HS 229: Environmental Economics

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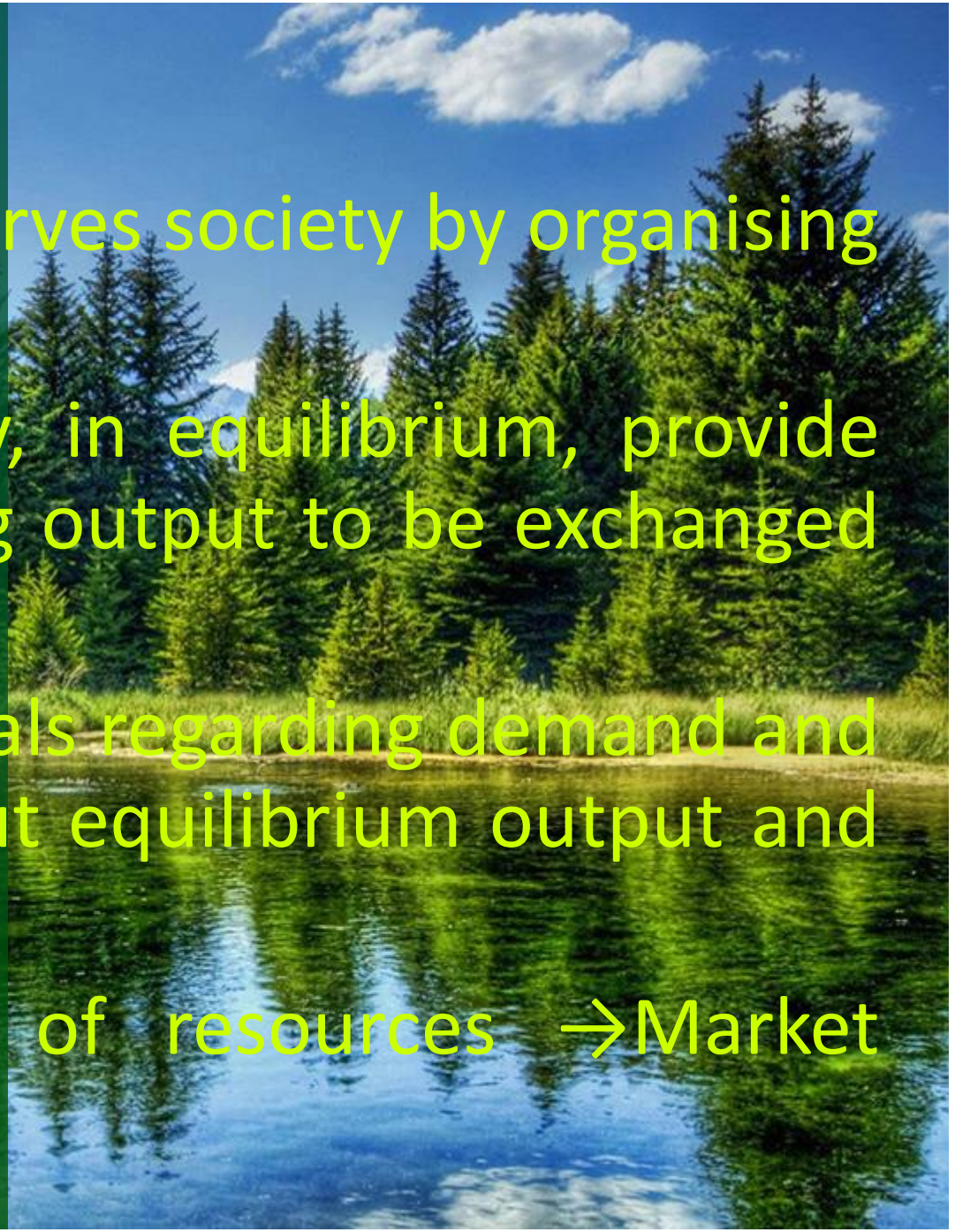
Market Failure

Markets

- An exchange institution that serves society by organising economic activity
- Forces of demand and supply, in equilibrium, provide signals through price regarding output to be exchanged in a market
- If market provides correct signals regarding demand and supply, then the decision about equilibrium output and price can be optimal
- Leads to optimal allocation of resources →Market success



Markets

- Market: Different types
  - Perfect Competition, Monopolistic Competition, Oligopoly, Duopoly, Monopoly

- Nature and functioning of these different markets vary considerably
- Number of sellers and nature of product determine type of market
- The success of a perfectly functioning market rests on a number of relevant issues

Market Success-Efficiency

- Market success-efficient allocation of resources
  - Allocative Efficiency
  - Also referred to as Pareto Efficiency (After Vilfredo Pareto, 1848–1923)

- **Pareto Efficient Allocation** – resources cannot be readjusted to make one consumer better off without making another worse off

- Pareto improvement

Market Failure

- When a set of competitive markets fail to generate an **efficient allocation** of resources between and within economies
- Resources could be reallocated to make at least one person better off without making any one worse off (Pareto improvement)
- Prices often understate the full range of services provided by an asset or simply do not exist to send a signal to the market place about the value of the asset
- For environmental assets market can fail if prices do not communicate society's desires and constraints accurately

Market Failure-Example

- Habitat destruction and threat to bio-diversity in Madagascar
- 4th largest island, bio-diversity hotspot but economically very poor
- Population: 2.89 crore (2021); GDP per capita: $1500
- Approx. 71% below poverty line (2012)
- Deforestation: @200,000 ha/yr.
- Economic cost of environmental degradation: $100-290 million (5-15% GDP)

Habitat Destruction and Biodiversity Loss

- Arises from several sources of market failure
  - Public ownership of large areas of land (open access regime and limited govt. capacity to manage land)
  - Insecure land tenure system
  - Many of the services are non-rival and non-excludable
- Bio-diversity in and of itself has no value reflected by market prices
- Commodity resources are valued on the market
- Pressure to harvest the commodity goods at the expense of bio-diversity

Sources of Market Failure

- Six cases of Market Failure:
  - *Incomplete Markets*
  - *Externalities*
  - *Non-exclusion*
  - *Non-rival and Public Goods*
  - *Non-convexities*
  - *Asymmetric information*

Incomplete Market

- Markets are complete when enough markets exist to cover each and every possible transaction or contingency so that resources can move to their highest valued use
- A complete market requires a set of well-defined property rights system
- **Property rights system**: *a set of entitlements that define the owner's privileges and obligations for use of a resource or asset*

Property Rights

- A well-defined property Rights system has the following key characteristics:
  - *Comprehensively Assigned:* all resources or assets should either be privately or collectively owned
  - *Exclusive:* all benefits and costs should accrue to the owner only either directly or by sale to others
  - *Transferable:* from one owner to another in a voluntary exchange
  - *Secure:* from involuntary seizure or encroachment by other individuals, firms or the government

INCOMPLETE MARKET

- Property rights in case of
  - Air
  - Rivers, etc.

EXTERNALITY

- One of the prominent reasons for market failure
- Normally actions or decisions by one individual agent does not directly affect anybody else
  - For example: purchase of shoes
- Some other actions affect others directly
  - For example: driving near hospital (harmful effects)
  - Inoculation of children (beneficial effects)

An externality is defined as an action by one individual agent that provides benefits or costs affecting other individual agents

EXTERNALITY

- Decision makers do not take into account the cost imposed on society and others as a result of their decision
  - e.g. pollution, traffic congestion, environmental degradation, depletion of the ozone layer, etc.

EXTERNALITY

- Two Types of Externality:
- Positive and Negative
  - Positive: when action of individual agent has beneficial effects
  - Examples:
    - Vaccination
    - Flower gardens
    - Production of Honey

EXTERNALITY

- Negative: when action has negative effects on the agents
  - Examples:
    - Playing of loud music at 4 a.m.
    - Riding on a noisy motor cycle
    - Smoking in a public place
    - Dumping of waste in a river by a paper mill

EXTERNALITY

Externality - the Problem:

- A.C. Pigou in his book titled *Wealth and Welfare* (1912) dealt with the problem of Externality systematically for the first time.
- Overall economic efficiency requires that:

  MSB = MSC

  where,

  MSB = MPB + MEB

  MSC = MPC + MEC

MSB = Marginal Social Benefit
MSC = Marginal Social Cost
MPB = Marginal Private Benefit
MPC = Marginal Private Cost
MEB = Marginal External Benefit
MEC = Marginal External Cost

- If, MSB>MSC, Output can be expanded because additional output adds more benefits to the society than the cost.
- In a situation when MSB≠MSC, the optimal condition of efficiency can be obtained through imposition of Tax and Subsidy

Why is externality a problem?

