

# BasicMicro. Economics: An Outline

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## Part II

### eleven Chapter

## Optimization and Markets

**E**conomics can be viewed as a social science or as a tool for decision science. As a tool economics provides some insights that help identify optimal choices with respect to specific alternatives. One of the basic precepts of Neoclassical microeconomics is that voluntary markets for goods with nonattenuated property rights will provide the information and incentives that coordinate individual behavior to achieve the maximum utility for society. Most of Neoclassical economics presumes that the agent is trying to maximize or minimize (optimize) some objective with respect to a set of constraints.

Rational choices require three basic steps:

- Identify the objective
- Identify all feasible alternatives
- Develop a criteria to evaluate each alternative with respect to the objective

### A Objective, constraints and alternatives

**T**he objective is a function of the values and preferences of the individual agent. Experience, social background as well as many other social and psychological characteristics that relate to the individual determine the nature of the agent's objectives. Economic agents have a variety of objectives.

- (1) **There are a variety of objectives that an agent might have.** These include profits, utility, sales, market share, income, growth,...With in a firm different individuals may have different objectives. The CEO may want to maximize profits while the Vice president of engineering may want to minimize the cost per unit and the person in charge of marketing may want to maximize the growth in sales or market share. The objectives may not be consistent so some sort of hierarchical or bureaucratic process must resolve the inconsistency. In a market setting, competing objectives of individuals is believed to be reconciled by voluntary transactions or exchanges.
- (2) **The achievement of any objective is subject to a set of constraints.** Constraints may be technology, quantity of factors of production, quality of factors, profits, utility, sales, market share, income, growth, social institutions, values, law or a myriad of other possibilities. The constraints and objectives can be structured in a variety of ways. For instance, a firm may try to maximize market share (objective) subject to the constraint that they earn a 12% return on capital investment. Alternatively, a firm might try to maximize the rate of return on capital

subject to the constraint that they maintain a 20% market share. An individual might try to maximize income subject to the constraint that they have 30 days of leisure time per year or they might try to maximize their leisure time subject to the constraint that they have at least \$50,000 income per year.

## B Criteria to evaluate alternatives

**C**hoice implies that the agent has alternatives to choose among. Once the agent has identified the objective and constraints they must evaluate each alternative with respect to the objective. The criteria they use for this evaluation is crucial to their choice. Generally, the criteria will involve two aspects; efficiency and ethics.

- (1) **Efficiency** is the measure of how well one achieves objectives given a set of constraints. Efficiency is not in and of itself the objective. The word "efficiency" is a popular term and is often used to justify choices and behavior. Reconsider the concepts of efficiency discussed in **Introduction**.

**Technical efficiency** is conceptually measured as a ratio of output to input. 
$$\text{Technical Efficiency} = \frac{\text{Objective}}{\text{constraints}} = \frac{\text{output}}{\text{input}} = \frac{Q_y + Q_x}{(L, K, \dots, \text{technology})}$$

For any given set of inputs, technology and output of one good, the maximum output of the other good is technically efficient.

**T**echnical efficiency can be considered in the production of a single good. In the short run where one input is fixed (say K), the maximum efficiency of the variable input (say L) occurs at the maximum of the  $AP_L$  (where  $MP_L = AP_L$ ). The level of technical efficiency of labour is a function of the amount of K as well as technology.

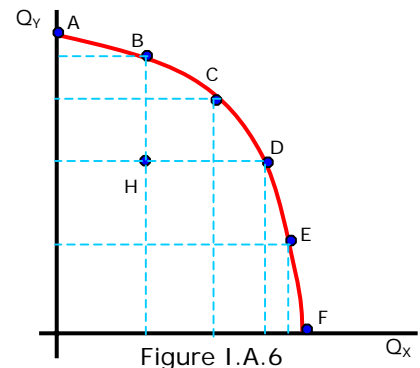
**T**echnical efficiency does not consider the value or relative prices of either inputs or outputs. In physics efficiency the concept of efficiency can be calculated by the different measures of energy (or the capacity to do work). Foot-pounds, foot-pounds per sec, Ergs, Joules, horsepower, horsepower-hours, BTU, kilowatts are all measures of energy. The input and output of energy of a particular process (internal combustion engine, electric motor, etc) can often be measured. From the perspective of economics technical efficiency can be more problematic. What is the efficiency of an automobile? This depends on the measures of inputs and outputs chosen. Typically, miles per gallon may be used as a measure. Miles traveled is the presumed output and "gallons of fuel" is the input. This measure presumes that the number of miles traveled is the sole objective output. Passenger miles, passenger safety, status of owner, or many other measures may better reflect the desired output or objective of the automobile. The same problem exists for the inputs. The presumption is that fuel is the only input. The other inputs such as energy to produce the tons of steel to create the car may be ignored.

