Chapter

17

Pricing Public Services

They (the Nabobs) raised the price of everything in their neighbourhood, from fresh eggs to rotten boroughs.

Thomas Macaulay, *Critical and Historical Essays*

Pricing Objectives ♦ Pricing Options ♦ Efficient Pricing ♦ Full Cost Recovery ♦ Equity Issues ♦ Conclusions

Most governments charge for publicly produced utility services, such as water, electricity and gas, post or telephone services, bus and rail services. Indeed, governments often establish business enterprises to supply and sell these services. Increasingly, governments also charge for other services, such as tertiary education, road use, property information and waste disposal.[1]

There are three main issues in public pricing. First, whether to charge for a service. It is not possible or desirable to charge for non-excludable public goods such as national or domestic security. More relevant to the discussion in this chapter are equity issues. It would be inappropriate to charge for a service which is regarded as provision of social welfare. Second, once charging is determined, efficient charging is usually regarded as marginal cost pricing. However, as we will see, determining marginal cost is not always easy and marginal cost pricing is not always efficient. This leads to the third issue: full cost recovery. Again, there are issues in determining what this means and when it should be applied.

In this chapter we start by outlining objectives for pricing public services and various pricing options. We then discuss efficient pricing policies when government is the sole supplier of a service and when there are competing suppliers. The fourth main section discusses full cost recovery including setting financial targets and how to fund trading deficits efficiently. The last major section addresses equity issues.

Pricing Objectives

In an ideal world, prices would be set to maximise some measure of social welfare that allows for both efficiency and equity objectives. Indeed, in the discussion of optimal taxes in Chapter 28, we will see that tax structures can be designed to maximise welfare according to some social welfare function.

[1] Economists distinguish between user charges (prices) and fees. A user charge is a payment for a service. A fee is typically a payment for a right. Examples are payments for motor vehicle registration, to sell alcohol or to emit pollutants. This chapter discusses user charges.

However, this would be impractical for setting prices for large numbers of goods and services. Therefore, in setting prices, economists usually seek first to determine whether pricing for the relevant goods meets equity criteria. If this is established, we then seek to set out efficient pricing principles. However, as we discuss below, there may remain equity considerations in setting prices.

Efficiency objectives. Efficiency objectives include producing the desired quantities of each good at least cost and providing goods to those who value them most highly.[2] Prices (user charges) play a critical role in achieving these efficiencies. They show (1) the values that consumers attach to goods and (2) the relative costs of production of alternative suppliers. Therefore, prices guide agencies to produce the goods that consumers want and to supply the goods to consumers who value them most highly. They provide benchmarks for productive efficiency and so encourage efficient production. Also, they promote efficient investment.

User charges (along with financial targets) have other related benefits. First, they facilitate efficient management. A financial target (generally a rate of return on capital) establishes performance goals and benchmarks for performance assessment; provides a basis for making investment decisions; forces agencies to consider the costs of capital tied up in their assets; and enables government managers to monitor performance. Clear financial objectives usually improve agency efficiency.

Second, user charges help to fund services. This reduces the tax revenue required to fund services and therefore reduces the distortions and deadweight losses associated with taxation. On the other hand, prices above marginal cost may also create a deadweight loss (DWL) by discouraging consumption when users are willing to pay for the marginal cost of a service. In designing an efficient price/revenue structure, the benefits of lower taxation need to be weighed against the DWL of user charges above marginal cost.

Also, user charges involve transaction costs. In any application of pricing, the benefits need to outweigh the transaction costs. To minimise transaction costs, user charges should be economic to administer, easy to understand and reasonably constant over time.

Equity objectives. Charging for services meets the equity benefit principle. This principle asserts that the cost of services should be born by beneficiaries of the services, not by others. This implies (1) that individuals should pay for the services they receive and (2) that consumers collectively should pay for the total cost of the service.

However, following an alternative principle of fairness, individuals should be charged for services according to their ability to pay for them. It follows that higher-income households would be expected to pay higher prices. This does not occur when prices are the same for everyone. A given price generally reduces the welfare of a low-income person more than the welfare of a high-income person.[3] Evidently, the ability-to-pay principle of fairness may conflict with the beneficiary principle.

Conclusions. The multiplicity of objectives creates conflicts that require resolution. Prices that satisfy one objective may not satisfy another. Efficient use of resources may require marginal cost pricing; efficient management may require full-cost recovery pricing; equity may require price discrimination between consumers. Economists should be able to show the benefits and costs of alternative pricing policies. Policy making is difficult when government objectives are unclear and/or inconsistent.

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[2] This is equivalent to the three major efficiency criteria in Chapter 3: product mix efficiency, technical efficiency and exchange efficiency respectively.

[3] This presumes diminishing marginal utility of income and interpersonal comparability of utility.

Pricing Options

In this section we identify five main pricing options. Four of these are based on the cost of producing services, including in some cases the costs of capital investment as well as operating costs. The fifth option, setting market prices, may involve setting prices above production cost for various reasons.

Short-run marginal cost
The cost of supplying an extra unit of a good or service in the short run

Short-run marginal cost (SRMC) pricing is based on the cost of supplying an extra unit of a good or service in the short run.[4] The short run is defined as the period over which capital assets are fixed. In principle, the cost of supplying one extra unit includes any depreciation of capital with use, but this may be negligible. Fixed costs, such as interest payments, overhead administration and operating expenses that are invariant with output in the short run are not included in SRMC pricing.

Average variable cost
The average cost of supplying goods over some specified period, excluding fixed costs

Average variable cost (AVC) pricing is based on the average cost of supplying extra goods over a given period such as one, three or twelve months. AVC pricing excludes all costs that are fixed over the relevant period. However, the longer the period, the more costs may vary with output. Therefore, AVC pricing usually includes more inputs than SRMC pricing.

