Regulatory techniques for addressing interconnection, access, and cross-subsidy in telecommunications

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Section I — introduction

Liberalisation of telecommunications markets worldwide has created the need to interconnect rival networks, prompted regulatory requirements that incumbent service providers provide network access to new entrants,[1] and increased regulatory interest in issues of cross-subsidy. Network interconnection and its pricing are important because of their strong link to the development of competition. Network access allows entrants to expand service more quickly than if they had to duplicate network components that are either costly or effectively impossible to duplicate. Ensuring that cross-subsidy does not occur is important to facilitate efficient competition and protect customers in residual monopoly markets from financing an incumbent's competitive efforts.

Prices and terms[2] for interconnection and access have been the most controversial interconnection issues. Prices are controversial because they affect profitability and the development of competition. In general, higher interconnection and access prices are thought to favour incumbents because higher prices preserve or enhance incumbents' revenue streams and raise entrants' costs. Conversely, lower prices are thought to favour entrants because lower prices mean lower entry costs, allow entrants to use incumbents' networks and pay less than what it would cost the entrants to build their own networks, and decrease incumbents' revenues. Terms for interconnection and access are controversial because they define what it is that service providers receive when they obtain interconnection with another provider's network. For example, terms that require an entrant to obtain interconnection at a high level in the network hierarchy force an entrant with an extensive network to purchase more transport and switching than is necessary.[3]

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[1] This paper uses the term interconnection to include the physical interconnecting of networks and the exchange of traffic. This paper uses the term access to mean the sale of essential inputs. In many jurisdictions, this would be called the provision of unbundled network elements. For purposes of this paper, the company selling the inputs may or may not be vertically integrated into the downstream market.

[2] 'Terms' refers to all non-price aspects of interconnection, such as allowed Points Of Interconnection (POIs) and the settlements process. 'Settlements process' refers to the payment system by which money from retail customers is distributed among service providers and by which service providers compensate each other for interconnection services.

[3] 'Network hierarchy' refers to the levels of switching in a network. In most telecommunications networks, a tandem switch is the highest level of switching and connects lower level switches called central offices. Central offices are the switches that connect directly to customers. Calls between local calling areas generally route through a tandem. If a service provider interconnects at a rival's tandem, then the service provider generally purchases switching at the tandem and the central offices, and

Cross-subsidy enters the debate in two ways. First, there is the issue of how to fund Universal Service Obligations (USOs). Traditionally, incumbents have funded these obligations by charging high prices to some customers (or for some services) and using the profits to fund below-cost prices required by the USO. The second cross-subsidy issue is the amount and type of price flexibility the incumbent should be permitted in markets with actual or emerging competition.

This paper describes tools that regulators have used to address these issues, and the strengths and weaknesses of these tools. In addition to this Introduction, this paper has three sections. The next section describes tools for regulating interconnection and access prices. The third section discusses cross-subsidy issues. The last section is the conclusion.

Section II — interconnection and access

This section describes tools for regulating prices for interconnection and access. A recent international survey of interconnection policies found that all of the countries surveyed expect service providers to negotiate interconnection and access agreements.[4] The scope of the negotiations varies across countries. In Canada, for example, the Canadian Radio-television and Telecommunications Commission treats interconnection and access as normal tariffed services, and requires negotiations for only a few technical details. At the other extreme, New Zealand and Sweden give regulators almost no authority over interconnection and access arrangements. New Zealand has no industry regulator, relying instead upon competition law and the threat of creating an industry regulator to police interconnection. Sweden has a regulator — the Ministry of Transport and Communications — but gives the regulator no authority over interconnection. Sweden limits the regulator's role to expressing opinions on fairness of proposals if negotiations fail.

It remains to be seen whether negotiations have a long-term role in interconnection and access. Some economists have concluded that, once competitive service providers become established, interconnection negotiations will become a vehicle for collusion.[5] This indicates a long-term role for regulation to limit collusion by regulating interconnection prices.

When regulators become involved in interconnection pricing, whether through settling negotiation disputes or through normal tariffing procedures, they generally consider three basic approaches to price setting: (1) the Efficient Component Pricing Rule (ECPR); (2) cost-based pricing; and (3) demand-based pricing or Global Price Caps (GPCs). This section explains these three approaches. Each approach has its own subsection.

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purchases transport between the tandem and the central offices. If this service provider were instead to interconnect at a central office, then the service provider would only purchase switching at the central office and would purchase no transport unless necessary to get from the service provider's network to the central office.

4 Jamison, Mark A., 'International Survey of Interconnection Policies', 31 March, 1998, (unpublished).

5 See, for example, Laffont, J.J., and Tirole, J., 'Creating Competition Through Interconnection: Theory and Practice,' *Journal of Regulatory Economics*, No. 10, 1996, pp 227–256; and Buehler, Stefan, 'A First Look at Interconnection Regulations in Switzerland,' 1998, (unpublished).

