MARKET REGULATION

Consider market curves (demand & supply) for some commodity good and assume that every unit sold is produced with a constant external cost → private WTA and, above, social WTA = private WTA + external cost. Example: steel.

The social optimum Q*, given by the intersection between WTP and social WTA, is different from market equilibrium Q_M, given by the intersection between WTP and private WTA.

Next to the market equilibrium price P_M, we define pseudo-prices corresponding to the social optimum Q*: P_H such that $Q_D(P_H) = Q^*$ and P_L such that $Q_S(P_L) = Q^*$.

How to go from Q_M to Q*? Different environmental policy measures are possible.

NB: for the sake of introducing simply the main economic instruments of environmental policy, it is assumed that the only way to lower external costs is to lower production. The other option – cleaner production through abatement – will be considered later.

Measure 1: The market equilibrium can be moved from Q_M to Q* by imposing a **unit tax on production** equal to the external cost. This would force the producers to internalise the external cost. Their new supply curve is moved up by the amount of the tax = external cost, and is now confounded with the social WTA. This new supply curve intersects with demand at Q*. The new equilibrium price is higher than Q_M but less so than by the amount of the tax. The tax is paid by sellers, but it is really split between the buyers, who pay more for the products, and sellers, who get less after tax for their products. The tax revenue = tax×Q* = (external cost)×Q*. The burden of this tax is split between the buyers and the sellers.

Measure 2: The market equilibrium can also be moved from Q_M to Q* by imposing a **unit tax on purchases** equal to the external cost (e.g., an anticipated recycling fee). This moves the demand curve down, to intersect at (Q^*,P_L). The buyers pay P_L to the sellers, who therefore do not propose more than Q*. In effect, they pay P_L+tax=P_H, which makes sure that they do not want to buy more than Q*. The market is in equilibrium. There is a tax revenue = tax×Q* = (external cost)×Q*, the burden of which is split between the buyers and the sellers in exactly the same way as when the sellers were sending the tax money to the tax authority.

Comparison of measures 1 and 2: It makes **no difference** whatsoever whether a same unit tax is paid by buyers or sellers. What drives the choice, in practice, is administrative considerations (on which side of the market are there fewer actors and thus tax collectors?)

and, sometimes, acceptance, as the side of the market that pays the tax has the illusion that it also bears its burden entirely. There are even instances where the tax is split between buyer and seller, e.g., social security contributions in Switzerland (AVS+AI+APG): the employer transfers 10.6% of her employee's salary to the social security administration, 5.3% subtracted from the employee's salary and the matching amount added by the employer.

Measure 3: The market equilibrium can also be moved from Q_M to Q* by offering a **subsidy to producers for reducing their sales**, equal to the external cost (e.g., subsidies to farmers to keep their land fallow or to reduce their cattle). If they sell a unit of the product, they earn the price P. If they do not, they earn the subsidy. Therefore, the net gain of selling is P−subsidy, just as it is P−tax when sellers are charged a tax for every unit that they sell. If subsidy = tax, their decision condition is identical, so they decide to sell the same quantity, Q*. The supply curve is moved up by the amount of the subsidy, as the sellers require a compensation for forgoing the subsidy when they sell. The amount of subsidy paid out is subsidy$\times$(Q_M−Q*) = (external cost)$\times$(Q_M−Q*). Sellers receive this, and, in addition, they can sell Q_M at the high price P_H. This is clearly the best solution for them.

Measure 4: Give buyers a **subsidy for not buying**… *<buyers' subsidy is illustrated in Market-regulation-Ex-1>*

Before moving on, we need to look at auctioned or tradable quotas.

Consider a demand curve and assume that there is a fixed quantity N of goods available. Ideally, the N buyers with highest WTP should receive the goods. This can be achieved in several manners without need to know each buyer's WTP. The classic way is to organise a market for the good, that lets the price adjust until it reaches a level where the demand at this price level is equal to N. Call this price P_M.

Equivalently, the authority could create quotas, for instance one quota entitles to one unit of the good for free. In that case, N quotas are created and the challenge is to make sure that the potential buyers with highest WTP get these quotas.

First, the authority could auction the quotas, i.e., invite buyers to bid for them. Each buyer's willingness to pay WTP' for a quota is equal to that buyer's WTP for the good. If all quotas are sold at the same price, a price that equates the demand for quotas with N, then the auction of the quotas leads to the same equilibrium price P_M as the good's market.

Suppose now that a quota does not entitle to a free unit of the good but rather to buy it at a low price P_L, a price at which the demand for the good would exceed N. Then, the willingness-

to-pay for a quota, WTP' = WTP – P_H and the auctioning of the quotas would yield an equilibrium price equal to $P_M – P_L$.

