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Market failures: Externalities
(Myles ch. 10. sections 4.4, 5, 7.2 & 7.3 excluded)

Introduction

- Connection between agents outside the price system
- The level of externality then is not controlled directly by price
- The standard efficiency theorems cannot be applied
- Market failure raises a role for correction through policy intervention
- Several applications: environmental issues

Outline

- Definitions
- Proof of the failure of an unregulated economy to reach the efficient outcome
- Missing markets: Coase theorem
- Corrective intervention: Pigouvian taxes
- Tradable licenses and the value of internalisation

Definition (1)

- According to its effects or to the reason for its existence:
- Effects: An externality is present whenever some economic agent's welfare (utility or profit) includes real variables whose values are chosen by others without particular attention to the effect upon the welfare of the other agents they affect.
- Production externality and consumption externality
- Positive or negative
- Problems with this definition: dependence upon institutional context (barter or competitive economy)

Definition (2)

- Existence: An externality is present whenever there is an insufficient incentive for a potential market to be created for some good and the nonexistence of this market leads to a non-Pareto optimal equilibrium.
- Emphasis on missing markets
- The externalities it identifies will be a subset of those identified by the first, however in most cases the two definitions will delineate precisely the same set of effects as externalities
- We will use the first definition

Representation

The utility functions take the form

- $U^h = U^h (x,y)$, h = 1,...,H,
- and the production set is described by
- $Y^j = Y^j(x,y)$, j=1,...,m.
- The utility functions and the production sets are dependent upon the entire arrays of consumption and production vectors.
- The optimal choices of each agent will depend upon the actions of others
- The economy may well have a competitive equilibrium, but this may not be Pareto optimal

Market inefficiency

- Two household economy with utility functions: $U^1 = U^1\left(x_1^1, x_2^1, x_1^2\right)$, $U^2 = U^2\left(x_1^2, x_2^2, x_1^1\right)$.
- The externality effect is generated by consumption of good 1 by the other household.
- The externality will be positive if U^h is increasing in x^j_1, h different from j, and negative if decreasing.

Supply side

- Supply of good 2 comes from an endowment to the households, good 1 is produced from good 2 by a competitive industry that uses one unit of good 2 to produce one unit of good 1.
- Normalising the price of good 1 at one, the structure of production ensures that the equilibrium price of good 2 must also be one.
- Given this, all that needs to be determined for this economy is the division of the initial endowment into quantities of the two goods.

Competitive equilibrium

Standard assumption: while maximising both households take the level of externality as given.

Incorporating this assumption into the maximisation decision of the households, the competitive equilibrium of the economy is described by the equations

$$\frac{\frac{\partial U^h}{\partial x_1^h}}{\frac{\partial U^h}{\partial x_2^h}} = 1, \ h = 1, 2, \tag{10.5}$$

$$x_1^h + x_2^h = \omega_2^h, \quad h = 1, 2, \tag{10.6}$$

and

$$x_1^1 + x_1^2 + x_2^1 + x_2^2 = \omega_2^1 + \omega_2^2. \tag{10.7}$$

Ratio of private benefits equal to ratio of private costs: effect of externality does not appear directly

Pareto optimal allocation

$$\max_{\{x_i^h\}} U^1\left(x_1^1, x_2^1, x_1^2\right) \text{ subject to } U^2\left(x_1^2, x_2^2, x_1^1\right) \geq \overline{U}^2,$$

$$\text{and } \omega_2^1 + \omega_2^2 - x_1^1 - x_1^2 - x_2^1 - x_2^2 \geq 0. \qquad (10.8)$$

Denoting the Lagrange multiplier on the first constraint by μ, the solution is characterised by the conditions

$$\frac{\frac{\partial U^1}{\partial x_1^1}}{\frac{\partial U^1}{\partial x_2^1}} + \mu \frac{\frac{\partial U^2}{\partial x_1^1}}{\frac{\partial U^1}{\partial x_2^1}} = 1, \qquad (10.9)$$

and

$$\frac{\frac{\partial U^2}{\partial x_1^2}}{\frac{\partial U^2}{\partial x_2^2}} + \mu^{-1} \frac{\frac{\partial U^1}{\partial x_1^2}}{\frac{\partial U^2}{\partial x_2^2}} = 1. \qquad (10.10)$$

- Comments: positive or negative externalities make Pareto optimum differ from competitive allocation
- Not necessarily true that with negative (positive) externality the comp. eq. produces too many (few) goods

Pareto irrelevant externalities

- There are some specific cases (preferences) in which externalities do not cause the failure of efficiency of the competitive equilibrium:

$$U^h = x_1^h x_2^h \left[x_1^j x_2^j \right]^{\rho^h},$$

- Where the term in brackets captures the externality effect. Prove it as an exercise.
- More in general, this irrelevance holds for preferences of the kind

$$U^h = U^h \left(f^1 \left(x^1 \right), f^2 \left(x^2 \right), \ldots, f^H \left(x^H \right) \right).$$

- The result arises because the externality effects exactly offset each other when the optimal allocation is determined.

