

COURSE CODE: *FWM 302*
COURSE TITLE: Forest Economics
NUMBER OF UNITS: *2 Units*
COURSE DURATION: *Two hours per week*

COURSE DETAILS:

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Office Location:
Other Lecturers:

COURSE CONTENT:

Definition of forest goods and services; application of economic principle to forest resources; decision-making in single and multiple resource use; cost-benefit analysis.

COURSE REQUIREMENTS:

READING LIST:

LECTURE NOTES

COURSE CONTENT

Definition of forest goods and services; application of economic principle to forest resources; decision-making in single and multiple resource use; cost-benefit analysis.

Definition of Economics

Economics, social science concerned with the production, distribution, exchange, and consumption of goods and services. Economists focus on the way in which individuals, groups, business enterprises, and governments seek to achieve efficiently any economic objective they select. Other fields of study also contribute to this knowledge: Psychology and ethics try to explain how objectives are formed; history records changes in human objectives; sociology interprets human behaviour in social contexts.

Standard economics can be divided into two major fields. The first, price theory or microeconomics, explains how the interplay of supply and demand in competitive markets creates a multitude of individual prices, wage rates, profit margins, and rental changes. Microeconomics assumes that people behave rationally. Consumers try to spend their income in ways that give them as much pleasure as possible. As economists say, they maximize utility. For their part, entrepreneurs seek as much profit as they can extract from their operations.

The second field, macroeconomics, deals with modern explanations of national income and employment. Macroeconomics dates from the book, *The General Theory of Employment, Interest, and Money* (1935), by the British economist John Maynard Keynes. His explanation of prosperity and depression centres on the total or aggregate demand for goods and services by consumers, business investors, and governments. Because, according to Keynes, inadequate aggregate demand increases unemployment, the indicated cure is either more investment by businesses or more spending and consequently larger budget deficits by government.

Economics is a social science that studies how society chooses to allocate its scarce resources, which have alternative uses, to provide goods and services for present and future consumption.

The definition starts “Economics is,” and that is what is being defined. So the remaining words need to be understood to make sense of economics. Let us start with “goods and services”.

Goods and Services

What exactly are goods and services? A **good** is anything that satisfies a want. That is the purpose of production — to provide goods that satisfy wants. So goods are produced, and the consumption of those goods satisfies wants. Goods can be tangible or intangible. Tangible goods are physical items such as bulldozers or pizzas. Intangible goods such as medical care or education are called services. Both goods and services satisfy wants and therefore can be called goods.

Forest goods and Services

Forest goods refer to the products that are tangible and physical objects of biological origin such as plants, animals and their products. Forest Services are the needs of the public and Society that forest provides, that is either organised by government or a private company e.g ecotourism, grazing, bioprospecting (pursuit of plant-derived chemicals for pharmaceuticals) and some other forest benefits which include soil conservation, soil fertility, watershed protection e. t.c.

Resources

The satisfaction of wants can only be accomplished by using up **resources**, the inputs, the so-called factors of production or means of production. These resources can be classified as land, labour, capital, and entrepreneurship.

Scarcity

Resources are scarce. Scarcity is a relationship between how much there is of something and how much of it is wanted. Resources are scarce compared to all of the uses we have for them. If we want to use more than there is of an item, it is scarce. Note that this meaning is different from the usual meaning of scarce, which is “rarely found in nature.” How are they different? Consider this example. Is water scarce? How could anyone argue that water is scarce in the usual sense? Water covers nearly two-thirds of the earth’s surface. Yet an economist would say that water is scarce. Why? The reason is that there are so many competing uses for water that more water is wanted than is available. If you find this hard to believe, ask farmers and ranchers in the West, where water rights are jealously guarded. As soon as someone is willing to pay for a good, or a resource, it is scarce by the economist’s definition. Consider scarcity from another point of view. What if scarcity did not exist? Then all goods would be free goods.

Scarcity

Unlimited wants alone are not a problem, but certainly a problem exists, when unlimited wants are combined with a limited means of satisfying those wants. The production of any good on our wish list, uses up resources. Then scarcity sets in. We can never satisfy all of society's unlimited wants with limited resources and the consequently limited goods. Unlimited wants reflect human nature. The limitation of resources is imposed upon us by nature. Therefore, unlimited wants competing for limited resources creates the basic economic problem of **scarcity**. This is a difficulty that cannot be overcome by cleverness or good fortune. Scarcity, the interaction of unlimited wants with limited resources, has been called the economic problem. In fact, you are starting the study of economics, which would not exist except for scarcity. If that makes you think that scarcity might be the cause of many of your problems, you are right. Scarcity is the economic problem. Therefore, choices must be made.

Choices

We must choose how to use our scarce resources. Scarcity forces choice. And economics, which deals with scarcity, is often called the study of choosing. We cannot have all we want of everything we want. Scarcity is imposed by limited factors of production yielding limited output of goods relative to unlimited wants. Choices must be made. Now you see that since we do not have enough capital goods to assist in the production of all those consumer goods to satisfy our unlimited wants, capital is a scarce resource. And we must choose how to use capital. For similar reasons, we must choose how to use land, labour, and entrepreneurship. The fact that choices must be made in turn reflects the fact that scarcity does exist.

Alternative Uses

So far we see that society is faced with the problem of not having enough resources to provide for all wants. And thus choices must be made about how those resources will be used or allocated. **Allocate** means distribute. Society must make choices among the alternatives. Society must decide which goods will be produced, how to allocate resources to produce goods, and how to allocate the goods among the population. The method used to decide how these allocations will be made depends on the kind of economic system the society has chosen. Since resources have alternative uses and are scarce, it is necessary to choose among the alternatives. Land, labour, capital, and entrepreneurship may be used in one combination to produce exactly what is most important to us at a given time. There are many alternative ways to use the resources, and choices must be made. It makes no difference whether the problem is how government will use its resources or how individuals or business use theirs. In every case, resources are scarce, and choices must be made. There are alternative ways that this problem of "scarce" could be solved. We must choose among alternatives. Scarcity imposes a limitation on the amount of output that society can produce. Because there are always alternative uses of the resources and because scarcity exists, society cannot produce all that it wants. It must therefore choose among the alternatives. Hence cost is imposed on society; economists call this cost opportunity cost.

What is opportunity cost?

Opportunity Cost

Opportunity cost is a concept you did not exist in the definition of economics. But not seeing it doesn't mean that it isn't there. There is yet more to say about the definition, but this is the logical place to introduce a related concept. Opportunity costs are everywhere, due to scarcity and the necessity of choosing. Opportunity cost is not what you choose when you make a choice — it is what you did *not* choose in making a choice. **Opportunity cost** is the value of the forgone alternative — what you gave up when you got something.

MACRO AND MICRO ECONOMICS

Macro and microeconomics are the two vantage points from which the economy is observed. Macroeconomics looks at the total output of a nation and the way the nation allocates its limited resources of land, labour and capital in an attempt to maximize production levels and promote trade and growth for future generations. After

observing the society as a whole, Adam Smith noted that there was an "invisible hand" turning the wheels of the economy: a market force that keeps the economy functioning.

Microeconomics looks into similar issues, but on the level of the individual people and firms within the economy. It tends to be more scientific in its approach, and studies the parts that make up the whole economy. Analyzing certain aspects of human behaviour, microeconomics shows us how individuals and firms respond to changes in price and why they demand what they do at particular price levels.

Micro and macroeconomics are intertwined; as economists gain understanding of certain phenomena, they can help nations and individuals make more informed decisions when allocating resources. The systems by which nations allocate their resources can be placed on a spectrum where the command economy is on the one end and the market economy is on the other. The market economy advocates forces within a competitive market, which constitute the "invisible hand", to determine how resources should be allocated. The command economic system relies on the government to decide how the country's resources would best be allocated. In both systems, however, scarcity and unlimited wants force governments and individuals to decide how best to manage resources and allocate them in the most efficient way possible. Nevertheless, there are always limits to what the economy and government can do.

ECONOMIC PRINCIPLES

Factors of Production

Land is land itself and anything that grows on it or can be taken from it —the “natural resources.” Imagine producing anything from a pizza to a medical doctor without the use of land somewhere along the productive process.

Labour: This is referred to as human effort, both physical and mental. The resource capital is also known as capital goods. An economist's use of capital is not a reference to money but to a resource.

Capital is a man-made tool of production; it is a good that has been produced for use in the production of other goods. Goods are produced for one of two purposes. A good may be a consumer good used for the satisfaction of wants, which is the ultimate purpose of production. Or a good may be a capital good produced not for consumption but for use in producing more goods, either consumer or capital. So capital goods, such as a mechanic's wrench or a school building, are resources that have been produced and that will combine with other resources, such as land and labour, to produce more output. Some goods may be a consumer good in one use and a capital good in another use. For example, consider a personal computer. When the computer is used to play solitaire, it is a consumer good. On the other hand, when it is used as a word processor to write a textbook, it is a capital good. To tell whether a good is a consumer good or a capital good, ask yourself a question: Is the good going to be consumed directly or will it be used to produce more goods? If it is to be consumed directly and purchased by consumers, it is a consumer good; if it is to be used to produce other goods and purchased by business, it is a capital good.

Entrepreneurship or Management is human effort again. Entrepreneurs are the risk takers. They are more than managers, although they use managerial ability. Entrepreneurs reap the profits or bear the losses of their undertakings. **Entrepreneurship** is the organizational force that combines the other factors of production — land, labour, and capital — and transforms them into the desired output. The output may be capital or consumer goods, but ultimately consumer goods are produced to satisfy wants.

Supply and demand

Supply and demand is perhaps one of the most fundamental concepts of economics and it is the backbone of a market economy.

