Reading material for Second year economics students

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Chapter Three

Efficiency, Property rights, Market failure and Environment

This chapter provides a brief explanation of economic efficiency and the conditions to achieve it. We also discuss the causes and effects of failures in meeting the efficiency conditions on the allocation of natural environmental resources. That is, the causes and effects of market failures as well as its impact on the environment will be discussed in detail.

3.1 Efficiency, discounting and intergenerational equity

Economic Efficiency

Economic efficiency implies an economic state in which every resource is optimally allocated to serve each individual or entity. Economic efficiency occurs when all goods and factors of production in an economy are distributed or allocated to their most valuable uses and waste is eliminated or minimized. When an economy is economically efficient, any changes made to assist one entity would harm another. In terms of production, goods are produced at their lowest possible cost, as are the variable inputs of production.

Some terms that encompass phases of economic efficiency include allocative efficiency, productive efficiency, distributive efficiency, and Pareto efficiency. A state of economic efficiency is essentially theoretical; a limit that can be approached but never reached. Instead, economists look at the amount of loss, referred to as waste, between pure efficiency and reality to see how efficiently an economy functions.

Economic Efficiency and Scarcity

The principles of economic efficiency are based on the concept that resources are scarce. Therefore, there are not sufficient resources to ensure that all aspects of an economy function at their highest capacity at all times. Instead, scarce resources must be distributed to meet the needs of the economy in an ideal way while also limiting the amount of waste produced. The ideal state is related to the welfare of the population with peak efficiency also resulting in the highest level of welfare possible based on the resources available. Hence, efficient allocation of resources describes or addresses three general questions.

- What output to be produced
- What combinations of inputs should be used
- How outputs should be distributed

By taking time as a preference, there are two measures of efficiency: the static efficiency and the dynamic efficiency. Static efficiency is concerned with the allocation of scarce at a given point in time. An allocation of resources is said to satisfy the static efficiency criterion if the economic surplus derived from those resources is maximized by that allocation. The dynamic efficiency on the other hand concerned with the allocation of resources over time. The dynamic resource allocation also called as intertemporal or intergenerational resource allocation as it is concerned with the allocation of scarce resources among generations overtime.

A. Static efficiency

An allocation of resources is said to be efficient if it is not possible to make one or more persons better off without making at least one other person worse off. Conversely, an allocation is inefficient if it is possible to improve someone's position without worsening the position of anyone else. A gain by one or more persons without anyone else suffering is known as a Pareto improvement. A state in which there is no possibility of Pareto improvements is sometimes referred to as being allocatively efficient, rather than just efficient, so as to differentiate the question of efficiency in allocation from the matter of technical efficiency in production.

Efficiency in allocation requires the fulfillment of three efficiency conditions – efficiency in consumption, efficiency in production, and product-mix efficiency. To see these, suppose that the economy consists of only:

- Two individuals A and B
- Two products X and Y, and
- Two resources L and K

Thus, the utility of individual A derived from the consumption of Good X and good Y that is; ($U^A = U^A\ (X^A,\ Y^A)$) and the utility of individual B is also derived from the consumption of those two goods X and Y that is; ($U^B = U^B\ (X^B,\ Y^B)$). The production of good X is the function of resource L and K, and the production of good Y is also the function of resource L and K; that is, $X(L^X,K^X)$ and $Y(L^Y,K^Y)$.

1. Efficiency in consumption

The consumption of the two goods said to be efficient if these goods are distributed for the two individuals or consumers in such a way that it is impossible to increase the utility of someone without decreasing the utility another one. Consumption efficiency requires that the marginal rates of utility substitution for the two individuals are equal:

$$(MRS_{XY})^{A} = (MRS_{XY})^{B} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots .. \ 1$$

This condition implies that, both individuals place equal value for goods. At this equilibrium point there is Pareto optimality or Pareto efficiency in consumption. It is impossible to make someone better off without making the other one worse off at the Pareto optimality. If this condition were not satisfied, it would be possible to rearrange the allocation as between A and B of whatever is being produced so as to make one better off without making the other worse off.