**T**he optimization (maximization) of technical efficiency can occur by maximizing the outputs for a given input or by minimizing the inputs for a given output. It is not possible to maximize output and minimize inputs at the same time. If a public health agency instituted a policy to immunize preschoolers for DPT (diphtheria, pertussis and tetanus) and wanted to maximize efficiency, the problem could be framed in two ways. First, they might be allocated a set of resources (vaccine, personnel, offices, etc) and then try to vaccinate as many children as

possible. Alternatively, they might try to vaccinate all children by using as few resources as possible. Neither the process nor the results are the same.

In the transformation or production possibilities model, technical efficiency lies on the transformation or production possibilities frontier. Review the earlier discussion of technical efficiency from **Introduction**.

The location and shape of the PPF is determined by technology, quantity and quality of inputs. It represents all output combinations possible. The quantity and quality of inputs are fixed. The task is to maximize the outputs. The output combination identified at point H is "technically inefficient." More of good Y or good X (or more of both) can be produced with the same set of inputs and technology. All technically efficient solutions lie on the PPF. Technical efficiency does not answer the question about which output combination is preferred or most valuable. Allocative or economic efficiency is required to answer that question.

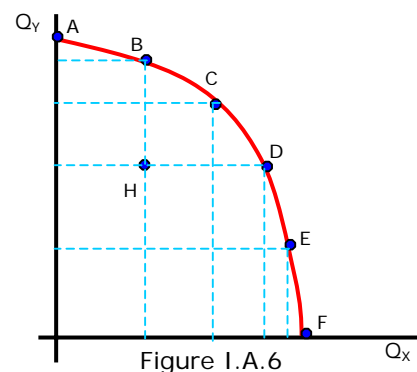


**Allocative or economic efficiency** includes the values or relative prices of outputs and inputs. The benefit or value of a choice is represented by the product of the price and quantity of each good or output (value of output =  $P_x Q_x + P_y Q_y + \dots + P_n Q_n$ ). The value of the inputs or cost is represented by the product of the prices and quantities of the inputs (cost =  $P_L L + P_K K + \dots + P_i Q_i$ ). Allocative efficiency is attained when we maximize the value of the outputs relative to the value of the inputs. The cost is minimized for a given output or output is maximized for a given cost. **The economically efficient solution must lie on the production possibilities function.**

**Pareto efficiency** is the condition where there are no alternatives that will increase the welfare (utility) of one person without reducing the welfare (utility) of any other person(s). Once an output combination on the production possibility function is attained, that output combination is Pareto Optimal.

**Pareto efficiency** is a restrictive criteria and tends to promote the *status quo*. Most choices involve marginal benefits and marginal costs that change the welfare or utility of more than one individual. The Pareto

The output combination at point H is not Pareto Optimal. Irrespective of individual preferences a move from point H to output combinations at point B or D (or any where in the area HDB) represent "Pareto Improvements." Each alternative in the area HDB is "Pareto Superior" to the alternative represent by point H. If the current output combination were at point E, it would be Pareto Optimal even if it were not the highest valued output. Any increase in good Y (or X) would require a decrease in good X (or Y). The individuals who prefer X (or Y) to Y (or X) would be "worse off" (their utility or welfare is lower). If the output is currently at point H, the area HDB is called "Pareto Safe."



