EFR summary

Applied Microeconomics, FEB12001X

2026-2027



Lectures 1 to 18

Weeks 1 to 7

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Details

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Applied microeconomics – IBEB – Lecture 1, week 1 (public 1) Perfect competition, public goods

Introduction

First fundamental theorem of welfare: In a perfectly competitive market, efficiency is maximised

- All possible gains from trade are exploited
- 'Invisible hand' automatically adjusts conditions to desired equilibrium (Adam Smith).

However, even under perfect competition, the government is needed to enforce property rights and sometimes to improve market outcomes.

Some ways to intervene:
(1) **public provision** (e.g: education, infrastructure)
(2) **affecting prices by taxes, excises, and subsidies** (e.g: cigarettes, gasoline)
(3) **regulation** (e.g: fishing, car insurance)
(4) **public production** (e.g. defence, income insurance, prisons).

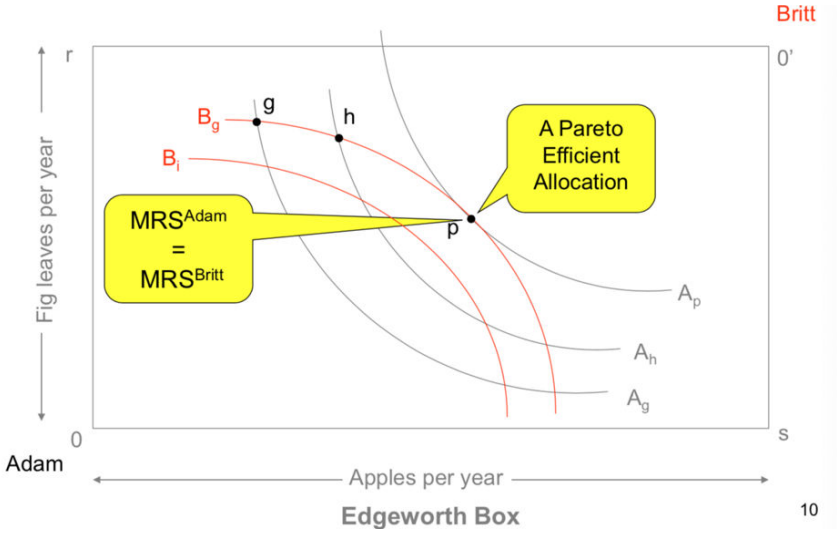
Perfect competition review

Condition for maximum efficiency:

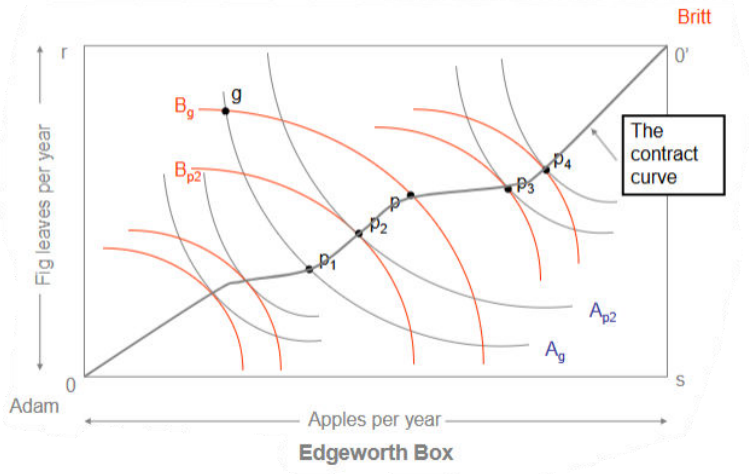
$$MRS^A = MRS^B$$

If $MRS^A \neq MRS^B$, it is possible to make a **Pareto improvement** (trade can make one better off without making anyone worse off).

For example, in the figure below, the movement from point **g** to point **p** is a Pareto improvement because Adam's utility is higher, and Britt's utility is not harmed.