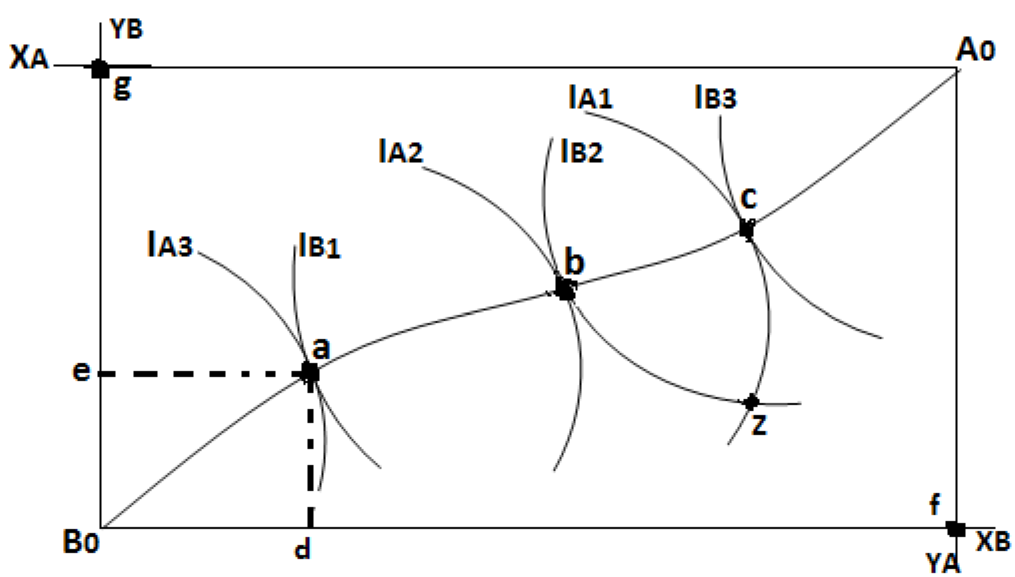


Figure I: Edgeworth Box of consumption

Figure I shows what is involved by considering possible allocations of fixed amounts of X and Y between A and B. The top right-hand corner, labeled A0, refers to the situation where A gets nothing of the available X or Y, and B gets all of both commodities. The bottom left-hand corner, B0, refers to the situation where B gets nothing and A gets everything. Starting from A0 moving horizontally left measures A's consumption of X, and moving vertically downwards measures A's consumption of Y. As A's consumption of a commodity increases, so B's must decrease. Starting from B0 moving horizontally right measures B's consumption of X, and moving vertically upwards measures B's consumption of Y.

Any allocation of X and Y between A and B is uniquely identified by a point in the box which is called as Edgeworth box. However, only points on the contract curve or points only on the line B0A0 are efficient; and are called as Pareto optimal or Pareto efficient. At these points it is impossible to increase the utility of one individual without decreasing the utility of the other individual. At the point a for example, B is consuming B0d of X and B0e of Y and generating the utility level indicated by indifference curve IB1, and A is consuming df of X and eg of Y and generates utility level that indicated by IA3. In moving from a to b however, the utility of B will be on the higher indifference curve IB2, but utility of A will be on the lower indifference curve IA2, that is the B's utility of increases but A's utility decreases.

In contrast to this, points outside the contract curve or points outside line B0A0 are inefficient and are called as Pareto improvement points as it is possible to improve the benefit of at least one individual without harming the other one. For example, at point z, the utility of B is indicated by IB2 and that of A is indicated by IA1. Consider a reallocation as between A and B, starting from point z and moving along IA1 to point c, this means increasing utility for B (movement onto a higher indifference curve IB3), and constant utility for A IA1. However, beyond point c any further such reallocations will involve decreasing utility for A. Point c is therefore, identifies a situation where it is not possible to make individual B better off while maintaining A's utility constant. It represents an efficient allocation of the given amounts of X and Y as between A and B. The slopes of IA1 and IB3 are equal at this point; implies that, A and B have equal marginal rates of utility substitution.

2. Efficiency in production

Turning now to the production side of the economy, recall that we are considering an economy with two inputs, Land K, which can be used to produce the goods X and Y. Efficiency in production requires that the marginal rate of technical substitution be the same in the production of both commodities. That is,

$$MRTS^X = MRTS^Y \text{ .... } 2$$

If this condition were not satisfied, it would be possible to reallocate inputs to production so as to produce at least more of one of the commodities without reducing the production of the other. Figure II shows why this condition is necessary. It is constructed in a similar manner to Figure I, but points in the box refer to allocations of capital and labor to the production of the two commodities rather than to allocations of the commodities between individuals.

