Basic Economic Principles

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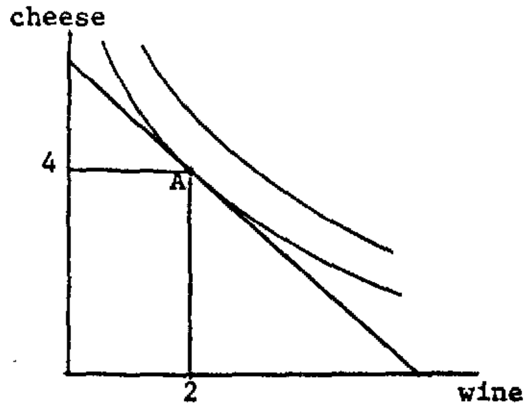
Economics shares with engineering a concern with solving problems: problems like how to produce shoes efficiently or how to control pollution--or how to design an efficient transportation system. However, the economic approach to solving problems differs from the engineering approach in one crucial way: In an economic context every problem has a solution. Economists achieve this miracle by defining their goals in such a way that doing without something is the correct "solution" if it is too expensive or impossible to obtain it. Thus if pollution can be eliminated only at a prohibitive cost, economists will seek the optimal amount of pollution. If Lockheed loses money no matter what it does, the economic solution is for Lockheed to go out of business.

Formally, the economic approach involves maximizing an objective function that reflects both goals and costs. This idea is sometimes stated incorrectly as, for example, "getting the most pollution control for the least amount of money." A correct statement in words is somewhat cumbersome: The goal is to control pollution at whatever level in a cost-minimizing manner, and to choose the level of pollution control that is most worthwhile considering its minimum cost. Similarly, economists look at the behavior of a consumer as solving a problem in the allocation of time and money. The goal for a consumer is to spend whatever money is earned in the manner that maximizes his satisfaction, or "utility," and to earn that amount of money that is most satisfying considering the disagreeableness of working harder and the satisfaction to be obtained from what the earnings from extra work will buy. Considering for the moment a choice between just two goods, say wine and cheese, we can associate



any pair of quantities of the two goods with a point in the first quadrant of a graph with Cartesian co-ordinates. Thus point A may represent 2 glasses of wine and 4 ounces of cheese. The other combinations of wine and cheese that would be equally satisfying to a consumer will, under reasonable assumptions, be on a curve through A that is convex to the origin. Economists call such a curve an "indifference curve." Combinations that are preferred over A lie on indifference curves farther from the origin. If the prices of wine and cheese are given, the other combinations that can be bought for the same amount of money as A will be on a straight line through A (the budget line), the slope of which is determined by the relative prices of wine and cheese. If A is preferred to all other combinations that can be bought with the same amount of money, then the indifference curve through A must be tangent to the budget line at A. Thus a graphical depiction of a process of consumer maximization involves finding where the boundary of attainable points is tangent to an indifference curve. In a more formal formulation a continuous variable called "utility" is assumed to depend on the quantities of wine and cheese in such a way that each indifference curve corresponds to a different level of utility, with higher levels of utility associated with indifference curves further from the origin. The consumer's problem is then one of maximizing

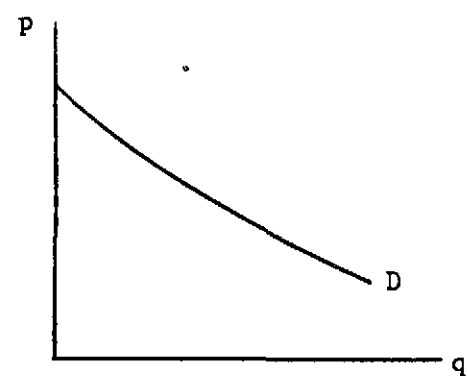
$$U = f(q_w, q_c) \tag{1}$$

subject to the constraint that

$$I = p_w q_w + p_c q_c \ , \qquad (2)$$

i.e., that expenditure be equal to income. To solve this kind of problem economists use Lagrangian constrained maximization techniques. Generalization to more than two commodities is straightforward.