Long-run marginal cost
The cost of supplying additional units of output in the long run

Long-run marginal cost (LRMC) pricing is based on the cost of supplying additional units of output in the long run, typically over a few years. It includes the cost of replacing fixed assets, as well as the cost of labour and other inputs required for supply of the good. Like SRMC, LRMC is forward looking. Sunk costs are ignored. However, future capital costs must be allocated over time periods and users.

Long-run average cost
The total cost of output divided by number of units supplied

Full cost recovery. This is, in effect, **long-run average cost** (LRAC) pricing. LRAC equals the total cost of supplying a good divided by the number of units supplied. LRAC usually includes any sunk costs that are relevant to the supply. It may also include an allocation of corporate overheads that are fixed and independent of long-run marginal cost. LRAC pricing is sometimes described "break-even" pricing.

Market prices are the prices that consumers are willing to pay for goods. When a good is in fixed supply, notably in the short run, the market price is the market-clearing price. This is the price that equates market demand with supply over a defined period. The price reflects the opportunity cost of the good or service to another consumer. In some cases, market prices may equate to cost-based prices. However, this is not necessarily when capacity is constrained and there is excess demand at SRMC or even at LRMC prices.

Conclusions. These definitions of costs provide useful guides to pricing strategies. However, the definitions are based on somewhat arbitrary distinctions between short- and long-run periods. Estimates of both SRMC and LRMC depend on judgements about which costs are fixed and would be incurred in any case, and which costs are variable. These judgements are often judgements about whether government is committed to provide a certain service rather than simply technical judgements.

It should also be noted that these pricing concepts are usually based on the assumption of efficient costs. Where production is inefficient, government could choose to offer a price discount on costs incurred. However, few governments would admit to this.

[4] Public officials often use the term 'avoidable cost' instead of 'marginal cost'. The terms are interchangeable. Avoidable cost is the cost avoided by not supplying an extra unit of a good.

Finally, government agencies may select price regimes that do not correspond to any of these categories. Indeed, they may choose prices that reflect what the public may bear politically that have no obvious economic explanation in relation to costs.

Efficient Pricing

Government usually supplies services either as sole supplier or with only a few competitors. It rarely supplies services in competitive markets. In competitive markets, private firms generally supply the market efficiently and government provision of services would achieve little, if any, added value. Accordingly, we consider here the principles of efficient pricing when (1) government is sole supplier of a service and (2) there are few competitors.

Efficient pricing as sole supplier

To start with, we assume no short-run supply constraint and that government can supply services at constant marginal cost.[5] This is plausible when a utility, such as water supply, has excess capacity or for labour-based human services. Therefore, in Figure 17.1a the horizontal line (P_1D) represents an SRMC schedule with perfectly elastic supply. Given the demand for services shown, Q_1 is the efficient level of output, where marginal benefit equals SRMC, and P_1 is the efficient price. At a higher price such as P_2, the marginal benefit exceeds marginal cost and there is a deadweight loss equal to area *ABC*. At a lower price such as P_3, marginal cost exceeds marginal benefit and there is a deadweight loss of area *CDE*. When price equals SMRC, welfare (defined as the sum of consumer and producer surpluses) is maximised and there is no deadweight loss.

Now consider the implications of a supply constraint, such as plant capacity, on output. Panel (b) illustrates the issues. The maximum supply of water per period is Q_2. Up to this point, water can be supplied for a constant SRMC per kilolitre (kL) of P_1. Once the supply constraint is reached, the SRMC of water is based on the concept of opportunity cost. The marginal opportunity cost of supplying water to one consumer is the marginal benefit forgone

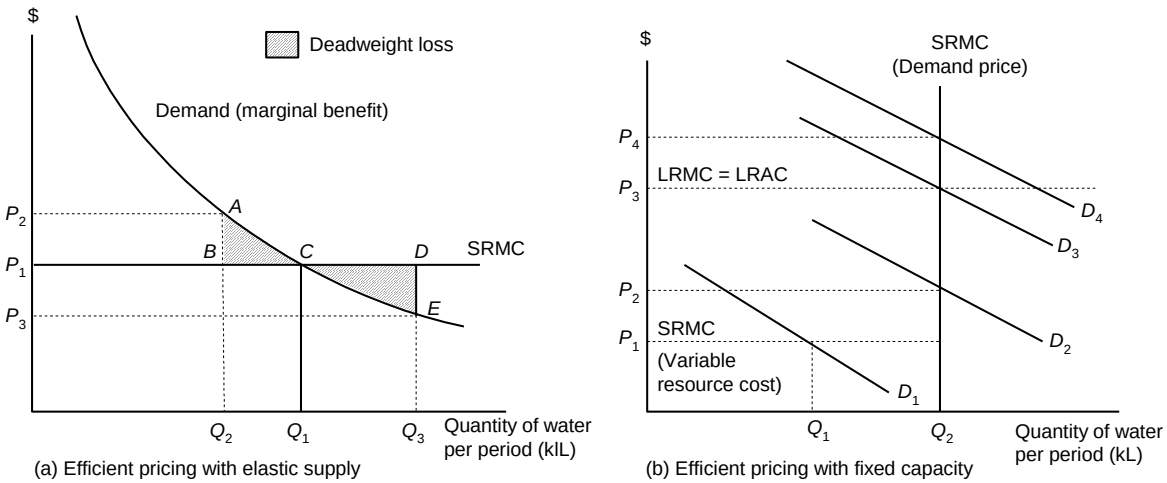

Figure 17.1 Efficient pricing when government is sole supplier

[5] To simplify the discussion in this chapter externalities are ignored. As discussed in Chapter 13, pricing should allow for externalities.

by the marginal user, which is the highest amount that he or she is willing to pay for a marginal kL of water forgone. This depends on the level of demand. Figure 17.1b shows four demand curves, D_1 to D_4. Each point on a demand curve represents the marginal benefit of an additional kL of water. The marginal benefit forgone is shown by the intersection of the relevant demand curve and the vertical supply curve at capacity. Thus, with D_2 demand, SRMC equals P_2. Given D_3, SRMC equals P_3 and so on. If the marginal resource cost of supplying water is \$1 per kL but someone is willing to pay \$2 per kL, the SRMC of supplying a kL to another consumer is \$2.