efficiency criterion fails to justify choices that result in the highest valued use of resources (economic efficiency). To remedy this problem the criterion of **Pareto Potential** is used. Pareto Potential justifies the choice of an alternative so long as the “winners” (individuals whose utility increased) can hypothetically compensate the “losers” (individuals whose utility decreased) and still be better off. This is the foundation of criteria such as Benefit/cost analysis, rate of return on investment and internal rates of return. The problem with Pareto Potential is that it introduces the question of equity. Consider the problem of breaching dam is the Pacific Northwest. There are winners and losers. Environmentalists, individuals who benefit from anadromous fish and agents who earn income from tourists are some of the winners. Electricity generators and farmers are examples of losers. Even if the marginal benefits of breaching the dam exceeded the marginal costs, there is no mechanism to insure the winners would compensate the losers. There is necessarily a judgment about the morality of the dams and the imposition of costs and benefits of various groups of individuals. This example also illustrates the issue that the *status quo* tends to be supported by the Pareto Optimality criterion. Building the dams imposed costs and conferred benefits on different groups of people just as breaching the dams will. As societies and individuals change their preferences, technology and environments change and alter the objectives and optimal use of scarce resources. In an ideal world, informed individuals engaged in voluntary exchanges will result in transfers of property rights that are Pareto improvements and lead to economic efficiency.

- (2) **Equity** is a judgment about the rightness or wrongness of the objective. In **I Introduction**, deontological and consequentialist ethics were discussed. Any objective can be ethical or unethical based on the type of ethical system used. Remember that microeconomics relies primarily on a consequential ethic called “Utilitarianism” and is directly related to the concept of Pareto Potential. If the benefits exceed the costs of an action, the consequence is an increase in utility. This does not mean that deontological ethics (based on duty) are not necessary for a reasonably functioning society. It is important to consider the morality of our objectives and the sacrifices that must be made to achieve them.

### A. Marginal Analysis

The Marginalist Revolution in economics during the last half of the 19<sup>th</sup> century provided economists with a useful tool to find maximums and minimums given functional relationships between variables. Basically, this Marginalist Revolution was the application of calculus to economic analysis. One of the purposes of economics is to maximize or minimize a given variable by making choices. Choices are always made at the margin. A saying attributed to some anonymous Chinese philosopher is “The longest journey begins with the first step.” This is used here to point out that every decision is a change from an initial state. In production, the manager must understand that a change in an input such as labour “causes” a change in output. A consumer must understand that a change in quantity consumed alters the level of utility. A seller must understand that a change in price alters the quantity sold and the total revenue. Marginal analysis is the analysis of rates of changes in variables. Every time the word “marginal” is used in economics it is related to a change in a dependent variable “caused” by a change in an independent variable. The rate of change can be interpreted as the slope of a line. The slope of a line is often defined as “rise over run.” The rise is usually the change in the

dependent variable while the run is the change in the independent variable. For example, the cost of producing more of one good, given full employment, requires a sacrifice of some other good. This was demonstrated in a Production Possibilities model. The slope of the PPF is called the “Marginal Rate of Transformation” (MRT). This is shown in Figure VI.1. The PPF function shows all combinations of Yawls (Y) and Xebecs (X) that can be produced given inputs and technology.

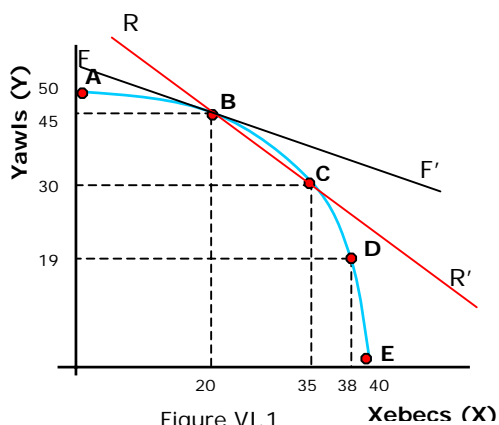


Figure VI.1

At point B, an increase in X ( $\Delta X=15$ , the run) requires a sacrifice of 15 units of Y ( $\Delta Y=-15$ ) This tradeoff is called the Marginal Rate of Transformation (MRT) and is illustrated by the line RR'. When the MRT (or slope) is calculated by subtracting values ( $\Delta$ ), the marginal value is the slope of an arc between the points. When the slope is calculated by a derivative, the value of  $\Delta X$  approaches 0, so the marginal value is represented by the slope of a tangent. In this example, it is the slope of FF' at point B.