The Coase theorem

- It provides those situations in which market activities will eliminate the effects of externalities and suggests new perspectives on why market solutions to externalities may fail and appropriate policy responses.
- Theorem (never formalised by Coase)
- "In a competitive economy with complete information and zero transaction costs, the allocation of resources will be efficient and invariant with respect to legal rules of entitlement".
- It states two claims: efficiency and invariance thesis

Coase theorem: comments

- Efficiency: The legal rules of entitlement, or property rights, are of central importance to the Coase theorem.
- If valid, it follows that there is no need for policy intervention with regard to externalities except to ensure that property rights are clearly defined: private agreements over
- Compensation will generate a Pareto optimal outcome.

Coase theorem: comments

- Invariance: One would expect that the assignment of rights will determine the equilibrium level of an externality, for example that the level of pollution under a polluter pays system will be less than that under a pollutee pays.
- The invariance thesis of the Coase theorem states that this is incorrect and that the equilibrium level of externality is independent of the assignment of property rights.
- **Example**: polluter and pollutee
- The invariance thesis can only be correct if there are no income effects. Since income effects will generally exist, the invariance thesis is false.

Markets for externalities

- In the study of externalities considerable emphasis has been placed on the value of markets for externalities. This arises because if the externalities were actually traded, the market outcome would be Pareto optimal.
- The failure of the competitive equilibrium to achieve optimality can then be seen as arising from the necessary markets being missing from the economy.
- The idea that externalities could be overcome by the introduction of markets for external effects was first introduced by Arrow (1969) and employed by Meyer (1971). Starret (1972) provided the formal development of the idea and the proofs of the central results;

Assumptions

- Consider an economy with three firms, j = 1, 2, 3, and two goods.
- Externality is introduced: the production set for each firm depends upon the production plans of the other firms. The production set, Y^1, of firm 1 is therefore defined on six-dimensional space with a typical element:

$$\left(y_1^1, y_2^1, y_1^2, y_2^2, y_1^3, y_2^3\right)$$

- Firm 1 only has direct choice upon the first two elements of this set. The same as for the P sets of firms 2 and 3 respectively.

Efficient allocation

- It will be on the boundary of the production set Y and, if it is convex, it will imply a price vector q under which y* maximizes qy over all y in Y.
- Is there any trade arrangement such that the equilibrium is Pareto optimal? (First Theorem)
- Is there any price system that leads to production plan y* through profit maximization of individual firms (Second Theorem)

Nature of the First and Second Theorems of Welfare Economics

- As for the first theorem, sufficient condition was that all agents were maximizing subject to prices with no externality
- As for the second one, necessary condition is that all firms' productions sets are independent, so that the price vector maximizing for the whole economy are also optimal for individual firms.
- Hence, key issue it the definition of the production sets (they must be independent between firms).

Production set independence

- It is obtained by defining goods as being different between firms that produce it and firms that receive the externality caused by that good.
- Define: y_i^{kj} as net output of good i by firm j *as observed* by firm k. Hence, the production set for firm k is:
- $(y_1^{k1}, y_2^{k1}, y_1^{k2}, y_2^{k2}, y_1^{k3}, y_2^{k3})$, k=1,2,3.

1) Now 18 commodities.
2) Production sets are independent
3) A price set is introduced on each good.
4) Hence, no firm has an external effect and, a) if they behave in a competitive way (max pq) and b) an equilibrium exists, including markets for externalities, then the equilibrium must be Pareto optimal.

Second welfare theorem with externalities

- Notice that there are sufficient prices to allow the control of firms' decisions that is necessary for decentralization: in fact, it is possible to choose prices such that the identity $y_1^{kj} = y_2^{k'j,}$ all k, j, k', l is satisfied.
- Theorem (Starret 1972): "The price vector (p_1^{11} …, p_n^{mm}) can be choosen such that the profit-maximising production plans of the firms have the property that they sum to the optimal aggregate output and the prices satisfy $\Sigma_k p_i^{kj} = q_i$."