Efficient component pricing rule

The ECPR, which is also called the Baumol-Willig rule, recommends that entrants pay incumbents their opportunity costs. In other words, the prices the incumbent would charge to competitors would ensure that the incumbent would make the same amount of profit regardless of whether it succeed in the competitive portion of the market.

The ECPR formula for setting interconnection and access prices (called wholesale prices in the formula) is:[6]

Wholesale price = Retail price - [Retail TSLRIC – Wholesale TSLRIC]

Or alternatively,

Wholesale price = Retail markup (above Retail TSLRIC) + Wholesale TSLRIC

For example, assume an incumbent would receive $200 000 serving a group of customers and incur costs of $130 000 to do so. Further assume that providing interconnection and access to a competitor that would serve these customers would cost $110 000. The set of ECPR-based interconnection prices would be a set of prices that would generate $180 000 in revenues.

The basic theory behind the ECPR is that, if the incumbent receives the same profits from interconnection and access as it does from sales of the retail product, then competitors can enter the market only if they are more efficient in providing retail functions than is the incumbent. The following example illustrates this idea.

Example 1. There are three products — Lines (L), Retail Calls (RC), and Cable Television (CT). Lines are a necessary input RC. So a firm that sells RC must either build L or purchase L. There are two firms, INCTEL and NEWTEL. INCTEL is the incumbent and owns lines.

The costs of producing these three products are as follows: *Cost*(L) = $100, *Cost*(RC) = $200 (which includes purchasing L for $100), *Cost*(CT) = $100, *Cost*(L + RC) = $180, *Cost*(RC + CT) = $275 (which includes purchasing L for $100), *Cost*(L + CT) = $200, and *Cost*(L + RC + CT) = $300. Based on these results, the most efficient market structure is for one firm to produce L and another to produce RC + CT. This market structure costs only $275. This $275 results from adding the costs of L and RC + CT, and netting the $100 payment for L.

In this example, if INCTEL produced both L and RC, the ECPR would set the final product price at $180 and line price at $100.[7] The $100 represents the difference between the total

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6 Explained in more detail below, TSLRIC is an incremental cost concept. It represents the additional cost of providing the current or anticipated volume of a service versus not providing the service in the long run. In other words, TSLRIC includes all of the usage costs and fixed costs that are involved in providing the service and that would not be incurred if the service provider did not provide the service. TSLRIC does not consider forgone profits as a cost.

cost of $180 and the $80 incremental cost of RC. Under the restrictive assumptions of the example, this sends correct price signals to the market because NEWTEL has lower incremental costs for producing RC and is able to reflect those lower costs in its price for RC. NEWTEL's incremental cost of producing RC is $75, net of the $100 payment for L. Because NEWTEL can charge a price for CT that is equal to the $100 stand-alone cost of producing CT, NEWTEL is able to charge $175 for the final product RC. This price is lower than would be INCTEL's price, so the ECPR results in an efficient market structure.

The ECPR's efficiency claim is based on an outdated assumption about telecommunications markets; namely, that new competitors are fringe competitors that can offer only some subset of what the incumbent produces.[8] The ECPR is inefficient if either the incumbent or its competitors cannot charge stand-alone costs for their other products. Modifications to Example 1 illustrate why the ECPR is inefficient in either of the circumstances just described.

Example 2. The first modification to Example 1 is to constrain the maximum price for L. Assume that rivalry creates a $90 maximum price for L.[9] The ECPR would have INCTEL price its products in one of two ways: (1) RC's price would be the $90 maximum price for L plus the $80 incremental cost of adding RC, or $170;[10] or (2) L's price would be RC's $180 price less the $80 incremental cost of adding RC, or $100.[11] Either price structure puts INCTEL out of business regardless of whether it is efficient (even though the firm is inefficient in the example). So the ECPR results in an inefficient market outcome.

Example 3. The other modification to Example 1 is to assume that rivalry creates a $90 maximum price for CT. The ECPR would have INCTEL price RC at $180 and L at $100. NEWTEL must be able to price RC in a way that covers the $100 that it must pay for L, and the remainder of the firm's costs that are not covered by the $90 maximum price for CT. This means that NEWTEL's price for RC is $185. This $185 price is higher than the price the ECPR would have INCTEL charge for RC even though NEWTEL is more efficient. This shows that the ECPR would allow INCTEL to retain the market for RC even thought

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7 Using the first ECPR formula shown on the previous page, the line price would be found as follows: $180 - ($180 - $100) = $100.

8 Willig, Robert, 'The Theory of Network Access Pricing,' in *Issues in Public Utility Regulation*, 109–52, (H. Trebing ed. 1979) at 139.

9 Jamison, Mark A., 'General Conditions for Subsidy-Free Prices,' *Journal of Economics and Business*, 48:371–85, 1996, explains how multilateral rivalry creates this situation.

