Consumer and Producer Goods and Services

The goods and services that are produced and utilized may be divided conveniently into two classes.

Consumer goods and services are those products or services that are directly used by people to satisfy their wants. Food, clothing, homes, cars, television sets, haircuts, opera, and medical services are examples. The providers of consumer goods and services must be aware of, and are subject to, the changing wants of the people to whom their products are sold.

Producer goods and services are used to produce consumer goods and services or other producer goods. Machine tools, factory buildings, buses, and farm machinery are examples. The amount of producer goods needed is determined indirectly by the amount of consumer goods or services that are demanded by people. However, because the relationship is much less direct than for consumer goods and services, the demand for and production of producer goods may greatly precede or lag behind the demand for the consumer goods that they will produce.

Measures of Economic Worth

Goods and services are produced and desired because they have ***utility***—the power to satisfy human wants and needs. Thus, they may be used or consumed directly, or they may be used to produce other goods or services. Utility is most commonly measured in terms of ***value***, expressed in some medium of exchange as the ***price*** that must be paid to obtain the particular item.

Necessities, Luxuries, and Price Demand

Goods and services may be divided into two types: ***necessities*** and ***luxuries***. Obviously, these terms are relative, because, for most goods and services, what one person considers a necessity may be considered a luxury by another. For example, a person living in one community may find that an automobile is a necessity to get to and from work. If the same person lived and worked in a different city, adequate public transportation might be available, and an automobile would be a luxury. For all goods and services, there is a relationship between the prices that must be paid and the quantity that will be demanded or purchased. This general relationship is depicted in Figure 01. As the selling price per unit (p) is increased, there will be less demand (D) for the product, and as the selling price is decreased, the demand will increase. The relationship between price and demand can be expressed as the linear function

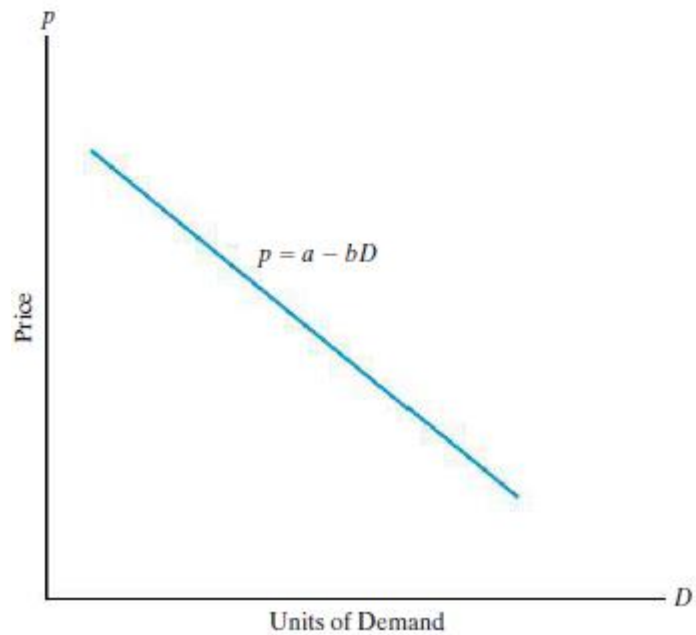

Fig 01: Price Demand Relationship

$$p = a - bD \qquad \text{for } 0 \leq D \leq ab \text{, and } a > 0, b > 0,$$

Where a is the intercept on the price axis and $-b$ is the slope. Thus, b is the amount by which demand increases for each unit decrease in p. Both a and b are constants. It follows, of course, that

$$D = \frac{a - p}{b}$$

Competition

Because economic laws are general statements regarding the interaction of people and wealth, they are affected by the economic environment in which people and wealth exist. Most general economic principles are stated for situations in which ***perfect competition*** exists. Perfect competition occurs in a situation in which any given product is supplied by a large number of vendors and there is no restriction on additional suppliers entering the market. Under such conditions, there is assurance of complete freedom on the part of both buyer and seller. Perfect competition may never occur in actual practice, because of a multitude of factors that impose some degree of limitation upon the actions of buyers or sellers, or both. However, with conditions of perfect competition assumed, it is easier to formulate general economic laws.

Monopoly

Monopoly is at the opposite pole from perfect competition. A perfect monopoly exists when a unique product or service is only available from a single supplier and that vendor can prevent the entry of all others into the market. Under such conditions, the buyer is at the complete mercy of the supplier in terms of the availability and price of the product.

The Total Revenue Function

The total revenue, TR, that will result from a business venture during a given period is the product of the selling price per unit, *p*, and the number of units sold, *D*.