Suppose, again, that one quota allows to get one unit of the good for free, and that they are handed out for free to the potential buyers. As the authority does not know their WTP, it must use some mechanism for this allocation: random drawing, first-come-first-serve, or on the basis of some criterion different from WTP for the good. Consider a low-WTP buyer who was handed out a quota and a higher-WTP buyer who was not. The quota is worth more to the latter than to the former, so he could make him an offer to buy his quota for a compensation situated between the two WTP. Such a trade is mutually beneficial, so it will take place in the absence of administrative or legal constraints. Mutually beneficial bilateral trades are possible until the N buyers with the highest WTP own the N quotas. If the transfer of quotas is organised like a regular market – some market maker records the number of buyers and sellers for a price he proposes – then, the transactions take place at a single price equal to the price that would be observed if the good was sold directly. In this case also, the buyers with the highest WTP get the N units of the good.

High-WTP buyers who were handed out a quota in the initial distribution get the good for free. High-WTP buyers who were not buy quotas from low-WTP beneficiaries of the initial quota distribution at price P_M.

This works also if the quotas do not entitle to a unit of the good for free, but only to buy the good at a below-equilibrium price P_L. In this case, the WTP for a quota is simply reduced by the amount of the price. It is equal to each buyer's surplus. The market equilibrium price for these quotas is equal to the market equilibrium price of the good minus the below-equilibrium price, or $P_M – P_L$. This is the amount that is transferred from high-WTP buyers without quotas to low-WTP buyers with quotas.

Quotas can also be used on the supply side, to determine who can sell units of the good without exceeding a cap on sales. Consider a supply curve with a high price P_H at which supply would exceed the cap. The value of a quota to each potential seller is P_H−WTA, i.e., his potential seller's surplus. The quotas can be auctioned or handed out for free to potential sellers. In the latter case, the quotas will be sold by low-surplus sellers to high-surplus sellers. The equilibrium price for the quotas market is equal to P_H minus the price that would equilibrate supply with a demand equal to the cap.

Let us now go back to the problem of the good produced with an external cost defining a socially optimal volume of trade Q* smaller than in the market equilibrium. More measures are possible to achieve Q*.

Note that the following measures – imposing a quantity or price – imply that the authority knows the optimal quantity or price; in contrast, the tax and subsidy instruments only require knowing the external cost…

Measure 5: Impose **maximum production** Q = Q* (production cap, e.g., through minimum fallow land). This cap implies that some mutually beneficial trades must be prevented, i.e., trades beyond Q* where there are still buyers and sellers with the property that the former's WTP exceeds the latter's WTA. How is the Q* allocated among producers? Efficient use of resources requires that whatever is produced is produced at minimum cost (WTA). This means that the costliest production is prevented, not that every producer reduces her production in the same proportion. And who gets Q*? It should be the buyers with the highest WTP.

If production and consumption are organised efficiently, there is still the question of how much the buyers have to pay. If they pay a price P_H, the sellers with the lowest WTA gain a lot over the market equilibrium (as in a cartel), the difference between P_H and P_M. This could be implemented with quotas. To make sure that production is at minimum WTA, the quotas could be auctioned. How much would sellers bid for the quotas? $P_H - WTA_j$, which is the smallest at $P_H - P_L$ for the marginal seller (the one who sells the Q^{*th} unit). In this case, sellers give up all their gain from rationing and end up with even smaller surplus than in market equilibrium. Revenues from the sale of the quotas = $(P_H - P_L) \times Q^*$ = (external cost)$\times Q^*$. The same result obtains if the quotas are sold at a price equal to the external cost. If the quotas are grandfathered, i.e., handed out to all producers up to Q_M in proportion of their production, it is like imposing the same reduction of production to all producers, irrespective of their costs, which is inefficient (total production is not obtained at minimum cost). However, this gets corrected through mutually beneficial trades between producers if the quotas are tradable, because low-cost producers will offer a price to high-cost producers for their quotas that these cannot refuse. With this quota allocation mechanism, producers who are banned from production by the cap (those who supplied the quantity between Q* and Q_M) get some financial compensation.

