Pricing in Thailand's Telecommunications Sector Before and After Concession Conversion: Note on a General Approach and the Basic Economics

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For a market with given price elasticity of demand, estimates of the likely quantity and the unit price at which the market will be cleared will indicate not only the expected intersection of the demand and supply schedules, but also the implicit parameters that uniquely determine the schedules' respective shapes, their slopes and intercepts. The estimates of such parameters rest on certain basic and orthodox assumptions: that the supply curve slopes upward and represents the marginal costs associated with given quantities supplied; that the demand curve slopes downward and represents the average unit prices associated with given quantities in demand; that the market is competitive and demand is responsive to price; and that a rules-based pricing policy is practiced. For the sake of simplicity, it may also be further assumed that both the price function (the demand schedule) and the marginal cost function (the supply schedule) are linear, although the associated total revenue and total cost functions clearly are not. The total revenue function *TR(D*) is a product of the linear price function *P(D)* and the quantity *D*; the total cost function *TC(D)* has fixed costs *F* as a constant which disappears when differentiated to give the linear marginal cost function *MC(D)* or the derivative supply curve with respect to *D*. The functions are described in the Appendix.

Telecommunications firms operating under concession from Thailand's state monopolies—either the Telephone Organization of Thailand (TOT) or the Communications Authority of Thailand (CAT)—in return for a share of revenue exacted as condition for the franchise, are themselves licensed monopolies. The revenue share may be described as monopoly tax, although the market may not be conventionally monopolistic: there are substitutes for the franchisee's products and their prices are regulated by the state. Under such circumstances it will not be plausible for the franchisee firm to price its product or service by restricting quantity sold to the level where the firm's marginal cost equals its marginal revenue, which is the derivative of its total revenue function. This is the classic pricing optimum for the monopolist who seeks to exploit the difference between price and the marginal revenue due to a downward-sloping demand curve. For a given demand schedule, the supplier will adjust the marketed quantity accordingly to set the price of his product.

Two other possible pricing options need to be considered which deviate from the optimum for the firm seeking to maximize profit. One option is to price the firm's product *at marginal cost*, which from the society's viewpoint is the most efficient, being the point at which a product is sold for exactly what it costs to produce at the margin. This pricing policy may not eliminate the monopolist's 'rent' or possible excessive profits, if his marginal cost is higher than the corresponding average cost. On the other hand if the average cost should turn out in fact to be higher than the price as given by the corresponding marginal cost, then the firm will surely be making a loss. The other option is to price the firm's product *at average cost.* This pricing policy will eliminate any monopolistic 'rent' and satisfies the condition of the firm's financial viability in the long run, although it will not necessarily be optimal from society's viewpoint. But it is clear that any rational pricing decision on the part of the firm or the regulator will require at least making transparent the firm's cost structure, in addition to the expected dynamics of the market with respect to changing prices and quantities.

Because the marginal cost function is the derivative of the total cost function *TC(D)*, marginal cost pricing sidesteps the need to quantify the firm's fixed cost which is a constant term in the function. Average cost pricing on the other hand will however need to take into account the firm's fixed cost, to which there will be an upper limit if the resultant average cost at any given quantity is not to exceed the corresponding marginal cost. In excess of this limit to the fixed cost, the firm which prices its product at marginal cost will incur a loss; short of the limit, the firm will be earning monopolistic 'rent' in excess of normal profit. Ideally, the design of revenue share agreement or monopoly tax in combination with regulated pricing should be such that the monopolist's product is priced optimally from society's viewpoint at marginal cost, but that it will be no more and no less than the average cost *AC(D)*. This ideal is represented in Figure 1 in which the average cost *AC(D)* at *D* is also the point of intersection between the demand curve *P(D*) and the marginal cost curve *MC(D*) at price P_0.

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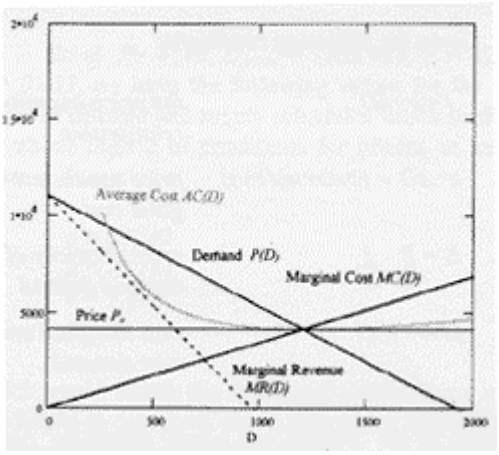