Thus,

$$\mathbf{TR = price \times demand = (\,} \boldsymbol{p \cdot D} \mathbf{)}$$

$$\mathbf{TR} = (a - bD)D = aD - bD^2 \qquad \text{for } 0 \le D \le ab \text{ and } a > 0,\ b > 0$$

The relationship between total revenue and demand for the condition expressed in above equation may be represented by the curve shown in Figure 2. From calculus, the demand, $\hat{D}$, that will produce maximum total revenue can be obtained by solving:

$$\frac{d\mathrm{TR}}{dD} = a - 2bD = 0.$$

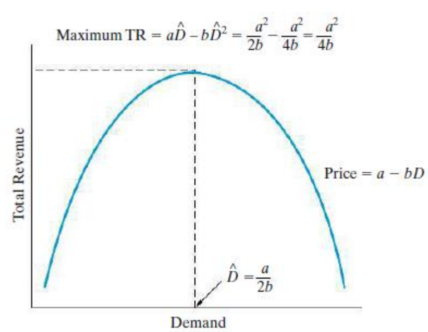

Fig 02: Total Revenue Function as a Function of Demand

Cost, Volume, and Breakeven Point Relationships

Fixed costs remain constant over a wide range of activities, but variable costs vary in total with the volume of output. Thus, at any demand *D*, total cost is

$$C_T = C_F + C_V$$

Where C_F and C_V denote fixed and variable costs, respectively. For the linear relationship assumed here,

$$C_V = c_v \cdot D$$

Where c_v is the variable cost per unit.

When total revenue and total cost are combined, the typical results as a function of demand are depicted in Figure 3. At ***breakeven point*** D'_1, total revenue is equal to total cost, and an increase in demand will result in a profit for the operation. Then at optimal demand, D^*, profit is maximized. At **breakeven point** D'_2, total revenue and total cost are again equal, but additional volume will result in an operating loss instead of a profit. Obviously, the conditions for which breakeven and maximum profit occur are our primary interest. First, at any volume (demand), *D*,

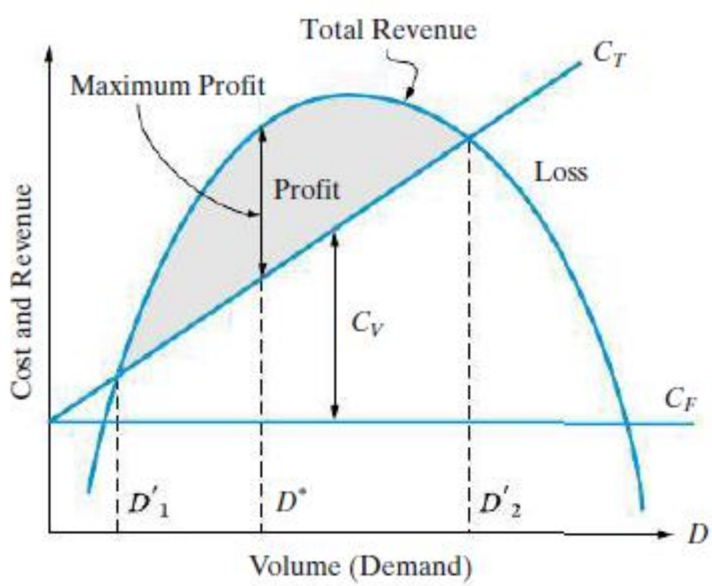

Fig: 03 Combined Cost and Revenue Functions, and Breakeven Points, as Functions of Volume, and Their Effect on Typical Profit

Profit (loss) = Total Revenue − Total Costs

$= (aD - bD^2) - (CF + cvD) = -bD^2 + (a - cv)D - CF$ for $0 \le D \le ab$ and $a > 0, b > 0$.

In order for a profit to occur, there are two conditions:

1. $(a - cv) > 0$; that is, the price per unit that will result in no demand has to be greater than the variable cost per unit. (This avoids negative demand.)

2. Total revenue (TR) must exceed total cost (CT) for the period involved.

If these conditions are met, we can find the optimal demand at which maximum profit will occur by taking the first derivative of Equation (2-9) with respect to D and setting it equal to zero:

$$\frac{d(\text{profit})}{dD} = a - c_v - 2bD = 0.$$

The optimal value of D that maximizes profit is

$$D^* = \frac{a - c_v}{2b}. \qquad (2\text{-}10)$$

To ensure that we have *maximized* profit (rather than minimized it), the sign of the second derivative must be negative. Checking this, we find that

$$\frac{d^2(\text{profit})}{dD^2} = -2b,$$

which will be negative for $b > 0$ (as specified earlier).