Social welfare is maximised when price is set equal to SRMC as just defined. Once capacity is reached, this is the market clearing price, which is the efficient strategy with excess demand. This price ensures that water is available to the users with the highest demand for it. Other methods of rationing scarce water would allocate water to some users with lower marginal benefit. Suppose, for example, that demand is given by the D_2 curve. If price is set equal to P_3, capacity would be under-utilised and there would be a large loss of consumer surplus. If price is set equal to P_1, water will be supplied to many consumers with relatively low demand for it. This happens in many countries where an excessive amount of water is supplied to agriculture and too little to industry and urban households (see Box 17.1).

In practice, demand may vary between or within periods. Demand for water is usually higher in summer than in winter. On the other hand, demand for electricity varies over the day, with peak-hour demand much higher than off-peak demand. Differential pricing according to season or time of day encourages efficient use of resources. Suppose that, in Figure 17.1b, demand curve D_3 is summer demand for water and D_1 is winter demand. The efficient charges would be P_3 and P_1 per kL of water in summer and winter respectively. This ensures the water is allocated efficiently in both summer and winter.

Efficient pricing is also important for investment decisions. High prices combined with high consumption indicate a need for more capacity. On the other hand, low prices combined with high consumption may suggest a need for more capacity when there would be little demand for it at prices that would justify the investment. Importantly, the design capacity of many systems is determined mainly by peak demand. If there is excess demand for only a few weeks of the year, it may not be economic to augment capacity. Seasonal pricing may significantly reduce excess demand for water in summer and thus defer the need for expenditure on new

Box 17.1 Water pricing in Australia

In Australian cities water is typically sold at a little over \$2 per kilolitre (kL). It has risen from less than \$1 per kL over a few years. However, the price of water is often much lower in regional and rural areas.

These prices have significant implications. Despite the price increases, at current prices under normal rainfall conditions there is significant excess demand for water in many cities and towns. Also, the marginal value of water use is often much lower in rural areas than in urban areas and there is an inefficient misallocation of water.

Low prices for water (relative to market clearing prices) tend to result in overuse of water and under-investment in replacement of leaking pipes, recycling and new capacity (dams, reservoirs and pumping systems). Consequently, water use is often restricted, rationed and misallocated.

Urban businesses and households who would be willing to pay more for water are unable to obtain it, while rural users have less incentive to economise on their use of water. In the cities, households are forced to adopt inefficient plant and labour-intensive methods to conserve water.

On the other hand, rather than raise water prices further, governments across Australia have invested heavily in expensive, energy-intensive, desalination plants. According to Hoang *et al*. (2009) the production costs of the desalination plants usually work out at between \$1 and \$2 per kL. However, this excludes the resource cost of water. To determine whether desalinisation is an efficient policy we would have to compare the costs of producing potable water via desalination plants with other methods of supplying water, including by recycling.

infrastructure. The discussion on pricing and investment in transport infrastructure in Chapter 19 illustrates these points.

Finally, it should be noted that in finding that SRMC pricing is efficient we made three important assumptions. First, that SRMC a precise concept. This may not be the case. Consider, for example, supply of an extra bus service. The marginal cost of this service depends on the services that would be provided, and the plant and equipment available without this extra service. The marginal cost of an additional service is much lower if a spare bus is available than if an extra bus is required. Also, a judgement is required on the services that would otherwise be provided. Costs, including labour costs, which are variable in some circumstances, are fixed in others. The shorter the decision period, and the higher the proportion of costs regarded as fixed, the lower is the marginal cost of production. This complicates the case for SRMC pricing. If SRMC depends on the circumstances, it is a less exact, and more discretionary, concept than economists commonly suggest.

Second, SRMC pricing is efficient only if there are no substitute products (the cross-price elasticity of demand is zero) or if the markets for substitute and complementary products are perfectly competitive (and adopting marginal cost pricing). Third, we have assumed that, if there is a trading deficit, there is no efficiency cost associated with funding it. We address these issues below.

Efficient pricing with competitors

Many public services are supplied in markets with a small number of other suppliers. For example, a public bus company may compete with some private bus operators. A publicly owned electricity retailer may compete with private electricity or gas suppliers. Here, competitive neutrality is required to achieve an efficient outcome.

When private firms have high fixed costs and low marginal costs, LRAC may exceed SRMC and the firms must set prices above SRMC to stay in business. When a private firm supplies a differentiated product, the demand curve for its product is downward sloping and the firm is again likely to set price above SRMC. In these cases, if a competing public company sets price equal to SRMC, consumption choices are distorted and there is generally excessive public output. This is an example of a second-best environment.

Suppose that a public company and a private firm produce competing, similar quality bus services and that the long- and short-run costs per passenger trip are as shown in Table 17.1. The private firm must charge at least $6 per passenger trip to pay for its operating costs and achieve a normal return on capital. Now, if the public company charges the SRMC of $4 per passenger trip, most bus passengers will use the public service. There is a resource cost of $1 per passenger trip in the short run and $2 per trip in the long run.