10 Manipulating the ECPR formula gives this result. From the formula:

Wholesale price = Retail price - [Retail TSLRIC – Wholesale TSLRIC]

We can solve for "Retail price" to obtain:

Retail price = Wholesale price + [Retail TSLRIC – Wholesale TSLRIC]

Then applying the numbers from the example, we obtain:

$170 = $90 + [$180 - $100].

11 Applying the ECPR formula:

Wholesale price = Retail price - [Retail TSLRIC – Wholesale TSLRIC]

gives this result as follows:

$100 = $180 - [$180 - $100].

NEWTEL is more efficient. The efficiency loss is at least the $5 by which INTEL's incremental costs of producing RC exceed NEWTEL's incremental costs of producing RC.[12]

The appropriateness of the ECPR is also based on some other assumptions that do not fit today's markets:

- there are no sunk costs and no monopoly profits[13]
- there is no discrimination against the entrant in price or quality of interconnection
- the margin between the incumbent's input price and retail price reflects the incumbent's economic costs of producing the retail product[14]
- the retail market is homogeneous (i.e. identical products)[15]
- entrants are price takers (i.e. they have no market power)
- regulators are able to perfectly regulate the incumbent.[16]

One advantage of the ECPR is that, because competition would have no impact on the incumbent's profits, the incumbent would be less likely to try to protect markets from competition, except the market for interconnection and access. The interconnection and access markets would become the source of the incumbent's profits. However, with the possible exception of the U.S. policy on setting wholesale prices for resale, no regulator appears to have adopted the ECPR for interconnection or access.[17] And in the U.S., competitors have complained that incumbents are protecting markets, even those where the competition is only from resellers.

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12 INCTEL's incremental cost of producing RC is calculated as:
Cost(L + RC) - *Cost*(L) = $180 - $100 = $80.
NEWTEL's incremental cost of producing RC is calculated as:
Cost(CT + RC) - *Cost*(CT) - *Payment*(L) = $275 - $100 - $100 = $75.

13 Tye, William, 'The Pricing of Inputs Sold to Competitors: A Response,' *Yale Journal on Regulation*, 11 (1994):203.

14 Kahn, Alfred, and Taylor, William, 'The Pricing of Inputs Sold to Competitors: A Comment,' *Yale Journal on Regulation*, 11(1994): 225.

15 Willig, Robert, *supra* at 138; and Armstrong, M., and Doyle, C., *Access Pricing, Entry and the Baumol-Willig Rule*, Discussion Paper No. 9422, University of Southampton (no date).

16 Mitchell, Mitchell; Neu, Werner, et. al., *The Regulation of Pricing of Interconnection Services*, 1995 (unpublished).

17 Jamison, (1998).

Cost-based prices

Regulators' options for cost-based prices for interconnection and access are similar to those for other products — regulators must choose between accounting approaches and economic approaches, and between having some contribution to shared costs and no contribution to shared costs. The difference is whether to include a subsidy amount to cover USO costs.[18]

Accounting approaches include Fully Distributed Cost (FDC) and embedded direct analysis (EDA). FDC allocates and assigns costs by account to service categories. Cost assignments are generally restricted to direct costs. Allocation factors that are generally believed to be related to cost causation and reasonable, form the bases for the cost allocations. Generally the factors are usage measures (volumes of demand). EDA is just like FDC, but without the allocation of corporate overheads.

It is generally believed that FDC simply distributes common costs[19] and that services continue to cover their incremental costs. This is not correct. In reality, FDC distributes all accounting costs, including costs that are incremental to only a single service. This misunderstanding results from accountants and non-accountants using the same words to mean different things. In general usage, direct cost means all of the costs caused by the service (or services) in question and not caused by any others. However, in the context of FDC, direct cost refers to the cost of inputs that are only needed to provide a specific service or set of services, and that have their own identity for accounting purposes; i.e. their own account or sub-account. So, for example, if a company were required to install ISDN lines to satisfy an USO requirement, the lines themselves would not be considered a direct cost of ISDN. Instead, they would be considered either a shared cost or a directly attributable cost. If line costs are considered as directly attributable costs, spreading the company's total line costs across all lines, and then multiplying the result by the number of ISDN lines would estimate ISDN line costs. So if the ISDN lines cost more or less than the company's average line, the costs allocated to ISDN might be less or more than what the company actually spent.

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18 Extensive discussion of these approaches can be found in Mitchell, Neu, et. al. (1995); Arnbak, J. et. al., 'Network Interconnection in the Domain of ONP: Study for the DG XIII of the European Commission,' 1994 (unpublished); and Jamison, Mark, 'A Competitive Framework for Pricing Interconnection in Global Telecommunications Markets,' *Denver Journal of International Law and Policy* 23(3):513–33, 1995.