Figure 1

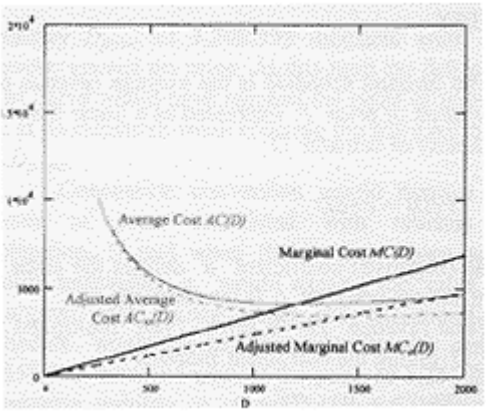

Figure 2

Consideration of the firm's average cost in this regard will necessarily take into account its fixed cost—the constant term *F* in its total cost function *TC(D)*. In reviewing any estimate of expected future prices and quantities, it is reasonable to assume that in the absence of any claim of possible financial loss the true average cost cannot be greater than the indicated price, whether or not that price represents the firm's true marginal cost. By implication, the firm's perceived fixed cost does not exceed the limit as given by pricing at marginal cost. It is also evident that any rational pricing decision on the part of the firm or the regulator requires due consideration of variable cost as well as fixed cost in making transparent the firm's cost structure affecting both its marginal cost and its average cost for any given level of marketed quantity.

The underlying rationale of the firm's pricing practice is crucial to any assessment of the impact of liberalization policy, when monopoly concessions will be revoked, free entry will be allowed, and competition encouraged. In particular, the implementation of this policy for Thailand's telecommunications sector will end revenue sharing agreements in exchange for which the concessions have been granted by the state monopolies. The question of compensation—a one-time payment against outstanding revenue shares based on expected annual earnings to the end of the concession period—requires an assessment of how the marginal and average costs will change, how the product's pricing will need to be re-set by the supplier, and how the market with given price-demand relationship—the demand schedule—will react to accommodate such changes.

Under typical telecommunications revenue share agreements based on a proportion of the gross sales, concession conversions which remove this cut of the revenue to the state monopolies will result in a progressive downward shift of the marginal cost curve together with a corresponding lowering of the average cost curve, shown in Figure 2 as dotted lines.

Under the option of marginal cost pricing, the market price is a multiple of $(1+s)$ times the firm's marginal cost where revenue share obligation is a proportion s of the sales. Termination of the revenue share agreement under concession conversion will lessen the price, and thus increase the quantity to a new point of intersection between the adjusted supply curve and an unchanged demand schedule as shown in Figure 3. The parameters of the demand schedule determine the net change in revenue at price P_1. The associated change in the average cost at the new market equilibrium to which demand and supply quantities will be adjusted determines the net change in the firm's profit.

In the particular case of the adjustments as illustrated in Figure 3, the adjusted average cost $AC_{xs}(D)$ is higher than the point of intersection between the demand schedule $P(D)$ and the adjusted marginal cost curve $MC(D)$ which gives the price P_1. The firm would therefore be making a loss by pricing quantity D at marginal cost. But if the level of the fixed cost were less, to the extent that the average cost is below marginal cost at quantity D, the firm would instead be making a profit and marginal cost pricing at P_1 would be a financially tenable proposition for the firm as well as being economically optimal from society's viewpoint.

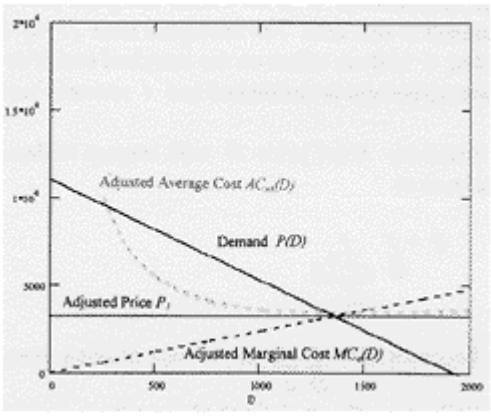

Figure 3

APPENDIX

The demand schedule is the average revenue per unit of product or price P expressed as a linear function of the quantity of demand D

$$P(D) = c+dD$$

where the (negative) coefficient d defines the slope of the curve and the constant c is the intercept.