Inefficiencies may also occur if the two operators produce different quality services. Suppose that the public company can match the private firm's marginal and average costs per passenger trip of $3 and $6 respectively by using older buses and that passengers are willing to pay $6 for a comfortable private bus trip but only $5 for a less comfortable public bus trip. Now, if the public company charges only $3 for a bus trip, everyone will travel in the less comfortable public buses because this gives them a consumer surplus of $2 per trip. Given that service costs are equal, the deadweight welfare loss is $1 per passenger trip—the difference between what users are willing to pay for private and public bus trips.

Table 17.1 Public and private bus trip costs (example)

Cost per passenger trip	*Public supply*	*Private supply*
LRAC ($)	8	6
SRMC ($)	4	3

In these cases, public sector SRMC pricing causes a loss of welfare. This conclusion is consistent with the general finding of second-best theory that, when there are one or more departures from perfect competition, welfare is not necessarily maximised by adopting perfectly competitive conditions in all other markets (Lipsey and Lancaster, 1957). On the contrary, welfare may be increased by departures from these conditions in other markets.

What pricing policy should a public agency adopt in such cases? This depends on the degree of substitutability between the public and private good. If they are fully substitutable, the absolute mark-up on the public good should be the same as the mark-up on the private good. Let us call the public agency (X) and the private firm (Y). Further, we assume that Y sets its price above marginal cost and that its output cannot be controlled directly. Agency X wishes to choose the level of output that maximises welfare defined as the sum of consumer and producer surpluses.

Now, if X raises its price above marginal cost and demand falls, there is a loss of consumer surplus. However, if consumers switch to Y, the private firm will gain producer surplus equal to $(P_Y - SRMC_Y)$. When there is one-for-one substitution, if the price mark-up over marginal cost is larger in Y than in X, there is a net gain from the switch to Y.

As shown by Rees (1984), the efficient mark-up for P_X is:

$$P_X - MC_X = -\beta\,(P_Y - MC_Y) \tag{17.1}$$

where $\beta = \Delta Q_Y / \Delta Q_X$. The parameter β is the ratio of the change in consumption of Y to the change in consumption of X following an increase in P_X over MC_X.[6]

When the two goods are substitutes, $\Delta Q_Y / \Delta Q_X$ is negative (because ΔQ_X is negative) and $-\beta$ is positive. Equivalently the efficient price for the public service (X) is:

$$P_X = MC_X - \frac{\Delta Q_Y}{\Delta Q_X}(P_Y - MC_Y) \tag{17.2}$$

If the services provided by X and Y are perfect substitutes, $\beta = -1$ and P_X should be set equal to MC_X plus $(P_Y - MC_Y)$. This price adjustment preserves the equilibrium quantities that would prevail if both services were charged at marginal cost. If there is no substitution between services from X and Y, $\beta = 0$ and P_X should equal MC_X.

Suppose that $\beta = 0.5$. Then P_X would equal $MC_X + 0.5\,(P_Y - MC_Y)$. Adopting the numbers in Table 17.1, P_X would rise from \$3.0 to \$4.50. Suppose that this mark-up caused 1000 passengers to stop using public buses and that 500 transferred to private buses. Firm Y would gain profit of \$1500 = (500 × \$3). On the other hand, 1000 passengers would lose an average consumer surplus of \$1.50 × 0.5 = \$0.75 (assuming a linear demand curve) and experience total loss of \$750. There would be a net social gain.

If agency X has two competitors (Y and Z) the efficient price for X becomes:

$$P_X = MC_X - [\beta_Y(P_Y - MC_Y) + \beta_Z\,(P_Z - MC_Z)] \tag{17.3}$$

where β_Y and β_Z are similar to β in Equation 17.1 but here relate to firms Y and Z respectively. If agency X has several competitors, the efficient mark-up of P_X over MC_X would be the weighted average of the mark-up of all other substitute goods where the weights would reflect the extent to which the other goods are substitutes for X (see Box 19.1 on p. 325).

Equations 17.2 and 17.3 show the nature of second-best pricing policy and are straightforward in principle. But the practical requirements are demanding. To apply these equations, public agencies need estimates of the relevant compensated demand functions and the marginal costs of supply for both their own service and their competitors' services.

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[6] This solution is based formally on compensated demand curves as defined in Chapter 6.

In the absence of such information, when there is competitive supply, resources may be allocated most efficiently when public agencies set prices for their services based on estimated LRMC. LRMC pricing encourages competition and reduces relative price distortions compared with SRMC pricing. It also provides financial discipline for the agency.

In some cases, a public agency is a sole supplier but there is potential competition. In such situations there is again a case for LRMC pricing instead of SRMC pricing. LRMC pricing ensures fair competition where competition exists and provides the appropriate incentive for competition where it does not currently exist but might do so.[7]

Efficient pricing with externalities

Where there are externalities, efficient pricing requires that these should also be incorporated into the pricing formula. Thus, in the case of negative externalities (with say road congestion) the SRMC or LRMC should represent full marginal social costs and include the cost of the negative externality. This is discussed in some detail in our discussion of pricing for transport in Chapter 19.

Full Cost Recovery

So far, we have set prices to achieve efficient use of resources on the assumption that if trading deficits occur, they would not matter.[8] Of course, deficits may matter politically if they are perceived to reflect inefficient management and mean higher taxation.

The main economic reason for full cost recovery is that a deficit is generally funded from consolidated revenue by increased taxes, which usually involve a deadweight loss. For example, taxation of labour income affects work hours. As we will see in Chapter 27, the estimated marginal deadweight loss associated with taxation is usually at least 20 per cent of revenue raised. Therefore, we need to consider whether pricing strategies to reduce trading deficits have a lower deadweight loss.