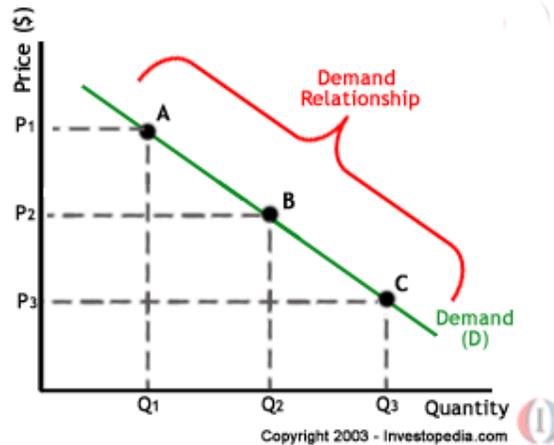
Demand refers to how much (quantity) of a product or service is desired by buyers. The quantity demanded is the amount of a product people are willing to buy at a certain price; the relationship between price and quantity demanded is known as the demand relationship.

Supply represents how much the market can offer. The quantity supplied refers to the amount of a certain good producers are willing to supply when receiving a certain price. The correlation between price and how much of a good or service is supplied to the market is known as the supply relationship. Price, therefore, is a reflection of supply and demand.

The relationship between demand and supply underlie the forces behind the allocation of resources. In market economy theories, demand and supply theory will allocate resources in the most efficient way possible. How? Let us take a closer look at the law of demand and the law of supply.

A. The Law of Demand

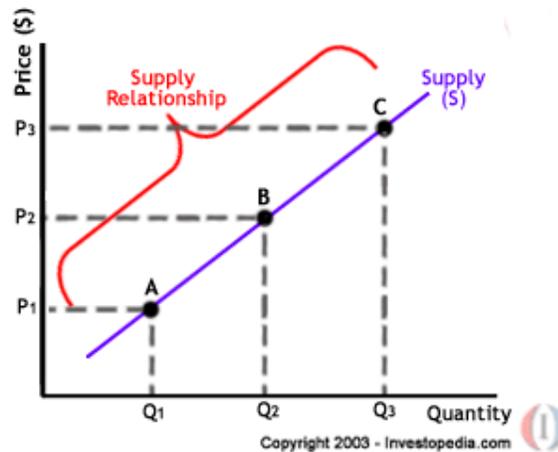
The law of demand states that, if all other factors remain equal, the higher the price of a good, the less people will demand that good. In other words, the higher the price, the lower the quantity demanded. The amount of a good that buyers purchase at a higher price is less because as the price of a good goes up, so does the opportunity cost of buying that good. As a result, people will naturally avoid buying a product that will force them to forgo the consumption of something else they value more. The chart below shows that the curve is a downward slope.



A, B and C are points on the demand curve. Each point on the curve reflects a direct correlation between quantities demanded (Q) and price (P). So, at point A, the quantity demanded will be Q1 and the price will be P1, and so on. The demand relationship curve illustrates the negative relationship between price and quantity demanded. The higher the price of a good the lower the quantity demanded (A), and the lower the price, the more the good will be in demand (C).

B. The Law of Supply

Like the law of demand, the law of supply demonstrates the quantities that will be sold at a certain price. But unlike the law of demand, the supply relationship shows an upward slope. This means that the higher the price, the higher the quantity supplied. Producers supply more at a higher price because selling a higher quantity at higher price increases revenue.



A, B and C are points on the supply curve. Each point on the curve reflects a direct correlation between quantities supplied (Q) and price (P). At point B, the quantity supplied will be Q2 and the price will be P2, and so on.

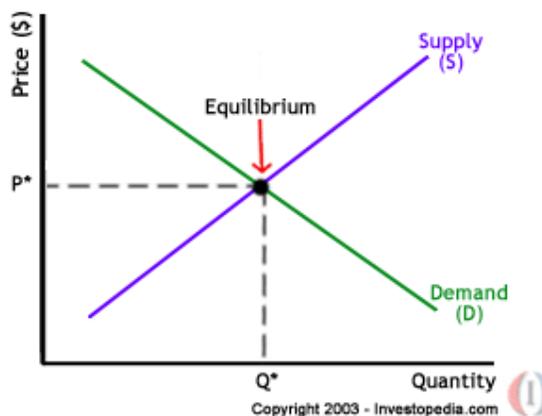
Time and Supply

Unlike the demand relationship, however, the supply relationship is a factor of time. Time is important to supply because suppliers must, but cannot always, react quickly to a change in demand or price. So it is important to try and determine whether a price change that is caused by demand will be temporary or permanent.

Let's say there's a sudden increase in the demand and price for umbrellas in an unexpected rainy season; suppliers may simply accommodate demand by using their production equipment more intensively. If, however, there is a climate change, and the population will need umbrellas year-round, the change in demand and price will be expected to be long term; suppliers will have to change their equipment and production facilities in order to meet the long-term levels of demand.

C. Equilibrium

When supply and demand are equal (i.e. when the supply function and demand function intersect) the economy is said to be at equilibrium. At this point, the allocation of goods is at its most efficient because the amount of goods being supplied is exactly the same as the amount of goods being demanded. Thus, everyone (individuals, firms, or countries) is satisfied with the current economic condition. At the given price, suppliers are selling all the goods that they have produced and consumers are getting all the goods that they are demanding.



As you can see on the chart, equilibrium occurs at the intersection of the demand and supply curve, which indicates no allocative inefficiency. At this point, the price of the goods will be P^* and the quantity will be Q^* . These figures are referred to as equilibrium price and quantity.

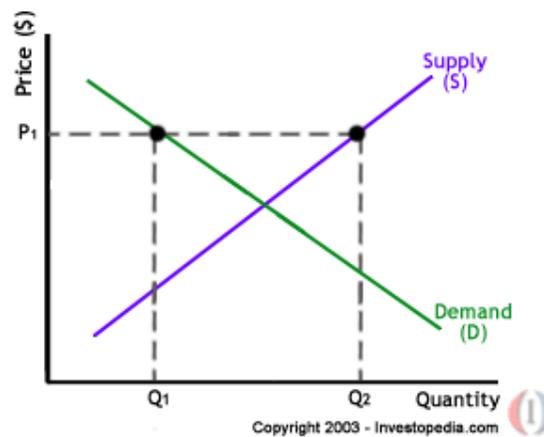
In the real market place equilibrium can only ever be reached in theory, so the prices of goods and services are constantly changing in relation to fluctuations in demand and supply.

D. Disequilibrium

Disequilibrium occurs whenever the price or quantity is not equal to P^* or Q^* .

1. Excess Supply

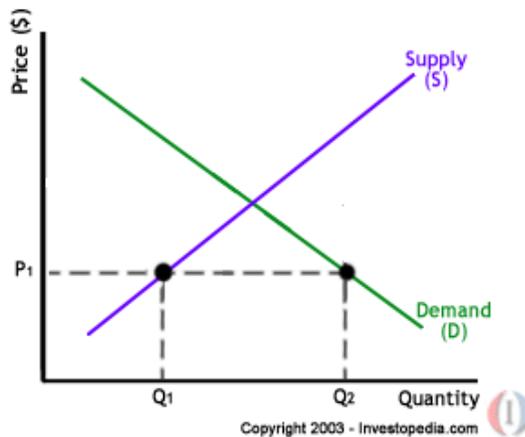
If the price is set too high, excess supply will be created within the economy and there will be allocative inefficiency.



At price P_1 the quantity of goods that the producers wish to supply is indicated by Q_2 . At P_1 , however, the quantity that the consumers want to consume is at Q_1 , a quantity much less than Q_2 . Because Q_2 is greater than Q_1 , too much is being produced and too little is being consumed. The suppliers are trying to produce more goods, which they hope to sell to increase profits, but those consuming the goods will find the product less attractive and purchase less because the price is too high.

2. Excess Demand

Excess demand is created when price is set below the equilibrium price. Because the price is so low, too many consumers want the good while producers are not making enough of it.



In this situation, at price P_1 , the quantity of goods demanded by consumers at this price is Q_2 . Conversely, the quantity of goods that producers are willing to produce at this price is Q_1 . Thus, there are too few goods being produced to satisfy the wants (demand) of the consumers. However, as consumers have to compete with one other to buy the good at this price, the demand will push the price up, making suppliers want to supply more and bringing the price closer to its equilibrium.

Factors affecting Demand

If price only changes, the demand curve for a good or service will not shift. Instead, there will be a movement **along** the demand curve. If price rises, demand will **contract**; less will be purchased in a given period of time. If price falls, demand will **expand**, and more will be bought in a given period of time.

The demand curve will shift to the left or right, if other factors, other from price, change. What are these other factors?

There are many, but some include

Changes in **income**. An increase in household income will see demand **increasing** (a shift of the curve to the right). Usually, this is associated with an increase in the price of the good or service being consumed.

- Changes in the prices of **substitutes**. If the price of a substitute falls, then demand for the good or service will also fall (or **contract**, to use the correct terminology).
- Changes in the prices of **complements**. If the price of a complement rises, then the demand for the good or service will **fall** (or "**contract**").
- Changes in the size and age distribution of the general population. As Australia's population is rapidly aging (as a result of smaller numbers of children per family), demand for many goods and services demanded by older people has risen. For example, in the building industry, there has been an increase in demand for retirement homes, and "medium density" housing.
- Advertising and changes in fashion can have a market effect on demand. Indeed, producers of goods that are close substitutes generally spend large amounts on advertising, reminding consumers that their product is "better" than the opposition's product. (Whether or not this is reality true, of course is another matter).
- Seasonal changes. For example, demand for ice-creams rises in warmer weather, and falls in the colder months of the year.
- Changes in **technology**. Firms are constantly attempting to gain greater sales through improvements in the quality and features of their product. This is seen clearly in the computer market. The introduction of a

new personal computer with a bigger memory chip or a faster operating speed soon results in prices of older model computers rapidly falling.