- An externality implies:

  Social Cost $\neq$ Individual Cost

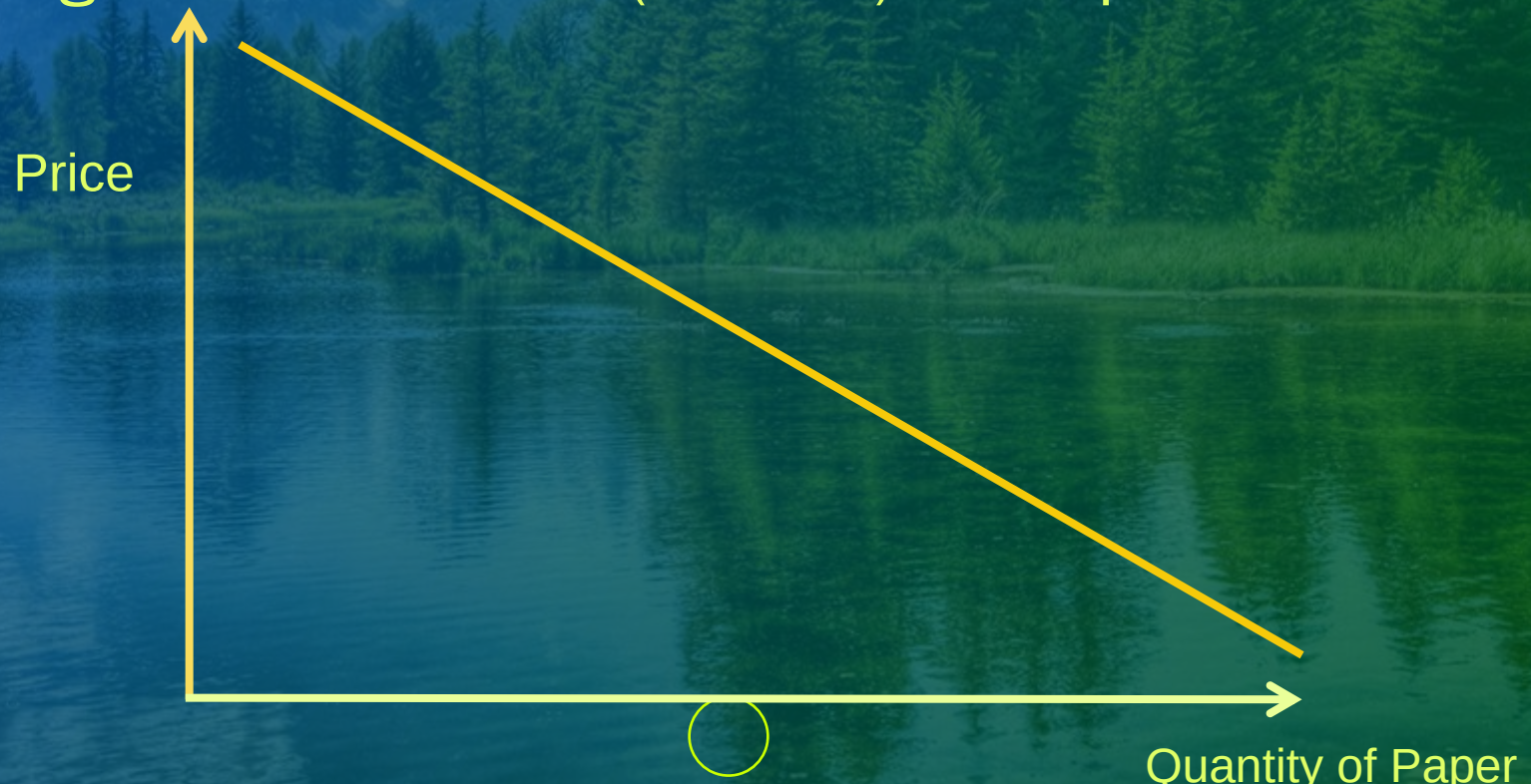
  Social Benefit $\neq$ Individual Benefit

- The incentives for the individual are **not** what society wants them to do
- As a result:
  - too much of socially costly goods are produced
  - too little of socially beneficial goods are produced

An Example : One Polluting Supplier of Paper

Demand for Paper

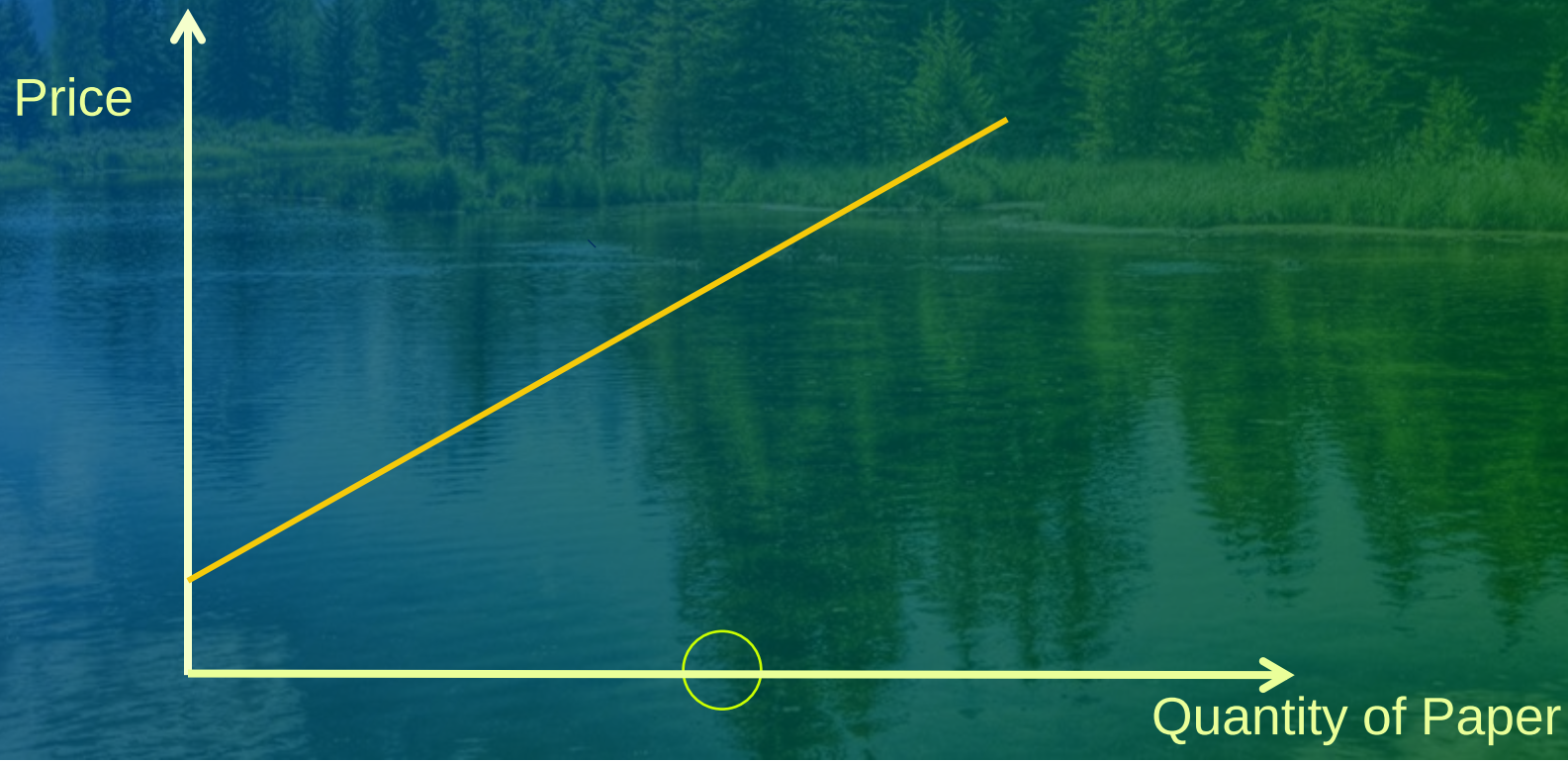
= Marginal Social Value (Benefit) for Paper