They reach the **Pareto Efficient** Allocation (impossible to make one person better off without making another worse off), for different initial endowments they reach different Pareto Efficient points through trade, which is represented by the **Contract curve**



Production possibilities frontier

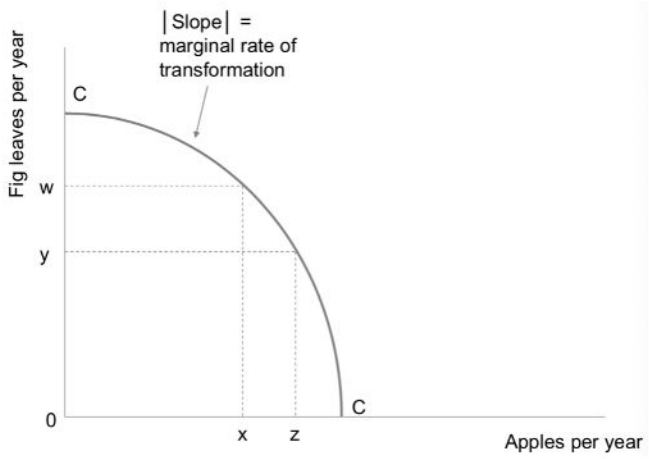
Production Possibilities Frontier:

- | Slope PPF | = Marginal Rate of Transformation (MRT)
- MRT: how much additional good Y can be produced when production of good X is reduced by 1
- $MRT = \frac{MC_x}{MC_y}$

Under perfect competition, prices adjust to get:

$$MRS^A = MRS^B = MRT = \frac{P_x}{P_y}$$

This again represents a **Pareto efficient equilibrium**.



Market failures

Four main reasons for market failures are:

1. **Market power:** Monopoly is a good example of this (high barriers to entry, prices above the marginal costs and general "consumer exploitation")
2. **Public goods:** These goods are usually not provided sufficiently without government intervention because of free-rider incentive.
3. **Externalities**
4. **Asymmetric information**

The last three market failures arise due to **missing markets**.

Government failure

Four main reasons for government failures:

1. **Lack of information** (on individuals' preferences and production processes)
2. **Imperfect political representation and problems in aggregating preferences** (Arrow's impossibility theorem)
3. **Rent-seeking and corruption**
4. **Limited or misaligned incentives**

Public goods

Characteristics of pure public goods:

1. **non-rival**: the consumption of the good by one party does not prevent the consumption of the good by another => MC of additional consumer = 0
2. **non-excludable:** it is impossible or extremely costly to prevent anyone from consuming the good (e.g. public roads)

***Example 1*: Lighthouse** (non-excludability illustration)

- Two harbours share one dangerous spot; no communication.
- Lighthouse: Construction cost: 15 (shared if both contribute).
  Benefit to each: 10 (non-excludable)

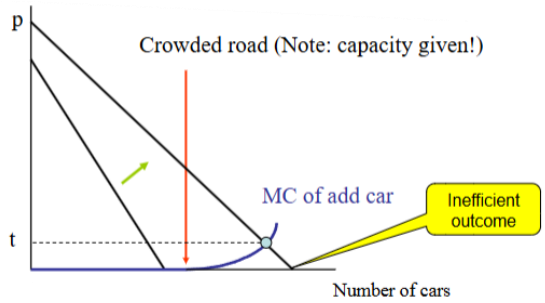
Question: In Nash equilibrium, will the lighthouse be constructed?
Answer: No, because of the free-rider problem. If the harbours could credibly commit to sharing the construction cost, however, the lighthouse could be constructed.

		H2	
		Construct	Do Not Construct
H1	Construct	(2.5, 2.5)	(-5, 10)
	Do Not Construct	(10, -5)	**(0, 0)**

Nash equilibrium: Both do not construct
=> Free-rider behaviour due to non-excludability, since both parties will benefit if at least one contributes, they will want the other to pay for it

***Example 2*: Traffic jams** ((non-)rival illustration)
On most roads, usage is free: p = 0

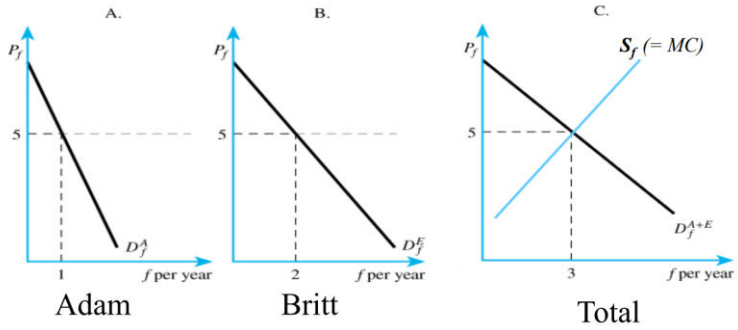
- Outside rush hour: road use non-rival: MC = 0
- During rush hour: road use rival: MC > 0 (represented by shift in demand)



Here, since the MC of additional cars is larger than 0 when there's a traffic jam, road usage becomes rival.

Road pricing equal to marginal cost can restore efficiency, although collecting the charge can itself be costly.

