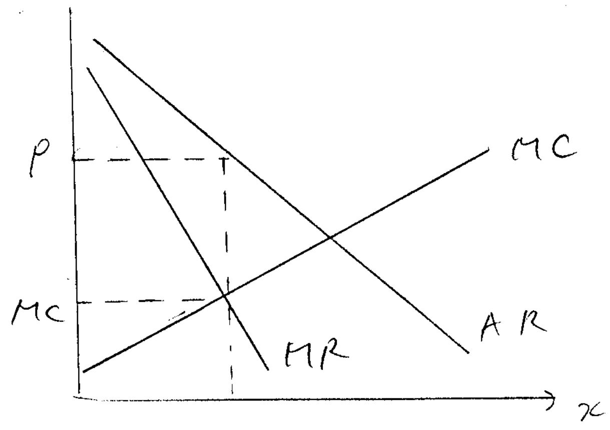
Natural monopoly and Ramsey-pricing rule

1. Monopoly

The producer knows the shape of the demand curve, $p = p(x)$, where x is the amount of the good consumed and p its price. The outcomes of this market when compared with the competitive market are that the price is higher than the MC and the output is reduced. The difference between the price and the MC is: $\frac{p - MC}{p} = \frac{1}{\varepsilon}$, where ε is the elasticity of demand.

As a consequence of the reduced output and increased price, the total surplus is reduced when compared with the competitive situation. Thus, the important result of the monopoly is that not only consumers lose and the producer gains, but their total surplus shrinks, implying that there occurs the efficiency loss.



Exercise: Discuss the monopoly price and output of the following special case. $p(x) = a + bx, a > 0 \text{ and } b < 0.$ $TC(x) = cx$.

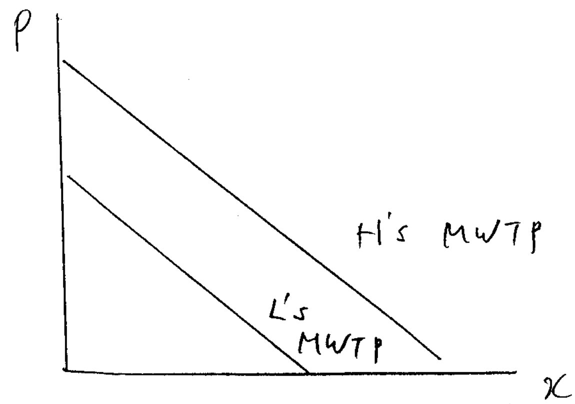
2. Price-discriminating monopoly

The monopoly can increase his profits by offering different prices to the good he is selling. The way he discriminates prices is not unique, but there are various ways. Starting from zero amount to sell, he can offer different prices to each of additional marginal amount he sells; he can offer, say 100 yen, for the first unit of the good, and 90 yen for the second unit and so on. Another way for the produce to choose is to sell a fixed amount for a certain price, say 10 units for 1000 yen. By either way of offering different prices for different amounts of the good, he can increase his profits from the case where he sells at a single price.

A further interesting situation is that there are different types of consumers with different MWTP and the monopoly producer does not know which of the consumer is which type. Let us assume there are two types of consumers such that the H-type has higher or equal MWTP to every amount of the good to consume than the L-type. Under this situation, the producer cannot absorb as much consumer surplus as he can under the full information, where he knows the type of his consumer.

The results under the incomplete information are first that the producer has to offer a discriminating price (corresponding to certain amount of the good) to the H-type to let him choose it for himself, and another set of the price and the quantity to the L-type so that like the H-type, the L-type chooses the one tailored for him by the producer. That is, *the two types of consumers will self-select the price-quantity combinations offered to them.*

The second result is that the self-selection constraint restricts the deal that the producer offers to the L-type, because the better the deal, the more chance that the H-type will pretend to be the L-type, and the producer loses. It could, thus, be even possible that the L-type would be shut out of the market. You can recall that sometimes you receive terrible services when you fly in an economy class. But, you, as an economist, had better not blame the airline, but rather think that it is merely collecting higher profits by offering poorer services to economy-class passengers. The poor services should be attracting more business customers. But relax. Of course, the real world is much more complicated; if economy-class passengers are ill treated by one airline, another will come forward to grab them by delivering better services.



3. Natural monopoly: the case of (average) cost-decreasing industry

3.1 How does it emerge?

Some industry has to make a huge investment before it can sell their product. The power company is a typical example: the costs of nuclear-power generators would be enormous, but the power company has to construct it before selling electricity. When the company operates, it has to recoup not only the variable cost, but also the fixed cost.

Let the total cost be such that $TC = F + cx$, where F is the fixed cost and cx is the variable cost. The average and marginal costs are respectively $AC = \frac{F + cx}{x} = \frac{F}{x} + c$, $MC = c$. You can readily figure out that the competitive equilibrium would make the producer fail to recover its fixed cost, for the fixed cost cannot be collected by setting the price equal to the marginal cost. This will intensify the competition among the loss-making producers in order to recover their fixed costs. This situation will continue up until all but the last one walk out of the market, and it will become a monopoly and start to collect its fixed costs by raising the price above the marginal cost.