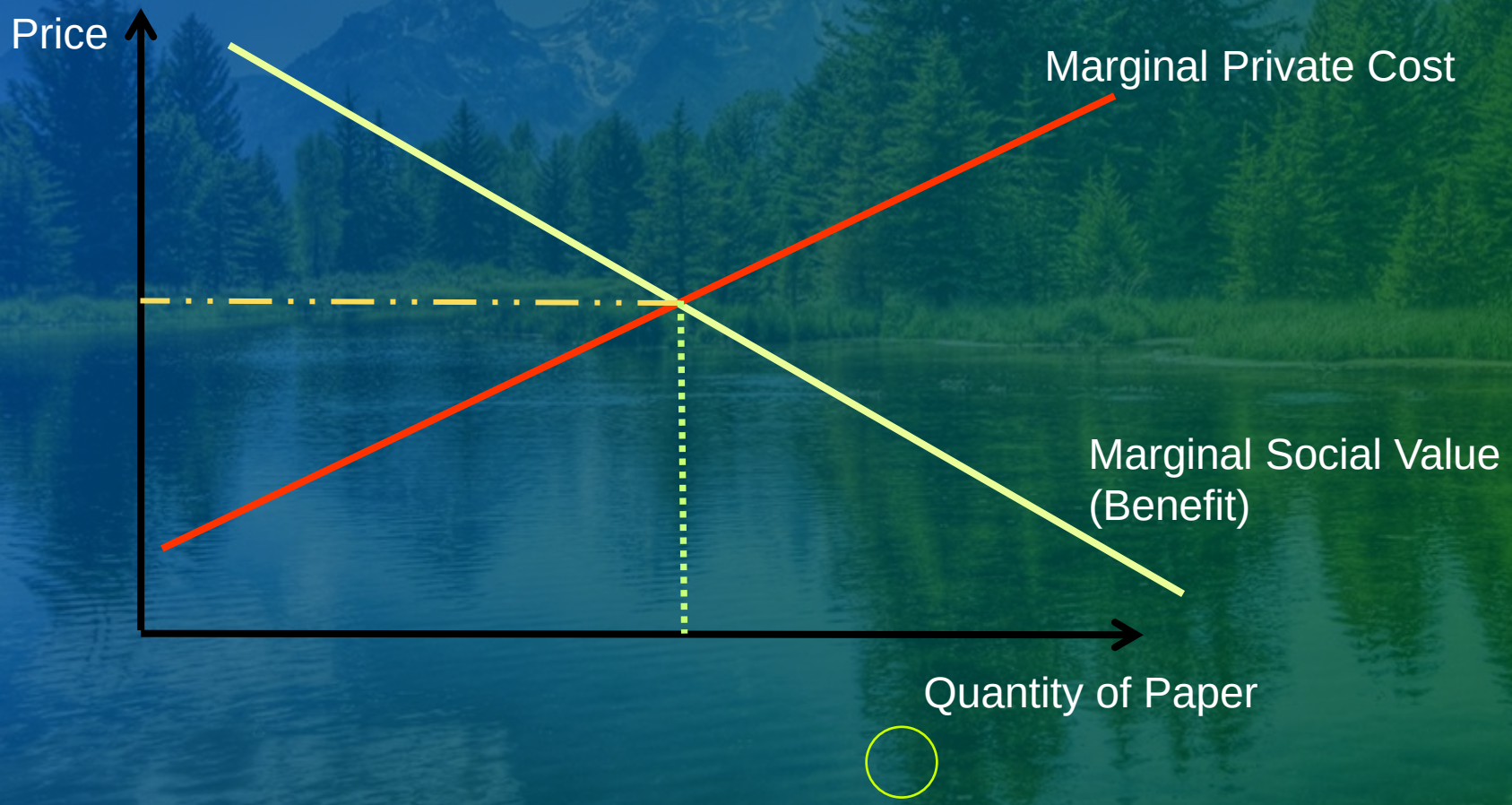
An Example : One Polluting Supplier of Paper

Supply of Paper

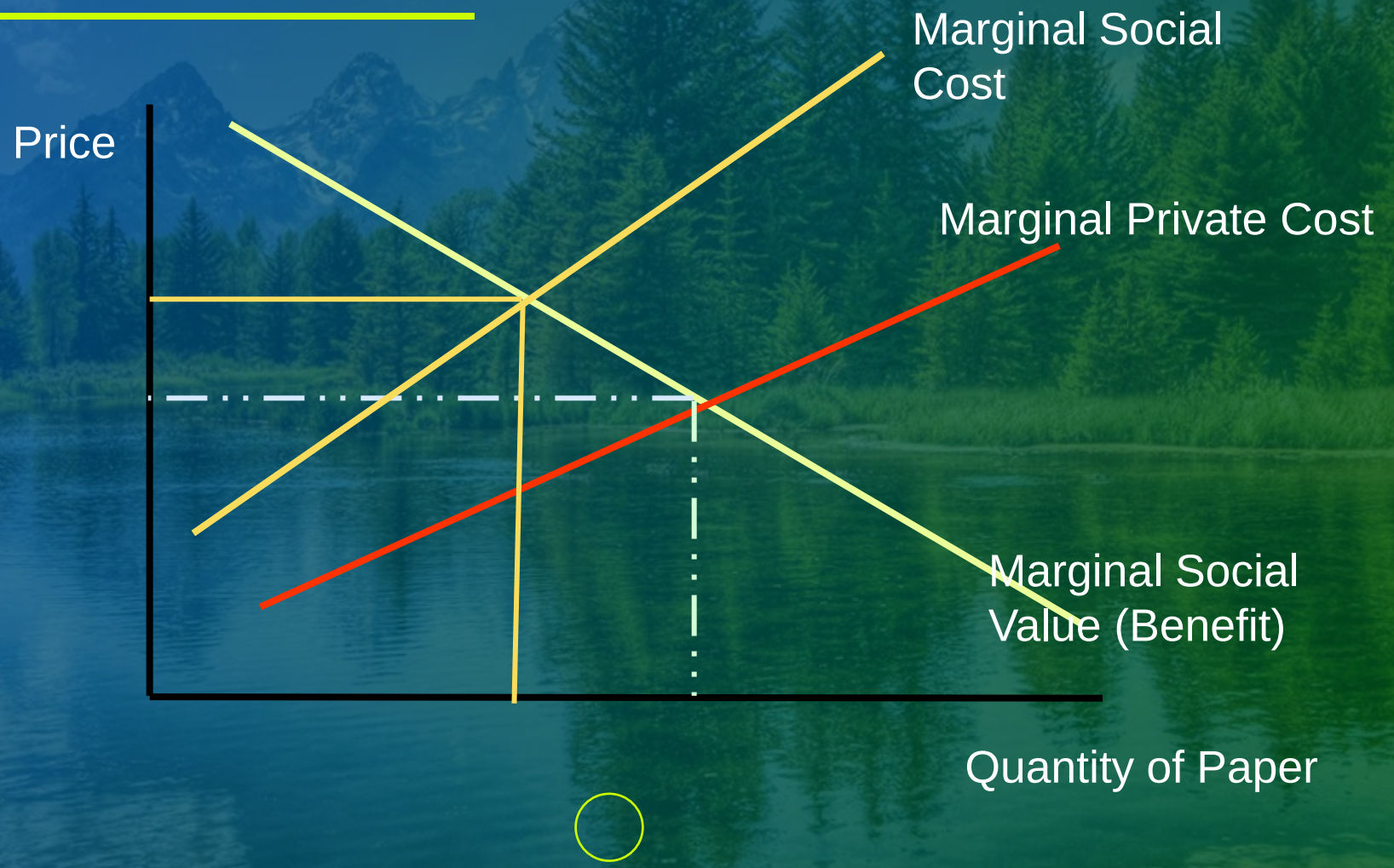
= Marginal Private Cost for Paper



Private Equilibrium determined by private costs and demand



Suppose the social costs of paper production were higher than the private costs (a negative externality)



Consequences

- Too much of paper is produced
- The price of paper is too low and does not reflect its true costs of production

So,

- Who gains here?
- What are the monetary values of the costs imposed on society?