There are other reasons for full cost recovery. As we noted above, a financial target encourages an agency to manage its assets efficiently. Funding from consolidated revenue reduces the incentive to manage assets efficiently. Also, such funding of deficits is often not a transparent process. In addition, when a public agency is competing with one or more private firms, resources are generally allocated more efficiently with competitive neutrality. This usually implies full-cost recovery. Indeed full-cost recovery is a common objective of Australian state jurisdictions (see Victorian Department of Treasury and Finance, 2013).

However, a caveat is in order. When there is little competition, full cost recovery may not indicate efficiency. An agency may achieve a target rate of return by raising prices rather than by improving productivity. In this situation, measures such as total factor productivity or cost per unit of service may be a better indication of efficiency than the rate of return on assets (Waters and Street, 1998).

Defining financial targets

The concept of full cost recovery implies a financial target. As we saw in Chapter 14, this target is a function of the value of capital employed and a target rate of return on this capital.

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[7] The case for LRMC pricing is looking forward and (rationally) ignores sunk costs. Because private firms cannot ignore financial liabilities, there is arguably a case for full-recovery cost (LRAC) pricing. This is the recommendation of the Victorian Department of Treasury and Finance (2013).

[8] Under some circumstances SRMC prices broadly defined do not result in a financial deficit. As shown in Figure 17.1b, demand can exceed capacity output at LRMC prices. If it does, SRMC pricing is equivalent to market pricing and potentially produces super profits.

The total revenue target is then set to cover operating expenses and achieve an acceptable return on capital.

A break-even target. A break-even target is a common accounting concept. This is the revenue required to meet all financial obligations, including debt payments and interest. Equation 17.4 represents a break-even requirement that revenue (R) equal or exceed costs:

$$R \geq VE + IE + DR \tag{17.4}$$

where VE is variable expenses (not including depreciation), IE is interest expenses and DR is debt repayments during the relevant period. However, this does not account for equity capital or any return on equity capital.

An accounting rate of return. Private firms also often adopt a revenue target based on a rate of return on the book value of capital employed. This target can be represented by:

$$R \geq VE + IE + BD + (K_B \times r) \tag{17.5}$$

where BD is book depreciation, KB is the depreciated value of capital owned by the business at the start of the year based on historic book values and r is a required rate of return on K_B.

This approach is based on the standard form of account keeping and is simple to administer. Also, it provides for the main financial needs of a business agency, that is, the revenue to meet obligations to creditors and a prudent level of reserves.

However, in this formulation, asset values and depreciation are based on historic costs. These costs do not reflect the true cost of using capital tied up in the assets. Nor does income include real changes in asset values. Thus, the revenue requirement may be understated.

An economic rate of return. A revenue target based on the economic rate of return (ERR) is designed to overcome these problems. The ERR is the return on the market value of assets owned by the business at the start of the period:

Economic rate of return
The return on the market value of assets owned by a business at the start of the period

$$R \geq VE + IE + \Delta K_M + (K_M \times r) \tag{17.6}$$

where K_M is the market value of assets owned at the start of the period and ΔK_M is the change in market value of assets over the period under consideration. This revenue target is based on current asset values and measures expenses correctly.

However, as we saw in Chapter 14, there are significant problems in establishing appropriate values for K_M and r. Market values for public assets are often unavailable or unreliable. In many cases, the assets could not be sold and employed elsewhere. And their market value in their current location depends on their market power and countervailing government regulation. Thus, there is often no ready measure of their market value.

Alternatively, assets can be valued at replacement cost. This is the cost of purchasing or reproducing an asset that can provide similar services using current technology. This cost is written down to reflect any economic depreciation in the value of the asset. Replacement cost is backward looking in that the revenue target is based on paying for existing assets rather than new ones. However, it generally provides a useful basis (in conjunction with a required rate of return) for estimating the revenue required from a set of assets.

The appropriate value of r is the opportunity cost of capital. Where this is equity capital, the main issue is allowance for systemic (of market) risk. The general principle is that the rate of return should reflect the return that can be achieved by private investment allowing for systemic risk that cannot be diversified away. However, an allowance may be made for public trading enterprises that have a below average systemic risk.[9]

[9] The points about the required rate of return in this paragraph pick up on points made in Chapters 8 and 14.

Efficient prices to fund deficits

The two main pricing strategies for dealing with trading deficits are mark-up pricing and non-linear pricing.

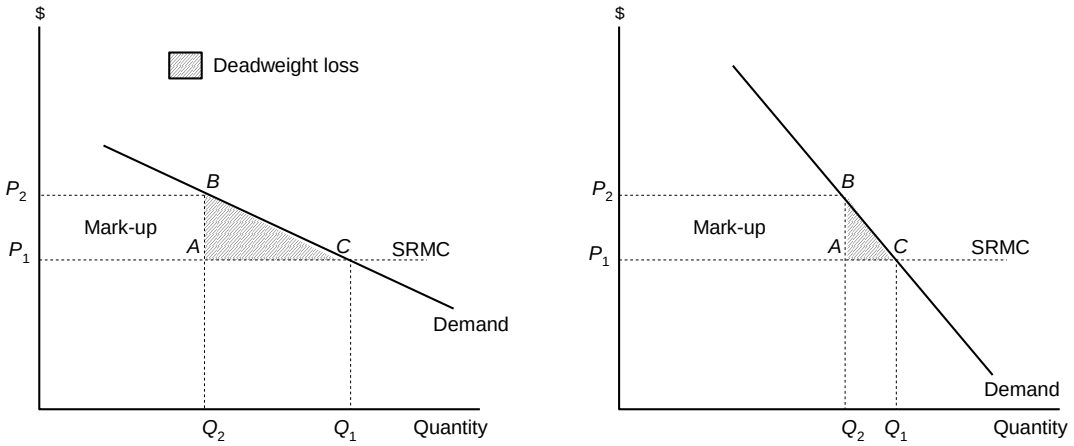
Mark-up pricing. This involves increasing prices above marginal cost until the revenue target is reached. However, when a sole-supplier agency sets prices above SRMC, there is a DWL of consumer surplus. As we saw in Chapter 14, DWL rises with the size of the price mark-up and the elasticity of demand. Figure 17.2 shows DWL with elastic demand in panel (a) and less elastic demand in panel (b). DWL rises with more elastic demand.