A demand curve can than be derived by finding the quantities of a good that solve the maximization problem as one varies the price of that commodity, holding income and the prices of all other goods constant. Or, more directly, one can say that a demand curve expresses the quantity of a good that a utility-maximizing person will want to buy as a function of the price, assuming that income and all other prices are fixed at given levels, and assuming that the person has no way of affecting the price he pays. For reasons of consistency with historical diagrams, economists always put quantity on the horizontal axes of their graphs and price on the vertical axes, even though they usually think of quantity as the dependent variable. Market demand at any price is obtained by summing the quantities demanded by all persons in the market at that price. Economists are often concerned with the "elasticity of demand," by which they mean



$\frac{dq}{dp} \cdot \frac{p}{q}$, the limit of the ratio of percentage changes in quantity to percentage changes in price along the demand curve.

A supply curve is derived by applying the idea of profit maximization of firms. Technology determines a relationship between inputs and output.

Economists call that relationship a "production function," but we won't delve into it. Suffice it to say that the production function and the prices of inputs determine a "total cost function," C(q) which gives the minimum cost at which any quantity of output can be produced. The profit, π, that a firm makes can be considered the difference between revenues and costs, each of which depend on the quantity of output:

$$\pi = R(q) - C(q) \tag{3}$$

If a firm cannot affect the price at which it sells its output (as in the economists' model of perfect competition), then revenue is simply the product of quantity and that inflexible price:

$$\pi = p \cdot q - C(q) \tag{4}$$

The condition for profit maximization can be obtained by differentiating with respect to q and setting that derivative equal to 0:

$$\frac{d\pi}{dq} = p - \frac{dC}{dq} = 0. \tag{5}$$

Thus

$$\frac{dC}{dq} = p. \tag{6}$$

Economists refer to the derivative of total cost with respect to quantity as "marginal cost," that is, the cost of producing one addition unit. Similarly, the derivative of revenue with respect to quantity is called marginal revenue. Profit maximization involves equating marginal revenue and marginal cost, which, in the cost of a competitive firm means choosing that output where marginal cost is equal to the price received. This is efficient because it means that the prices by which consumers choose how much to buy correspond to the costs of producing what they buy.

There is a second-order condition of profit maximization: Marginal cost must be rising. And one further condition: revenue must be greater than "variable costs," that is the costs that could be avoided by not producing. This condition may also be stated as the condition that price be greater than average variable cost. All three conditions are summarized in the statement that a competitive firm's supply curve is that part of its marginal cost curve that is greater than average variable cost and rising.

A market supply curve is obtained by summing the quantities that all firms would supply at each price. If all firms have the same cost functions, then in the long run, when all costs are variable, a competitive market will supply unlimited quantities at a price that just covers costs. Profit, exclusive of an ordinary return to capital and entrepreneurial effort, is exactly zero.

The competitive result may be contrasted with the profit maximizing outcome when a firm can affect the price of its output by varying the quantity it produces. Then (2) may be written as

$$\pi = p(q) \cdot q - C(q). \tag{7}$$

Differentiating and setting the result to zero,

$$\frac{d\pi}{dq} = \frac{dp}{dq} \cdot q + p - \frac{dC}{dq} = 0. \tag{8}$$

Rearranging,

$$\frac{dC}{dq} = p + \frac{dp}{dq} \cdot q, \tag{9}$$

or

$$\frac{dC}{dq} = p\left(1 + \frac{1}{\frac{dq}{dp} \cdot \frac{p}{q}}\right) \tag{10}$$

In words, a profit-maximizing producer who can affect the price of his product will choose a level of output where marginal cost is equal to price multiplied by one plus the reciprocal of the elasticity of demand. Since the elasticity of demand is negative, this means that marginal cost will be less than price, so that consumers will be economizing on this output inefficiently, treating it as if it were more valuable than it is in terms of resources used in production.

A regulated firm might have no control over the price of its product, but it could affect both revenues and costs through such variables as advertising and frequency of service. An economic analysis would predict that regulated firms would maximize with respect to the variables they did control, setting them at levels where their marginal contributions to revenues equaled their marginal contributions to costs, with appropriate second-order conditions.

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For further reading

R. G. Lipsey and P. O. Steiner, Economics (Harper & Row).

P. A. Samuelson, Economics (McGraw-Hill)

Kelvin Lancaster, Introduction to Modern Microeconomics (Rand McNally)--
a more theoretical treatment.

J. M. Henderson and R. E. Quandt, Microeconomic Theory (McGraw-Hill)--
a mathematical treatment.