EXTERNALITY: PRODUCTION AND CONSUMPTION

Negative Externality in Production

Figure 1: Negative Externality in Production

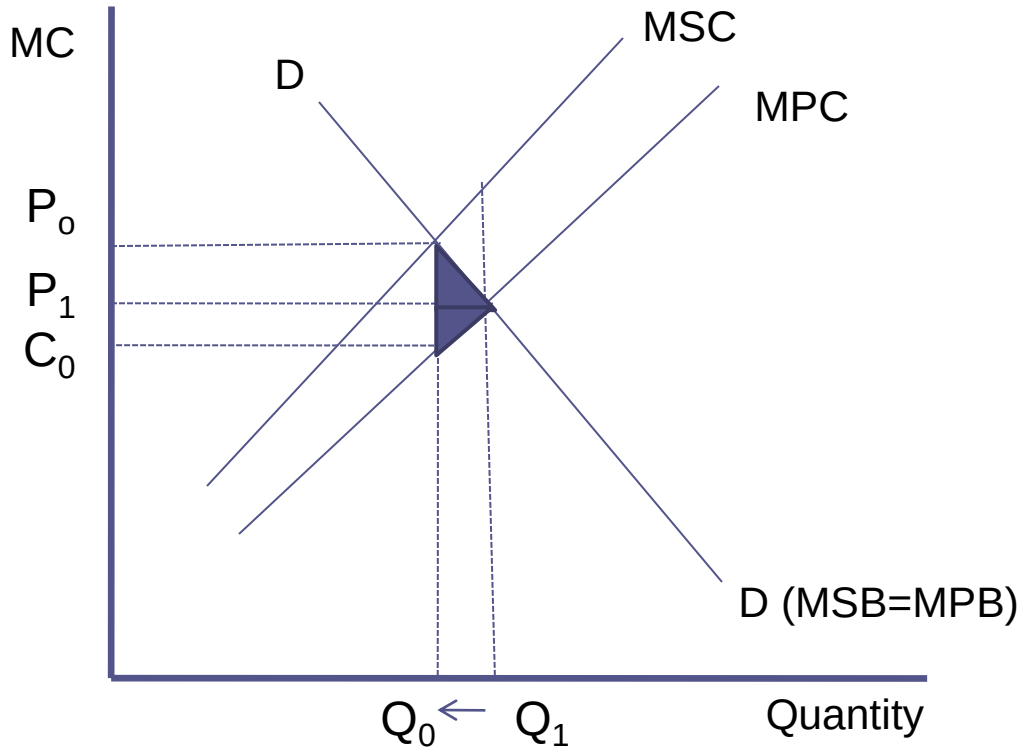


Fig. 1 illustrates negative externality in Production (MSC>MPC)

Assuming no externalities in consumption, DD shows MSB and MPB (MSB=MPB)

With MSC the optimal output produced is Q_0 corresponding to Price P_0 (where MSC=MSB)

EXTERNALITY: PRODUCTION AND CONSUMPTION

- The Competitive Market (when left alone) produces Q_1 with a price P_1 - there is a tendency to overproduce.
- At Q_0 the Price is P_0 but the MPC is C_0
- Therefore the Govt. can levy a per unit tax of (P_0 - C_0) which in turn will increase MPC by (P_0 -C_0) and reduce output from Q_1 to Q_0
- At $Q_{0,}$ the consumers would pay $P_{0,}$ the full marginal social cost of Production.

EXTERNALITY: PRODUCTION AND CONSUMPTION

- The extra revenue earned from taxation can be used for external damage from production of this product.

- The tax revenue could be more or less than the external damage

- The tax revenue is equal to $(P_0 - C_0) \times Q_0$ whereas the total external cost would be equal to area between MSC and MPC
- The Net Gain to the Society is equal to $\sum$(MSC-MSB) over Q_0 to Q_1 (the shaded area) which is eliminated by tax.

EXTERNALITY: PRODUCTION AND CONSUMPTION

Positive Externality in Production

Figure 2: Positive Externality in Production

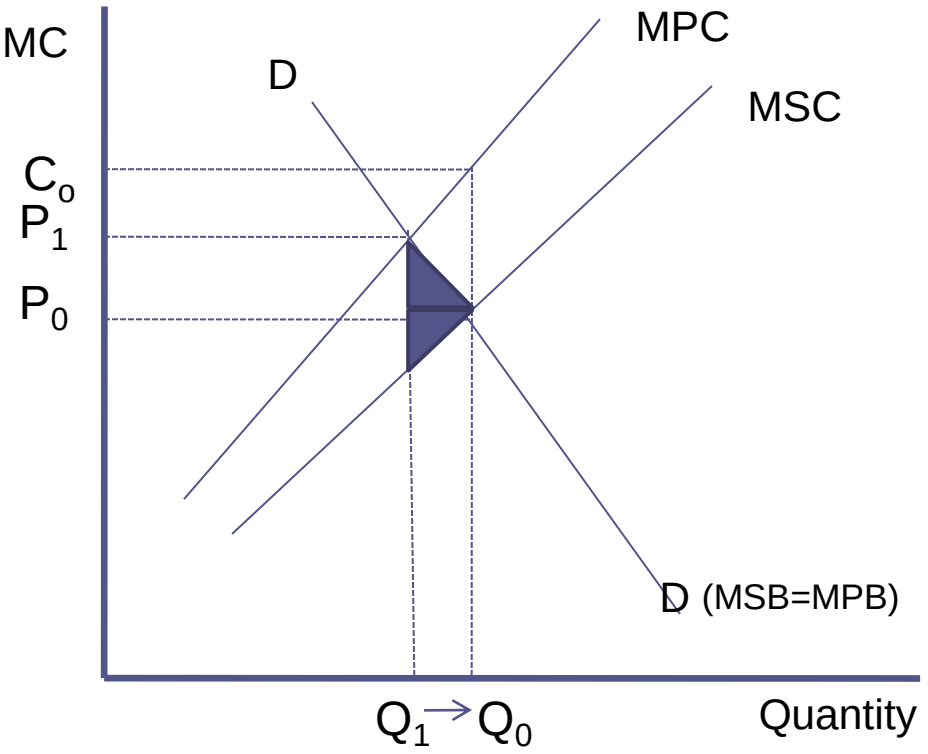


Fig 2 illustrates positive externality in Production (MSC<MPC)

Assuming no externalities in consumption, DD shows MSB and MPB (MSB=MPB)

With MSC the optimal output produced is Q_0 corresponding to Price P_0 (where MSC=MSB)

EXTERNALITY: PRODUCTION AND CONSUMPTION

The Competitive Market (when left alone) produces Q_1 with a price P_1 where DD intersects MPC, under production from social point of view

At Q_0 the Price is P_0 but the MPC is C_0

Therefore to produce more output (from Q_1 to Q_0) the Govt. has to provide a subsidy of (C_0-P_0)

At Q_0 the consumers would pay P_0 {Or (C_0-P_0)}.

EXTERNALITY: PRODUCTION AND CONSUMPTION

Govt. could collect the money from people reaping the external benefits

The expenditure on subsidy could be more or less than the external benefit

The Net Gain to the Society is equal to $\sum$(MSB-MSC) over Q_1 to Q_0 which is obtained through subsidy.