Comments

- The equality states that the total cost of a unit of good i for firm j (qi) including all the externality effects it has upon other firms, sums to the social cost. (private and social costs coincide).
- The externality effects are brought into the price system.
- Each good can be seen as a bundle of commodities traded on the artificial markets and the price of the bundle is the sum of the prices of its components.

Comments

- An alternative way of viewing this result is to note that the direct price of a unit of good i for firm j is pi^{jj}. Taking q_i to be the consumer price of good, it i follows that:
- $pi^{jj}+\Sigma_{k\neq j}p_i^{kj} = q_i$.
- The sum above can be seen as total tax payment per unit of good i by firm j to cover the externality effects.
- This expression captures the duality between prices on artificial markets and corrective taxation.

Summing up

- If artificial markets are created for the externalities, so that they are treated as distinct goods according to the firm that produces them and the firm that they affect, then a price system defined over these constructed commodities can support the optimal allocation (second welfare theorem)
- In addition, this price system can also be interpreted as defining a set of optimal taxes to counter the externalities.

Two possible interpretations

- Firstly, it can be taken as prescriptive of what should be done to overcome inefficiency due to the existence of externalities: if there is an externality problem then this can be overcome by the introduction of markets for external effects.
- Secondly, it can be seen as a proof of the efficiency thesis of the Coase theorem: if externalities can be traded on competitive markets then the equilibrium must be efficient.
- The Coase theorem becomes almost tautological. If the markets exist then, as in the second definition of an externality, there must actually be no externalities.
- Policy prescriptions: trading in the artificial commodities is equivalent to trading property rights, hence policy should facilitate the exchange of property rights.

Non-existence of markets

- Property rights: If property rights are not clearly specified, it may not be obvious who should be seen as the recipient of payment (e.g. air pollution)
- Non-convexities
- Transaction costs and missing markets and side-payments
- Bargaining (i.e. in general one agent on each side of the market…)
- The Coase Theorem suggests that externalities can be overcome by decentralised trading between affected parties.
- In practice it is difficult to imagine that its conditions are actually satisfied so that it cannot be given too much weight as a foundation for the formulation of policy.
- The arguments above provide some reasons why the full set of markets required for optimality may not exist.
- Furthermore they also show why bargaining between affected parties is also unlikely to achieve efficiency.

Corrective taxation: introduction

- We now derive a set of taxes for a model of consumption externalities.
- Notice that the rates of tax need to be differentiated between commodities and between consumers. This is a stronger requirement than that normally imposed upon models of commodity taxation and is hardly administratively feasible.
- When the requirement that the taxes must be uniform across consumers is imposed, the first-best allocation cannot, in general, be sustained except for some special cases.
- This leads to the choice of taxes that will generate the optimal second-best outcome. Uniform taxes are considered later.

Pigouvian taxation: non-uniform taxes with consumption externalities

Let the utility of household h be given by

$$U^h = U^h\left(x_1^{h1}, ..., x_1^{hH}, x_2^{h1}, ..., x_n^{hH}\right),$$

where the externality effects have been included as artificial commodities with $x_i^{h\widetilde{h}}$ denoting the consumption of good i by $\widetilde{h}$ as viewed by h. The aggregate quantity, X_i, of good i is defined by

$$X_i = \sum_{h=1}^{H} x_i^{hh}, \tag{10.52}$$

and the production feasibility constraint is expressed as

$$F\left(X_1, ..., X_n\right) \leq 0. \tag{10.53}$$

Mayer (1971): optimal taxes are derived by solving for the Pareto optimal allocation for this economy, which is the solution to the following problem:

$$\max_{\left\{x_1^{11}, ..., x_n^{HH}, X_1, ..., X_n\right\}} \sum_{h=1}^{H} \beta^h U^h$$

s.t.

$$X_i \geq \sum_{h=1}^{H} x_i^{hh}, 0 \geq F\left(X_1, ..., X_n\right), x_i^{hh} = x_i^{\widetilde{h}h},\ i = 1, ..., n, h, \widetilde{h} = 1, ..., H, h \neq \widetilde{h}.$$

λ_i, $i = 1, ..., n$, denote the Lagrange multipliers on the first n constraints, λ_0 be the multiplier on the production feasibility constraint and $\xi_i^{\widetilde{h}h}$, $i = 1, ..., n$, $h = 1, ..., H$ be the multipliers on the remaining $H(H-1)n$ constraints.