- Consumer **expectations** also affect demand. People tend to maintain high levels of consumption when they feel confident about their continuing employment in the future. If people, for whatever reason, feel less confident about the future, they tend to decrease consumption and increase saving. If households believe that inflation will rise in the future, or that government taxes will rise, they will increase their demand for many goods and services, to "beat" the price rise.



Factors Affecting Supply

Economic factors affecting the supply of forest biomass include production costs, prices of biomass and its substitutes, competing uses of forest resources, and policy, among others. First, technologies for forest production, biomass harvest and transport, and energy conversion will dictate the production costs of forest biomass and bioenergy. Thus, research and development will have an important role to play in forest biomass and bioenergy development. The costs will also vary with scale of operation, biomass spatial density, terrain conditions, average stem diameter, and transport distance, among other things. The most cost-effective production of biomass for energy occurs when it is produced simultaneously with other higher valued forest products (sawlogs, pulping chips).

Second, there also must be a demand for (buyers of) forest biomass in local markets, which interacts with the supply to determine the market price. Though there are some local buyers in limited locations currently, large buyers have not emerged region-wide. Potential buyers include independent developers, utility companies, bio-refineries, larger-scale users of biomass for space heating and chilling, and the producers of other bio-based products in the future.

Third, prices of other types of energy such as fossil fuels will have an influence on the supply of forest biomass. Increases in the price of oil or natural gas will favor bio-energy. Forest bio-energy will also face competition with other renewable energy sources such as agricultural crops and crop residues, solar, wind, and hydro energy, among others.

Fourth, competing or complementary uses of forest resources for pulpwood, timber, and ecological services will also interact with the supply of forest biomass for energy. Recent adjustments in the forest products industry, particularly in the pulp and paper sector may present an opportunity for using small-diameter trees for bio-energy.

Yet, forest bio-energy is unlikely to compete with lumber and wood products industry demand for large-diameter trees, because of the low relative value of energy feedstocks. Production of forest biomass for energy, for example, thinning over-stocked stands, may enhance the production of high quality logs and reduce fire risk whereas there is some concern about the potential loss of soil productivity resulting from excessive removals of biomass. Demand for ecological services such as biodiversity may have a negative or positive impact on the supply of biomass from forests (Schaberg and others 2005).

Finally, policies pertaining to energy, forest management and utilization, environmental protection, and land use, as well as assistance and incentive programs to forest landowners and bio-energy producers and consumers will also affect the supply of forest biomass. Some of these policies include carbon emission taxes, the renewable portfolio standard, etc. These factors combined will determine the profitability of producing forest biomass and bio-energy, a key determinant for developing and sustaining a forest biomass and bio-energy industry.

Others include;

The Price of Inputs

In addition to the price of the product being the main factor as stated in the Law of Supply, the price of production inputs also plays a part. The lowest price at which a firm can sell a good without losing money is the amount of money that it costs to produce it. Producing a good or service involves taking inputs and applying a process to them to produce an output. The output is the finished good or service, and inputs are raw materials, labour, utilities, licensing fees, or even other goods. These inputs are also known as factors of production. If the price of inputs goes up, the cost of producing the good increases. And therefore at each price producers need to sell their good for more money. So an increase in the price of inputs leads to a decrease in supply. Similarly, a decrease in the price of inputs leads to an increase in supply.

The Current State of Production Technology

Production of a good involves taking inputs, applying a process to them, and producing an output. Well, production technology is involved in the process part. Increases in the level of production technology can make that process more efficient. For example, imagine that you run a basic T-Shirt screen printing business out of your home. Now let's say you decide to invest in a workshop installed with the latest production technology. With this use of technology, the operation becomes more efficient and you are able increase the supply of T-shirts. If you decide to expand even further, some added technological improvements might be warranted. This further increases your ability to supply t-shirts since it reduces your labour costs. By automating the process, reliance upon labour is lessened and those resources are released for utilization elsewhere.

The Producer's Expectations

It doesn't just matter what is currently going on - one's expectations can also affect how much of a product one is willing and able to sell. For example, if your firm produces mp3 players and you hear that Apple will soon

introduce a new iPod that has more memory and longer battery life, you (and other producers) may decide to hurry up and sell your players to stores before the new iPod comes out. When people decide to increase production/sales today, they are increasing the current supply for mp3 players because of what they EXPECT to happen in the future.

The Number of Producers in the Market

As more or fewer producers enter the market this has a direct effect on the amount of a product that producers (in general) are willing and able to sell. More competition usually means a reduction in supply, while less competition gives the producer an opportunity to have a bigger market share with a larger supply.

ELASTICITY

Elasticity is a measure of responsiveness. For example, an economist may like to know how the quantity demanded for oil will be impacted by a 10 percent price increase. In other words, the economist is looking at how responsive the quantity demanded is to a change in price. Measuring and understanding elasticity is a very important skill that economists use when advising policy makers on the impact of establishing a new tax, or removing a current one, on the market. Also, firms can gain valuable insight on how increasing or decreasing their price will affect total revenue. The three basic categories we will focus on are **price elasticity**, **income elasticity**, and **cross price elasticity**. We will also take a look at elasticity in practice with its relationship to taxes.

Price Elasticity

Price Elasticity of demand or supply gives economists and business owner's exact measures of the quantity response to a change in price. In other words, the measure tells us exactly how much the quantity supplied or demanded changes as a result of a change in the price. For this reason, price elasticity is the most commonly used elasticity concept.

The price elasticity of demand measures the responsiveness of quantity demanded due to a change in price.

$$E_D = \frac{\% \text{ change in qty demanded}}{\% \text{ change in price}}$$

% change in price

The price elasticity of supply measures the responsiveness of quantity supplied due to a change in price.

$$E_S = \frac{\% \text{ change in qty supplied}}{\% \text{ change in price}}$$

% change in price

Example:

Suppose the quantity supplied of chopsticks increases by 4% and the price increases by 6%. Calculate the Elasticity of Supply as follows...

$$E_S = 4/6 = .67$$

Example:

Suppose the price of particle board increase by 15% and the quantity demanded decreases by 1.5%. Calculate the Elasticity of Demand as...

$$E_D = -1.5/15 = |-1.10|$$

CHARACTERISING ELASTICITY

Elastic ($E > 1$). We say that a good is (price) elastic when we find the elasticity to be greater than 1. Quantity demanded or supplied responds quite a bit to a change in price.

We typically look at goods that have elastic demand or supply curves as ones with many substitutes. Typically, we see particle board and fibre board as substitutes. For example, if the price of particle board were to increase, people are more likely to purchase fibre board. We can say that consumers are basically indifferent between the two products; this makes consumers sensitive to the price.

Inelastic ($E < 1$). We say that a good is (price) inelastic if we find the elasticity to be less than 1. Quantity supplied or demanded is not very responsive to a change in price.

Unit Elastic ($E = 1$). A good is unit elastic if we calculate the elasticity to be equal to 1.

Perfectly Elastic ($E = \infty$). The quantity supplied or demanded responds a great deal to a change in price. This is characterized by a horizontal line on a graph.

A perfectly elastic good implies easily accessible substitutes and perfect information. In other words, if the price of a particular good increases, no units will be bought. For example, consider two nearly identical brands of wood products. If the price of one of the goods increases (and they are perfectly elastic), no units of this good will be bought.

Perfectly Inelastic ($E = 0$). The quantity supplied or demanded does not change at all when there is a change in price. This is characterized by a vertical line on a graph.

For an example, we can think of a diabetic's insulin as a perfectly inelastic. Presumably, because a diabetic depends on insulin to keep him or herself alive, the insulin will be bought no matter how much it costs.

Income Elasticity measures the responsiveness of demand due to an increase or decrease in consumer income.

$$\mathbf{Y}_{ED} = \frac{\% \text{ change in qty demanded}}{\% \text{ change in income}}$$

$$\mathbf{Y}_{ED} = \text{Income Elasticity of Demand}$$

Example:

Suppose Frankie Lee's income rises 10% and his uses of particle boards increases by 5%. Calculate the Income Elasticity as follows...

$$\text{Income Elasticity of Demand} = 5/10 = .5$$

CHARACTERISING INCOME ELASTICITY

Normal Goods ($E > 0$). These are goods whose consumption increases with an increase in income.

- A good example of a normal good is the type of clothes you buy. While you are in college and your income is low, you may shop at Wal-Mart for your clothing. However, after you complete your degree, and you are making a lot of money as an economist, you are more likely to buy more expensive clothes from retailers in a shopping mall. In other words, your consumption increases as your income increases as you buy more expensive clothing.

Necessity ($E < 1$). These are goods whose consumption increases an amount smaller than an increase in income.

-An example of a necessity is drinking water. While you may upgrade to Dasani from Sam's Choice with an increase in income, however, it is unlikely that your consumption of water will increase an amount more than your increase income. For instance, if your income were to increase by 25 percent, you will probably not consume 25 percent more drinking water.

Luxury Good ($E > 1$). These are goods whose consumption increases an amount larger than an increase in income.

-An example of a luxury good is a round of golf. With low income, your consumption of rounds of golf will likely be zero. However, once your income rises enough to afford to play, your increase in rounds of golf will probably

be higher than the increase in income. In other words, once you make enough money to play the first round of golf, your increase in round of golf consumption will be 100 percent while the increase in income may have only been 15 percent.

Inferior Good ($E < 0$). These are goods whose consumption decreases with an increase in income.

- A classic example of an inferior good is Ramen Noodles. The idea here is that you will consume fewer Ramen Noodles as your income increases. For example, after you graduate from college, you may have higher quality (more expensive) Chinese takeout instead of Ramen Noodles for some of those quick, late night, meals.

Cross Price Elasticity

Economists may like to know how responsive/elastic the quantity demanded for a good is in response to a change in the price of another good. For example, if the price of CD players decreases, what will happen to the quantity demanded for CDs? Well, we can imagine that more CDs will be bought/demanded to go along with people's CD players.