19 In accounting, common costs are the costs of inputs that are shared by more than one output; e.g. a telecommunications central office switch. In general usage (and in economics), common costs are costs that are not changed if the service or services in question change, including going to zero production. Joint costs are the costs of inputs that, once placed into production, necessarily produce more than one product in fixed proportions. There are very few joint costs in telecommunications. Shared costs is a general term for common and joint costs. There are two types. Shared incremental costs are shared costs that are specific to only some services. For example, some consumer services may have shared costs in consumer billing, but these costs are not shared with business services. Overhead shared costs are costs shared by all services. These are costs that do not change or go away unless the company goes out of business. The classic example is the president's desk, but it's not a perfect example because the desk's cost tends to grow with the company.

Accounting approaches have all of the benefits and suffer from all of the deficiencies of accounting approaches for rate design in general. The general benefits of FDC are that: (1) FDC-based prices add up to the total revenue requirement under rate of return regulation; (2) FDC can be simple to implement, appear fair, and be easy to understand, although the minutia can create bureaucratic inertia; and (3) if costs can be traced, FDC may encourage companies to be responsible for service-specific investments. The disadvantages of FDC are that: (1) it may be unfair because volumes drive cost allocations;[20] (2) there is a lot of discretion, so widely varying results can be justified; (3) costs are historical rather than forward looking; (4) FDC may assign overhead costs to new services that have not yet established a market; and (5) FDC can result in a cross-subsidy.[21]

In the case of interconnection, FDC has an additional deficiency. If accounting costs are much greater than economic costs, competitors end up providing to the incumbent positive cash flows that the incumbent can then use to finance competitive pricing responses. On the other hand, if accounting costs are much lower than economic costs, the interconnection price makes the competitor's services appear to be much more efficient than they really are.

Economic-cost approaches to pricing interconnection and access use either TSLRIC (or TELRIC) or TSLRIC + contribution (TSLRIC+C). To estimate these, analysts use engineering process models to model the way telecommunications firms incur costs. The models isolate service costs by examining how the network changes when services change.

The economic-cost approach, and specifically TSLRIC+C,[22] is the most popular approach for pricing interconnection and access.[23] There may be several reasons for this, but the most prevalent appears to be that this approach promises to prevent discrimination and cross-subsidies. The conventional wisdom is that prices that are cost-based are non-discriminatory and are subsidy free.

However, the real effects of TSLRIC+C are sensitive to the methods used to determine contribution and to estimate the TSLRIC. If the contribution is comparable to what the incumbent can expect from other products on average, then the contribution should be both sustainable and consistent with competitive market outcomes. Basing the contribution on

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[20] Having volumes drive cost allocations creates problems because: (1) customers in non-competitive markets have to carry the full cost of the company if it has problems in competitive markets; and (2) the company's competitive operations have to bear increasing loads of cost if the company is successful.

[21] When two or more services are responsible for the costs in an account, the account is allocated among them based on relative use. The actual costs they cause may be greater than their relative use of the account. For example, if capacity drives costs for central office switching, and a large business customer has primarily peak demand (20% of the total) and very little off-peak demand (only 1% of the total), FDC could allocate only 1% of the central office costs to this customer even though this customer caused 20% of costs.

[22] Prices equal to TSLRIC are unlikely to be sustainable because there is little assurance that they will be subsidy-free. See Jamison, (1996).

[23] Jamison (1998).

Ramsey-pricing principles (a demand-based approach discussed below) may promote allocative economic efficiency if competition does not affect demand elasticities, but may not be sustainable or free of cross-subsidies.

Getting the TSLRIC estimate correct has proven to be very difficult. Typically, the engineering process models estimate the cost of a newly constructed firm established to serve current demand with growth factors to estimate spare capacity for future demand. Implicit in these models is the assumption that the plant constructed is either used for its entire depreciated life, or is part of the growth-based spare capacity for some portion of its depreciated life. These assumptions ignore a common business event — demand either evaporating or diminishing after the plant is placed to serve the demand. Unless this plant is fungible in that it can be immediately be either used to serve someone else or become part of growth-based spare capacity, then the engineering process models underestimate the company's actual economic costs. This underestimate makes shareholders bear all of the risk of projects that do not fit the engineering process model's assumptions. This is a greater risk than occurs under rate of return regulation and generally under price cap regulation.

Demand-based prices

The demand-based approach to interconnection and access pricing uses Ramsey-Boiteux pricing principles to promote consumer and producer welfare. This is also called the **Optimal Access Pricing Rule** or **GPCs**.[24]

With Ramsey-Boiteux pricing, customers are charged different prices based on their responsiveness to price changes. 'Responsiveness' is measured in terms of how much customers change the amount they purchase. Customers who do not respond very much to price changes are said to have inelastic demand. Customers who respond a lot are said to have elastic demand. 'Break even' means that the company's revenues equals its economic costs. This is also called the inverse elasticity rule because prices are increased in inverse proportion to the customer's elasticity of demand. The objective of Ramsey-Boiteux pricing is to deviate as little as possible from the consumption mix that would occur if prices were equal to marginal cost.