An economic breakeven point for an operation occurs when total revenue equals total cost. Then for total revenue and total cost, as used in the development of Equations (2-9) and (2-10) and at any demand D,

$$\text{Total revenue} = \text{total cost} \qquad (\text{breakeven point})$$

$$aD - bD^2 = C_F + c_v D$$

$$-bD^2 + (a - c_v)D - C_F = 0. \qquad (2\text{-}11)$$

Because Equation (2-11) is a quadratic equation with one unknown (D), we can solve for the breakeven points D'_1 and D'_2 (the roots of the equation):*

$$D' = \frac{-(a - c_v) \pm [(a - c_v)^2 - 4(-b)(-C_F)]^{1/2}}{2(-b)}. \quad (2\text{-}12)$$

With the conditions for a profit satisfied [Equation (2-9)], the quantity in the brackets of the numerator (the discriminant) in Equation (2-12) will be greater than zero. This will ensure that D'_1 and D'_2 have real positive, unequal values.

A company produces an electronic timing switch that is used in consumer and commercial products. The fixed cost (C_F) is \$73,000 per month, and the variable cost (c_v) is \$83 per unit. The selling price per unit is $p = \$180 - 0.02(D)$, based on Equation (2-1). For this situation,

(a) determine the optimal volume for this product and confirm that a profit occurs (instead of a loss) at this demand.

(b) find the volumes at which breakeven occurs; that is, what is the range of profitable demand? Solve by hand and by spreadsheet.

Solution by Hand

(a) $D^* = \frac{a - c_v}{2b} = \frac{\$180 - \$83}{2(0.02)} = 2{,}425$ units per month [from Equation (2-10)].

Is $(a - c_v) > 0$?

$$(\$180 - \$83) = \$97, \quad \text{which is greater than } 0.$$

And is (total revenue − total cost) > 0 for $D^* = 2{,}425$ units per month?

$$[\$180(2{,}425) - 0.02(2{,}425)^2] - [\$73{,}000 + \$83(2{,}425)] = \$44{,}612$$

A demand of $D^* = 2{,}425$ units per month results in a maximum profit of \$44,612 per month. Notice that the second derivative is negative (−0.04).

(b) Total revenue = total cost (breakeven point)

$$-bD^2 + (a - c_v)D - C_F = 0 \qquad \text{[from Equation (2-11)]}$$

$$-0.02D^2 + (\$180 - \$83)D - \$73{,}000 = 0$$

And, from Equation (2-12),

$$D' = \frac{-97 \pm [(97)^2 - 4(-0.02)(-73{,}000)]^{0.5}}{2(-0.02)}$$

$$D'_1 = \frac{-97 + 59.74}{-0.04} = 932 \text{ units per month}$$

$$D'_2 = \frac{-97 - 59.74}{-0.04} = 3{,}918 \text{ units per month.}$$

Thus, the range of profitable demand is 932–3,918 units per month.

An engineering consulting firm measures its output in a standard service hour unit, which is a function of the personnel grade levels in the professional staff. The variable cost (c_v) is \$62 per standard service hour. The charge-out rate [i.e., selling price (p)] is \$85.56 per hour. The maximum output of the firm is 160,000 hours per year, and its fixed cost (C_F) is \$2,024,000 per year. For this firm,

(a) what is the breakeven point in standard service hours and in percentage of total capacity?

(b) what is the percentage reduction in the breakeven point (sensitivity) if fixed costs are reduced 10%; if variable cost per hour is reduced 10%; and if the selling price per unit is increased by 10%?

Solution

(a)

$$\text{Total revenue} = \text{total cost} \qquad \text{(breakeven point)}$$

$$pD' = C_F + c_v D'$$

$$D' = \frac{C_F}{(p - c_v)}, \tag{2-13}$$

and

$$D' = \frac{\$2{,}024{,}000}{(\$85.56 - \$62)} = 85{,}908 \text{ hours per year}$$

$$D' = \frac{85{,}908}{160{,}000} = 0.537,$$

or 53.7% of capacity.

(b) A 10% reduction in C_F gives

$$D' = \frac{0.9(\$2{,}024{,}000)}{(\$85.56 - \$62)} = 77{,}318 \text{ hours per year}$$

and

$$\frac{85{,}908 - 77{,}318}{85{,}908} = 0.10,$$

or a 10% reduction in D'.

A 10% reduction in c_v gives

$$D' = \frac{\$2{,}024{,}000}{[\$85.56 - 0.9(\$62)]} = 68{,}011 \text{ hours per year}$$

and

$$\frac{85{,}908 - 68{,}011}{85{,}908} = 0.208,$$

or a 20.8% reduction in D'.

A 10% increase in p gives

$$D' = \frac{\$2{,}024{,}000}{[1.1(\$85.56) - \$62]} = 63{,}021 \text{ hours per year}$$

and

$$\frac{85{,}908 - 63{,}021}{85{,}908} = 0.266,$$

or a 26.6% reduction in D'.