Thus, you can expect a monopoly firm emerges as a natural consequence of the competition. Whatever the reason for its existence, once a producer becomes a monopoly, the efficiency of the market will decline. A question would here be that how the government responds to this industry where it tends to converge to a monopoly.

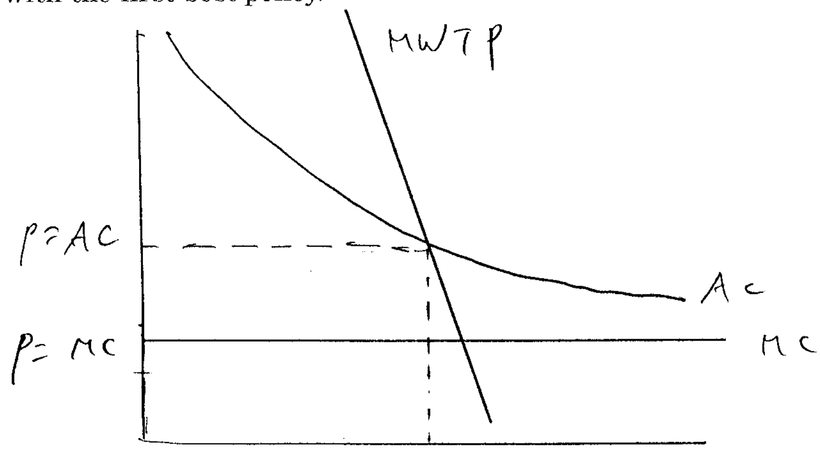
3.2 What is the best policy and why do we have to look for the second-best policy?

The best policy is always the one which achieves the highest social surplus. That is TWTP minus Total Cost. Setting the price equal to the marginal cost will achieve this goal and there is nothing special about this rule, no matter whether there is a fixed cost or not.

The best policy will additionally require that the fixed cost that cannot be recovered by the price-equal-marginal-cost policy needs to be collected directly from consumers by slashing their surplus. If this transfer from consumers to the producer is available and possible, we should go for the best policy. An important question is now whether this straightforward transfer can be possible or not.

You may think that there are many ways to let consumers pay for the fixed cost to the producer. Raising revenue by the personal income tax is one way. But can this be a cost-free transfer? Taxing consumers will affect their behavior, say by choosing the good or leisure that is taxed to a smaller degree, and this will cause another efficiency loss. This will lead us to think that rather than constructing a mechanism to transfer the consumer's surplus directly to the producer, we should modify the price, barring the possibility of the direct lump-sum transfer.

This restricted class of problem is called *the second-best problem.* We start to look for the price that gives no loss or no profits to the producer and that maximizes the social surplus. In one-good case, the no-loss-no-profit condition dictates the price to be the average cost. Hence, the second-best policy will reduce the amount of consumption in comparison with the first-best policy.



3.3 Ramsey-pricing rule

Suppose the producer makes the two goods, x_1 and x_2, and the total cost is given by $c = F + c_1x_1 + c_2x_2$. Applying the concept of the second-best policy, we would like to think about how to price the two goods.

The no-loss or no-profit condition is

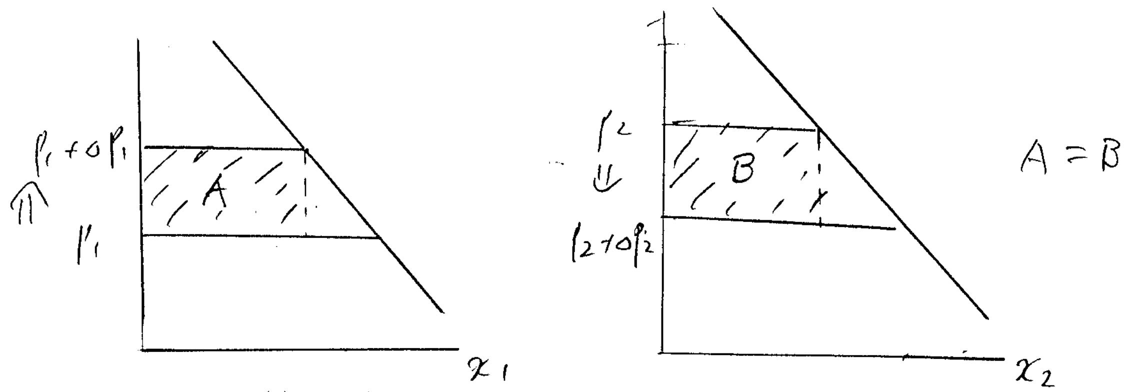
$$p_1x_1 + p_2x_2 = F + c_1x_1 + c_2x_2 \tag{1}$$