For the choice of good x_i^{hh}, the first-order condition is

$$\beta^h \frac{\partial U^h}{\partial x_i^{hh}} - \lambda_i - \sum_{\widetilde{h}=1, \widetilde{h}\neq h}^{H} \xi_i^{\widetilde{h}h} = 0, \tag{10.56}$$

and for good $x_i^{\widetilde{h}h}$,

$$\beta^{\widetilde{h}} \frac{\partial U^{\widetilde{h}}}{\partial x_i^{\widetilde{h}h}} + \xi_i^{\widetilde{h}h} = 0. \tag{10.57}$$

It can be seen in (10.57) that the multipliers $\xi_i^{\widetilde{h}h}$ are proportional to the externality effect. In addition, dividing two of the first-order conditions (10.56) for goods i and j for a consumer, h, gives

$$\frac{\frac{\partial U^h}{\partial x_i^{hh}}}{\frac{\partial U^h}{\partial x_j^{hh}}} = \frac{\lambda_i + \sum_{\widetilde{h}=1, \widetilde{h}\neq h}^{H} \xi_i^{\widetilde{h}h}}{\lambda_j + \sum_{\widetilde{h}=1, \widetilde{h}\neq h}^{H} \xi_j^{\widetilde{h}h}}, \tag{10.58}$$

which would be the first-order condition for choice of the consumer if they faced prices given by $\lambda_i + \sum_{\widetilde{h}=1, \widetilde{h}\neq h}^{H} \xi_i^{\widetilde{h}h}$ for good i, a fact first noted by Davis and Whinston (1965). Therefore the multipliers $\xi_i^{\widetilde{h}h}$ can be treated as the per-unit tax rate on consumer h for each unit of good $x_i^{\widetilde{h}h}$ they generate. The total tax paid on a unit of consumption, that is for each unit of good x_i^{hh}, is then the sum of these individual taxes. This is the same interpretation as given after (10.17). Note that from (10.57), if the externality is negative, the individual tax component will be positive.

The remaining first-order conditions take the form

$$\lambda_i - \lambda_0 \frac{\partial F}{\partial X_i} = 0. \tag{10.59}$$

- These equations imply that the marginal rates of transformation between each pair of goods is equated to the ratio of the λs.
- Since the λs can be interpreted as pre-tax prices it follows that there is production efficiency and hence the optimal tax system distorts only the consumption side of the economy in response to a consumption externality.

Taking stock

- A set of taxes can be derived that will support a Pareto optimum in the presence of externalities. However, in general they need to be differentiated both across goods and across consumers. If the model was extended to include production externalities, the taxes would also need to be differentiated across firms.
- Since they are based on private information of a similar nature, this general conclusion also applies to the differentiated Pigouvian taxes that support the first-best.
- Consequently, although a first-best outcome can be achieved if the necessary information were available, the implied tax scheme is unlikely to be implementable.

Uniform taxation

- In general uniform taxation will not generate first best allocations.
- Exceptions: identical individuals ξ identical in (10.58)
- Meade's (1952) additive atmosphere externality.
- γ, such that

$$\gamma = \gamma\left(\sum_{h=1}^{H} x_i^h\right), \quad \gamma' \geq 0. \tag{10.60}$$

- Assumption: Marginal contribution of individual's consumption of good i on the externality is identical

To simplify the notation, assume a two-consumer, two-good economy; neither of these restrictions is of any consequence. With the atmospheric externality the utility function are written

$$U^h = U^h\left(x_1^h, x_2^h, \gamma\right), \quad h = 1, 2, \tag{10.61}$$

and, assuming that the externality is generated by the consumption of good 1, γ is determined by

$\Upsilon' > 0$

$$\gamma = \gamma\left(x_1^1 + x_1^2\right). \tag{10.62}$$

The optimum is then characterised as arising from the solution to

$$\max_{\{x_1^1, \ldots, x_2^2, X_1, X_2, \gamma\}} \sum_{h=1}^{2} \beta^h U^h, \tag{10.63}$$

subject to

$$X_i \geq \sum^{2} x_i^h, 0 \geq F\left(X_1, X_2\right), \gamma = \gamma\left(x_1^1 + x_1^2\right). \tag{10.64}$$