Total revenue TR is price $P(D)$ multiplied by quantity D giving the non-linear function

$$TR(D) = cD+dD^2$$

the derivative of which is the marginal revenue MR, i.e.,

$$MR(D) = c+2dD .$$

Total cost (TC) is a non-linear function made up of the two elements of variable cost and fixed cost. The variable cost is a non-linear function of demand and the fixed cost is a constant F giving the total cost function of the form

$$TC(D)=vD^2+wD+F .$$

If there is a revenue share agreement in proportion s of the gross sales, variable cost will be raised by a multiple of $(1+s)$ and the total cost function becomes

$$TC(D)=(vD^2+wD)(1+s)+F .$$

The average cost (AC) is the total cost function divided by the quantity D

$$AC(D)=\frac{(vD^2+wD)(1+s)+F}{D} .$$

Marginal cost (MC) or the supply schedule is the derivative of the total cost function as defined above and is a linear function of demand

$$MC(D) = (2vD+w)(1+s)$$

in which the intercept w is zero if the marginal cost at zero demand is also zero. The multiplier term $(1+s)$ is reduced to 1 with no effect on the marginal cost if revenue share agreement is terminated and s assumes zero value.

Elasticity E (of price P with respect to demand D) is defined as

$$E = \frac{P}{D}\ \frac{1}{\frac{dP(D)}{dD}}$$

which becomes $E = \frac{P}{D}\frac{1}{d}$ in the case of linear demand curve $P(D) = c+dD$ as defined above whose derivative is its coefficient.

Given the following conditions:

$P=c+dD$	*the price-quantity relationship*
$c+dD = (2vD+w)(1+s)$	*price equals marginal cost*
$E = \frac{P}{D}\ \frac{1}{d}$	*price elasticity of demand defined*
$(2v0+w)(1+s) = 0$	*zero marginal cost at zero demand*

the values of the demand and supply schedules' coefficients v,w,d and of the demand intercept c can be found against any given values of $P,D,E,$ and s. The value of the quantity of demand $D_{mr=mc}$ at which the marginal revenue equals the marginal cost is then given as

$$D_{mr=mc} = \frac{-1}{2}\ \frac{(-c+w+ws)}{(-d+v+vs)}$$

whereas the quantity of demand $D_{p=mc}$ at which price equals marginal cost is given as

$$D_{p=mc} = \frac{(c-w-ws)}{(-d+2v+2vs)} .$$

The corresponding prices at these quantities are found from the function $P(D)=c+dD$. Termination of revenue share agreements affects the above quantities and corresponding prices by changing the value of s — the proportion of the concessionaire's gross revenue going to state monopolies — to zero.

From the fact that the average cost at its minimum is equal to the marginal cost, the limit of the fixed cost F_{limit} which would allow the average cost to equal the marginal cost is set by the derived functional relationship

$$F_{limit}(D) = D^2v(1+s) .$$

At this limit to the fixed cost, the unit price for quantity D set at marginal cost would also be equal to the average cost and would ensure the minimum condition for financial viability in the long term for the firm practicing marginal cost pricing. The situation is as represented in Figure 1. If the actual fixed cost were less than this limit, the firm would be making an economic profit, i.e., in excess of the level which perfect competition would permit.

To illustrate, we may take for example the case of a hypothetical telecommunications firm with a concession from TOT for domestic long-distance calls. The revenue share agreement is 43.5 *per cent* of the gross sales. Price elasticity of demand is estimated to be -0.6. Unit price as indicated by the average revenue per unit of demand (per user per year) is 4,140 Baht, at which the quantity of demand is 1,203.935 thousand units.

So at $P= 4140$, $D_{p=mc} = 1203.935$, $E = -0.6$, and $s = 0.435$, we have the following values for the coefficients of demand and supply schedules which conform to the above regime of conditions for pricing at marginal cost:

$c = 11040$
$d = -5.731$
$v = 1.198$
$w = 0$

which would satisfy the functional relationships and the conditions as described above, and which would indicate that optimal pricing for the firm as an unregulated monopoly would have been 6,794 Baht at the quantity $D_{mr=mc}$ restricted to 740.883 thousand units. Pricing at marginal cost would however be a financially tenable proposition if the firm's fixed cost is within the limit of F_{limit} at 2,492.145 million Baht and the average cost at quantity $D_{p=mc}$ of 1,203.935 thousand units does not thereby exceed the price. At this limit the falling average cost curve would have reached the point of inflexion and be at its minimum when crossing the marginal cost curve at $D_{p=mc}$.

Concession conversion would remove the elements of costs associated with revenue sharing obligation. If and when the revenue share agreement would terminate, s would assume the value of zero. Marginal cost pricing under the unchanged demand schedule would re-set the quantity of demand to 1,358.346 thousand units at the price of 3,255 Baht. The long-term stability or otherwise of the situation would depend on the firm's average cost in relation to the marginal cost at the newly increased quantity. That would critically depend in turn on the actual level of the firm's fixed cost in relation to the limit F_{limit} and whether or not its average cost curve was falling or rising previously at quantity $D_{p=mc}$.