There are two demand-based approaches: (1) regulator-set prices (mentioned in the context of cost-based pricing); and (2) GPCs. The regulator-set prices requires knowledge of service provider costs and of demand elasticities for the service provider's and the competitor's markets. GPCs treats interconnection as a product and places it in a global price cap basket with exogenous weights. If exogenous weights cannot be determined, then forecasted demand and estimates of market share may be substituted.

The benefits of demand-based approaches are:

- They promote allocative efficiency if competition does not affect demand elasticities and if the incumbent does not engage in strategic pricing.

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24 See Laffont and Tirole, (1996).

- GPCs eliminate or substantially reduce incentives for exclusion and cross-subsidies.
- With GPCs, increasing the weights can effect lower interconnection prices.
- Prices can reflect (but not equal) marginal costs while also allowing the incumbent to cover its total cost.

The problems with using these approaches are:

- GPCs require price cap regulation of all prices, including prices in competitive markets.
- Entrants must behave competitively for GPCs to work.[25]
- It is unclear how dynamic weight updating should be done with GPCs.
- Customers and politicians often oppose these approaches because they give the highest mark-ups over marginal cost to the customers who have the least ability to protect themselves.
- GPCs allow incumbents to benefit from predatory pricing and cross-subsidy if entrants can be kept from markets by short-lived price reductions in competitive markets.

Section III — cross-subsidy issues

This section describes tools regulators use for preventing subsidies to competitive markets and for funding USOs. These tools involve applications of the ECPR, cost-based pricing, and price caps.

Defining cross subsidy

The first issue to confront on cross subsidy issues is to decide what is meant by cross subsidy. There is often general agreement that cross subsidies are problematic, but there is generally wide disagreement on what constitutes a cross subsidy. There are four basic views, although there are many flavours of each.

- **The public policy view**. From a public policy perspective, cross-subsidisation occurs in a regulated industry when the regulated firm uses revenues from one market to keep operations in another market financially viable. The cross subsidy is considered anti-competitive if the cash flows from non-competitive to competitive markets. The cross subsidy is considered an USO if the cash flow: (1) goes the other way; (2) occurs only because regulatory rules create it; and (3) would not occur absent the government policy and/or if the funding markets were competitive. In a nutshell, the public policy view is that the cash flow is a cross subsidy if fully competitive markets would not allow it.

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[25] Laffont and Tirole, (1996), point out that entrant market power in final product markets distorts optimal pricing. However, this problem may not be unique to global price caps.

- **The cost allocation view**. In more general usage, if a service's prices do not make a reasonable contribution to overhead costs, it could be argued that the service is not carrying a fair share of the overheads and is therefore being subsidised.

- **The Baumol-Faulhaber view**. Baumol and Faulhaber[26] have taken the view that cross-subsidisation occurs when prices for a service do not cover the service's incremental cost and the company still earns a normal profit (i.e. zero economic profit) overall. This implies a maximum price of stand-alone cost. This is a popular view among economists.

- **A more comprehensive economic view**. More recent economic studies have shown that cross-subsidisation occurs when prices for a service are higher than would be charged by the next most efficient competitor and the company still earns a normal profit.[27] A variation on Example 1 illustrates this view.

Example 4. There are three products — lines (L), switching (S), and cable television (CT). There are also two firms, INCTEL and NEWTEL. INCTEL provides L and S, while NEWTEL provides CT. Assume that either can adopt any technology, so that neither has an inherent cost advantage. The costs of producing these three products are as follows: *Cost*(L) = $100, *Cost*(S) = $110, *Cost*(CT) = $150, *Cost*(L + S) = $180, *Cost*(S + CT) = $250, *Cost*(L + CT) = $235, and *Cost*(L + S + CT) = $340. Based on these results, the most efficient market structure is the current market structure — one firm producing L + S and another producing CT. This market structure costs only $330.

Table 1 illustrates the subsidy-free prices for Example 4. The first row shows minimum and maximum subsidy-free prices under the Baumol-Faulhaber view.[28] These match the incremental costs of L and S ($70 and $80 respectively) and the stand-alone costs of L and S ($100 and $110 respectively). This view ignores the possibility of NEWTEL offering either of the services. The second row shows minimum and maximum subsidy-free prices under the more comprehensive view.[29] This framework incorporates NEWTEL's potential production. This forces INCTEL's minimum prices to be greater than incremental cost and INCTEL's maximum prices to be below stand-alone cost.

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26 Baumol, William J., 'Minimum and Maximum Pricing Principles for Residual Regulation', *Eastern Economic Journal*, 5 (1–2), pp 235–248, January 1979; and Faulhaber, Gerald R., 'Cross-subsidisation in Public Enterprises', *American Economic Review*, 65(5), pp 966–977, 1979.

27 Jamison, (1996).

28 The minimum prices are calculated as follows. For L, the floor is *Cost*(L + S) - *Cost*(S) = $180 - $110 = $70. For S, the floor is *Cost*(L + S) - *Cost*(L) = $180 - $100 = $80.