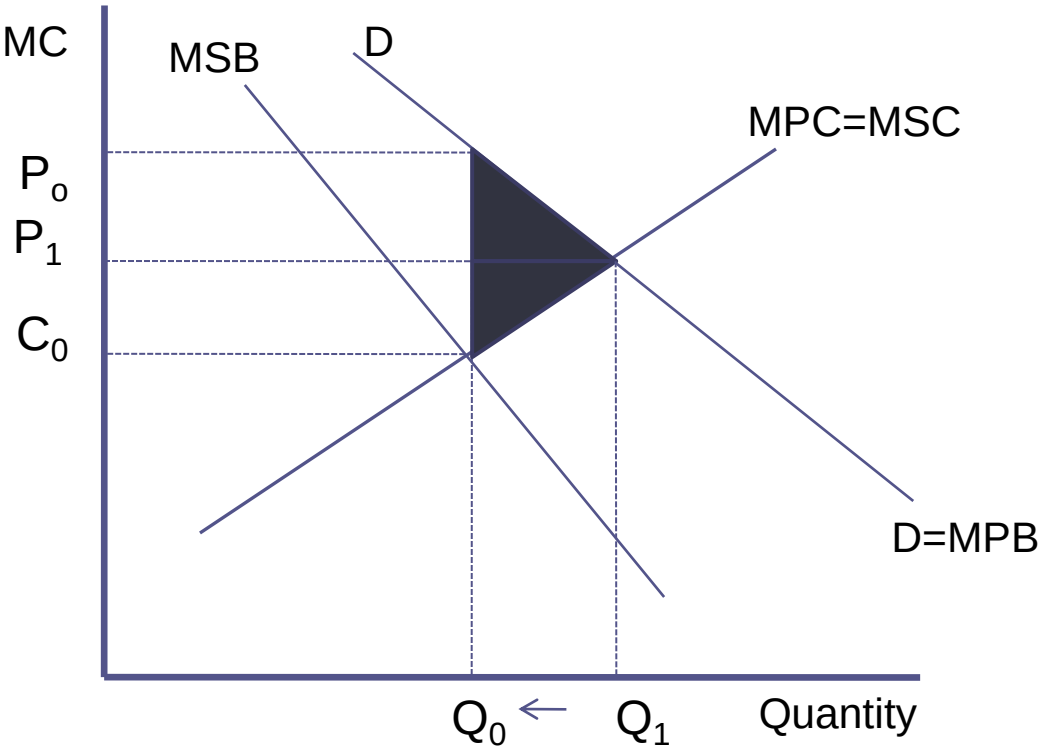
EXTERNALITY: CONSUMPTION

Externality in Consumption: Negative and Positive

Figure 3: Negative Externality in Consumption

Fig. 3 illustrates negative externality in Consumption (MPB>MSB)

Assuming no externalities in production (MSC=MPC)



The optimal quantity is given by Q_0 (the point where MSB=MSC)

EXTERNALITY: CONSUMPTION

In the absence of any intervention, the quantity supplied and produced is Q_1 with a price P_1

At Q_1 there is overproduction of the commodity compared to social optimality

To restrict the output to Q_0, the price has to be increased to P_0

But the supply price for Q_0 is C_0

Hence a tax equal to (P_0 - C_0) needs to be levied

EXTERNALITY: CONSUMPTION

The price consumers pay is P_0 (=MPC + Cost of Externality in Consumption)

The revenue generated from the tax on consumption could be used to compensate those who are hurt by the external cost arising from the consumption of the product

The shaded area measures net benefit of the tax policy.

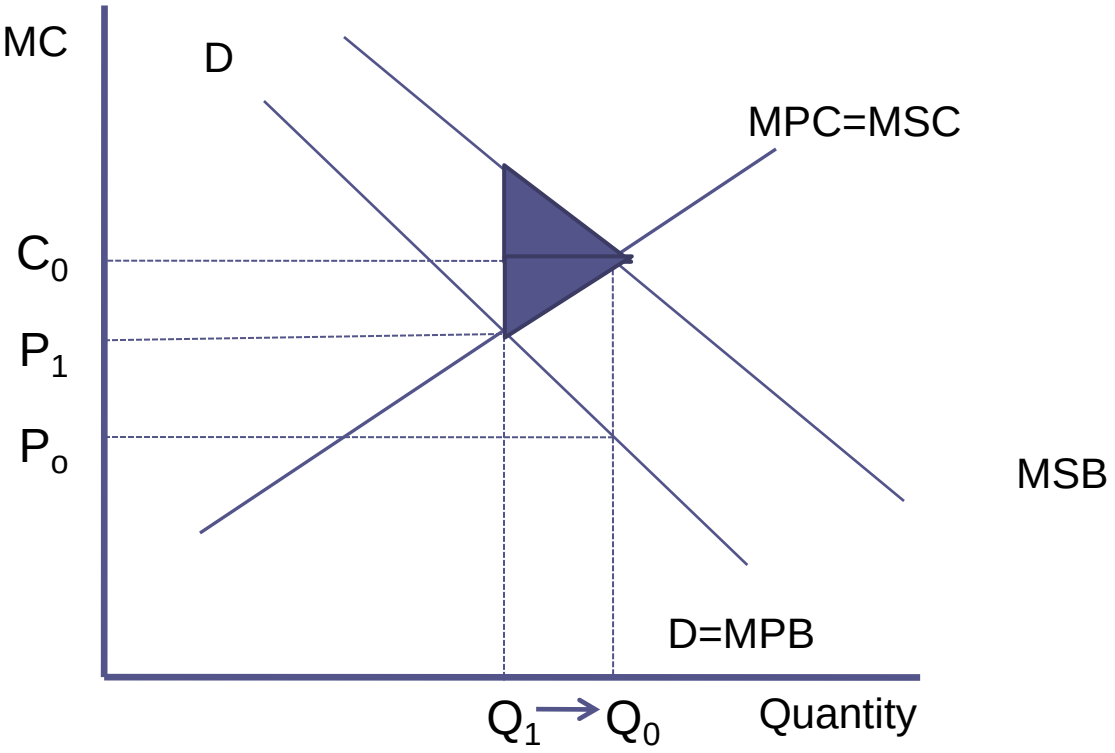
EXTERNALITY: PRODUCTION AND CONSUMPTION

Externality in Consumption: Negative and Positive

Figure 4: Positive Externality in Consumption

Fig. 4 illustrates positive externality in Consumption (MPB<MSC)

Assuming no externalities in production (MSC=MPC)



The optimal quantity is given by Q_0 (the point where MSB=MSC)

EXTERNALITY: PRODUCTION AND CONSUMPTION

In the absence of any intervention, the quantity supplied and produced is Q_1 with a price P_1
At Q_1 there is underproduction compared to socially optimal level

To produce output Q_0, the price is P_0 But the supply price for Q_0 is C_0

Hence a consumers need be given a subsidy equal to (C_0 - P_0)

The price consumers pay is P_0 the producers get C_0

EXTERNALITY: PRODUCTION AND CONSUMPTION

At least part of the cost of the subsidy $(C_0 - P_0) \times Q_0$ could be collected from those reaping external benefits arising from the consumption of this good

The shaded area measures net benefit to the society from the subsidy. It's the (MSB-MSC) for the output range Q_1 to Q_0

EXTERNALITY: PRODUCTION AND CONSUMPTION

Summary:

1. In the presence of externalities, the socially optimal level of output (Q_0 in our example) is given by the condition MSB=MSC
2. The private production of output Q_1 is given by the condition MPB=MPC
3. To bring output level to the socially desirable level, ($Q_{0)}$ tax and subsidy programs can be used as shown in Table-1.

