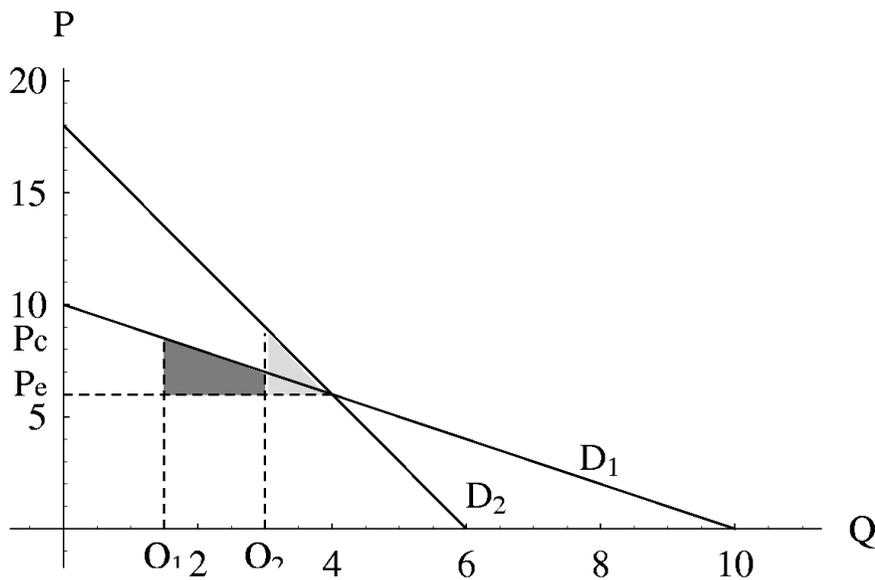


## Utility Cost Allocation

Utilities typically are multi-product firms supplying to different customer classes. For example, they supply high and low voltage customers as well as peak and off peak services. A utility's fixed cost may contribute to services for more than one product or customer class. Fully distributed cost (FDC) deals with the issue of how to distribute these fixed costs over customer or product classes.

One way to allocate fixed costs is to distribute them in the price across all consumers. This, however, distorts consumption decisions and causes losses in social welfare, since price will no longer be equal to marginal cost. To get some intuition on how to minimize this distortion note the two demand classes in Figure 4.12.  $D_1$  is the more elastic demand and  $D_2$  is the less elastic. Both demands are chosen to cross at the marginal cost of 6 to make the illustration easier to interpret. The efficient price would be 6 and quantity would be the same in both markets. If the price were raised to the total average cost of  $P_c$ , quantity in market 1 would fall to  $Q_1$  and quantity in market 2 would fall to  $Q_2$ . Consumer surplus lost in market 1 would be the area under  $D_1$  and above the marginal cost curve and the consumer surplus lost in market 2 would be the area under  $D_2$  and above costs. Part of this area in each case goes to producers to pay for their fixed costs and is not lost. But part of the area in each case goes to no one. This is the darker gray area for market 2 and the lighter gray area plus the bottom part of the darker gray area for market 1. These are the deadweight losses in the two markets. It is quite easy to see that deadweight losses are much larger in the market where demand is more elastic. Thus, the most efficient way to price in this market, or the pricing scheme that nets the smallest social or deadweight losses would allocate more of the cost to markets where demand is inelastic. This pricing scheme is called Ramsey pricing.

**Figure 4.12 Distributing Fixed Cost Across Consumer Class**



The more efficient way to allocate fixed costs is as fixed charges. To investigate this issue, consider the following example from Viscusi et al (1995). Suppose a utility has two classes of customers. Residential customers (X) demand low voltage electricity and industrial customers

(Y) demand high voltage. Their cost curves are as follows if each group is serviced by a different utility.

$$C_x = 700 + 20X$$

$$C_y = 600 + 20Y$$

Now suppose that one utility provides services to both customers and has the following cost curve for X and Y.

$$C_{xy} = 1050 + 20X + 20Y$$

Note that the costs of producing in the same plant are less than the costs of producing in separate plants because

$$C_x + C_y = 1300 + 20X + 20Y > C_{xy}$$

This condition is called subadditivity and typically results from load curves that vary across classes, so that the utility can run at a higher capacity factor when producing both X and Y. When cost functions are subadditive, the firm has economies of scope. That is it cheaper to produce both goods together as joint products than in separate firms. In the above example, marginal or operating costs are the same across the above two customers and economic theory suggests that price should be equal to marginal cost for the two classes.