This problem generates the first-order conditions

$$\beta^h \frac{\partial U^h}{\partial x_1^h} - \lambda_1 + \xi_1 \frac{\partial \gamma}{\partial x_1^h} = 0, \ \ h = 1, 2, \tag{10.65}$$

$$\beta^h \frac{\partial U^h}{\partial x_2^h} - \lambda_2 = 0, \ \ h = 1, 2, \tag{10.66}$$

$$\lambda_i - \lambda_0 \frac{\partial F}{\partial X_i} = 0, \quad i = 1, 2, \tag{10.67}$$

and

$$\beta^1 \frac{\partial U^1}{\partial \gamma} + \beta^2 \frac{\partial U^2}{\partial \gamma} + \xi_1 = 0. \tag{10.68}$$

As $\frac{\partial \gamma}{\partial x_1^1} = \frac{\partial \gamma}{\partial x_1^2}$, (10.65) and (10.68) have the implication that the consumers should face the same shadow prices for the two goods or, equivalently, that the tax rate on good 1 should not be differentiated across the consumers. Therefore uniform taxes can sustain the first-best in the presence of the atmosphere externality.

Direct and indirect taxes

- When uniform taxation cannot implement first best, then distortionary taxes must be used (second best).
- Two cases: direct and indirect taxes
- The former are levied upon the good generating the externality
- The latter on some activity that is related to the externality

Direct taxes

- Suppose a two-good economy, linear utility functions in the non externality good (good 2).

$$U^h = U^h\left(x_1^1, ..., x_1^H\right) + x_2^h.$$

- Assume also concavity and separability

$$\frac{\partial^2 U^h}{\partial x_1^h \partial x_1^h} < 0, \frac{\partial^2 U^h}{\partial x_1^h \partial x_1^{\widetilde{h}}} = 0, \quad h \neq \widetilde{h}.$$

- Problem for consumer h (price 2 normalized to 1):

$$\max_{\left\{x_1^h, x_2^h\right\}} U^h\left(x_1^1, ..., x_1^H\right) + x_2^h \text{ s.t. } \left[p_1 + t_1\right] x_1^h + x_2^h = M^h, \quad (10.72)$$

- generating the demand function: $x_1^h = x_1^h\left(p_1 + t_1\right).$

Distortionary taxes

Assume that tax revenues are retruned to the consumers via lump-sum taxes (as in Diamand 1973). Social welfare function can be written as:

$$W = \sum_{h=1}^{H} U^h \left(x_1^1 \left(p_1 + t_1\right), ..., x_1^H \left(p_1 + t_1\right)\right) - p_1 \sum_{h=1}^{H} x_1^h \left(p_1 + t_1\right) + \sum_{h=1}^{H} M^h. \tag{10.73}$$

$dU^h/dx_1=\lambda(p+t)$

$dU^h/dx_2=1=\lambda$

Differentiating (10.74) with respect to t_1, setting the expression equal to zero for a maximum, and using the first-order condition from (10.72), the optimal tax can be written implicitly as

$$t_1 = \frac{-\sum_{h=1}^{H} \sum_{\tilde{h}=1, \tilde{h} \neq h}^{H} \frac{\partial U^{\tilde{h}}}{\partial x_1^h} \frac{\partial x_1^h}{\partial t_1}}{\sum_{h=1}^{H} \frac{\partial x_1^h}{\partial t_1}}. \tag{10.74}$$

- The optimal tax is given by the sum of externality effects weighted by the demand derivatives.
- Comments: strong assumptions: such as separability.

Direct and indirect taxes

- When separability is removed Diamond (1973) shows that in a two-consumer example $t_1 = 0$ is the optimal solution despite the presence of a negative externality.
- Green and Sheshinski (1976) introduce a third good that enters into the non-linear part of the utility function.
- With this formulation they allow for indirect taxation of the third commodity and show that an optimum may involve a zero direct tax but a non-zero indirect tax.
- We show this in the work by Balcer (1980). The previous model is extended by assuming a utility function of the form

$$U^h\left(x_1^h, x_3^h\right) + \overline{U}^h\left(x_1^1, ..., x_1^{h-1}, x_1^{h+1}, ..., x_1^H\right) + x_2^h. \quad (10.75)$$

Intuition

- This will occur if the either the externality is of the atmospheric kind or if the consumers are identical. These are the situations for which a uniform tax can sustain the first-best so the present conclusion is simply an application of that result.
- In other situations the values of the tax rates are determined by two factors: the degree of aggregate complementarity or substitutability and how those individuals that cause a greater amount of externality at the margin view the good.
- When the larger offenders view the goods as complements and the goods are aggregate complements then $t_2 < 0$ and t_1 is less than the value determined by the Diamond formula.
- Moving to aggregate substitutability makes t1 greater than the Diamond value whilst the signs are all reversed when larger offenders view the goods as substitutes.