Table 1: Taxes and Subsidies in the presence of Externalities

Condition	Tax or Subsidy	Amount of Tax or Subsidy*
MSC>MPC	Tax Producers	MSC – MPC
MSC<MPC	Subsidize Producers	MPC – MSC
MSB<MPB	Tax Consumers	MPB – MSB
MSB>MPB	Subsidize Consumers	MSB - MPB

**These amount are measured at the socially optimal level*

EXTERNALITY: THE COASE THEOREM

- Ronald Coase (1960) challenged Pigou's main proposition that govt. should intervene through taxes and subsidies in the presence of externalities

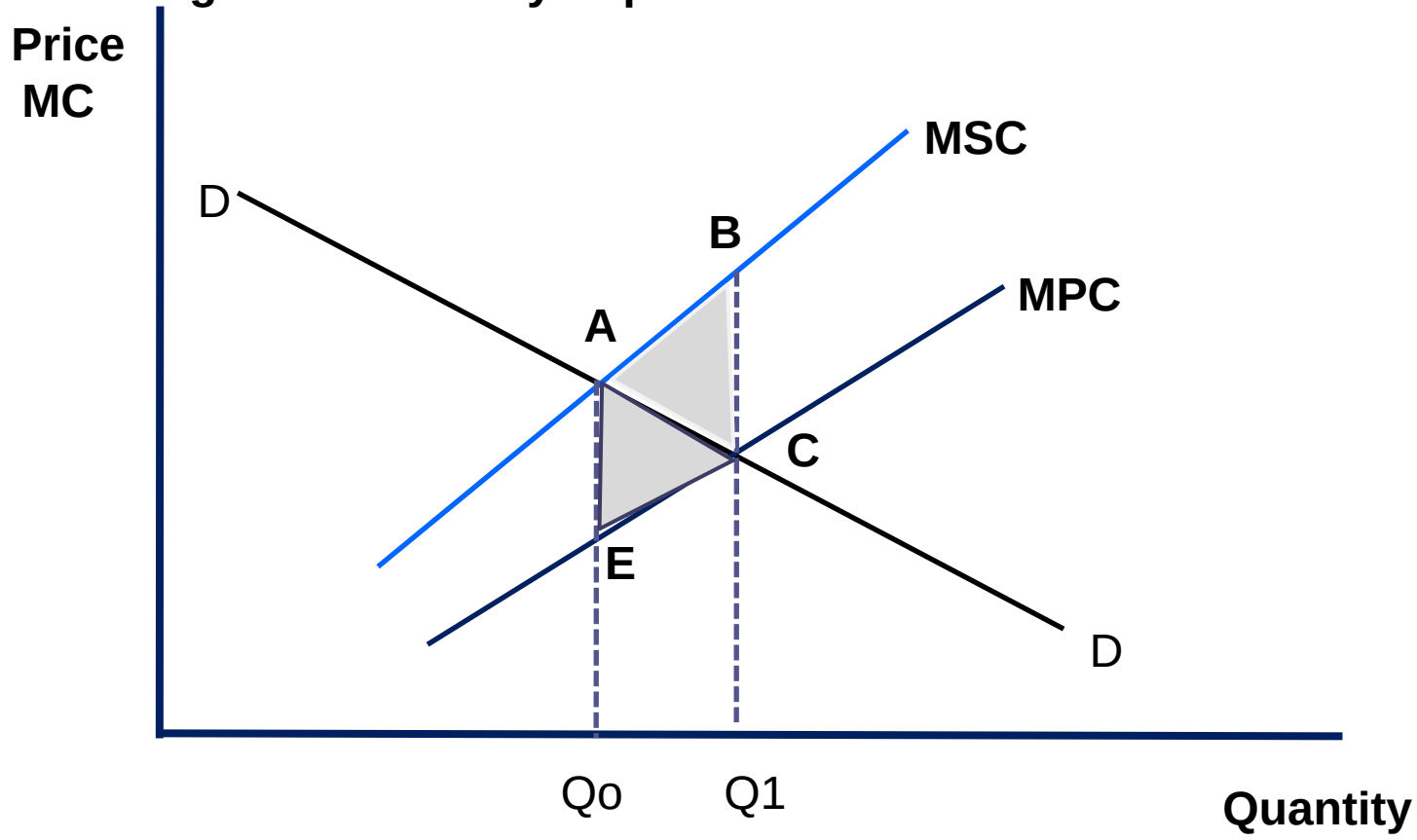
- According to Coase, since administering of taxes or subsidies cost something, if these costs are higher than the social benefits from intervention (shown by the areas of the triangles in figures 1 to 4) then govt. intervention will not increase social welfare

- Secondly, Coase argued that the same result that govt. seeks to achieve through taxes or subsidies can also be attained through private deals (Consider figure 5)