The aim therefore is to find the mark-up prices that minimise the DWL due to lower consumption. This is achieved by raising prices for goods in inelastic demand or by charging higher prices to consumers with an inelastic demand for the goods. If demand for a good is perfectly price inelastic, even a very large mark-up does not affect consumption. There is a transfer payment from consumers to the producer, but no reallocation of resources.

Ramsey (1927) showed that to meet a revenue target with least DWL the percentage reductions in the quantities of each good contributing to this revenue must be equal. Strictly these are reductions in quantities along compensated demand curves. To achieve this, providing that there are no cross-price effects (i.e. the price of one good does not affect the demand for another), the percentage price mark-ups should be inversely proportional to the compensated price elasticities of demand for each good.[10] This can be expressed as:

$$\frac{(P_i - MC_i)}{MC_i} = \frac{k}{\eta_i} \tag{17.7}$$

where k is a constant, η is the compensated price elasticity of demand and i is the ith good. The constant k is set so that the mark-ups yield the revenue to meet the revenue target.[11] This form of mark-up pricing is known as Ramsey pricing.[12]



(a) Deadweight loss with elastic demand

(b) Deadweight loss with inelastic demand

Figure 17.2 Deadweight loss and demand elasticity

[10] A more detailed proof of these propositions is given in our discussion of optimal tax in Chapter 27.

[11] Allowing for cross-price effects, Weare and Friedman (1998) show that if two goods are strong substitutes (complements), the optimal Ramsey mark-up is increased (reduced).

[12] Ramsey (1927) is usually credited with the principle of least-cost mark-up pricing. The same principle applies to efficient taxation (Chapter 27).

If an agency supplies one or more goods with inelastic demand, an efficient mark-up strategy can raise revenue with low deadweight cost. However, if mark-ups are not based on the Ramsey principle, mark-up pricing can result in distortions of consumption and deadweight loss.

Non-linear pricing. With a non-linear price structure, prices per unit of consumption vary with the level of consumption. A volume discount is an example of this.

A two-part tariff, sometimes described as access pricing, is a common non-linear tariff structure. With a two-part tariff, users are charged for access to a system (such as a telephone network or water utility) and for use of it. Access charges can pay for the fixed costs, user charges for variable costs. Figure 17.3 shows how this can work. The efficient level of output is Q_1, which reflects the intersection of the market demand curve and the SRMC line (i.e. the equality of marginal benefit and cost). If the agency charges P_2 to cover LRAC, consumption would fall to Q_2. With a two-part tariff, consumers pay P_1 per unit of consumption plus a fixed charge that equals the fixed cost (area $ABCP_1$) divided by the number of consumers. This system is generally efficient. Because the demand for access to utilities is usually highly inelastic, an access charge has little effect on consumption. On the other hand, if user charges reflect SRMC, the key relationship between user charge and marginal cost is maintained.

However, a two-part tariff can present problems. First, access charges can create a DWL when consumers are deterred from access and drop out of the market altogether. This effect may be minimised by offering customers options with various fixed and user cost components so that they can choose their preferred combination. Second, access charges have limited application when services have no obvious access component, for example data on property titles. The marginal cost of supplying these data is low. However, because all property owners benefit from the security of title provided by the work of the agency, the agency's fixed cost could be recovered by a fee when properties are transferred or an annual fee on all property owners. This would have a minimal adverse resource allocation impact. A third potential weakness of access charges is that they are generally flat charges across the population and independent of use. Therefore, they may be more regressive than charges that vary with use.

In conclusion. Ramsey mark-up pricing and non-linear tariff structures are the main ways to raise revenues to meet a budget target with least deadweight loss. When prices are marked up on goods in inelastic demand or when tariffs are levied on access to a service for which demand is inelastic, mark-up prices and access charges have low DWL. In other cases, mark-up pricing and non-linear tariffs can have high DWL, especially if applied inefficiently.

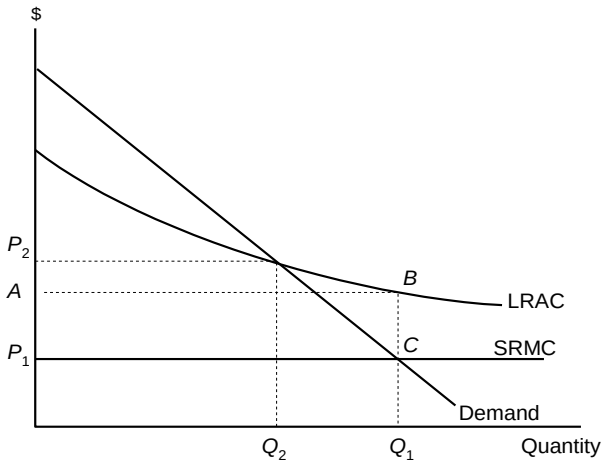


Figure 17.3 Two-part tariff or access pricing

Equity Issues

As we have seen, equity in pricing can be viewed in terms of two, not always consistent, principles: the benefit principle and the ability-to-pay principle. Pricing services at full cost is consistent with the benefit principle. But the ability-to-pay principle suggests that government should subsidise essential services, such as power or transport, for less well-off households.