By calculating cross-price elasticity, we can measure the responsiveness and determine if the goods are substitutes, compliments, or not related to each other.

The cross-price elasticity of demand measures the responsiveness of the quantity demanded of one good when compared with a change in the price of another good.

$$E_D = \frac{\% \text{change in quantity demanded of good A}}{\% \text{change in price of good B}}$$

Characterizing Cross-Price Elasticity

Substitutes ($E > 0$). Are goods that can be used in exchange for one another. For instance, if the price of Pepsi were to increase, the demand for Coca Cola would increase because people generally see these two goods as

substitutes for one another.

Complements ($E < 0$). Are goods that people tend to consume hand in hand. For example, if the price of hamburger meat increases, the demand for American Cheese will decrease. This is because people commonly use American Cheese to make cheeseburgers.

Independent ($E = 0$). These are goods that show no relationship. An example of independent goods is Halloween costumes and marble flooring.

DIMINISHING RETURNS

The Short Run and Variable Inputs

The first step toward understanding the law of diminishing returns is to recognize when the law applies. The major consideration is the time period. The short-run period of time is the only time period in which the law operates. You will soon realize that diminishing returns cannot be avoided in the short run. The short run must be carefully distinguished from the long run.

The **short run** is a period of time in which at least one of the factors of production is fixed.

The **fixed factors** of production, as the name indicates, are the inputs that cannot be increased during the short-run productive process. These inputs cannot be increased in number to produce more of a good during the short run.

However, the **variable factors** of production, or variable inputs, are those inputs that can be increased during production. All inputs, both fixed and variable, are the familiar scarce resources — land, labour, capital, and entrepreneurship. Each productive process uses variable inputs in combination with at least one fixed input in the short run. A productive process uses inputs and transforms them into output, some consumer or capital good. The mowing of the family lawn is itself a productive process, contrary to the opinion of many of those who must mow. There are inputs, both variable and fixed, and the output is a mowed lawn — a consumer good. The variable inputs — labour, mower, and gasoline — can be increased. The size of the lawn is a fixed factor. The existence of a fixed factor always identifies a short-run productive process.

Land is usually a fixed factor for a farmer. At the time the farmer ploughs and plants, there is a limited amount of land available. More tractors, more seed, more fertilizer can always be added, but only to a fixed amount of land. You might suggest that the farmer obtain more land by purchasing an adjoining farm. But if this addition to the farmer's land occurs, the time period has changed. If land is no longer a fixed factor, then all the inputs are variable. This fits the description of the long run.

The **long run** is a period of time in which all inputs to the productive process are variable. Recognize that the critical distinction between the short and the long run is that *only* in the short-run are there fixed factors.

Total and Marginal Product

Product is the output that is produced. Product, output, and returns are terms that are often interchanged.

Total product (TP) is the total output produced by the inputs of a firm. Normally one expects that as the inputs increase, so must the total product. As you will soon discover, this expected increase in total product may not happen. Marginal means extra or additional.

Marginal product (MP) is the change in total product as one more unit of variable input is added to the productive process. Marginal product measures the contribution to total production of another unit of input. The marginal product assists in the decision whether to employ another unit.

The Law of Diminishing Returns

The **law of diminishing returns** states that as an increasing amount of a variable factor are added to a fixed factor, the marginal product of the variable factor will eventually fall. The law of diminishing returns is critical to an understanding of the basic realities around us. This law occurs during a productive process and affects the technological relation between inputs and output. Diminishing returns is a short-run condition that requires at least one fixed factor to be present. The source of the law of diminishing returns is the existence of a fixed factor together with the fact that resources are not perfect substitutes for one another.

Investment

This is spending or setting aside money for future financial gain. For an individual, investment might include the purchase of financial assets, such as stocks, bonds, mutual funds or life insurance. It could also include the purchase of durable goods such as housing or car. For an economist, investment refers to the increase in real capital in an economy, such as an increase in factories and machinery or in its human capital that is a skilled and educated labour.

Economies of scale

These are factors that cause the average cost of production to decrease as output increases. Economies of scale are the driving force behind all mass production. For example, when establishing a plantation of trees for pole production, there is a large initial cost involved. However once the plantation is fully established, and harvesting is done selectively or through clear felling, the cost of producing such poles remain fairly constant. Achieving large economies of scale, demands substantial investment.

DECISION MAKING IN MULTIPLE AND SINGLE USE MANAGEMENT

Single-Use Management: This is the management of land for one single use.

Multiple-Use Land Management The management of land or forest for more than one purpose, such as wood production, water quality, wildlife, recreation, aesthetics, or clean air.

Multiple-Use Forestry -Concept of forest management that combines two or more objectives, such as production of wood or wood-derivative products, forage and browse for domestic livestock, proper environmental conditions for wildlife, landscape effects, protection against floods and erosion, recreation, and protection of water supplies.

Multiple-Use Management -Management of land resources with the objective of achieving optimum yields of products and services from a given area without impairing the productive capacity of the site.

Multiple use is a familiar term to foresters. Pictured were the five major uses of forest land

- for wood production,
- use as watersheds,
- grazing by domestic livestock,
- the forest as habitat for wild game and fish,
- and use of the forest for outdoor recreation.

Although " multiple use " may not be a customary term everywhere, the practice of multiple use has been long established in some intensively managed forests of other countries. As FAO noted, management of land to serve as many uses as possible is everywhere becoming more essential. When there is abundance of natural resources and few people, there is little need for multiple purpose land use. But when increasingly large numbers of people must rely on an unchanging or diminishing resource base, they must make the most effective use of the resources they have. Multiple use of renewable land resources thus is a necessity born of scarcity of resources and abundance of people who need these resources.

Competition for the use of land is growing throughout the world. This competition will not decrease but will increase as world population increases. World population is now about 3,000 million persons. It has increased as much in the last two decades as was the total growth of population up to the year 1750. To these basic necessities of life we must add today our dependence on natural resources for all the raw materials of industry. The history of mankind is the history of man's competition for land, of man's struggle to obtain adequate natural resources - and of man's over-utilization of resources.

The wise use of forest lands, however, cannot be considered in a vacuum. It must be considered in relation ship to the fullest possible yield of all the products and services that forest land provides for people.

In past years many of us have thought that we had enough land in forest in the to meet all foreseeable needs for wood and other products and services of forest lands. Today we are not so sure. We think our earlier estimates were too conservative. We are now genuinely concerned. Much forest land is being taken for other uses. Competition for land is becoming intense everywhere. For example, wherever you may travel in this country you will see great expansion of urban areas. This is taking land which heretofore was included in our estimates of available forest area.

Superhighways, new airports, transmission lines for electrical power, oil, and natural gas, and construction of dams and reservoirs are taking many millions of acres of forest land. Forest land will continue to be taken for national defence purposes. Large pressures are developing to set aside additional forest lands exclusively for recreational use. Conversion of land from forest to food production, inevitable in the next few decades, will include substantial portions of our most productive forest land.

Use of forest land for these several purposes is nothing new. In every country and for centuries forest land has been so used.

What is now is the rapidly growing awareness of the need to apply multiple-use management more widely and more intensively. This comes not only from the obvious need to make forest lands more fully useful to the people but also to lessen the pressures to divert forest lands from a combination of uses to some one exclusive use. In most instances, forest land is not fully serving the people if it is used exclusively for a purpose which could also be achieved in combination with several other uses.

Multiple use of forest lands in the United States did not spring into full flower overnight. While the term has become commonplace only in the last two decades, the practice of multiple use in the United States goes back to the origin of the national forests, more than half a century ago. National forest policies from the very first have emphasized resource use. The first Forest Service manual, significantly termed the " use book," recognized a multiplicity of uses. Even before this, the Forest Service had been instructed by the Secretary of Agriculture that national forest land was to be devoted to its most productive use for the permanent good of the whole people, that all of the resources were for use, and that decisions would always be made, from the standpoint of the greatest good of the greatest number in the long run. These instructions have constituted Forest Service doctrine from the beginning. They are the genesis of multiple use.

An essential of multiple use is positive, affirmative management of the several uses involved. Haphazard occurrence of these uses on some particular tract of land does not constitute multiple-use management. Multiple use is not a passive practice. On the contrary, it is the deliberate and carefully planned integration of various uses so that these will interfere with each other as little as possible and will supplement each other as much as possible. Multiple use is by no means an assemblage of single uses. It requires conscious, co-ordinated management of the various renewable resources, each with the other, without impairment of the productivity of the land.

Multiple use must be over a period long enough to experience the cycle of the seasons, that is, a year or more. It does not require that all uses involved be practiced simultaneously at the same instant.

Size of area is a key factor in multiple-use management. Application must be to areas large enough to give sufficient latitude for periodic adjustments in use to conform to changing needs and conditions. On the national forests, we normally think in terms of our smallest administrative units, which at present average about 200,000 acres. On large private holdings similar acreages might be applicable, but for small private ownerships the unit areas would, of course, be much smaller. They might be as small as 40 acres.

Multiple-use management of the renewable surface resources obviously requires control of all uses on the same land by one authority. Such management is not possible if several coordinate authorities are each trying to direct. Multiple-use management as we practice it on the national forests requires us to consider all of the five basic renewable resources, although on any specific area we may not have all of them in operation at any one time. It obliges us to co-ordinate these various uses even though doing this results in less than fullest possible productivity of some uses. The requirement for sustained yield applies to all renewable resources and is aimed both at getting a high level of productivity and at preventing over-use of any resource or impairment of productivity of the land.

Multiple use is not a panacea. It has limitations, but it also has overriding advantages.

DISTINCT MERITS

First of all, multiple -use helps to overcome problems of scarcity.

It tends to reduce or resolve conflicts of interest and competition for resources.

It promotes balance in resource use.

