ is small). In this case, a global price cap appears particularly promising (principle 3). The cap would take the following form: $\bar{q}_1 p_1 + \bar{q}_2 a \leq \Pi$, where $\bar{q}_1$ and $\bar{q}_2$ are the equilibrium quantities of goods 1 and 2. The global price cap Π would provide good incentives for the owner of the infrastructure to favor interconnection that would increase its business.

> ***Principle 3.*** *If the services provided by users of access to the incumbent do not compete seriously with the services sold by the incumbent, a global price cap should be favored; more generally, regulation of such access should be treated just like regulation of an end-user service.*

However, congestion and inflexible pricing might cause problems in allocating the infrastructure with prices. If rationing occurs, favoritism could be a problem, particularly in developing countries. An example of this problem is an incumbent railway that serves only freight and passenger cars (see the appendix example of Argentina). The problem of favoritism brings up two issues. First, it is important to allow peak-load pricing of access and end-user service symmetrically to avoid favoritism. Second, an increase in the number of users decreases the shadow price of the budget constraint and therefore leads the incumbent to lower the access price.

In case b, competitive users offer services that are very close substitutes for the services provided by the incumbent. Equation 1 shows that the access price should be higher than in case a in order to avoid inefficiency and balance the budget of the incumbent (principle 4). A regulation that does not allow this "competitive" response of the incumbent will create incentives for exclusionary behavior. Examples include telecommunications in Ghana and Colombia (see the appendix).

> ***Principle 4.*** *When entry leads to business stealing, the access price should be higher than the marginal cost corrected by the Ramsey own-elasticity term.*

A good policy would allow an access-pricing rule that is generous for the incumbent and that focuses regulatory resources on implementing quick and high-quality interconnection. The policy could be based on the efficient component-pricing rule: $a = P_1 - C_1$. If data were not available for calculating the incumbent's cost, C_1, in the competitive context considered here, pricing could be based on the marginal cost of the entrants, unless the incumbent can demonstrate that its cost is lower (warning 4).

> ***Warning 4.*** *When competitive entrants offer services that are highly substitutable with the incumbent's services, pricing can be based on the efficient component-pricing rule supplemented by active regulatory oversight to favor nondiscriminatory interconnection. Alternatively, pricing could use a global price cap supplemented by maximum access prices defined by the efficient component-pricing rule.*

Two-Way Access

When network competition develops, reciprocal access charges between networks must be determined. This situation of network duplication is not common in the developing countries considered here, but it may arise in telecommunications and railways.

If final prices are regulated, the networks can negotiate interconnection charges. The regulatory resources can facilitate interconnections and agreements, especially when the networks are asymmetric in size. When the final prices are unregulated, reciprocal access prices should be regulated, but two dangers must be avoided. First, networks might collude on high reciprocal access charges that induce monopolistic final prices (see principle 5). Given that we can expect weak competition among networks, we favor the "bill and keep" doctrine of zero access charges because of its simplicity (warning 5). Indeed, for such situations the access payments wash out whatever the access price, and a low access price encourages competition in the final prices.

> ***Principle 5.*** *When symmetric networks compete in linear prices, the optimal access charges should be below the marginal cost of access to undo the monopolistic competition of networks on final prices.*[3]

[3] This principle assumes that the fixed costs of the network are recovered. Otherwise, principle 5 must be combined with recovery of such costs.

Warning 5. *For symmetric networks competing in linear prices, we favor the "bill and keep" doctrine of zero access charges.*

The second danger is that networks might choose not to be interconnected. Again, regulatory resources should focus on ensuring good interconnection. Theory shows that if networks compete under nonlinear tariffs, the collusion effect disappears and access should be priced at marginal cost. The bill and keep doctrine leads to marginal prices that are too low and to fixed charges that are too high, with high levels of exclusion for consumers.[4] However, such a situation is unlikely in developing countries.

A more difficult situation occurs when networks (fixed and mobile networks) are asymmetric in their marginal costs of access and in size. When networks are of mature size, regulatory resources are likely to be on the high side. In this scenario, a reasonable option would be negotiated access tariffs under the threat of competition policy.

The most difficult case corresponding to the second danger (lack of interconnection of networks) is when a small network tries to enter. The incumbent network is likely to use access charges to block entry. Therefore, it is important to make sure that network competition does not interfere with network development in areas of interest. If network competition, say, in an urban area, is still desired, it must be because large unsatisfied demand exists and the networks may develop without interconnection (for example, the telecom sector in Colombia). At some point the regulator will be able to mandate negotiated access prices with a fallback option of using international benchmarking (see warning 6).

Warning 6. *In the cases where network competition is desirable, mandated negotiation under the threat of arbitration by an international body is an interesting option.*

Conclusion

Recommendations about access pricing—including the optimal use of the network when cost recovery is a constraint—depend on many factors. In practice, further considerations must be kept in mind. First, the type of available accounting information is crucial to assess the workability of cost-based access-pricing rules. In the absence of such data, price cap regulation and international benchmarking are the only possible options.

[4] A menu of tariffs including linear prices might then emerge.