29 These price ranges are calculated as follows. For L, the floor is *Cost*(L + S) - *Cost*(S + CT) - *Cost*(CT) = $180 -$250 - $150 = $80, and the ceiling is *Cost*(L + CT) - *Cost*(CT) = $235 - $150 = $85. For S, the floor is *Cost*(L + S) - *Cost*(L + CT) - *Cost*(CT) = $180 - $235 - $150 = $95, and the ceiling is *Cost*(S + CT) - *Cost*(CT) = $250 - $150 = $100. For a comprehensive explanation of these calculations, see Jamison, (1996).

Table 1. Subsidy-free prices under the two economic views

	Subsidy-free prices	
	Minimum	**Maximum**
Lines		
Baumol-Faulhaber view	$70	$100
Comprehensive view	$80	$85
Switching		
Baumol-Faulhaber view	$80	$110
Comprehensive view	$95	$100

Detecting and remedying cross subsidy

Regulators have used various devices for detecting and dealing with cross-subsidy issues. Generally, detecting a cross-subsidy is little more than applying the definition chosen. However, it is not always simple. For example, if the regulator chooses the cost allocation view, then the regulator must decide which cost allocation is the appropriate standard. Generally this involves decisions on mechanics of FDC. As was explained above, there are large numbers of reasonable options, so the detection can become quite involved. Also, the more comprehensive economic view requires large amounts of information for detecting cross subsidy. Fortunately, there are some fairly simple tools, which will be discussed later, which take care of this view's cross subsidies without getting into detection.

Techniques for remedying cross-subsidy concerns vary depending on whether the concern is which anti-competitive cross subsidies or USOs, but fall into the general groups of FDC, incremental cost, and imputation (which is actually the ECPR in reverse).

The fully distributed cost technique

In instances where regulators use earnings to regulate prices, such as in the case of rate of return regulation or assessing earnings during price reviews (as is done in the UK), there is really little way to avoid using FDC. The basic technique is to either base regulated prices on their FDCs or to require competitive prices to cover their FDCs. FDC has some clear drawbacks:

- FDC's underlying theory is that regulators can use accounting records to determine the costs caused by particular services. Unfortunately, FDC allocates costs by account. For the reasons explained above, the costs allocated to a service may be less than, or even a lot more than, the costs the service actually caused.

- FDC formulas shift costs to non-competitive markets. This happens for two reasons. First, the accounting records on which FDC is based do not show why costs were incurred. So it is at best difficult for regulators to prevent companies from acting on the incentive to shift costs incurred for competitive services into prices for non-competitive services. Second, usage-based allocators shift costs to non-competitive markets when companies lose market share in competitive markets. This shifts the risk of cost recovery from shareholders to captive customers.

- FDC restricts regulated companies' abilities to innovate and respond to competition in four ways.

  a. First, regulatory processes to approve investments and new services cause delays. In the US, local exchange carrier (LEC) video dialtone services are a recent example. Prior to passage of the *Telecommunications Act of 1996,* LECs had to get approval of the FCC before constructing facilities for video dialtone. This prior approval was required to prevent cost shifting through the accounting process.

  b. The second reason FDC limits innovation is that it creates rigid structures and procedures. For example, US Federal Communications Commission (FCC) rules contain artificial distinctions between switched and non-switched services. The FCC also requires uniformity across LECs in how they provide and measure costs for some non-regulated services.

  c. The third way that FDC limits innovation is that it constrains management thinking about services and markets. Service development, introduction, and marketing follow the accounting framework because companies must conform their businesses to the regulatory structure.

  d. FDC limits how regulated companies respond to competition by sending false cost signals to management. When a regulated company gains or loses customers in a competitive market, changes in FDCs affect this company's bottom line, not the costs caused by the gain or loss of customers. This sends false signals to management because changes in FDC may be greater or less than the costs actually caused by the change. If the FDC change is too large, management will be discouraged from pursuing customers. If the FDC change is too small, management will be encouraged to over invest in the market. Both actions cause a loss of economic efficiency and could harm the long-term financial interests of the company.

Despite these problems, FDC does have its benefits. Section II listed these benefits, so they are not repeated here.

Regulators could also apply FDC to measure costs for USOs. With this approach, the difference between the price the service provider is allowed to charge in a market and the FDCs of the market is treated as the cost of the USO. This, in effect, is setting prices (actually price plus subsidy) on FDC. As a result, this method suffers from all of the problems and enjoys all of the benefits of using FDC for interconnection and for protecting against anti-competitive cross subsidies.[30]

The stand-alone cost technique

Several regulatory techniques fall under the rubric of incremental cost. These include setting maximum prices at stand-alone cost and setting minimum prices at incremental cost, generally TSLRIC. The Baumol-Faulhaber view of cross subsidy forms the basis for these techniques. So to the extent that this view is out of date, these tools are also out of date. However, because they are still in use, they are discussed below.