It impedes the ascendancy of single-interest pressures. Properly applied,

Multiple use involves consideration of both aesthetic and economic criteria in arriving at management decisions.

It offers balance between materialistic and non-materialistic values.

Multiple use properly understood and properly applied is now, and will continue to be, the best management for most of the publicly owned forest lands. It will gradually become the best management for many of the large private holdings. It will always have less applicability to smaller private properties, but many of these owners will in time find it to their own best interest to practice some degree of multiple use.

Finally, the overwhelming advantage of multiple-use is that through it foresters can make forest lands contribute their utmost to society. The basic purpose of forest conservation is a social one to satisfy the intangible as well as the materialistic needs of people. In this way, I believe foresters can make a major contribution to human betterment and perhaps even to world peace.

Multiple-use forest management is a challenge to foresters to broaden their vision. We must be forest land managers instead of primarily timber growers. The thinking of foresters is believed to be preoccupied with timber and dominated by Silviculture. To some extent this criticism is justified. But multiple-use, when properly applied, eliminates this bias. The future success of foresters and the contribution of the forestry profession to the welfare of our countries may depend on our response to the need for a balanced use of forest land resources.

COST -BENEFIT ANALYSIS

Cost–benefit analysis, understood broadly, is an economic appraisal of all the costs and all the benefits, whether marketed or not, to whomsoever accruing, both present and future, under a range of plausible scenarios, in so far as possible in a common unit of account, of alternative courses of action or allocations of resources. There is again, it might be said, variety of interpretation between commentators, but the above definition contains all the main elements that might be present, and some would say that should be present.

A cost benefit analysis is done to determine how well, or how poorly, a planned action will turn out. Although a cost benefit analysis can be used for almost anything, it is most commonly done on financial questions. Since the cost benefit analysis relies on the addition of positive factors and the subtraction of negative ones to determine a net result, it is also known as running the numbers. A cost benefit analysis finds, quantifies, and adds all the positive factors. These are the benefits. Then it identifies, quantifies, and subtracts all the negatives, the costs. The difference between the two indicates whether the planned action is advisable. The real trick to doing a cost benefit analysis well is making sure you include all the costs and all the benefits and properly quantify them.

Cost-benefit analysis is a term that refers both to:

- Helping to appraise, or assess, the case for a project, programme or policy proposal;
- An approach to making economic decisions of any kind.

Under both definitions the process involves, whether explicitly or implicitly, weighing the total expected costs against the total expected benefits of one or more actions in order to choose the best or most profitable option. The formal process is often referred to as either CBA (Cost-Benefit Analysis) or BCA (Benefit-Cost Analysis).

Benefits and costs are often expressed in money terms, and are adjusted for the time value of money, so that all flows of benefits and flows of project costs over time (which tend to occur at different points in time) are expressed on a common basis in terms of their “present value.” Closely related, but slightly different, formal techniques include cost-effectiveness analysis, economic impact analysis, fiscal impact analysis and Social Return on Investment (SROI) analysis. The latter builds upon the logic of cost-benefit analysis, but differs in that it is explicitly designed to inform the practical decision-making of enterprise managers and investors focused on optimizing their social and environmental impacts.

Cost benefit analysis tests the economic viability of an existing or proposed activity, and/or compares two or more ways of doing something. Because of prevailing social and economic structures, the standard of measure generally used is money. This leads to difficulties in establishing the worth of "unpriced values" such as scenery, clean air and personal happiness. In a natural resources management context, cost benefit analysis involves subtracting the monetary costs of a development from the monetary value of all the benefits generated by the same development to obtain a net monetary benefit or cost for the proposed activity. "Benefits" or "costs" for various management or land use options for a particular area can be compared. Usually the method with the highest monetary benefit is selected by decision makers

There are also three modes of cost–benefit analysis. Financial cost–benefit analysis considers benefit as revenue, and cost as expenditure, for the agency responsible for a project or programme, and possibly also for other economic agents involved in its implementation.

Economic cost–benefit analysis considers in addition benefits and costs which lie outside the market and accrue to all stakeholders, usually through the medium of **willingness** to pay. It also accepts that market prices are not necessarily an accurate reflection of opportunity costs of resources, and that environmental and social costs outside the market are appropriately measured as **willingness to accept compensation** for bearing them. Social cost–benefit analysis is a term much misunderstood at present. In its classical form, evolved in the 1960s and 1970s, its focus was not on products and resources, but on gains and losses to stakeholders. It was more often practised in the conditions of developing countries than in the UK. Those unfamiliar with the evolution of cost–benefit analysis often assume that social cost–benefit analysis means “cost–benefit analysis applied to social projects”, but the distinctiveness lies in the approach, not the subject to which it is applied. The terms “environmental” and “extended” cost–benefit analysis are both redundant: cost–benefit analysis’s scope in principle includes all costs and benefits anyway.

Within a classical decision-making structure –

1. Setting objectives
2. Defining alternatives
3. Enumeration
4. Valuation
5. Synthesis
6. Decision-taking
7. Monitoring/ex post evaluation

Cost–benefit analysis concerns itself most with the stages of valuation and synthesis. Over the past few decades numerous techniques for evaluating non-market benefits and costs have formed the focus for efforts in developing cost–benefit analysis. There remains much disagreement on the relative merits and even validity of different techniques.

METHODS OF VALUING NON-MARKET COSTS AND BENEFITS

- 1 Marketable benefits are created or lost elsewhere in the economy as a result of externalities.
- 2 Financial costs are saved, imposed, or voluntarily undertaken elsewhere in the economy.
- 3 Comparable products are marketed elsewhere in the economy.
- 4 Voluntary subscriptions are made to related causes or campaigns.
- 5 Consumers/clients are asked what they would be willing to pay for a product, or what compensation they would accept for suffering a “bad” (this is the popular contingent valuation method).
- 6 Decision makers or experts ask themselves the same questions as in 5 above, or get a “feel” for acceptable answers.
- 7 The costs (including opportunity costs) of past decisions made to favour non-market benefits, or abate non-market costs, are taken as a measure of presumed benefit, or cost.
- 8 Willingness to pay for market goods which give access to non-market goods is measured. Synthesis involves aggregating on the four dimensions implied in the definition: benefits and costs from different goods or for different resources, to different stakeholders, over different time periods, and across different scenarios. Great and ongoing debate attends each dimension of aggregation.

The following account is not about cost–benefit analysis of forestry, but about the difference between different types of forestry: the three versions of continuous cover forestry described, with clear felling or rotational forestry as the baseline, or “do-nothing”, or “business-as-usual” alternative, against which the versions of continuous cover forestry are compared. There is no attempt to present a particular and detailed cost–benefit analysis of an individual forest as it might be managed for either continuous cover forestry or for rotational forestry: such a study if properly conducted would be very time-consuming. Instead, relevant factors are raised and indicative figures are given for the kind of differences that might be found, with illustrations where appropriate from individual cases.

.ETHICS OF ANALYSIS

A cost benefit analysis is based on a framework of assumptions and decisions. An analysis is a model of the interaction of economic, social and ecological factors in a study area. As with all models, a cost benefit analysis is only as good as the skill of the modellers, and reflects their personal biases and viewpoints. The combination of personal and/or institutional viewpoints which shape a cost benefit analysis model can be termed the "ethic" of the analysis. Persons with a conserver ethic will tend to produce an analysis which places high value on the protection and the ecologically responsible use of natural and social resources. Diversity within biological and social/economic communities will be stressed. The community will often be "locally" defined, e.g. local town or region. A person with a short term profit/technology ethic will be influenced by an economic principle which states "dollars gained today are more valuable than dollars obtained tomorrow". Such an approach relies upon the belief that technology will overcome any social or biological/ecological problems which arise from human actions. The community is often defined as local town or region plus Vancouver or all of British Columbia. These two hypothetical people/analysts would likely come to different conclusions given identical information.

VALUATION - MONETARY AND UNPRICED VALUES

Cost benefit analyses usually use monetary criteria to evaluate all considerations. This approach works well in traditional economic analysis where most factors can be easily quantified. For example an analysis of timber extraction can assign dollar values to logging costs, regeneration costs, soil degradation costs, log values, and commodity values. However, when unpriced values are considered, the practice of valuing all inputs to a cost benefit analysis in monetary terms becomes unworkable. Factors with unpriced values include wilderness areas, pleasant views, pure water, spiritual values, cultural traditions, diverse gene pools and functioning ecosystems. Economists agree that these unpriced values have worth. However, their monetary value is difficult or impossible to establish, and these values are very open to personal interpretation.

The ethics of the analyst will have a large impact on the results of the cost benefit analysis when unpriced values are present in the study area. A conserver ethic will use unpriced values to offset or reduce short-term gains from developments which degrade these values. A short-term profit/technology ethic will largely ignore unpriced values, rationalize that technology can replace or repair damage to such values, and/or argue that similar "substitute" values can be found in other locations.

DISCOUNTING

Discounting is the process which cost-benefit analysis uses to aggregate different time periods. It has been one of the most controversial aspects of cost-benefit analysis (Price, 1993). Its influence is pervasive in forestry and environmental economics. In evaluation of continuous cover forestry it has three particular influences, on:

1. Short-term costs during transformation versus long-term benefits – particularly if a better timber assortment can be obtained – once in place;
2. Short-term advantages of economic thinning versus possible long-term dysgenic effects;
3. Short-term costs versus slow-in-developing environmental values.

TIMEFRAME AND DISCOUNTING

Time frame affects cost benefit analysis, especially with regard to natural resource development. In a simplified example, if an analyst chose to examine only the first three years of a timber management development, the analysis would be distorted because all the revenue producing activities would be included (logging, milling) but many of the costs. It is believed that the timeframe for cost benefit analysis of forest use should be theoretically infinite. We cannot, of course, achieve this standard, but the principle is important. Using such an approach, only ecologically responsible development is acceptable (i.e. activities where the integrity of the whole ecosystem is fully protected). Rejected are non-sustainable activities which degrade ecosystems, or those whose cumulative costs will negatively affect the future. Assessing costs and benefits over one timber management rotation is not acceptable.