Tradable licences

- Altering the relative cost of generating an externality through taxation can lead to the optimal quantity of externality. Alternative to this is to introduce licences that permit the generation of an externality and to allow agents to produce externalities only to the extent of the licences they hold (Dales 1968)
- Allowing the licences to be traded should permit the use by the agents who value them most highly resulting in efficient generation of externalities.
- However, markets may be thin so that the competitive outcome will not be achieved.
- Administratively, the use of licences has much to recommend it.

Cont’d

- The calculation of tax rates requires considerable information. Changes in other prices will affect the optimal tax rates and taxes will need continuous adjustment.
- These problems are avoided entirely by licences. In a spatial economy, the control of the spatial distribution of externalities will only be achieved through taxation if the tax rates are spatially differentiated which raises the information necessary for their design.
- In contrast, licences can restrict the right to emit externalities to a given area and control the spatial allocation directly.
- All in all the choice between properties of licences and taxes is not as clear-cut as these administrative advantages may suggest.

Certain costs and benefits

- Parish (1972): a market in pollution quotas would see them purchased by those who value them most highly and that such purchasers would give the best return to society for the given level of pollution.
- The quantity of licences would determine the level of externality that would be generated, which it is presumed would be set at the optimal level, whilst the bidding for them would see this quantity allocated efficiently between alternative sources.
- The tradeable licence system therefore attains an efficient outcome.
- When all costs and benefits are known with certainty by both the government and individual agents, tradeable permits and taxation are equivalent in their effects up to a redistribution of income (see Montgomery (1972), Bergstrom (1976) Pezzey (1992)).

Certain costs and benefits

- The distribution of income resulting from licences is dependent upon the method of distribution of licences.
- If each externality generating agent is sold a quantity of licences equal to their optimal quantity at the market clearing price then no further trading will take place and the distribution of income will be identical to that with taxation.
- Alternatively, the licences may be distributed free, possibly in proportion to agents existing level of generation of externality, which will lead to a redistribution of income from the government to the externality generators relative to the tax solution (a market of licences then would take place).
- Other then these income differences, the choice between the two systems under certainty will primarily depend on administrative convenience. (See European law on externalities).

Internalisation

- A further method of externality control is merging of firms.
- Such arguments have also been proposed as providing part of the rationale concerning the existence of the firm.
- Issues:
- 1) An industry in which the productive activity of each firm in the industry causes an externality for the other firms in the industry. In this situation the internalisation argument would suggest that the firms become a single monopolist.
- If this were to occur, welfare loss would then arise due to the monopolistic behaviour and this may actually be greater than the initial loss due to the externality.
- The welfare loss due to market power then has to be offset against the gain from eliminating the effect of the externality.
- 2) The economic agents involved may simply not wish to be amalgamated into a single unit. This objection is particularly true when applied to consumption externalities since if a household generates an externality for their neighbour it is not clear that they would wish to form a single household unit, particularly if the externality is a negative one.

Internalisation

- In summary, internalisation will eliminate the consequences of an externality in very direct manner by ensuring that private and social costs are equated. However it is unlikely to be a practical solution when many distinct economic agents contribute separately to the total externality and has the disadvantage
- of leading to increased market power.

Conclusions

- Externalities are a prevalent feature of economic life and their existence can lead to inefficiency in an unregulated competitive economy.
- Coase theorem suggests that such inefficiencies will be eliminated by private trading in competitive markets, but several objections araise:
- lack of well-defined property rights, the thinness of markets, the incomplete information of market participants. Each of these impediments to efficient trading undermines the practical value of the Coase theorem.

Cont’d

- Policy responses: introduction of a system of corrective Pigouvian taxes. That are proportional to the marginal damage caused by externality generation.
- Differentiation of these taxes between different agents leads to first-best outcome, but such a system is not practical due to its informational requirements.
- Uniform taxes across agents allow the first-best to be achieved in some special cases but, generally, leads to a second-best outcome.
- Marketable licences: they have administrative advantages over taxes and lead to an identical outcome in conditions of certainty. With uncertainty, licences and taxes have different effects and combining the two can lead to a superior outcome.
- This is what is currently happening in Europe.