Second, the rules should depend on the other types of instruments available. Often access-pricing rules are also used for accommodating entry. With fixed costs of entry, there is no simple solution to this problem and one should not use access prices for this purpose. Instead, other instruments should be used to encourage entry.

Third, the main entry problem in developing countries is in infrastructure. Access rules should make sure that investors in infrastructure can recover their costs; generous access rules may be needed for this purpose. From this point of view, the obsession with long-run incremental cost goes in the wrong direction.

Finally, nonprice conditions for interconnection are as important as pricing for efficient liberalization. Regulatory attention to these issues by independent technical staff is essential.

Appendix. Pricing Rules in Telecommunications in Selected Countries

Argentina

Argentina was divided into two territories of approximately equal size and each one was assigned to a monopoly regulated by price caps. The northern part of the country (north of Buenos Aires) was awarded to France Télécom and the southern part to Telefónica. As tariffs between the two regions were balanced, interconnection charges washed out and the pricing of interconnection did not matter.

Since fall 1999, competition has been open to many operators. The two incumbents will be regulated with price caps on their initial territory until "competition is a fact." Interconnection charges are negotiated, but the regulator can intervene if deviations from forward-looking incremental costs are important. In addition, if operators do not agree, the regulator will impose a price with reference to the forward-looking incremental cost. Given the uncertainty surrounding this cost, it is possible that the two incumbents will set high interconnection charges to blockade further entry.

China

China first introduced competition in the mobile telephone sector without having any problem of interconnection. Now Unicom, which was initially owned by various ministries and the army, is facing problems in trying to enter the fixed-link market, which is controlled by the incumbent China Telecom. After four years, interconnection agreements have been reached in only three cities; for example, Chongching is not interconnected.

Colombia

A constitutional amendment prohibits monopolies, even public ones. There are several regional public companies offering local telephone service: Bogotá Telecom Company, with 25 percent of the market; Medellín, 10 percent; Cali, 7 percent; and four mobile phone companies.

There appears to be no problem in setting interconnection charges for mobile phones or for long-distance service. The services are sufficiently complementary, so that both operators gain from quick interconnection. However, the access charges might be too high.

When the Telecom and Medellín companies entered Bogotá's local market, access was refused by Bogotá Telecom. Now there are three fixed-linked companies in Bogotá that are not fully interconnected. Indeed, access charges are not included in the price cap on final prices. Access prices are determined by

historical costs according to the fully distributed method. Bogotá Telecom makes no money on access and has all the incentives for exclusionary behavior.

Côte d'Ivoire

Competition has been introduced only in the mobile phone market where prices are unregulated. The operator of the fixed link (Citelcom) has been a monopoly for years and its final prices are regulated.

Here we consider the interconnection agreement between Citelcom and the mobile phone operator, Comstar Cellular, which was accepted by the regulator. Citelcom has committed to the following tariffs (where p_l is the local tariff and p_L is the long-distance tariff):[5]

For a call from Citelcom to Comstar:

Local $p_l = 25 + a_1$, where a_1 is the access price of Comstar
Long distance $p_L = 130 + a_2$, where a_2 is the access price of Comstar.

For a call from Comstar to Citelcom, the access prices are (in CFA francs per minute):

Local $a_1^l = 25$
Long distance $a_1^L = 130$

Citelcom uses an "efficient component pricing rule" if we interpret (a_1, a_2) as the avoided costs of Citelcom. Citelcom's access price equals its opportunity cost of losing a customer:

Local $p_l - a_1 - 25$
Long distance $p_L - a_2 - 130$

Comstar's access and final prices are unregulated. The idea is that the mobile phone market is competitive and the avoided costs of Citelcom are approached by the costs of the mobile phone competitors.

These prices must be contrasted with Citelcom's tariffs (in CFA francs per minute):

Local calls 10
Long-distance calls 180.

[5] We neglect some taxes and some factors taking account of unpaid invoices.

However, given that tariffs are unbalanced, it is not possible to relate the prices of access to Citelcom's costs.

A danger of the efficient component pricing rule for Citelcom is that mobile phone operators collude in choosing high access prices, reducing Citelcom's revenues from the outgoing calls of its own subscribers. However, Citelcom's subsidiary in the mobile telephone sector could maintain a downward pressure on prices. But this is not really the case because competition to attract consumers has no effect on the high charges that consumers of the fixed-linked network have to pay to access the mobile network.

Note that we have focussed on marginal prices. There are fixed parts both in consumer tariffs and in interconnection pricing. Finally, the mobile companies have a zero reciprocal access price, but must pay Citelcom's local access price.

Ghana

Competition was introduced in the telecommunications sector starting in 1992. Three mobile operators entered and developed interconnection agreements with the incumbent, Ghana Telecom, through largely bilateral negotiations. However, as theory would predict, access charges are very high. Ghana Telecom charges cellular companies for interconnection more than its local tariff (note, however, that tariffs are unbalanced). Ongoing disputes surround the issue of sharing revenues from access.

A second license for fixed-linked telephone service was sold to Westel, which has not started its activities. Due to the weakness of the regulator, the future of competition is not assured.

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