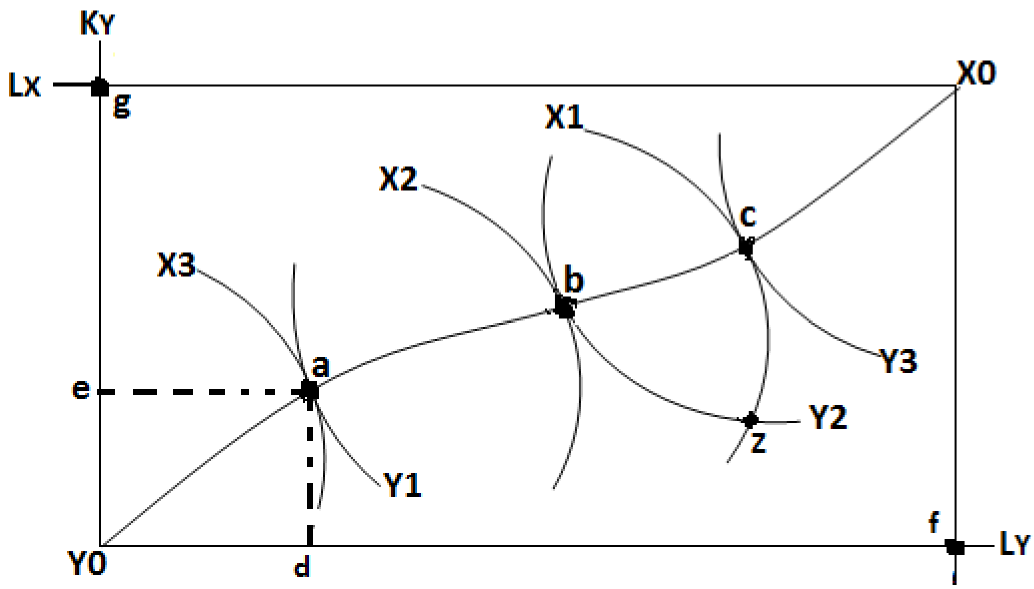


Figure II: Edgeworth box of production

At X0 neither capital nor labor is devoted to the production of commodity X (all of both resources are used in the production of Y). Moving horizontally to the left from X0 measures increase in the use of labor in the production of X, and moving vertically down from X0 measures increasing use of capital in the production of X. The corresponding variations in the use of inputs in the production of Y– any increase/decrease in use for X production must involve a decrease/increase in use for Y production – are measured in the opposite directions starting from origin Y0.

X1, X2, and X3 are isoquants for the production of commodity X. Consider movements along X1 to the 'south-east' from point c to z, so that in the production of X capital is being substituted for labor, holding output constant. Correspondingly, given the full employment of the resources available to the economy, labor is being substituted for capital in the production of Y. Y1, Y2, and Y3 are isoquants for the production of Y. Moving along X1 from z towards c means moving onto a higher isoquant for Y– more Y is being produced with the production of X constant. Thus, points outside the contract curve points like z are Pareto improvements. But, points on the contract curve like a, b, and c are Pareto optimal (it is impossible to increase the production of one commodity without reducing the production of the other commodity). At point c for example, the slopes of the isoquants in each line of production are equal – the marginal rates of technical substitution are equal. If these rates are not equal just like point z, then clearly it would be possible to reallocate inputs as between the two lines of production so as to produce more of one commodity without producing any less of the other.

3. Product-mix efficiency

The final condition necessary for economic efficiency is product-mix efficiency. This requires that

$$MRT_L = MRT_K = MRS^A = MRS^B \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 3$$

This condition can be understood using Figure III.

Given that equation 3 holds, so that the two individuals have equal marginal rates of utility substitution and $MRS^A = MRS^B$. Given the equality of the MRS, their indifference curves have the same slope at an allocation that satisfies the consumption efficiency condition, so we can simplify, without any real loss, by assuming the same utility functions and drawing a single indifference curve I that refers to all consumers.

When we think about the rate at which the economy can trade off production of X for Y and vice versa, it does not matter whether the changed composition of consumption is realized by switching labor or capital between the two lines of production. Consequently, in Figure III we show a single production possibility frontier (PPF) YmXm.

PPF shows the output combinations that the economy could produce using all of its available resources. The slope of YmXm is MRT (marginal rate of transformation).