Cumulative degradation of the forest environment may occur over successive rotations, with large cumulative effects/costs in the future. These long-term costs need to be included in a cost benefit analysis. Conventional cost

benefit analyses discount all future costs and revenues to present value at a set interest rate. This reflects the business principle that money received today is worth more than money received in the future. The belief that a person, given the use of a sum of money for a year, can use the money to earn profits is the basis of this approach. Thus, maximizing today's dollars maximizes return on investment. If money cannot be quickly acquired profits will be lost.

Discounting justifies this perception by calculating a reduced current value for all future income. The strictest interpretation of this concept would dictate that all forests should be liquidated and converted to dollars as quickly as possible. Discounting biases all decisions to favour today's world. In this artificial system, small benefits today can outweigh large costs tomorrow. Therefore, decisions can be justified which are good for a few people today, but which may prove very costly for us, our children, human society, and for ecosystem functioning in the future. Many people agree that discounting is not at all suitable for analysis of forest resource developments, because forests are fundamentally necessary for human sustenance and because of the long time frames involved in forest management. It has been noted that "Very few investments in forestry are worthwhile when based on an acre by acre economic analysis. If economists were in charge of forestry, we would not have forests in the future. Discounted at 4%, a forest worth \$1 million in 200 years is worth only \$392 today. It was argued by an analyst, that using discounting is unnecessary.

Ecologically responsible cost benefit analysis expresses future benefits or future costs as though they are obtained in the current fiscal year. Without discounting, we believe that the future, either in terms of benefits or costs, is more fairly represented and protected. It is believed by some analyst that "unpriced values" should be subjectively evaluated. This analysis should be considered in conjunction with dollar evaluations of benefits and costs in the decision making process. Activities in forest management, such as timber yield or water production, are alleged to be carried out on a sustainable or even flow basis. This means that the production of relatively equal, annual amounts and quality of water, timber, etc. is anticipated. Thus, to be sustainable, today's use of renewable natural resources can not result in future costs which degrade tomorrow's benefits. For example, soil degradation as a result of current activities will degrade water quality and decrease timber yields in the future. This is not sustainable, but can be encouraged through discounting which reduces future benefits and costs to trivial levels.

Discounting is, therefore, not appropriate for cost benefit analysis carried out with an ethic of true sustainability (i.e. maintaining the support system for all life). This is particularly true when considered from the standpoint of a local community which may absorb the social and environmental costs of a development, while many of the benefits accrue to non local organizations. The goal of sustainable resource development is to maintain an even, annual flow of benefits and costs over the long term. This cannot be achieved if today's benefits create tomorrow's costs. An undiscounted economic analysis of a single year, or decade, of operations of a truly sustainable development (i.e. an activity which has no large deferred costs which prejudice future benefits) should correspond to a conventional discounted analysis of the same operation. Only enterprises which transfer social/environmental costs to future generations appear more economically favourable in discounted cost-benefit analyses.

COMPLETE ACCOUNTING OF COSTS AND BENEFITS

Cost benefit analysis must account for all costs and all benefits from a project in order to be valid. Whether or not this is achieved is dependent on the ethic and the skill of the analyst. As explained above, the full accounting of costs and benefits also is related to the time frame chosen as the limits of the analysis. Omitting costs such as ecosystem degradation, damage to spiritual values, lost opportunities for non-timber forest uses (e.g. trapping, ranching, tourism), future employment losses, decreases in future timber productivity, visual aesthetics, etc. from an analysis of large scale clear-cutting would bias the analysis. These costs are real, and are attributable to the

planned development. Lost opportunity costs must be included in cost benefit analysis. Lost opportunity costs arise when something must be given up to gain something else. Trapping and tourism revenues become a lost opportunity cost when large scale clear-cut logging takes place in an area.

An assessment of all costs and benefits can quickly lead to modification of forestry activities. For example, despite its higher operational costs, holistic forest use is more economically viable than conventional clear-cutting because it does not incur large costs to "other forest users" and provides more employment benefits per tree cut compared to conventional timber management. Silva incorporates all benefits and costs in our holistic cost benefit analysis. "Non-dollar" benefits and costs are considered subjectively.

COMPOSITION OF COSTS

Total Cost

The study of cost begins with the group of total cost. The total cost group is composed of three cost concepts: total fixed cost, total variable cost, and total cost.

Total fixed cost (TFC) is the cost that does not change with the level of output. This means that the total fixed cost remains the same, or constant, whether zero or an infinite amount of output is produced. Fixed cost is not related to the level of production. Fixed cost occurs because in the short run, there is at least one factor that cannot be changed. The cost of the fixed factor is the fixed cost. The cost of this factor does not depend on the level of output produced because the amount of the factor, and therefore its cost, remains unchanged. Examples of total fixed cost are rent, insurance, and taxes. The license plate fee is a fixed cost of operating a car. The fee remains the same regardless of how many miles the vehicle is driven. If you leave your car in the garage for a year, the state still expects the same payment. The license plate fee is not related to the amount of transportation produced by the car.

Total variable costs (TVC) are those costs that change with the level of output. If the car is not driven at all, the variable cost will be zero. The more miles the car is driven, the greater is the variable cost. Variable cost can include labour, raw materials, capital, and energy. As more inputs are purchased and output is increased, variable cost rises. Total variable cost always increases with the level of output.

Total cost (TC) is the sum of the fixed cost and the variable cost at each level of output. Total cost is the highest curve since it is the total of both the fixed cost curve and the variable cost curve beneath it.

The Economic Concept of Cost

Economists view total cost differently from what is commonly meant by cost. Many people interpret total cost as the money spent to produce the output. Thus they see total cost as the payments that are recorded in the accounting books. Economists call these particular costs explicit costs.

Explicit costs are the money payments made during the production of the product. Rent, wages, and raw material cost are all easily explained opportunity costs of production and should be clearly recorded in the books. These explicit costs are the out-of-pocket costs of production. However, these explicit costs are not total cost to the economist. An economist's concept of total cost truly means *total* cost. This economic cost includes all the opportunity costs of producing the good. The opportunity cost of all resources used in producing the good are included. The economist recognizes additional costs of production that may not be so obvious and are not found by looking at the cash outlays. These other costs are known as implicit costs. Implicit costs are the opportunity costs of production that are not explicit money payments.

Implicit costs are the opportunity costs of owner-owned resources. Payments to workers are money costs; the cost of this labour is an explicit cost. But what about self-owned labour of the firm. Implicit costs are not as obvious as explicit costs but should not be overlooked. An accountant considers total cost to be the sum of the explicit costs. An economist considers total cost to be the opportunity cost of the good. The opportunity cost of *all* inputs is included, owner owned or not. In this text, total cost always means the sum of all explicit *and* implicit costs associated with production.

Average Cost

Once the total cost is known, you can use a simple process to find the average cost. This is the familiar process you use to find your average test score at the end of the term. First add the points per test to find the total points; then divide the total by the number of tests. This is the same process as finding a total cost and dividing by the level of output. The group of average costs is composed of average fixed cost, average variable cost, and average total cost.

The **average fixed cost (AFC)** is the total fixed cost divided by the number of units produced. The result is the fixed cost per unit of output. $AFC = \frac{\text{total fixed cost}}{\text{quantity of output}}$

Average variable cost (AVC) is the total variable cost divided by the level of output. Consider the following expression for average variable cost: The average total cost curve is also U-shaped.

Average total cost (ATC) is total cost divided by the level of output.

Marginal Cost The marginal cost group consists of only one cost, marginal cost.

Marginal cost (MC) is the change in total cost as one more unit of output is produced. It is the additional, extra, cost of producing one more unit. These cost concepts are important since cost is information used by the firm to make supply decisions, and supply and demand together determines how resources are allocated. So an understanding of cost is essential for an understanding of the resource allocation process.

Application and history

The practice of cost–benefit analysis differs between countries and between sectors (e.g., transport, health) within countries. Some of the main differences include the types of impacts that are included as costs and benefits within appraisals, the extent to which impacts are expressed in monetary terms, and differences in the discount rate between countries. Agencies across the world rely on a basic set of key cost–benefit indicators, including the following:

- NPV (net present value)
- PVB (present value of benefits)
- PVC (present value of costs)
- BCR (benefit cost ratio = PVB / PVC)
- Net benefit (= $PVB - PVC$)
- NPV/k (where k is the level of funds available)

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GLOSSARY

A

Absolute Advantage is the ability of a country to produce a larger quantity of a good with the same amount of resources as another country.

Aggregate means the sum total.

Aggregate Demand is the total demand for output by consumers, business, and government at each price level.

Aggregate Supply is the total amount of output produced at each price level.

Allocate means to distribute, as in the case of scarce resources or scarce goods.

Allocation of Resources or **Resource Allocation** answers the following questions:

1. *What* goods will be produced and in what quantities?
2. *How* will resources be combined to produce the goods?
3. *For whom* are the goods produced? How much of each good will each consumer get?

Antitrust legislation is aimed at reducing monopoly power.

Assumptions are the simplifying device.

Automatic Stabilizers, such as unemployment compensation and the progressive income tax structure, tend to move the level of income toward the full employment level and help "smooth out" the business cycle.

Average Fixed Cost (AFC) is the total fixed cost divided by the number of units produced. The result is the fixed cost per unit of output. The expression for AFC follows:

AFC average fixed cost total fixed cost TFC quantity of output Q

Average-Marginal Relation specifies that if the marginal is greater than the average, the average will rise; and if the marginal is less than the average, the average will fall.