In practice, governments often use public trading enterprises to achieve social goals, such as cheap urban transport and subsidised communications for regional and rural households. The subsidies may be financed from consolidated revenue, as typically occurs with rail subsidies in Australia. Other subsidies may be financed by cross-price subsidies, with some users paying prices above long-run average cost for their services. This often occurs with communications and electricity in Australia.

Two main questions arise. First, are subsidised services the best instrument for achieving equity goals? Second, if a subsidy is appropriate or politically unavoidable, what is the best way to provide it?

As discussed in Chapter 22, untied income support generally raises the welfare of households more than the equivalent income tied to specified goods. Most people prefer $1000 in cash or untied tax relief to $1000 in subsidies for public transport or other services that they might not purchase with untied income. Second, fiscal transfers target less well-off households better than do subsidised goods. For example, subsidising goods sold to regional households by taxing metropolitan consumers is a crude form of redistribution as there are affluent households in regional areas and poor ones in urban areas. Third, fiscal transfers usually have lower costs of administration than service subsidies. Economists usually conclude that equity goals are achieved best by fiscal measures and that departures from efficient pricing policies are an inferior instrument for achieving equity goals.

Nevertheless, governments often subsidise services because they believe that fiscal transfers are not sufficient. A public choice explanation would be that administration of subsidised services enhances the role of public servants more than do simple income transfers. Accordingly, we need to consider how best to provide these subsidies.

Service subsidies can be provided in four main ways:

1. Undercharging all users of selected services and financing the deficit from consolidated revenue.
2. Undercharging targeted services or users, such as pensioners, and financing the deficit from consolidated revenue.
3. Undercharging for some services and overcharging for others (i.e. by cross-price subsidies).
4. Providing subsidies, in vouchers or cash, to targeted users.

Governments generally employ a mixture of the first three strategies, although the fourth strategy is gradually being used more.

Strategy 1 (undercharging all users) is a blunt instrument. Subsidies would be provided to rich and poor alike. The Industry Commission (1994) showed that a high proportion of the annual billion dollar subsidy for public transport in Australian cities accrues to medium- and high-income households. Moreover, there is no benchmark for how much subsidy to provide and no financial or management discipline for the trading agency. The deficit is often treated as an open-ended bucket of public money.

Strategy 2 (undercharging selected users) is a more direct and generally lower cost subsidy approach. It is often implemented with a **community service obligation** (CSO) payment. A CSO requires that government and the trading agency agree on (1) the subsidies to be provided, (2) the cost of the subsidies to the trading agency and (3) the method of

reimbursement by government. This approach has several advantages over strategy 1. First, government, not the trading agency, decides the intent and level of subsidy. Second, a CSO is a transparent payment. Third, the trading agency is subject to commercial accountability—the CSO is incorporated into the revenue stream of the trading agency. However, the strategy requires that the subsidies and their costs be well defined. This means determining the extent to which service costs exceed charges. This depends in turn on whether the benchmark cost is SRMC, LRMC or LRAC. Government and a trading agency may disagree on the size of a CSO. Sometimes, strategy 2 is hard to distinguish from strategy 1.

Cross-price subsidies (strategy 3) are rarely equitable or efficient. Their real incidence is often obscure. For example, transport or telecommunication subsidies to households who live in designated areas generally benefit property owners (who can charge higher rents) rather than renters. On the other hand, the real burden of high input prices for business often falls on consumers via higher prices, rather than on shareholders. Even if the subsidies are well directed, it is not clear why other service users should bear the cost rather than the whole community via consolidated revenue, as in strategy 2. In terms of efficiency, charging some consumers above LRAC to pay for the subsidies discourages efficient consumption and creates a deadweight loss.

Providing subsidies to users directly rather than to suppliers (strategy 4) can work in two main ways. Government can provide vouchers to targeted individuals that entitle them to a specific service (e.g. electricity) at a reduced price. On receipt of the vouchers from a service provider government reimburses the provider for the agreed amount of the voucher. Alternatively, government can reimburse targeted users on receipt of specified expenses. Whichever means is adopted, this strategy has significant advantages. The consumer can choose how to use the subsidy to maximise his or her service benefits. Also, the strategy maximises the opportunity for competition between service providers. The main disadvantage is the administrative cost of dealing with large numbers of consumers rather than with a small number of service suppliers, sometimes only one.

Conclusions

The principles for efficient pricing of public services can be summarised as follows. When government is sole supplier of a service, price should generally be set equal to SRMC of production. When there is a supply constraint, the SRMC is the highest price that someone would pay for a marginal unit of output as this reflects the opportunity cost of supplying the good to one consumer rather than to another.

When actual or potential private firms can supply substitute services and private sector prices are set to cover LRAC, the principle of competitive neutrality (or second-best arguments) requires that public prices be marked up in similar fashion to the private sector. This may require that a public agency price its services at least at LRMC.

However, SRMC or LRMC prices may not achieve full cost recovery, with consequent demands on consolidated revenue and related DWL. This may lead to a preference for full cost recovery. To achieve cost-recovery efficiently, agencies should mark up prices according to the inverse price elasticity rule or use a non-linear price structure like a two-part tariff.

There are several constraints to implementing these principles. One is the amount of information required on cost functions and demand elasticities. Competitor firms will not willingly provide these data. Calculation of efficient prices often requires information on demand price elasticities for specific services and specific consumer groups, including cross-price elasticities. Consequently, precise applications of Ramsey pricing are rare.

Another issue is the notion of the marginal increment in output. The marginal costs of picking up one extra bus passenger, of making a regular additional bus stop and of running an extra bus service are each different. Similar examples abound in other sectors. Determining

the relevant marginal cost depends on the decisions to be made. In the case of the bus service, the main decision may be whether, or not, to run the service. A secondary decision will be where to pick up passengers. Prices cannot be adjusted to the marginal cost of every decision, such as whether to pick up an extra passenger.