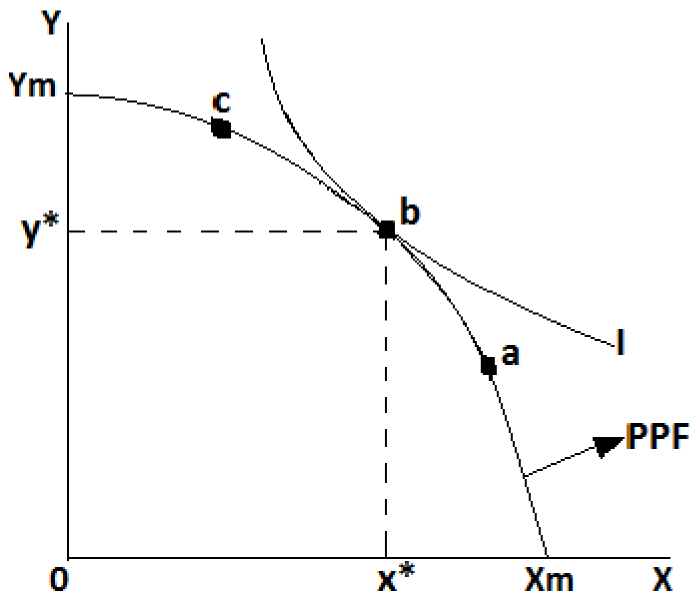


Figure III: product-mix efficiency

In Figure III the point a must be on a lower indifference curve than I. Moving along Ym Xm from point c toward b must mean shifting to a point on a higher indifference curve. The same goes for movement along YmXm from a toward b. On the other hand, moving away from b, in the direction of either a or c, must mean moving to a point on a lower indifference curve. We conclude that a point like b, where the slopes of the indifference curve and the production possibility frontier are equal, corresponds to a product mix – output levels for X and Y– such that the utility of the representative individual is maximized, given the resources available to the economy and the terms on which they can be used to produce commodities. We conclude, that is, that the equality of MRS and MRT is necessary for efficiency in allocation. At a combination of X and Y where this condition does not hold, some adjustment in the levels of X and Y is possible which would make the representative individual better off.

An economy attains a fully efficient static allocation of resources if the conditions given by equations 1, 2, and 3 are satisfied simultaneously. Moreover, it does not matter that we have been dealing with an economy with just two persons and two goods. The results readily generalize to economies with many inputs, many goods and many individuals. The only difference will be that the three efficiency conditions will have to hold for each possible pair wise comparison that one could make, and so would be far more tedious to write out.

We have already stated that a central question in resource and environmental economics concerns allocative efficiency. The role of markets and prices is central to the analysis of this question. As we have noted, a central idea in modern economics is that, given the necessary conditions, markets will bring about efficiency in allocation.

B. Dynamic Efficiency

The static efficiency criterion is very useful for comparing resource allocations when time is not an important factor. How can we think about optimal choices when the benefits and costs occur at different points in time?

The traditional criterion used to find an optimal allocation when time is involved is called dynamic efficiency, a generalization of the static efficiency concept already developed. In this generalization, the present-value criterion provides a way for comparing the net benefits received in one period with the net benefits received in another.

An allocation of resources across n time periods satisfies the dynamic efficiency criterion if it maximizes the present value of net benefits that could be received from all the possible ways of allocating those resources over the n periods. The present value of a onetime net benefit received n years from now is given by;

$$PV(B_n) = \frac{B_n}{(1+r)^n}$$

And, the present value of a stream of net benefits $\{B_{0,\dots,}B_n\}$ received over a period of n years is computed as;

$$PV[B_{0,\dots,}B_n] = \sum_{i=0}^{n} \frac{B_i}{(1+r)^i}$$

Where r is the appropriate interest rate and B_0 is the amount of net benefits received immediately. The process of calculating the present value is called discounting, and the rate r is referred to as the discount rate.

The number resulting from a present-value calculation has a straightforward interpretation. Suppose you were investigating an allocation that would yield the following pattern of net benefits on the last day of each of the next five years: $3,000, $5,000, $6,000, $10,000, and $12,000. If you use an interest rate of 6 percent (r = 0.06) and the above formula, you will discover that this stream has a present value of $29,205.92. Notice how each amount is discounted back the appropriate number of years to the present and then these discounted values are summed.

Demonstrating Present Value Calculations

Year	1	2	3	4	5	Sum
Annual amounts	3000	5000	6000	10000	12000	36000
Present value at r = 0.06	2830.19	4449.98	5037.72	7920.94	8967.10	29205.92

Interpreting Present Value Calculations

Year	1	2	3	4	5	6
Balance at beginning of year	29205.92	27958.28	24635.77	20113.92	11320.75	0.00
Year-end fund balance before payment (r = 0.06)	30958.28	29635.77	26113.92	21320.75	12000	
Payment	3000	5000	6000	10000	12000	

What does that number mean? If you put $29,205.92 in a savings account earning 6 percent interest and wrote yourself checks, respectively, for $3,000, $5,000, $6,000, $10,000, and $12,000 on the last day of each of the next five years, your last check would just restore the account to a $0 balance. Thus, you should be indifferent about receiving $29,205.92 now or in the specific five-year stream of benefits totaling $36,000; given one, you can get the other. Hence, the method is called present value because it translates everything back to its current worth.

It is now possible to show how this analysis can be used to evaluate actions. Calculate the present value of net benefits from the action. If the present value is greater than zero, the action should be supported. Otherwise it should not.

3.2 Market Failure

This section provides a brief explanation of market failure, how it occurs, and its effects in relation to the natural environmental resources.