The stand-alone cost approach allows service providers to increase prices in non-competitive markets up to stand-alone cost — the total cost of a specialised company producing only the service or services in question. For example, the stand-alone cost of providing water to residential customers would be the total cost of a company that provided only sufficient pumping, processing, distribution, etc. to serve residential customers and produced nothing else.

This approach has been used at least twice. The US Interstate Commerce Commission used stand-alone cost tests to determine if captive rail shippers were paying too high prices. More recently, the Independent Pricing and Regulatory Tribunal of New South Wales used stand-alone costs as the standard for maximum prices for contract services in gas. The application distributes overhead costs among customers, so the effective price ceiling is below stand-alone cost.

Aside from the problems with the underlying theory, stand-alone cost suffers from a practical problem. It effectively assigns all common costs to residual customers, the very customers regulation generally intends to protect. So applying this tool would appear to conflict with basic regulatory mandates.

TSLRIC price floors

Regulators frequently TSLRIC-based minimum prices in competitive markets. There are two benefits from using this approach. First, the practice is well established, so there are many examples to follow. Second, if properly implemented, it ensures that captive customers do not cover costs incurred only to produce the competitive services.

Unfortunately, there are several problems. The first is that TSLRIC fails to protect against cross subsidy. This happens for two reasons: (1) TSLRIC ignores strategic pricing. Through strategic pricing, a dominant firm can drive more efficient, non-dominant competitors from

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30 A more complete discussion of measuring costs for USOs can be found in Jamison, Mark A., ‘Estimating Costs for Universal Service Obligations,’ *Telecommunications Journal of Australia* 47(1), pp 51–58, 1997; and Jamison, Mark A., ‘Principles for Estimating Universal Service Costs,’ Paper Presented at the Telecommunications Policy Research Conference, September 1997 which can be found at http://www.cba.ufl.edu/eco/purc/primary/mjamison.htm.

markets without lowering prices below incremental cost in competitive markets. (2) TSLRIC is based on the Baumol-Faulhaber definition of cross subsidy.

Another problem with TSLRIC price floors is that they fail to protect captive customers because they shift costs to non-competitive markets. This happens in two ways. First, as with stand-alone cost, TSLRIC price floors place all of the responsibility of covering common costs on captive customers. In effect, customers in non-competitive markets ensure the company is financially viable because the only costs that are put at risk of non-recovery are those that can be avoided by exiting the competitive market. Second, the incremental cost studies that form the bases for the price floors sometimes omit costs caused by a competitive service. For example, studies done after a service is developed would generally omit development costs. These development costs remain in the regulated company's overall cost and are potentially covered by other services.

TSLRIC floors also restrict regulated companies' abilities to innovate and respond to competition. This happens because the price floors can remove companies' abilities to price below incremental costs. This is overkill because there are legitimate reasons, as well as anti-competitive reasons, to price below incremental costs. Examples of legitimate reasons include filling product and market gaps, maintaining stakes in strategic markets, expanding markets, and engaging in price wars.

The last problem with TSLRIC price floors (or any price floors) is that they increase the regulator's role in competitive markets. Intuitively, we would expect that regulation should decrease as competition increases. However, because these price floors apply to competitive markets and the number of stakeholders is higher in competitive markets than in non-competitive markets,[31] the amount of regulatory oversight actually increases as competition increases.

Regulators frequently use incremental cost techniques for dealing with USOs. Examples include the UK and Australia. With this approach, the difference between the price the service provider is allowed to charge in a market and the TSLRICs of the market is treated as the cost of the USO. This, in effect, is setting prices (actually price plus subsidy) equal to TSLRIC. This has many of the problems and benefits of using TSLRIC for interconnection and protecting against anti-competitive cross subsidies, so these are not repeated here. There is one exception. The Baumol-Faulhaber view may actually be appropriate in this context. As long as providers are not competing for the USO, and as long as the USO does not hinder USO providers in their competing in other markets, then the Baumol-Faulhaber assumptions would appear to hold. This appears to be the case in the UK and in Australia.[32]

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[31] Competitive markets have all the stakeholders of non-competitive markets, plus the new competitors.

[32] Jamison, 'Estimating Costs', (1997), and Jamison, 'Principles', (1997), contain more complete discussions of this point.

Imputation techniques

The last approach for remedying cross-subsidy is imputation. Generally, imputation is a method of setting price floors for a company's competitive services when that company also provides essential, non-competitive inputs for those competitive services. The objective is to prevent a price squeeze by forcing a service provider to charge itself the same price for non-competitive, essential inputs that it charges its competitors.

Imputation is basically a reverse application of the ECPR. Advocates generally suggest one of two basic methods. One method includes two elements: (1) incumbent's own input prices; and (2) the incumbent's TSLRIC of being a competitive service provider in addition to an input provider. This system can be illustrated with the following formula:

$\text{I-Floor} = \text{Price}_{input} + \text{TSLRIC}_{competitive}$

Where:

I-Floor = the price floor for the incumbent's competitive service;

Price_{input} = the incumbent's regulated prices for essential, non-competitive inputs; and

$\text{TSLRIC}_{competitive}$ = the incumbent's cost of providing the competitive services, over and above the cost of providing the essential, non-competitive inputs.