Efficient provision of private goods

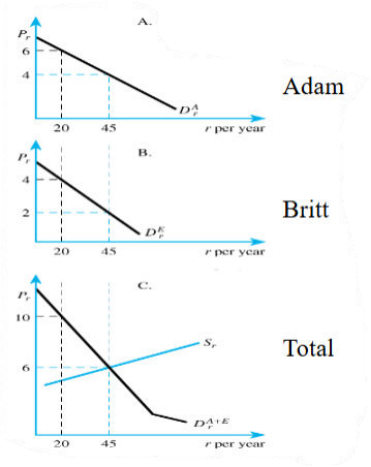


Total demand: Horizontal summation
Efficient provision: $MRS^A = MRS^B = MRT$

Private goods

- Quantity consumed differs among people
- Everyone pays the same price, and has the same marginal valuation (= MRS)
- Market generates Pareto-efficient equilibrium

Efficient provision of public goods



Total demand: Vertical summation
Efficient provisio : $MRS^A + MRS^B = MRT$

Public goods

- Everyone consumes the same quantity
- People have different marginal valuations
- Market does not provide efficient outcome (Market failure)

Samuelson condition: the total marginal valuation of the last/marginal unit must be equal to the social cost of providing this last unit.

Problems in private provision of public goods

Non-excludability implies:

- People benefit from public goods even without contributing => everyone prefers that others pay for public good

Non-rivalness implies:

- If someone contributes, others will benefit from the public good.
- However, when contributing, people may not take into account the benefit of their contribution to others => private provision results in **free rider behaviour**, which leads to **under provision** of the public good.

Example: Consider N identical individuals, who can all contribute max 1 unit of a public good.

- G is the number of units of the public good
- Marginal cost per unit is constant and equals p>0.
- Utility of individual *i* is $U_i = V\ln(G) - pg_i$ where V is a parameter and $g_i \in \{0,1\}$.
- Therefore, **$MU_i = V/G$.**

Calculate the socially efficient level of G

Solution:

$$\sum_i MU_i = p$$

$\frac{NV}{G} = p$ => $G = \frac{NV}{p}$

Now suppose all individuals decide independently whether to buy one unit of the public good What is the Nash equilibrium outcome on this market?

Solution:
For any individual, it is optimal to buy one unit if
$MU_i \geq p \Rightarrow \frac{V}{G} \geq p$

Hence, the Nash equilibrium is $G = \frac{V}{p}$
This means that we will have a market failure as soon as N > 1
Generally, **efficiency loss is larger in larger populations**.

Possible solutions to free-rider behaviour

- Make consumption **excludable** and charge an admission fee. However, making a good excludable may be costly, and because the good is non-rival, excluding people with low valuations is inefficient.
- Use **personalised (Lindahl) prices**, where people with higher valuations pay more. However, individuals then have an incentive to understate their valuation, bringing back the free-rider problem.

Efficient provision of public goods

Government provision is not a solution that can be made easily. This is because:

1. The government does not know individuals' preferences.
    - Individuals have incentive to exaggerate their (marginal) valuation of the public goods
    - Overprovision
2. To finance public goods provision, the government must raise taxes, which might lower efficiency through tax distortions

Applied microeconomics – IBEB – Lecture 2, week 1 (personnel 1) Principal-agent model

The model is a simple yet profound approach to the economic relationships between two or more people. This problem's structure can be applied to many situations (for example, the relationship between a politician (agent) and his voters (principals), but here we will study employer-worker relationship with this model.

The basics of the model

In a simple principal-agent model, we can define the principal as someone who hires the agent to work for her with the objective of maximising her profits.

- For the sake of simplicity, we assume that the sole goal of the principal is to maximise their profits,
- and the agent's is to maximise his utility (more income, less effort is preferred). Agent is lazy and selfish.
- In other words, we assume that both parties are rational economic actors who only care about maximising their own self-interest.

The basic timeline of this model is given as follows:

1. The principal gives the agent an offer/**contract.**
2. **Participation constraint:** The agent will then have to decide to either **accept or reject** the offer. In the case the agent rejects, the interaction of the two parties ends. **Note:** we will see this in week 2 (personnel 2)
3. **The incentive-compatibility constraint:** The agent accepts and chooses how much **effort** he would spend working for the principal.
4. The total output and the principal's **profit is realised**; the agent gets paid for the work according to the contract.

Assumptions and variables

The principal's profits are given by $\boldsymbol{\pi = pQ - Y}$, where:

- **Q** is the agent's output and Y is what the principal pays worker.