The classical and neo-classical economics is concerned with markets for goods allocating scarce resources to alternative uses, and prices being established which reflect the scarcity and levels of demand for goods. In our real world however, market fails in allocating resources efficiently from the societal point of view. The situation when markets fail to allocate resources efficiently is known as market failure; and it occurs when the conditions for the free market are not met.

Think for a moment about our daily life and what affects it. We live in a particular environment, breathing the air. However, we do not pay a price for the air, since there is no market in air. As a result, we cannot reflect our preference for breathing clean rather than dirty air through the market. This is an example of **market failure**. There are different causes for market to fail some of these are explained bellow.

1. Property Rights

We know that the market mechanism will lead to the socially optimal outcome only under very specific conditions. However, it is highly unlikely that these conditions will be fully satisfied. The existence of perfect competition in reality as it is defined in textbooks is highly unlikely. For example, we require that prices will result from the realization of all possible markets working and existing. This is only likely to occur when a complete and effective system of property rights exists, including property rights to environmental goods such as clean air.

Property Rights and Efficient Market Allocations

The manner in which producers and consumers use environmental resources depends on the property rights governing those resources. In economics, property right refers to a bundle of entitlements defining the owner's rights, privileges, and limitations for use of the resource. By examining such entitlements and how they affect human behavior, we will better understand how environmental problems arise from government and market allocations.

These property rights can be vested either with individuals, as in a capitalist economy, or with the state, as in a centrally planned socialist economy. How can we tell when the pursuit of profits is consistent with efficiency and when it is not?

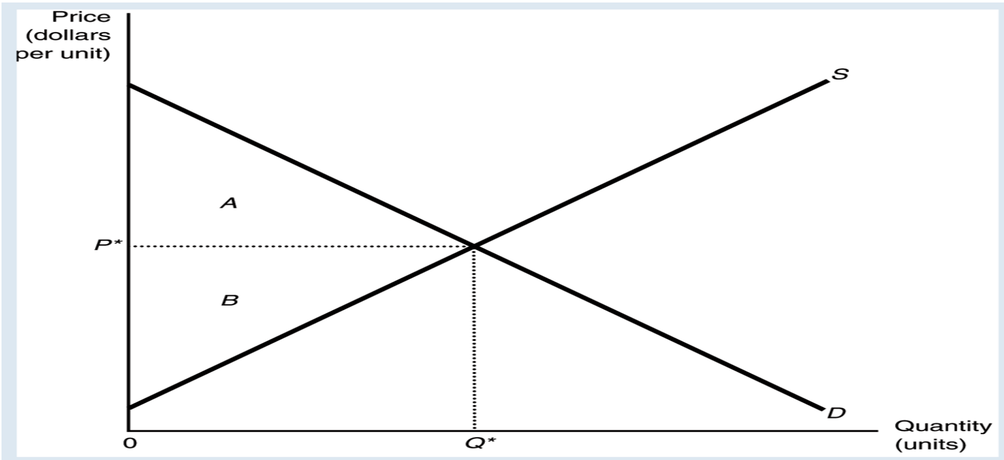
Efficient Property Rights Structures

The structure of property rights that could produce efficient allocations in a well-functioning market economy has three main characteristics.

1. Exclusivity: All benefits and costs accrued as a result of owning and using the resources should accrue only to the owner, either directly or indirectly by sale to others.
2. Transferability: All property rights should be transferable from one owner to another in a voluntary exchange.
3. Enforceability: Property rights should be secure from involuntary seizure or encroachment by others.

An owner of a resource with a well-defined property right (one exhibiting these three characteristics) has a powerful incentive to use that resource efficiently because a decline in the value of that resource represents a personal loss. Farmers who own the land have an incentive to fertilize and irrigate it because the resulting increased production raises income. Similarly, they have an incentive to rotate crops when that raises the productivity of their land.

When well-defined property rights are exchanged, as in a market economy, this exchange facilitates efficiency. We can illustrate this point by examining the incentives consumers and producers face when a well-defined system of property rights is in place. Because the seller has the right to prevent the consumer from consuming the product in the absence of payment, the consumer must pay to receive the product. Given a market price, the consumer decides how much to purchase by choosing the amount that maximizes his or her individual consumer surplus.



The Sum of consumer surplus (area A) and producer surpluses (area B) is a social surplus. SS = A+B, and is distributed between consumers and producers. In a well defined property rights and competitive markets both producers and consumers try to maximize their surplus. System induces self-interested parties to make efficient choices from the point of view of society. System designed to produce a harmonious and friendly outcome could function effectively while allowing consumers and producers freedom in making choices.