If the output were at  $X = 20, Y = 45$  (shown as point B in Figure VI.1), an increase in Xebecs would require a decrease in the output of Y. The increase in X from 20 to 35 is 15 units of X. This is labeled as  $\Delta X = 15$  ( $35-20=15$ ) and is the “run.” The change in Y ( $\Delta Y$ ) is -15 ( $30-45= -15$ ) and is called the “rise.” The line RR' represents the change in Y ( $\Delta Y$ ) caused by the change in X ( $\Delta X$ ).

The slope of RR' is  $\frac{-15 \text{ (rise)}}{15 \text{ (run)}} = -1$

Slope of RR' =  $\frac{\text{rise}}{\text{run}} = \frac{\Delta Y}{\Delta X}$ , or the change in Y caused by a change in X

Calculus lets the change in X approach 0. When the change in X approaches 0, the change in Y is shown by the line FF' which is tangent to the PPF at point B. In principles of economics calculus is not normally required so the term marginal is calculated by differences and is represented by the slope of a straight line. When a function is nonlinear, the slope between two points is the slope of an arc.

It is crucial to remember that the marginal value (cost, benefit, etc) is the value associated with a specific choice.

- (1) **marginal benefit (MB)** is the change in total benefits associated with a choice. For an individual MB might be MU for a firm it may be MR
- (2) **marginal cost (MC)** is the change in total cost (or variable cost since fixed costs don't change) caused by a change in and activity, usually production.
- (3) **marginal decision rule** You should engage in any activity so long as the  $MB > MC$ , the optimal level of activity is where  $MB = MC$ , when  $MC > MB$  you should not undertake the activity. There is a variation of this rule called the equimarginal rule.

The marginal decision rule can be illustrated by the decision to gather wild blackberries (good X). The cost of travel to the blackberry patch is treated here as a sunk (fixed) cost, we are already at the patch. How many berries shall we pick? The answer depends on our analysis of the benefits and costs of each unit of berries we pick. Generally, the marginal benefits of berries will tend to decrease primarily because of diminishing marginal utility. The marginal benefit (MB) of each unit of berries is shown in Figure VI.2. Typically we will gather the berries that are easiest to pick first. These are the berries that are approximately waist level and on the outside of the bushes. As we pick more berries we have to reach further up or down and into the bushes where there are thorns. The marginal cost (MC) of berries rises. The MC of each unit of berries is also shown in Figure VI.2. The MB function decreases as more berries

are obtained. The area under the MB function up to the quantity obtained represents the total benefits (TB). In Figure VI.2 when 73 units are picked, TB is the area OREB. The MC rises as berries become more difficult to pick. MC represents

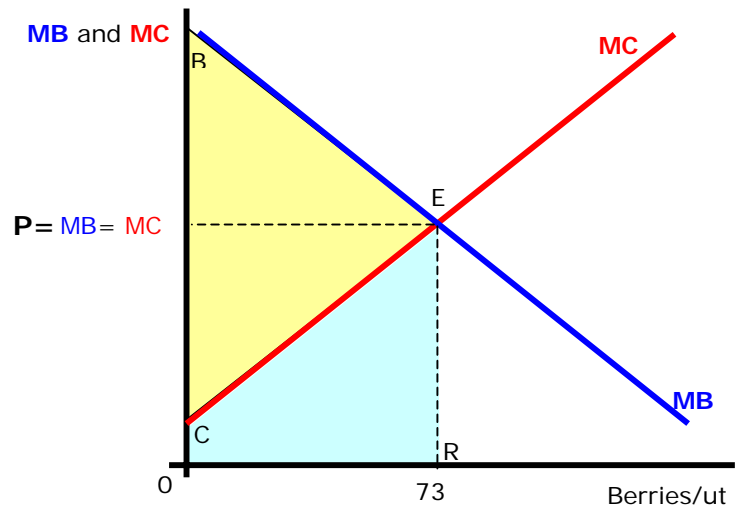


Figure VI.2

the marginal cost of each unit. The total costs (TC) is the area under the MC function. When 73 units of berries are picked, the TC will be represented by the area OREC (the area in blue). The first units of berries are picked because the marginal benefit of each unit (MB) is greater than the marginal cost (MC). There is a net benefit obtained from each unit. Seventy-three units of berries are picked because the MB of the first 73 units is greater than the MC of those units. The TB is OREB; the TC is OREC. The net benefit is the area CEB (in yellow). **Net benefits are maximized when MB = MC.**

This rule has several applications.