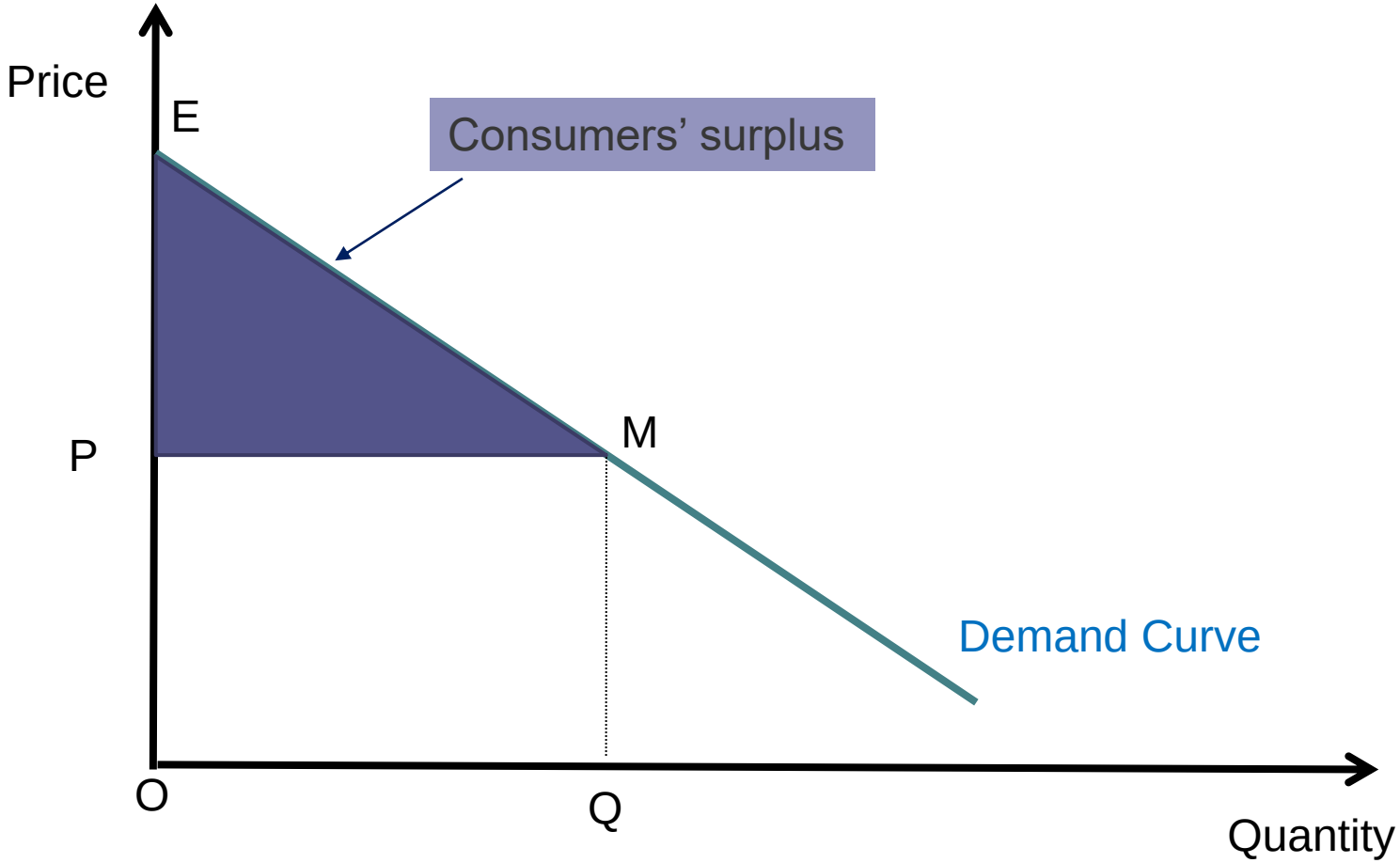
EXTERNALITY: THE COASE THEOREM

Example: The Paper Mill dumping waste in a river and thus hurting the fishing

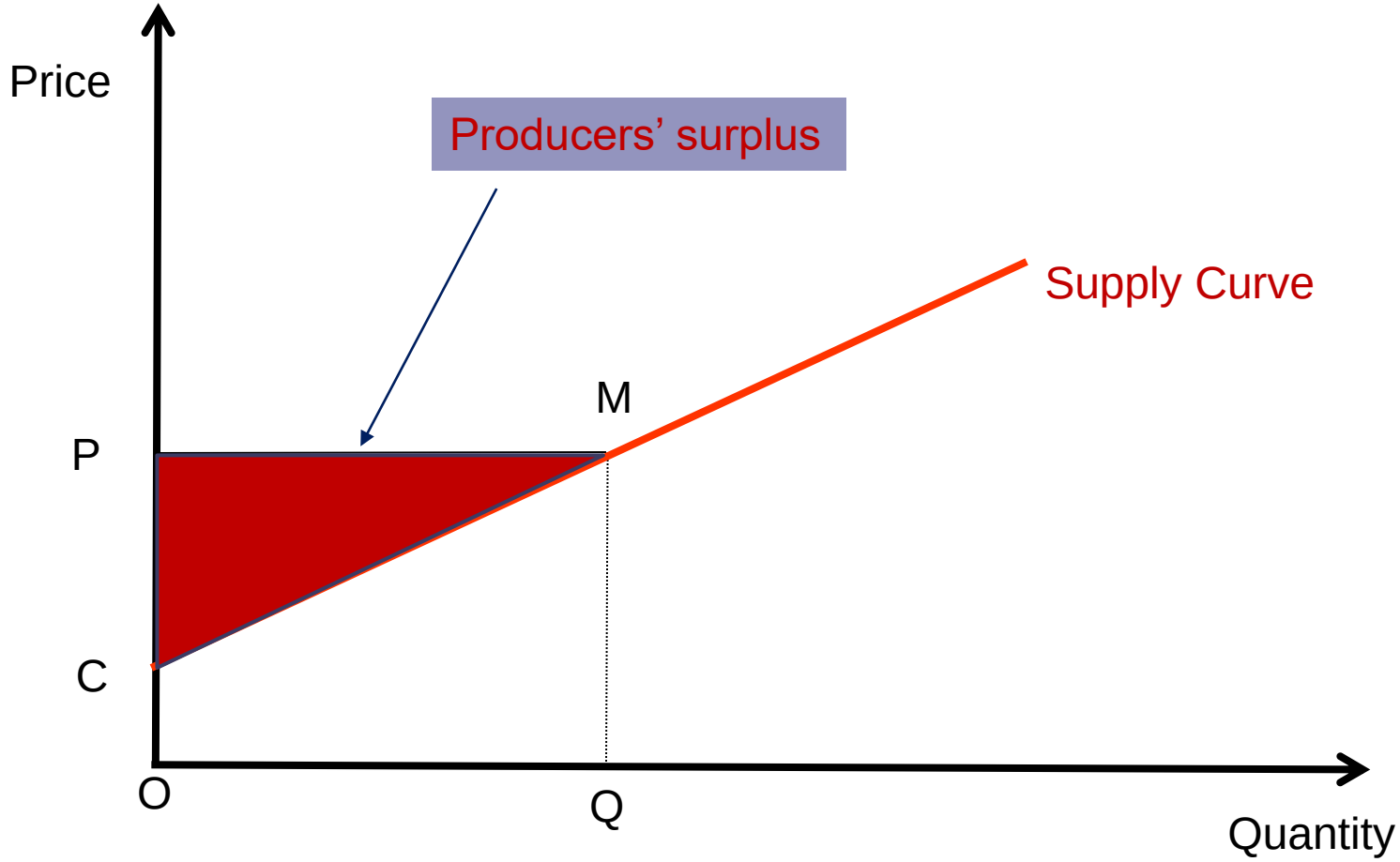
Figure: Possibility of private deals under externalities