Area under the price line is total revenue; area under the marginal cost curve is total variable cost producer's surplus is related to profits. Most natural resource industries give rise to rent. Producer's surplus is not eliminated by competition, even with free entry in the long run. Producer's surplus, which persists in long-run competitive equilibrium, is called scarcity rent.

Regimes

Property rights to a good must be defined, their use must be monitored, and possession of rights must be enforced. The costs of defining, monitoring, and enforcing property rights are termed transaction costs. Depending on the level of transaction costs, various forms of property rights institutions will develop. Each institutional form can be described by the distribution of rights. The following list is ordered from no property rights defined to all property rights being held by individuals

- Open-access property: open-access property is not managed by anyone, and access to it is not controlled. There is no constraint on anyone using open-access property (excluding people is either impossible or prohibitively costly). An example of currently open-access property is outer space or ocean fisheries (outside of territorial borders).

- Public property or state property: is property that is publicly owned, but its access and use are managed and controlled by a government agency or organization granted such authority. An example is a national park or a state-owned enterprise.
- Common property: or collective property is property that is owned by a group of individuals. Access, use, and exclusion are controlled by the joint owners. True commons can break down, but, unlike open-access property, common property owners have greater ability to manage conflicts through shared benefits and enforcement.
- Private property: is both excludable and rival. Private property access, use, exclusion and management are controlled by the private owner or a group of legal owners.

Property rights give the owner or right holder the ability to do with the property what they choose. That includes preserving it, holding on to it, selling or renting it out for profit, or transferring it to another party. Hence, well-defined and enforceable private property rights are one of the necessary conditions to conserve and allocate resources efficiently. However, because property rights do not exist, or are not clearly defined, for many environmental resources, markets fail to allocate those resources efficiently. In such circumstances, price signals fail to reflect true social costs and benefits, and a prima facie case exists for government policy intervention to seek efficiency gains. In areas where property rights don't exist, the ownership and use of resources are allocated by force, normally by the government. That means these resources are allocated by political ends rather than economic ones. Such governments determine who may interact with, can be excluded from, or may benefit from the use of the property that may leads to allocation inefficiency; and in the case of open-access property, no one owns or manages it such as waterways. This results in overutilization and thereby leads to the depletion of the natural resources. This situation is called as tragedy of commons.

2. Externalities

An externality is a cost or benefit of an economic activity experienced by an unrelated third party. The external cost or benefit is not reflected in the final cost or benefit of a good or service. Therefore, economists generally view externalities as a serious problem that makes markets inefficient, leading to market failures. The externalities are the main catalysts that lead to the tragedy of the commons.

The primary cause of externalities is poorly defined property rights. The ambiguous ownership of certain things may create a situation when some market agents start to consume or produce more while the part of the cost or benefit is covered or received by an unrelated party. Environmental items, including air, water, and wildlife, are the most common examples of things with poorly defined property rights that leads to negative spillover effect on the third party.

Types of Externalities

Generally, externalities are categorized as either negative or positive.

i. Negative externality

A negative externality is a negative consequence of an economic activity experienced by an unrelated third party. The majority of externalities are negative. Some negative externalities, such as the different kinds of environmental pollution, are especially harmful due to their significant adverse effects. Negative externalities are divided into production and consumption externalities. Examples of negative production externalities include:

- **Air pollution:** A factory burns fossil fuels to produce goods. The people living in the nearby area and the workers of the factory suffer from the deteriorating air quality.
- **Water pollution:** a tanker spills oil, destroying the wildlife in the sea and affecting the people living in coastal areas.
- **Noise pollution:** People living near a large airport suffer from high noise levels.

Some examples of negative consumption externalities are:

- **Passive smoking:** Smoking results in negative effects not only on the health of a smoker but on the health of other people.
- **Traffic congestion:** The more people use roads, the heavier the traffic congestions are.

ii. Positive externality

Positive externality is a benefit from an economic activity experienced by an unrelated third party. Despite the benefits of economic activities that involve positive externalities, the externality also creates market inefficiencies. Positive externalities can also be distinguished as production and consumption externalities.