The question with distributed fixed costs is how to allocate the combined fixed costs across customer classes. If costs were additive or

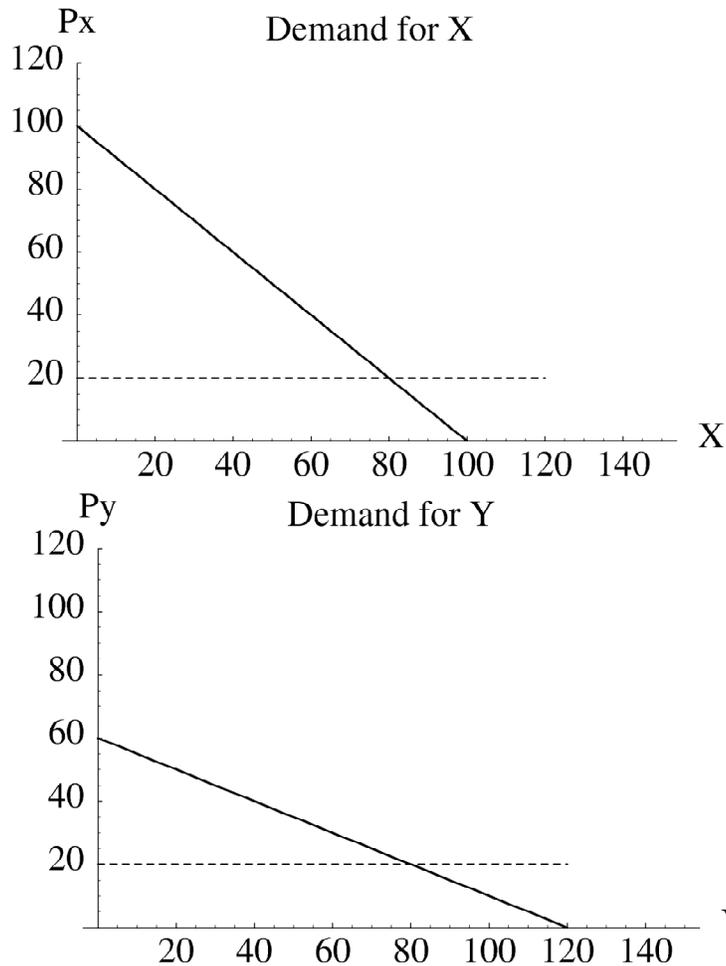
$$C_x + C_y = C_{xy},$$

instead of subadditive, a fair way would be to merely attribute the fixed costs accrued by each customer class to that customer class. With subadditivity it is less clear how the 1050 fixed costs should be divided across customer classes. Subjective criteria for this allocation include a sense of fairness, avoiding undue discrimination and no group subsidizing another. A more objective criteria would be to allocate costs in such a way as to maximize social welfare, which we will consider below.

- a. Another criteria is to not have one group subsidize another. We determine whether one group is subsidizing another by comparing price to stand alone average cost, where stand alone average cost is the average cost of producing for just that customer class. If a consumer's price is greater than the stand alone average cost, then the pricing is unfair to that consumer class and they are subsidizing the other consumer class.

An alternative to spreading the fixed cost over all units of the good is to charge each consumer the marginal cost of the product and then add a fixed amount. Since the consumer pays the fixed amount no matter what quantity they buy, they should maximize their consumer surplus by buying the quantity where price equals marginal cost. For any lesser amount, benefits exceed costs and they add to their consumer surplus by buying the item. The one exception is if the fixed charge exceeds the consumer surplus. Then the consumer should not buy any of the good.

### **Figure 4.13 Demands for X and Y**



We represent the problem using the above example in **Figure 4.13**. If we charge the marginal cost of 20 per unit, then X maximizes his consumer surplus by consuming where price equals marginal cost  $100 - X = 20 \Rightarrow X = 80$ .

Y maximizes her consumer surplus by consuming where price equals marginal cost

$$60 - 0.5Y = 20 \Rightarrow Y = 80.$$

Fixed cost in this model is 1050. Since each consumer consumes the same amount we could divide this amount over the two consumers, letting X pay 525 and Y pay 525. Each consumer would still consume the same amount as before unless the fixed charge were greater than their consumer surplus. Consumer surplus in these two markets are

$$CS_x = 0.5(100-20)*80 = 3200$$

$$CS_y = 0.5(60-20)*80 = 1600$$

Since consumer surplus is greater than the fixed charge, both consumers are better off consuming than dropping out of the market. As long as each consumer is consuming where price equals marginal cost, the market is efficient. The precise allocation of the fixed charge, then is not an efficiency issue but is a distribution problem. Since economists are loath to make interpersonal comparisons, theory does not tell us how to allocate the fixed cost, except that no

one should pay more than their consumer surplus. For the exact allocation, we need to rely on more normative criteria such as fairness.