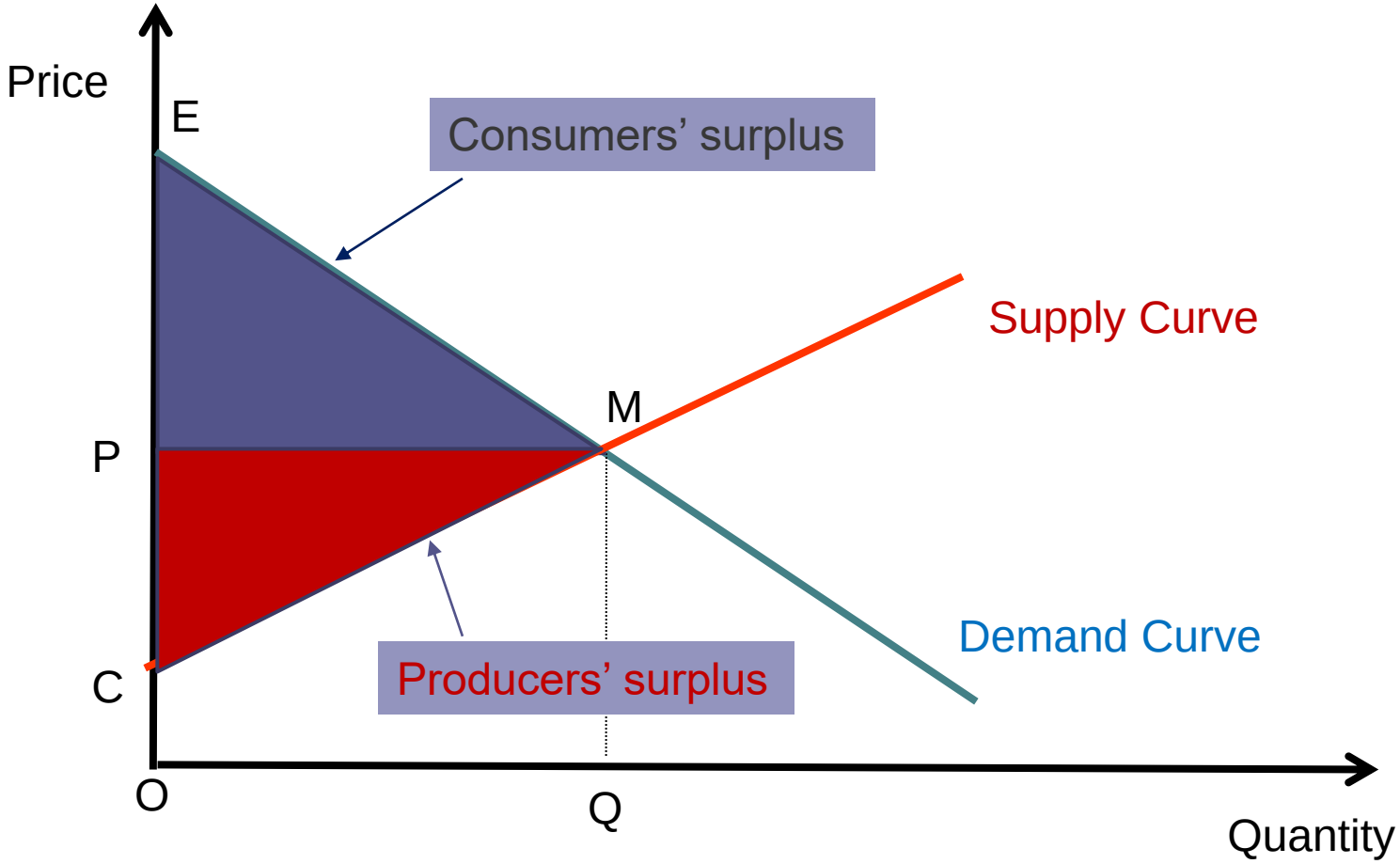
Consumers' Surplus



Producers' Surplus



Consumers' and Producers' Surplus



EXTERNALITY: THE COASE THEOREM

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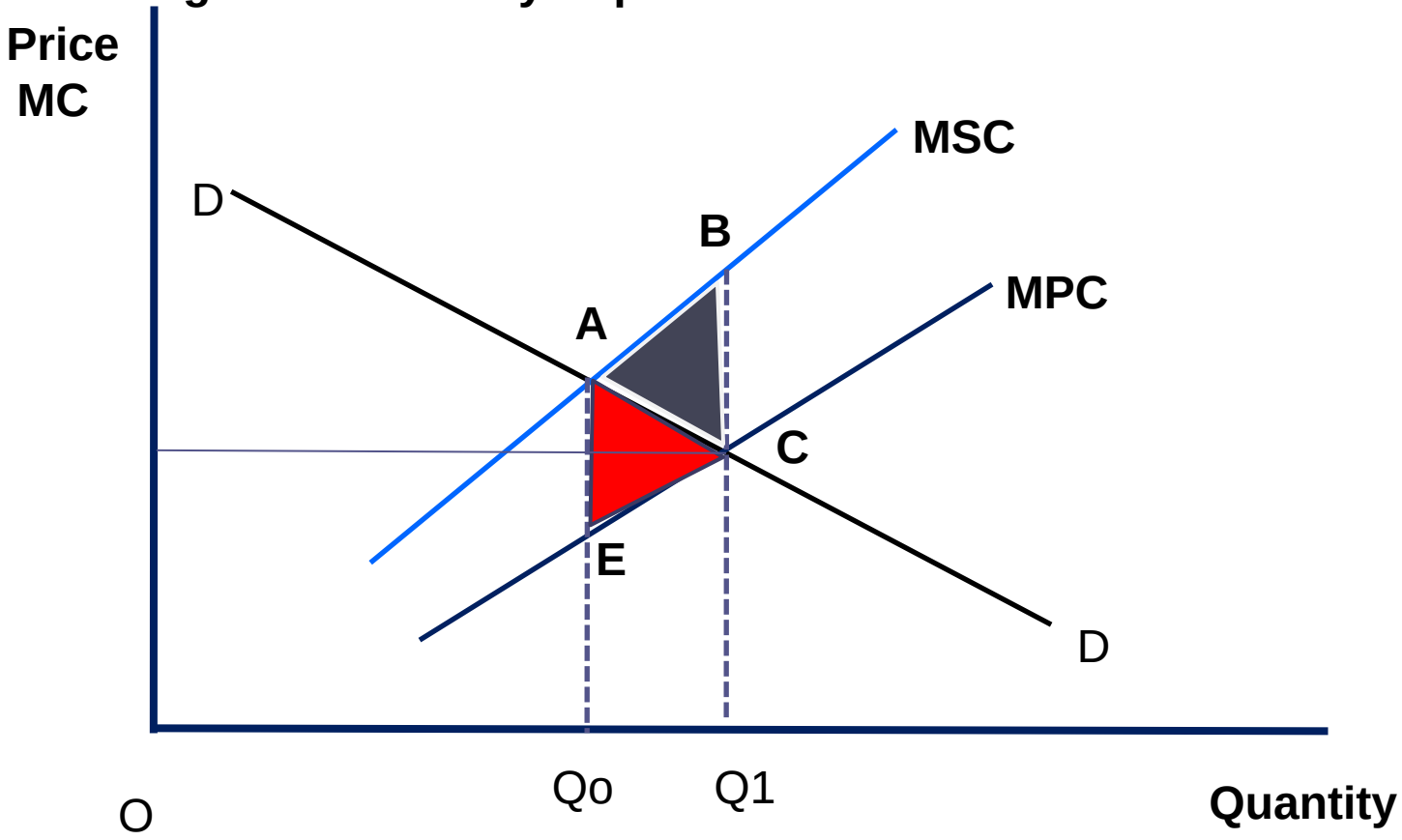

EXTERNALITY: THE COASE THEOREM

In figure 5. Q_0 is the socially optimal output while the competitive market produces Q_1

If the paper mill reduces output from Q_1 to Q_0 the net loss in the producer's and consumer's surplus is ACE (shaded in orange) but the gain to the fishers is ABCE (the excess of MSC over MPC for the output range Q_0 to Q_1).

Since ABCE>ACE so that gain to the fishers is larger than the loss to the consumers and producers, there is the possibility for the fishers to bribe the producers and consumers to cut production to Q_0.

Thus, this proves that socially optimal level of output could be achieved without government taxing or subsidizing.

EXTERNALITY: THE COASE THEOREM

If the number of people involved is large, the bargaining costs will be high

Assignment of property rights to any party also does not make any difference to the allocation of resources
In our example, if property rights to the river were assigned to the fishers, the paper mill would have to pay the fishers compensation for dumping the waste in the river equal to (MSC-MPC) per each unit in fig.
The paper mill, thus, would have to take the costs of compensation in to account when calculating its costs.
Thus the externality has been internalized.

EXTERNALITY: THE COASE THEOREM

Coase Theorem: *Under Perfect Competition, if income effects and transaction costs are ignored, voluntary agreements among the different parties concerned will lead to a socially optimal output even in the presence of externalities, and the result will be the same regardless of which party is assigned the property rights to the contestable resource.*

NON-EXCLUSION

- Another reason for Market Failure
- Implies a situation when it is impossible or at least very costly to deny access to an environmental asset
- In the presence of non-exclusion, but with rivalry in consumption user finds incentive to capture the goods as soon as possible before anyone else captures them
- Over-use of resource as the market fails to signal true scarcity value of the asset
- The problems of non-exclusion implied by such open access property rights have long been recognized
  - Popularized by Hardin (1968)- “The Tragedy of the Commons”

NON-EXCLUSION

Concepts:

Commons: Refers to the environmental resources itself

Common Property Resources: refers to a property right regime that allows members of a group or collective body to use the asset and devise rules to exclude non-members from using the resource.

Open Access Resources: Implies there is no ownership of the asset in the sense that "everybody's property is nobody's property".

PUBLIC GOODS

- An environmental asset is considered a pure public good if its consumption is non-rival and non-excludable
- Paul Samuelson-1950s
- Non-rival- good is available to all and one person's consumption does not reduce another person's consumption
  - The marginal cost of supplying the good to an additional individual is zero

- It is not Pareto efficient to set prices that will exclude anyone who derives positive marginal benefits from the public, hence, market failure occurs.

Public Goods-Examples

Type of Goods	Exclusive	Non-Exclusive
Rival	Most Goods	Online computer services
	Mobile Handsets	Fishing
	Shoes	Congested Highways
Non-Rival	When not in capacity: Airline Seats	Pure Public Goods
		National Defence
		Streetlights

PUBLIC GOODS

- Pure public goods - the problem of free riding
- A free rider is one who conceals his or her preferences for the good in order to enjoy benefits without paying for them
- In the presence of free-ride, market will provide less of public good than is socially desired resulting in misallocation of resources

NON-CONVEXITIES

- Convexities associated with environmental bads (e.g. pollution):
  - results from the assumption that marginal benefits and cost functions are well behaved: i.e. marginal benefits are decreasing while marginal costs are increasing
  - implies that if an equilibrium level of pollution exists, it is unique
  - therefore, if a set of complete markets exists for water or pollution control, the market will send the correct signal about the socially optimal level of pollution.

NON-CONVEXITIES

- In real situation, for many physical systems the marginal benefit or cost curve need not be so well behaved as assumed by convexities

- Marginal costs may at first increase with increased pollution but then may actually decrease or go to zero as the physical system is so badly damaged that there are simply no more costs as pollution costs as pollution increases

NON-CONVEXITIES

- Thus Non-convexities implies that there may be more than one locally optimal level of pollution

- In the presence of non-convexities, market fails to send correct signal about the socially optimal level of pollution

ASYMMETRIC INFORMATION

- Asymmetric Information arises when there exists differences of information among the agents/parties involved in a transaction.

- Examples:
  - *When an insuree knows more about his precautionary behaviour than the insurer*

  - *Seller knows more about the quality of a product than a buyer*

ASYMMETRIC INFORMATION

- Two types of Asymmetric Information: Moral Hazard and Adverse Selection

- **Moral Hazards:** the *moral hazards or incentive problem* arises when the actions of one person is unobservable to a second person.

- **Adverse Selection:** the *adverse selection* problem exists when one person can not identify the type or character of the second person.

ISSUES WITH MORAL HAZARD

- Shirking on pollution abatement
- An insurer will withdraw from the pollution liability market.

ISSUES WITH ADVERSE SELECTION

- May be a problem for development of eco-products
- Eco-products: More expensive due to lack of scale economies
- If consumers fail to distinguish between ordinary products and eco-products, there is every likelihood of the producers withdrawing from eco-product market
- So, eco-product market collapses

Texts:

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Anindya Sen, Microeconomics, Theory and Applications, (2nd Ed.), Oxford University Press, 2006

J. Hanley, F. Shogren and B. White, *Environmental Economics: In Theory & Practice,* 2nd Revised edition, Palgrave MacMillan, 2006

THANK YOU!