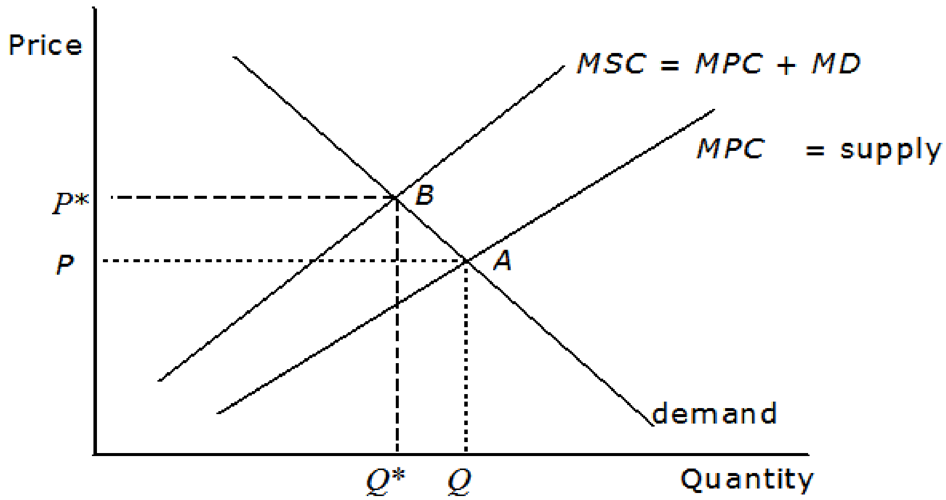
Positive production externalities include:

- **Infrastructure development:** Building a subway station in a remote neighborhood may benefit real estate agents who manage the properties in the area. Real estate prices would likely increase due to better accessibility, and the agents would be able to earn higher commissions.
- **R&D activities:** A company that discovers a new technology as a result of research and development (R&D) activities creates benefits that help the society as a whole.

Examples of positive consumption externalities are:

- **Individual education:** The increased levels of an individual's education can also raise economic productivity and reduce unemployment levels.
- **Vaccination:** Benefits not only a person vaccinated but other people as well because the probability of being infected decreases.

Let us work through the argument for a negative externality. In this case, the marginal private cost (*MPC*) is less than the marginal social cost (*MSC*). The marginal private cost represents the short-run market supply curve. Hence, with a negative externality, the short-run market supply curve is lower than society's short-run supply curve would be. The difference between *MSC* and *MPC* are the marginal damages (*MD*). *MDs* are the amount of the negative externality which as the quantity of output increases, increase as well. These are damages being inflicted on society as a result of the private producer not taking account of the costs that result from production, such as air or water pollution. The following graph shows the effect of negative production externality on the socially optimal level of production and price.



The socially optimal level internalizes externality and is obtained where MSC = MB (demand). But, market equilibrium ignores the externality and is obtained where MPC = MB (demand). Accordingly, A shows the equilibrium position with a negative externality. Price is P and quantity supplied is Q. B shows the socially optimal outcome, where price is P* and quantity supplied is Q*. Hence, with a negative externality, too much of the good producing negative externality is supplied at too low price (relative to the optimum). This is an example of market failure. It results from the absence of property rights and a market for the marginal damages produced by this activity.

3. Public goods

Public goods, defined as those that exhibit both consumption indivisibilities and non-excludability, present a particularly complex category of environmental resources. Non-excludability refers to a circumstance where, once the resource is provided, even those who fail to pay for it cannot be excluded from enjoying the benefits it confers. Consumption is said to be indivisible when one person's consumption of a good does not diminish the amount available for others. Several common environmental resources are public goods, including not only the "charming landscape" referred to by Emerson, but also clean air, clean water, and biological diversity.

Biological diversity includes two related concepts: (1) the amount of genetic variability among individuals within a single species, and (2) the number of species within a community of organisms. Genetic diversity, critical to species survival in the natural world, has also proved to be important in the development of new crops and livestock. It enhances the opportunities for crossbreeding and, thus, the development of superior strains. The availability of different strains was the key, for example, in developing new, disease-resistant barley.

Because of the interdependence of species within ecological communities, any particular species may have a value to the community far beyond its intrinsic value. Certain species contribute balance and stability to their ecological communities by providing food sources or holding the population of the species in check.

The richness of diversity within and among species has provided new sources of food, energy, industrial chemicals, raw materials, and medicines. Yet, considerable evidence suggests that biological diversity is decreasing.

Can we rely on the private sector to produce the efficient amount of public goods, such as biological diversity? Unfortunately, the answer is no! Suppose that in response to diminishing ecological diversity we decide to take up a collection to provide some means of preserving endangered species. Would the collection yield sufficient revenue to pay for an efficient level of ecological diversity? The general answer is no. Let's see why.

What is the efficient level of diversity? It can be determined by a direct application of our definition of efficiency. The efficient allocation maximizes economic surplus, which is represented geometrically by the portion of the area under the market demand curve that lies above the constant marginal cost curve. The allocation that maximizes economic surplus is the allocation where the demand curve crosses the marginal cost curve.

Why would a competitive market not be expected to supply the efficient level of public? Since the society gets very different marginal willingness to pay from the efficient allocation of this good, the efficient pricing system would require charging a different price to each consumer. Remember consumers tend to choose the level of the good that equates their marginal willingness to pay to the price they face. Yet the producer would have no basis for figuring out how to differentiate the prices. In the absence of excludability, consumers are not likely chosen to reveal the strength of their preference for this commodity. All consumers have an incentive to understate the strength of their preferences to try to shift more of the cost burden to the other consumers.