Average Total Cost (ATC) is total cost divided by the level of output. ATC is found by the following expression: ATC average total cost total cost TC quantity of output Q

Average Variable Cost (AVC) is the total variable cost divided by the level of output. The expression for AVC follows: $AVC = \frac{\text{total variable cost}}{\text{quantity of output}}$

B

Balance of Payments is the sum of the current account and the capital account from the international payments account. If this sum is positive, there is a surplus balance of payments, and if negative, a deficit.

Balance of Trade is the difference in the value of what we export and what we import. If the value of what we import is greater than the value of what we export, then there is a balance-of-trade deficit. When the value of our exports exceeds the value of our imports, there is a balance-of-trade surplus.

Balanced Budget results when tax collections and government spending are equal.

Barriers to Entry are factors that keep firms from entering the market when there are incentives for them to enter.

Barter System is a method of trade without money where one good is directly exchanged for another.

Break-even Points are the points of intersection between demand and the average total cost. Any production level between the two break-even points yields an economic profit.

Business Cycles are more-or-less-regular fluctuations in the level of economic activity. These are the up and down phases that accompany the increases or decreases in gross domestic product. Each business cycle goes through four phases: peak, recession, trough, and recovery.

C

Capital is a man-made tool of production; it is a good that has been produced for use in the production of other goods. Capital is a scarce resource.

Capital Account is the international account that records the flow of money from one country to another for the purpose of buying financial assets.

Capitalism is an economic system where the individuals own and control the resources.

Cartel is a group of firms acting as one — in effect a monopoly — to determine the profit maximizing level of output and price.

Change in Demand is a shift of the whole demand curve and occurs when a determinant of demand changes.

Change in Quantity Demanded is a movement along the demand curve and occurs when the price of the good changes.

Change in Quantity Supplied is a movement along the supply curve and occurs when the price of the good changes.

Change in Supply is a shift of the whole supply curve and occurs when a determinant of supply changes.

Circular Flow is a macro model showing the flows of income and product between consumers and business.

Classical Economists believe that the economy will always achieve equilibrium at full employment.

Coefficient of Price Elasticity greater than one indicates elastic demand. A coefficient of price elasticity equal to one indicates unitary elasticity. A coefficient of price elasticity less than one indicates inelastic demand.

$\text{coefficient of price elasticity of demand} = \frac{\% \text{ change in quantity demanded}}{\% \text{ change in price}}$

Communism is an economic system identified by public — government — ownership of resources.

Comparative Advantage means a country can produce a good with a lower opportunity cost than the opportunity cost for the same good in another country.

Complements are goods such that if you purchase more (less) of one, you purchase more (less) of the other.

Conclusion is drawn from a model and is a prediction of behaviour.

Consumer Price Index (CPI) records the percentage change in the price of a selected number of consumer goods compared to a base year.

Consumption (C) is the purchase of goods and services by households.

Consumption Function is the direct relation between income and consumption that tells the amount of consumption at each level of income.

Cost-Push Inflation is a rise in the average price level due to an increase in production costs. Cost-push originates from the supply side of the economy.

Crowding-Out Effect occurs when deficit spending by government increases interest rates and reduces investment.

Currency is the portion of our money supply consisting of coins and Federal Reserve notes.

Current Account is the international account that essentially records the value of what is sold to foreign countries, the exports, minus the value of what is bought from other countries, the imports.

Cyclical Unemployment occurs when the economy slows down and there are more unemployed people than there are available jobs.

D

Deficit Budget occurs when government spends more than it collects in taxes.

Deflation is a continued fall in the price level and an increase in the value of a dollar.

Demand is a list or schedule of the quantities of a particular good that a buyer would be willing and able to buy at alternative prices.

Demand-Pull Inflation is a rise in the average price level caused by excess demand at full employment. The excess demand increases the average level of prices, which is inflation.

Determinants of Demand, including a change in taste for a good, a change in income, an expectation of a change in the price of a good, or a change in the price of a related good, are capable of shifting the demand curve.

Determinants of Price Elasticity of Demand include whether the buyer views the good as a luxury or necessity, the availability of acceptable substitutes, and how large a part of the budget the purchase is for the buyer.

Determinants of Supply are changes in nature, the cost of production, the price of other goods, and expectations of a change in price, all of which are capable of shifting the supply curve.

Differentiated Product is one where the consumer can distinguish one firm's output from another firm's output.

Discount Rate is the interest rate that banks pay on money borrowed from the Federal Reserve System.

Disposable Income is income after taxes and can be either spent or saved by consumers.

Dissaving consumers are consuming more than they are making, either borrowing or spending past saving.

Double Counting occurs when we count the value of the intermediate products as well as the value of the final product in GDP.

E

Easy Entry is the absence of entry barriers in a market. Easy entry results in more firms and less control over price; more barriers to entry result in fewer firms and more control over price.

Economic Loss occurs when total cost exceeds total revenue.

Economic Profit occurs when total revenue exceeds total cost. The revenue of the firm more than covers all opportunity cost. After paying the explicit cost and accounting for the implicit cost, the firm has revenue left over. This remaining revenue is economic profit.

Economics is a social science that studies how society chooses to allocate its scarce resources, which have alternative uses, to provide goods and services for present and future consumption.

Economic System is the process used by each society to allocate resources.

Economies of Scale cause the average total cost to decline in the long run as the productive capacity of the firm increases and are a basis for natural monopoly.

Efficient Allocation of Resources occurs when a good is produced at the lowest possible opportunity cost. This means as few of society's scarce resources as possible are used up, leaving resources free to be used in the production of other goods. A firm produces efficiently at the level of output corresponding to the lowest point on the average total cost curve.

Elastic Demand occurs if the coefficient of elasticity is greater than one. This means that buyers are relatively responsive to a change in the price of the good.

Entrepreneurship is the organizational force that combines the other factors of production — land, labour, and capital — and transforms them into the desired output. Entrepreneurship is a scarce resource.

Equation of Exchange says that the money supply times the velocity of circulation equals price times output, or $MV = PQ$.

Equilibrium is a balance of forces.

Equilibrium Point occurs at the intersection of the market supply and the market demand curves.

Excess Reserves are any reserves that a bank has over and above its required reserves. A bank is free to make loans with its excess reserves.

Exchange Rate is the price of one currency in terms of another.

Expectations Inflation occurs when people expect prices to rise and act upon the expectation by buying more. Prices will rise as a result.

Expenditure Approach to gross domestic product is the sum of all spending by consumers, business, government, and net exports.

Explicit Costs are the money costs of producing the product.

Externalities occur when the cost to society of production differs from the cost to the producer.

F

Fallacy of Composition is an error in thinking that assumes that the behaviour of the whole is the same as the behaviour of its parts.

Fiscal Policy is the use of the federal budget as an economic tool to stabilize the economy.

Fixed Factors of production are the inputs that cannot be increased during the short-run productive process.

Fractional Reserve System requires that banks hold a percentage of their deposits as reserves.

Free Good is a good with zero opportunity cost, which means that you can have all you want without giving up anything else.

Frictional Unemployment includes those people in the process of relocating from one job to another.

Full Employment is defined at some level of unemployment. The exact percentage of unemployment that marks full employment is open to debate.

G

GDP Price Deflator is a special price index used to convert money GDP into real GDP.

Good is anything that satisfies a want.

Government Spending (G) is the total expenditure by government.

Gross Domestic Product (GDP) is the total dollar value of all final goods and services produced within a nation's border during a year.

H

Hyperinflation is an accelerating increase in the average price level.

Implicit Costs are the opportunity costs of owner-owned resources which are used in production, and for which no money is paid.

Income is the money society earns through productive processes. The payments to resource owners are rent, wages, interest, and profit and are the returns to land, labour, capital, and entrepreneurship.

Income Approach to GDP is found by adding all income received by the resource owners.

Income Effect of a change in price measures the change in consumption of a good because of the change in purchasing power when the price changed.

Income Multiplier means that any initial change in spending results in a greater change to total income. The income multiplier is the reciprocal of the marginal propensity to save.

Inelastic Demand occurs if the coefficient of elasticity is less than one. This means that buyers are not so responsive to a change in the price of a good.

Inferior Good is a good for which demand decreases as income increases.

Inflation is a continued rise in the average level of prices.

Investment (I) represents business spending for capital goods plus inventories. Business is the only sector of the economy that invests in the economic sense.

K

Keynesian Economists believe that the economy can be fine tuned using the fiscal and monetary tools.

Kinked Demand is a model of oligopolistic behaviour.

L

Labour is human effort, both physical and mental. Labour is a scarce resource.

Labour Force consists of those employed and those unemployed but looking for work.

Laissez-Faire is the classical attitude that the government should leave the macro economy alone.

Land is land itself and anything that grows on it or can be taken from it — the “natural resources.” Land is a scarce resource.

Law of Demand states that there is an inverse relationship between the price of a good and the quantity demanded of that good.

Law of Diminishing Returns states that as an increasing amount of a variable factor is added to a fixed factor, the marginal product of the variable factor will eventually fall.

Law of Increasing Costs states that as society obtains an extra unit of one good, ever-increasing amounts of the other good must be sacrificed.

Law of Supply states that a direct relation exists between the price of a good and quantity supplied of that good.

Long Run is a period of time in which all inputs to the productive process are variable.

M

Macroeconomics (macro) is the study of the economy as a whole.

Marginal Cost (MC) is the change in total cost as one more unit of output is produced. It is the additional or extra cost of producing another unit. The expression for marginal cost follows: $MC = \frac{\text{marginal cost change in total cost } TC}{\text{change in quantity of output } Q}$

Marginal Input Cost (MIC) is the change in total cost due to the hiring of another unit of a variable input.

Marginal Product (MP) is the change in total product as one more unit of variable input is added to a productive process.

Marginal Profit is the change in total profit when one more unit is produced and sold.