- Where  $MR = MC$ , profits are maximized
- Where  $MB = P$  (cost), utility is maximized

This rule was first clearly stated by the French engineer/economist, Jules Dupuit in the 1830's.

## B. Market Exchange and Efficiency

The ideal market has two important characteristics:

- Individuals voluntarily contract among themselves. There is no coercion and each is informed of their preferences (objectives) and alternatives. They make informed judgments about the outcomes of their choices.
- The individuals exchange goods that are characterized by nonattenuated property rights. Nonattenuated property

rights are exclusive, enforceable and transferable. The benefits and cost associated with the production or consumption of any good falls only on the agents engaged in the contract or transaction.

Under these conditions, from a utilitarian perspective, no one would rationally engage in a voluntary exchange if it made them worse off. Therefore, any voluntary exchange must lead to *Pareto superior* results. Individual agents know their preferences (objectives) and react to any changes by altering their choices. The idealized market results in individuals who constantly reappraise their objectives and alternatives and alter choices to maximize their welfare. Since exchanges are perceived to be voluntary, no individual would choose to make themselves worse off. Voluntary markets of goods with nonattenuated property rights are consistent with the Utilitarian Ethic and Pareto Efficiency.

### C. Prices as Information

The function of the market is to coordinate the preferences and behavior of the buyers and sellers. There are two important elements that are necessary if markets are to perform this task of coordination. First, buyers and sellers must have information. Prices, or more precisely relative prices perform this task. Secondly, buyers and sellers must have an incentive to respond to the information contained in prices.

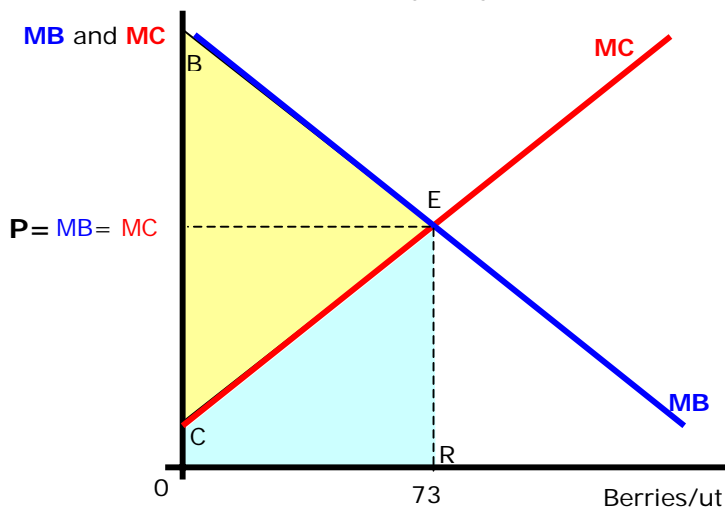


Figure VI.2

Using Figure VI.2 again, the role of prices can be shown. The MB function represents the buyers' evaluations of their marginal benefits. As the quantity of berries increases, the marginal value goes down, The MB function is negatively sloped and resembles a demand function. It is not a demand function because it does not include the ability to buy the goods. It only measures the buyers' evaluation of marginal benefits. Notice the MB of the 73<sup>rd</sup> unit to the buyers is P. Similarly, the MC function represents the opportunity cost or producing each unit. The MC of producing the 73<sup>rd</sup> unit is also P. For all unit of berries, up to and including, the 73<sup>rd</sup> unit, the MB is greater than the MC. We could restate this: the marginal benefit from each of the first 73 units is greater than its opportunity cost. The value (MB) that buyers have for each of the first 73 units is greater than the market price of P. The sellers sacrifice an opportunity cost of less than P on each of the first 73 units. The price of P represents the marginal value (MB) of the last unit exchanged to the buyers. P also represents the marginal value (MC) of the last unit exchanged to the sellers. A price of P provides information about both the buyers and sellers evaluations. Since  $MB = MC$  produces maximum net benefit, the ideal is where the price reflects MB and MC, **MB = P = MC**.

So long as the price is less than the MB of the buyers, additional units will be purchased. Once the  $P > MB$  buyers cease to purchase the good.

When the  $P > MC$ , sellers will produce and offer units for sale. Once the  $P < MC$ , the sellers will cease production.