This condition is preserved through changes of prices. That is,

$$\Delta p_1x_1 + p_1\Delta x_1 + \Delta p_2x_2 + p_2\Delta x_2 = c_1\Delta x_1 + c_2\Delta x_2 . \tag{2}$$

Now, when p_1 and p_2 are chosen right, the marginal changes of welfare by the perturbation of prices, i.e., Δp_1 *and* Δp_2, will be cancelled out. The gain caused by the decline of one of the two prices will be lost by the increase of another price. Let us let $\Delta p_1 > 0$ and $\Delta p_2 < 0$. Disregarding the second-order change, we will get

$$\Delta p_1 x_1 + \Delta p_2 x_2 = 0 \tag{3}$$



Plugging the equation (3) into (2) yields

$$p_1 \Delta x_1 + p_2 \Delta x_2 = c_1 \Delta x_1 + c_2 \Delta x_2 .$$

$$(p_1 - c_1)\Delta x_1 = -(p_2 - c_2)\Delta x_2 \tag{4}$$

Combing the equations (3) and (4) gives

$$(p_1 - c_1)\frac{\Delta x_1}{\Delta p_1 x_1} = (p_2 - c_2)\frac{\Delta x_2}{(-\Delta p_2) x_2} .$$

This is identical with the Ramsey-pricing rule.

$$\frac{p_1 - MC_1}{p_1} / \frac{p_2 - MC_2}{p_2} = \frac{\varepsilon_2}{\varepsilon_1},$$

This formula says that prices of the decreasing-cost industry are such that more distortion is made to the good that is less elastic.

4. Application of the Ramsey-pricing to taxing commodities

We have assumed that the lump-sum transfer is impractical and considered how to pay for the costs of natural monopoly by adjusting its price. We call it the Ramsey-pricing rule and it turns out to be inversely ~~reciprocal~~ proportional to the demand elasticity. This idea can be applied to taxing different commodities.

Taxing different commodities at a uniform rate implies taxing labor and this triggers another price distortion between the choice over labor and commodities. We cannot a-priori claim that a uniform tax is better than discriminatory taxes among commodities. We have also noticed that taxing goods as well as *leisure* uniformly will be the best policy, but taxing leisure is obviously impossible in practice. Therefore, our problem here is exactly the same with looking for appropriate prices for natural monopoly which produces different goods.

Now, suppose the government has to collect the fixed amount of revenue, T, by taxing the goods x_1 and x_2. The tax on a unit of the two goods are respectively t_1 and t_2. The government's revenue constraint is given by

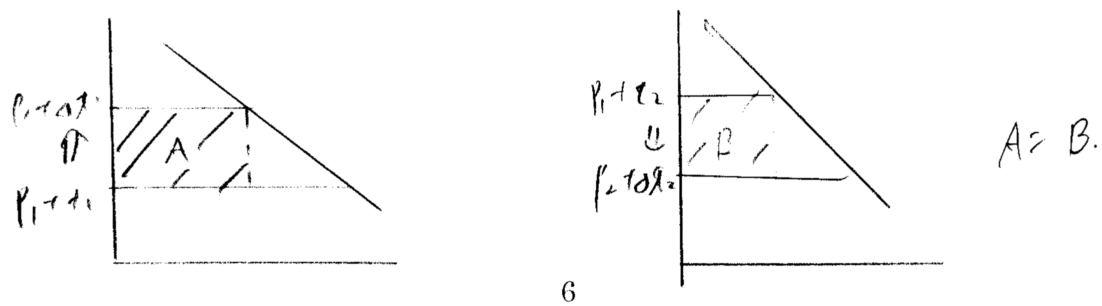
$$T = t_1 x_1 + t_2 x_2 . \qquad (1)$$

Without the lump-sum transfer, the government seeks to choose the optimal taxes for the two goods. Before passing on to the necessary condition for the optimal choice of taxes, the revenue constraint above can be written in a perturbation form like the following,

$$\Delta t_1 x_1 + t_1 \Delta x_1 + \Delta t_2 x_2 + t_2 \Delta x_2 = 0 \qquad (2)$$

When the taxes are chosen right, the welfare gains from the tax cut of one good must be the same as the loss from the tax increase of another. Ignoring the second-order changes, this optimality condition is expressed by

$$\Delta t_1 x_1 + \Delta t_2 x_2 = 0 \qquad (3)$$



Combing the equations (2) and (3) yields that

$$t_1 \Delta x_1 + t_2 \Delta x_2 = 0 \qquad (4)$$

The equations (3) and (4) and an identity that $t_1 = \Delta p_1$ and $t_2 = \Delta p_2$ gives

$$\frac{t_1}{p_1} / \frac{t_2}{p_2} = \frac{\varepsilon_2}{\varepsilon_1},$$

where ε_1 and ε_2 are respectively the price elasticities of the good 1 and 2. This is the Ramsey-tax formula of different commodities.