Third, when agencies are required to recover full costs, joint costs must be allocated. For instance, rail or telephone infrastructure may have to be allocated to users of the networks. Regulators often allocate these overhead costs among users according to their proportionate use of the facilities. These proportions may be estimated as the percentages of use (e.g. rail passenger kilometres), of revenues generated or of variable costs attributed to the service. However, these regulatory practices may be inefficient. Often joint costs reflect the need for capacity, which may be administrative or infrastructure capacity. The costs should be allocated to the services that require this capacity. For example, the costs of new rail infrastructure should be allocated to peak-hour services rather than to off-peak services.

Transaction costs are another problem. Transaction costs include metering use, administering a pricing system and enforcing prices. If transaction costs were zero and the demand for services such as road use or electricity were continuously variable, the solution would be real-time (instantaneous) pricing. This is rarely practical. Transaction costs must be factored in to development of an effective pricing strategy.

In addition to efficiency issues, there are frequently concerns about equity especially where the services are perceived as welfare services. Here, decisions are required as to whether services should be subsidised and, if so, what is the best method of subsidy. If a service is to be subsidised, a strong case can be made for setting an efficient price and for providing a transparent subsidy to users rather than reducing prices to all users or adopting cross-price subsidy strategies.

Given these constraints, the pricing of public services rarely resembles the detailed prescriptions for efficient pricing described in this chapter. However, the prices of public services are probably closer to the economist's prescriptions for efficient pricing today than they were 10 or 20 years ago.

Summary

- Prices for public sector services have several functions: to promote efficient use of resources, to facilitate efficient management, to distribute services fairly and to raise revenue with minimum deadweight loss. The multiple objectives create potential conflicts that require resolution.
- When government is sole supplier of a service, efficiency requires that prices be set equal to short-run marginal cost. If there is a supply constraint, the short-run marginal cost is the opportunity cost of supplying a service to one consumer rather than to another.
- When there is competition in supply of a service, setting public prices equal to the long-run marginal cost of supply encourages a level playing field and efficient allocation of resources.
- Also, short-run marginal cost prices may create trading deficits. Deficits are inefficient if they weaken management incentives to be efficient or are financed by taxes that create deadweight losses.
- Cost recovery revenue targets depend on the valuation of capital assets and required rates of return on capital as well as on operating expenses.
- The most efficient ways to pay for fixed costs, or to reach revenue targets, are by mark-up pricing on goods in inelastic demand or by a non-linear pricing system, such as a two-part tariff scheme.
- If government wishes to subsidise a service, it should provide a transparent community service obligation payment either to targeted users or to service provider(s). Open-ended public subsidies to fund deficits and cross-price user subsidies are often inefficient ways to achieve social goals.

Questions

1. The Productivity Commission (2001b) points out that many regulatory agencies, such as the Therapeutic Goods Administration, recover all or a high proportion of their costs, whereas most information agencies, such as the ABS, recover only a small part of their costs.
   i. What principles should determine whether government agencies should recover costs for services provided?
   ii. Should regulatory agencies aim to recover 100 per cent of their costs?
   iii. Should information agencies aim to recover some or all of their costs?
2. What are the main strengths and weaknesses of short-run marginal cost pricing?
3. When does short-run marginal cost pricing lead to full cost recovery?
4. Suppose government is the sole supplier of a good to the public. Demand for the good is given by $Q^d = 50 - P$. Short-run marginal cost is constant at \$10 per unit of output. Suppose the government is producing 30 units of the good. Is this an efficient level of production? If not, what is the efficient level and price to be charged?
5. Suppose government adopts a strategy of mark-up pricing for a good. Demand for the good is given by $P = 50 - 2Q$. The government can produce at a constant marginal cost of \$10 per unit. Government marks up the price by 20 per cent over marginal cost.

   Determine the following;
   i. The price and quantity under the mark-up pricing strategy.
   ii. The efficient price and quantity combination.
   iii. The deadweight loss that emerges as a result of the pricing strategy.
   iv. Suppose that demand for the good becomes more inelastic. What will happen to the size of the deadweight loss as a result of the mark-up?
6. Suppose that a bridge can be built for \$30 million and that there are no operating costs. The expected demand is $Q^d = 800 - 100P$ where Q is the number of crossings in thousands per annum and P is the price per crossing.
   i. If a private company builds the bridge, what will be the profit-maximising price?
   ii. Will that price lead to the efficient number of crossings? Why or why not?
   iii. What will be the company's profit or loss? Will the company build the bridge? Note this may involve a discussion of discount rates.
   iv. If the government were to build the bridge, what price should it charge?
   v. What is the social benefit from the bridge and what is the social rate of return? Should the government build the bridge?
7. What is the main difference between an accounting and an economic rate of return? If a government agency makes an economic rate of return, does that mean that it is making an economic profit?
8. If a government agency is operating at a loss, what are the most efficient ways to reduce the deficit?
9. A government agency produces two goods, *X* and *Y*. Selling both goods at prices equal to their respective short-run marginal cost, the agency sells 20 units of *X* at \$10 and 30 units of *Y* at \$20. The price elasticities are –1.0 and –2.0 for *X* and *Y* respectively. To cover its fixed costs the agency needs to raise \$100 over its short-run costs. At what prices should the agency sell *X* and *Y*? What is the deadweight loss associated with the mark-up in each case? Show why these mark-ups are efficient.
10. If government wishes a publicly owned electricity supplier to provide subsidised electricity to low-income households, what method would you recommend and why?
11. When a public agency supplies water, how should it determine charges? When is it sufficient for charges simply to cover (i) operating costs and (ii) operating and capital costs?

Further Reading

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