Marginal Propensity to Consume (MPC) is the amount by which consumption changes when income changes by one dollar. The expression for MPC follows: $MPC = \frac{\text{marginal propensity to consume change in consumption } C}{\text{change in income } Y}$

Marginal Propensity to Save (MPS) is the change in saving when income changes by one dollar. The expression for MPS follows: $MPS = \frac{\text{marginal propensity to save change in saving } S}{\text{change in income } Y}$

Marginal Revenue (MR) is the change in total revenue as one more unit is produced and sold. Marginal revenue answers the question, What is the extra revenue from the sale of one more unit of output? The following is the expression for marginal revenue: $MR = \frac{\text{marginal revenue change in total revenue } TR}{\text{change in output } Q}$

Marginal Revenue Product (MRP) is the change in total revenue due to the use of another unit of the variable input.

Market is a situation where buyers and sellers meet to negotiate price and to trade.

Market Power is the ability to control price. When a firm changes the price of its good, not only will it affect its own revenue, but it may affect the revenue of other firms as well.

Market Structure refers to the elements of market organization that affect the behaviour of the firms. Three elements identify the market structure: the number of firms in the market, freedom of entry and exit, and the degree to which the product is standardized.

Measure of Debt is a function of money that records the amount of money to be paid in the future.

Medium of Exchange is anything that is generally accepted in exchange for goods and services. Medium of exchange is a function of money.

Microeconomics (micro) is the study of the individual parts of the economy.

Misallocation of Resources occurs when a good is produced at other than the lowest point on the average total cost curve.

Model is a simplification of reality.

Monetarists believe only changes in the money supply affect output or prices.

Monetary Policy is the use of monetary tools by the Federal Reserve System to influence the money supply and interest rates to stabilize the business cycle.

Money serves as a medium of exchange and also functions as a standard of value, a store of value, and a measure of debt. Anything that is money performs these functions in a society.

Money or Current GDP is the GDP figure without adjustment for changes in price.

Money Demand tells how much money people will hold in currency or in checkable deposits at each interest rate.

Money Multiplier is the multiple change in the total money supply resulting from any initial change in bank excess reserves. The money multiplier is the reciprocal of the reserve requirement.

Money Supply in the narrow M1 definition consists of currency in circulation and any checkable deposits.

Monopolistic Competition is characterized by a market structure that has many sellers, a differentiated product, and easy entry.

Monopoly is a market structure where there is a single seller, no acceptable substitutes for the product, and entry into the market is restricted. The firm faces the same downward-sloping demand as the market because the firm is the market.

National Debt is the outstanding government debt created when the government spends more than it collects in taxes. The national debt is also commonly referred to as the federal or public debt.

Natural Monopoly is characterized by a market that is large enough to support only one firm of an efficient size.

Natural Rate of Unemployment is frictional plus structural unemployment.

Net Exports is the difference between exports and imports and accounts for the foreign sector in the expenditure approach to GDP.

Normal Good is a good for which demand increases as income increases.

Normal Profit results when total revenue equals total cost. A normal profit is also called a zero economic profit. This means that the firm exactly covers its opportunity cost.

Normative models express value judgments that prescribe how the world should be.

Official Settlements Account is the international account that includes the movements of cash from one country to another or the movement of credit from one central bank to another, and records changes in the government's reserves of foreign currencies.

Oligopoly is a market structure of just a few sellers, usually protected by barriers to entry, for a product that is either standardized or differentiated.

Open Market is the exchange where negotiable government securities are traded, just like the stock market.

Open Market Operation is the purchase or sale of negotiable government securities in the open market by the Federal Reserve.

Opportunity Cost is the value of the foregone alternative — what you give up when you get something.

P

Per Capita GDP is GDP per person. To find per capita GDP, divide GDP by the population.

Perfectly Competitive Market is a market structure characterized by many firms, a standardized product, and easy entry. When a market is competitive, no firm has control over price.

Perfectly Elastic Demand occurs if the coefficient of elasticity is some number divided by zero. No matter how many units are bought, the price stays the same.

Perfectly Inelastic Demand occurs if the coefficient of elasticity is zero. No matter what the change in price, the quantity demanded does not respond.

Phillips Curve shows the inverse relation between unemployment and inflation. The outward shift of the Phillips curve shows stagflation.

Positive economic models are models that describe.

Potential Equilibria are the combinations of Y and $C + I$ (or $C + I + G$) where equilibrium could possibly occur, where $Y = C + I$ (or $Y = C + I + G$).

Price is what the buyer gives up to get another unit of a good.

Price Elasticity of Demand measures the responsiveness of the quantity demanded to a change in price.

Price Index Number records the percentage change in the price of a selected combination of goods compared to the base year. The price index number is a measure of the average price level. The expression for a price index number follows: $\text{price index number} = \frac{\text{cost of the market basket, current year}}{\text{cost of the market basket, base year}}$

Price Leadership is the practice of all oligopoly firms uniformly increasing price after an increase in price by the industry leader. The price leader may be the most powerful firm or simply one taking the position by custom.

Producer Price Index (PPI) is a measure of the prices of certain goods sold at wholesale and is thought to be a predictor of consumer price movements.

Production Possibilities model shows all possible combinations of two different outputs that the society is capable of producing.

Profit is total revenue minus total cost.

Profit Maximization means making the greatest possible amount of profit.

Profit Maximization Point (input) is the point of intersection of the marginal input cost with the marginal revenue product. The level of input that this point represents is the profit maximizing level of input.

Profit Maximization Point (output) is the point of intersection of the marginal cost with the marginal revenue. The level of output that this point represents is the profit maximizing level of output.

Public Goods are goods that we consume collectively; that is, goods for which an increase in your consumption does not require me to decrease mine.

Quantity Demanded is the amount a buyer is willing and able to buy at a specific price.

Quantity Supplied tells the amount that a seller is willing and able to produce at a specific price.

Quota is a restriction on the amount of a particular good that can be imported.

R

Rational Expectations is the belief that people adjust to expected actions by the government so that, when the action actually occurs, its effect has already been accounted for in the market.

Real GDP is a measure of output produced by an economy valued in the prices of the base year. To find the real level of output, real GDP, divide the current level of output, money GDP, by the GDP price deflator index number for the current year: $\text{real GDP} = \frac{\text{money GDP}}{\text{GDP price deflator}}$

Required Reserves are the amount of its deposits that a bank is required to hold in reserve and not lend out.

Reserve Requirement is the percentage of its deposits that a bank must keep in reserve as required by the Federal Reserve.

Resources are the so-called factors of production or means of production. These resources can be classified as land, labour, capital, and entrepreneurship.

S

Saving (S) is that part of income that is not spent for consumption or taxes.

Saving Function is the direct relation between income and saving that tells how much is saved at each level of income.

Say's Law states that supply creates its own demand. The meaning of this statement is that the money paid to resource owners for the use of their resources will be used to purchase the output of producers.

Scarcity is the basic economic problem of unlimited wants competing for limited resources.

Seasonal Unemployment occurs when workers are laid off during the off season.

Shortage exists whenever the quantity demanded is larger than the quantity supplied at the going price.

Short Run is a period of time in which at least one of the factors of production is fixed.

Shutdown Decision tells the firm to stop production if its revenue does not cover its variable cost.

Shutdown Point is the lowest point on the average variable cost curve.

Socialism is an economic system that favours a combination of private and public ownership of resources.

Social Science uses the scientific method to study human behaviour.

Stabilization Policy is any action taken by the government to smooth out the business cycle and includes both monetary and fiscal policies.

Stagflation is undesirable rates of both unemployment and inflation together. An outward shift of the Phillips curve shows stagflation.

Standard of Value is a function of money that permits people to measure and compare the values of different goods.

Standardized Product is one where the consumer cannot distinguish one firm's output from another firm's output. The products seem identical.

Store of Value is a function of money that allows people who have money now to spend it at a later time.

Structural Unemployment occurs when there are many people unemployed while there are many jobs available, but the unemployed lack the necessary qualifications for the jobs.

Substitutes are goods such that if you buy more (less) of one, you buy less (more) of the other.

Substitution Effect of a change in price measures the change in consumption of a good because the good becomes a less or more attractive substitute for other goods.

Supply is the list or schedule of alternative prices and the amount of the product that the seller is willing and able to offer for sale at each price.

Supply-Shock Inflation is inflation that results from infrequent drastic changes in production cost of fundamental products.

Supply-Side Economics is a view that emphasizes the importance of policy action on the aggregate supply curve.

Surplus is the condition that occurs when the quantity supplied exceeds the quantity demanded at the going price.

Surplus Budget is a budget that results when the government collects more in taxes than it spends.

T

Tariffs are taxes imposed on imports.

Technology is the knowledge required to turn inputs into output.

Total Cost (TC) is the sum of the fixed cost and the variable cost at each level of output.

Total Fixed Cost (TFC) is the cost that does not change with the level of output. This means that the total fixed cost remains the same, or constant, whether zero or an infinite amount of output is produced. Total fixed cost is not related to the level of production.

Total Output is the amount produced by the economy, real GDP.

Total Product (TP) is the total output produced by the inputs of a firm.

Total Revenue (TR) is the money the firm collects by selling the good (price times quantity sold).

Total Spending is the amount spent by all sectors of the economy, $C + I + G$ ($C + I$ in a two-sector economy).

Total Variable Cost (TVC) are those costs that change with the level of output.

U

Underemployment occurs when workers can find only part-time employment or jobs not utilizing their skills.

Unemployment exists when people are looking for a job, but they are unable to find work at the going wage.

Unemployment Rate for the United States measures the percentage of the labour force that is not able to find employment.

Unitary Elasticity means that the percentage change in quantity demanded will be the same as the percentage change in price.

V

Variable Factors of production, or variable inputs, are those inputs that can be increased during production.

Velocity of Circulation is the number of times a dollar is spent in a year in buying the final output of the economy.