The other method differs from the first method in that this second method adds an adjustment for economies of sequence[33] that the incumbent might have from being both an input provider and a provider of the downstream product. Two formulas are generally proposed for this method. One formula uses an implicit adjustment where the incumbent would include in the imputation study the difference between the TSLRIC of input services and the TSLRIC of the incumbent's own competitive services. This formula is:

$\text{I-Floor} = \text{Price}_{input} - \text{TSLRIC}_{input} + \text{TSLRIC}_{competitive}$

where:

TSLRIC_{input} = the incumbent's TSLRIC for the essential, non-competitive inputs; and

$\text{TSLRIC}_{competitive}$ = the incumbent's TSLRIC for downstream services.

Incumbents generally prefer this method, which is called the lost contribution method. The other formula includes an explicit adjustment for economies of sequence. This formula is:

$\text{I-Floor} = \text{Price}_{input} + \text{TSLRIC}_{competitive} - \text{TSLRIC}_{vertical}$

[33] Economies of sequence are where it is cheaper for a company to both produce an input and use it to produce the final product than to produce only the input, sell it to someone else, and have the input buyer produce the final product.

where:

$TSLRIC_{vertical}$ = any efficiency gains the incumbent receives from being both an input provider and a provider of the final product.

This formula is mathematically the same as the previous formula. Competitors prefer it because it is easier to review assumptions about vertical integration.

Price cap techniques

An indirect method of remedying cross-subsidy concerns is through price caps for non-competitive services. Sometimes called cost-based price caps, this method applies the comprehensive view of cross-subsidy by ensuring that some, but not all, common costs are covered by prices in non-competitive markets. As described by Trebing[34] and Jamison,[35] this system would: (1) deregulate all prices except prices for basic utility service, interconnection, and access; and (2) use cost-based price caps as the regulatory limit on these prices. No price floors or cost allocations would be used for any services. Establishing cost-based price caps involves two steps: (1) choosing a target level for the prices; and (2) estimating this target price level. The target price level should cover the services' TSLRIC and provide a limited (generally average) contribution to shared costs. Proxy costs should be used to estimate the price level. This method, in effect, kills two birds with one stone. First, it protects customers in non-competitive markets by ensuring that they cover no more common costs on average than the competitive services. Second, it should help prevent cross-subsidisation by limiting non-competitive profits that the incumbent could use to finance competitive operations.

Conclusion

This paper describes techniques regulators use to address interconnection, access, and cross-subsidisation, and discusses their advantages and disadvantages. None of the tools discussed has a clear advantage over all others in all situations. As a result, regulators will generally find it necessary to assess the applicability of these tools in the context of regulatory objectives, institutional abilities, and markets. However, that some techniques have things in common with other techniques, and that some techniques conflict with others, helps narrow the choices.

For example, and as has already been discussed, the use of earnings in price reviews and in rate of return regulation implies that some form of FDC is already in use for cross-subsidy issues. Substituting TSLRIC or imputation-based price floors for the FDC cross-subsidy may

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34 Trebing, Harry, 'Public Control of Enterprise: Neoclassical Assault and Neoinstitutional Reform', *Journal of Economic Issues*, 18 (1984): 353.

35 Jamison, Mark, *Pricing and Deregulation during Telecommunications' Transition to Competition,* Presented at the Consortium for Research on Telecommunications Policy conference, May 1996; at the 1996 Annual Meeting of the American Law and Economics Association, May 1996; and at the 1997 Annual Meeting of the American Economic Association, January 1997.

bring about the worst of both worlds by increasing regulators' oversight of competitive markets and giving incumbents the opportunity to use the earnings monitoring to recover competitive costs that are not captured in the TSLRIC estimates.

Likewise, adopting ECPR for interconnection implies adoption of imputation for price floors, and vice versa. Mixing with other mechanisms would generally be ineffective. For example, basing interconnection and access on TSLRIC makes imputation unnecessary because the company cannot lower retail prices even near the imputation level without earning losses because common costs would be unrecovered.

In countries where competition is expected to be strong in at least some markets, some form of price caps would likely be preferred, especially something along the lines of the cost-based price caps. An earnings monitoring (which is implicit in FDC) provides incentives and opportunities that directly conflict with what regulators expect from competitive markets. Incumbents have the incentive and opportunity to shift costs from competitive to non-competitive markets. They also have little incentive to become more efficient in the competitive markets because high profits are taken away and low profits are compensated. In contrast, the price caps look just like competitive market pressure to the incumbent. The incumbent cannot increase the price caps to protect overall profits while competing aggressively in competitive markets, cannot use the non-competitive markets to cover common costs that competitors must cover in their competitive operations, and can keep every reward from competitive success that any other firm can keep.