Measure 6: Impose **maximum purchases** Q = Q* (consumption cap, the basis of rationing). Ideally, the social planner would identify the buyers with the highest WTP and the sellers with the lowest WTA and allocate production and consumption efficiently. There remains the question of the price. If buyers can exercise pressure on sellers, they can push the price down

to P_L, like a buyers' cartel. To make sure that consumption maximises WTP, the quotas could be auctioned. How much would buyers bid for the quotas? $WTP_i - P_L$, which is the smallest at $P_H - P_L$ for the marginal buyer (the one who buys the Q^{*th} unit). In this case, buyers give up all their gain from their demand being rationed (low price for product) and they end up with even smaller surpluses than in market equilibrium. The revenues from the sale of the quotas = $(P_H - P_L) \times Q^*$.

Comparison of measures 5 and 6: no significant difference! In both cases, buyers pay P_H for the good, whether it is because this is the price charged by sellers or because they pay the low price P_L to sellers plus $P_H - P_L$ for a purchasing quota. In both cases, sellers get P_L for the good, whether it is because this is the price offered by buyers or because they sell at high price P_H, but must give up $P_H - P_L$ for a selling quota. In both cases, the environmental authority collects $(P_H - P_L) \times Q^*$ for the quotas if it auctions them. It even does not matter whether the sellers or the buyers pay for the quotas. The burden of this is shared between the buyers and the sellers in proportion of the price increase $P_H - P_M$ for the buyers and the price decrease $P_M - P_L$ for the sellers.

Measure 7: Impose **maximum price** $P_{max} = P_L$ so that $Q_S(P_{max}) = Q^*$. In this case, efficient production is guaranteed, but rationing of demand is needed and it ought to be efficient. If the buyers with the highest WTP get the product, they gain a lot over the market equilibrium (as with a buyers' cartel). A quota mechanism would make sure that the buyers with the highest WTP get the products and it could collect (part of) the rent if the quotas are sold. However, the quota mechanism must be on the side of the buyers, i.e., it has to be buying quotas, as the supply side is already taken care of by the price ceiling.

Measure 8: Impose **minimum price** $P_{min} = P_H$ so that $Q_D(P_{min}) = Q^*$. In this case, efficient consumption is guaranteed but efficient production must be ensured somehow. And this time it is the sellers with the lowest WTA who gain a lot over the market equilibrium (as in a sellers' cartel). A quota mechanism would make sure that the sellers with the lowest WTA get to produce the products and it could collect (part of) the rent if the quotas are sold. However, the quota mechanism must be on the side of the sellers, i.e., it has to be production or selling quotas, as the demand side is already taken care of by the price floor.

Types of measures or instruments: Limiting the quantity that can be sold or bought or fixing the price are **prescription** type measures, or **command and control**. If the control guarantees that the caps are kept, these measures are **effective**. They need not be **efficient**, i.e., total surplus maximising, in the absence of an additional mechanism that makes sure that the lowest-cost producers get to produce and the buyers with the highest WTP get to buy the

product. Quota mechanisms with a price (set by the authority, set by auctioning or resulting from trading the quotas) guarantee efficiency, because they are **pricing or market** type measures.

Other possible measures:

- **Merger of polluter and polluted**. This is another way of internalising the external cost, as it makes the polluter consider the impact of his production on the polluted. This is only possible if there are very few polluters and polluted.
- **Voluntary approaches**: information & persuasion → downward shift of demand, as WTP for 'bad' commodity or service is reduced. There could also be an upward shift of supply, as producers may apply an internal price for external costs (e.g., internal carbon price).
- **Reducing the external cost**: abatement, mitigation, adaptation → will be developed.

External benefit in place of an external cost: What if the production activity creates **benefits for third parties** that the producers cannot enjoy. E.g., the beekeepers whose bees pollinate their neighbours' plants and trees. Or, all those measures that improve the environment (quality of soils, waters, landscape, ecosystem, biodiversity, etc.).

- In that case, the **optimum quantity** to be traded **exceeds** that of the market equilibrium.
- It is difficult to impose **minimum production/sales or minimum purchases**, except when combined with some compensation or regulation (e.g., electricity distributors must purchase a minimum amount of renewable electricity; or food distributors could be forced to buy and offer a minimum share of domestic production when they apply for import quotas).
- A **price ceiling** would lead to higher demand, but who supplies that demand?
- A **subsidy on production** equal to the external benefit would shift down the supply curve and move the market equilibrium to the social optimum. Cost of subsidy = subsidy×Q* = (external benefit)×Q*. Even if sellers are granted the subsidy, it also benefits partly the buyers through lower prices.
- A **subsidy on purchases** would push up demand and have exactly the same effect.
- Could a **tax** do the job? It would have to be levied on 'insufficient production', i.e., sellers would have to pay it if they do not achieve the target level of production. Or on buyers who do not buy enough, per unit below Q*.