Therefore, inefficiency results because each person is able to become a free-rider on the other's contribution. A free rider is someone who derives the value from a commodity without paying an efficient amount for its supply. Because of the consumption indivisibility and non-excludability properties of the public good, consumers receive the value of any diversity purchased by other people. When this happens it tends to diminish incentives to contribute, and the contributions are not sufficiently large to finance the efficient amount of the public good; it would be undersupplied.

4. Common Property resources

Within the field of economics, common resources are generally referred to as common pool resources, common property resources, or common access resources — a type of good whose characteristics or size make them costly or difficult to regulate and exclude potential users from obtaining benefits from their use. Common pool resources typically contain a core resource (e.g., timber in a forest) from which a limited quantity of units can be extracted when the natural systems replenishing this resource are properly maintained and the resource is not degraded.

Economists generally categorize types of goods by their rivalry and their excludability. Since the core resources of common pool resources are subtractable and can be consumed to the point of overexploitation, common pool resources are considered rivalrous. Since it is difficult to exclude individuals from accessing using common pool resources, they are generally considered non-excludable. In contrast, private goods such as food and housing are considered rival and excludable, while public goods such as national defense or free music performances are non-rival and non-excludable. Common pool resources are often managed as impure public goods, open access resources, or private goods in an attempt to manage their availability of use to a specific group of individuals and prevent their overexploitation by users.

Common pool resources can be managed through a number of ownership protocols. They may be owned by national, regional, or local governments as public goods, or owned by individuals as private goods, and managed through law or formal rules of access. Alternatively, common pool resources can be owned and managed communally through a specific common property protocol. In order to manage common pool resources at the local level, communities can also attempt to develop the complex rules and strategies necessary to prevent overuse of the core resource by individuals and to allocate benefits derived from the core resource appropriately.

3.3 Correcting Market Failures

Due to the adverse effect of both negative and positive externalities on market efficiency, economists and policymakers intend to address the problem. The "internalization" of the externalities is the process of adopting policies that would limit the effect of the externalities on unrelated parties. Generally, the internalization is achieved through government intervention either through pricing or non-pricing regulations. Possible solutions include the following:

1. **Defining property rights**

The stricter definition of property rights can limit the influence of economic activities on unrelated parties. However, it is not always a viable option since the ownership of particular things such as air or water cannot be unambiguously assigned to a particular agent.

2. **Taxes**

A government may impose taxes on goods or services that create externalities. The taxes would discourage activities that impose costs on unrelated parties. It bears cost to firms and forces them to raise the price and thereby cut their production.

3. **Subsidies**

A government can also provide subsidies to stimulate certain activities. The subsidies are commonly used to increase the consumption of goods with positive externalities.

4. State intervention in the provision of public goods, merit goods, and to correct missing and incomplete markets for resources.

Exercises

1. While some economists argue for the creation of private property rights to protect the environment, many others concerned for the environment find this approach repugnant. What are the essential issues in this argument?
2. Suppose that a tannery that supplies semi-processed leather products for shoes factories is situated on a bank of the River Tekeze. The private total cost of the tannery for the production of semi-processed leather is $\mathbf{400Y + 0.75Y^2}$ birr per ton; where Y is tons of semi-processed leather produced. In addition to this private total cost, an extra external total cost is incurred since the tannery produces and damps its residuals into the river which causes damage valued at $\mathbf{100Y}$ birr per ton. This external cost is borne by the wider community but not by the polluting firm. The total benefit that the society can obtain from the production of the semi-processed leather product is $\mathbf{600Y - 0.25Y^2}$ birr per each ton (assume that, there is no an extra external benefit from the production process).

   A. Draw a diagram illustrating the marginal cost (MC), marginal benefit (MB), external marginal cost (EMC) and social marginal cost (SMC) functions.
   B. Suppose that there is no an extra external benefit that borne by the production process. Given this assumption, find the profit-maximizing output of leather.
   C. Find the output level which maximizes social net benefits.
   D. Is the socially efficient output lower or higher than the private profit maximization output level? Explain why?
   E. How large would marginal external cost have to be in order for it to be socially desirable that no semi-processed is produced?
3. Environmental economists argue that, ‘a clean environment is a public good whose benefits cannot be privately appropriated. Therefore private industry which is run for private gain will always be the enemy of a clean environment.’ Examine this proposition.
4. Discuss the causes, effects, and ways of correcting the market failure.
5. Explain in detail the relevance and application of the concept of externalities in environmental economics.