The agent's utility is given by $\boldsymbol{U = Y - C(E)}$, where:

- **C(E)** is the function of his cost of effort.
- In general, we assume C(E) is an increasing function that also exhibits increasing marginal costs of effort $(\mathbf{C'(E) > 0;\ C''(E) > 0})$.
- An example we often use is $C(E) = \Theta E^2/2$. It is also important to note that E is not verifiable, whereas Q and Y are more easily measured and visible.

We will assume that the contract indicates $\boldsymbol{Y = a + bQ}$.

- In other words, the principal and agent agree on a linear contract, where the agent will receive ***a*** as the base salary, plus ***b*** for every unit of output the agent produces(bonus).

The production function takes the form of $\mathbf{Q = kE}$, where:

- *k* is the factor of transformation from effort to output, i.e. **k indicates the worker's productivity** (all production capital taken into account).

Solving the Principal-agent problem

Timeline of the principal agent problem (for this example)**:**

1. Principal chooses b
    - **Note:** in this example a = a*, fixed value that agent accepts job for sure
    - This assumption will change in week 2 (Personnel 2)
2. Agent chooses e
3. Profits are realised, salary is paid

Backward induction is applied as we first need **e** to get **b**

2. Agent chooses e:

$$U = Y - C(E)$$
$$U = a^* + bQ - \frac{1}{2}\Theta E^2$$
$$U = a^* + bkE - \frac{1}{2}\Theta E^2$$

- Agent's objective is to maximise **U** with respect to the effort he/she exerts, so we derive w.r.t **E**:

$$MU = \frac{\partial U}{\partial E} = bk - \Theta E = 0$$

Optimal effort: $E = \frac{bk}{\Theta}$

1. Principal chooses b:

$$\pi = pQ - Y$$
$$\pi = pkE - a^* - bkE$$
$$\pi = pk(\frac{bk}{\Theta}) - a^* - bk(\frac{bk}{\Theta})$$

- Principal objective is to maximise $\boldsymbol{\pi}$ w.r.t the bonus, so we derive w.r.t **b**:

$$\pi' = p\frac{k^2}{\Theta} - 2b\frac{k^2}{\Theta} = 0$$
$$p = 2b => b = \frac{1}{2}p$$

The production of Q:

$$Q = ke$$
$$Q = k\frac{bk}{\Theta}$$
$$Q = \frac{pk^2}{2\,\Theta}$$

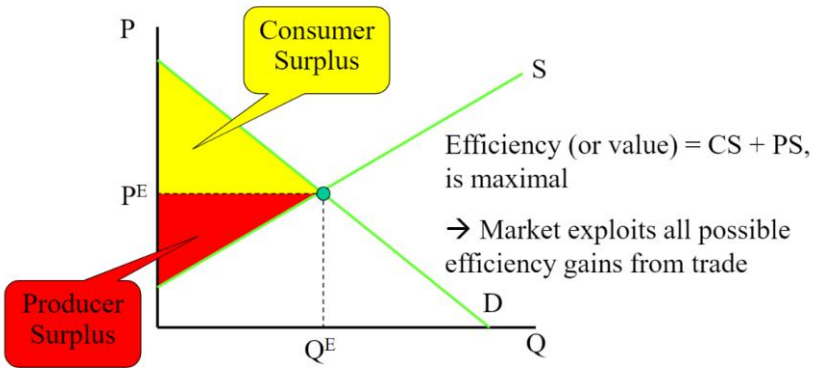
This implies that the base salary a does not influence the agent to spend more effort.

- The amount of effort spent increases with the commission rate **b** and the productivity level **k**.
- This can be understood as the more productive a worker is (given that there is a commission per unit of output), the more effort he would spend doing it.

Applied microeconomics – IBEB – Lecture 3, week 1 (public 1.5) Review of Perfect competition, more on public provision

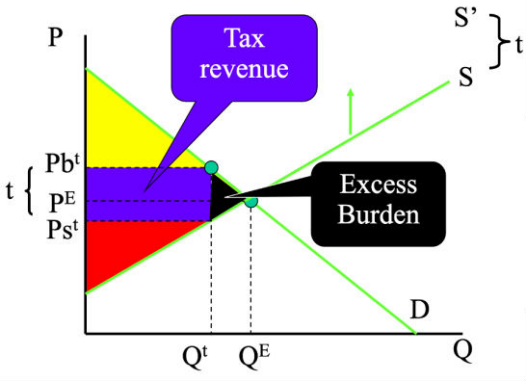
Market equilibrium

The “Invisible hand” sets prices such that demand equals supply.



Tax

Taxes are distortionary as it reduces the total efficiency due to the excess burden (the benefit that now cannot be exploited by any party) created.



The exchange economy

First Fundamental Theorem of Welfare

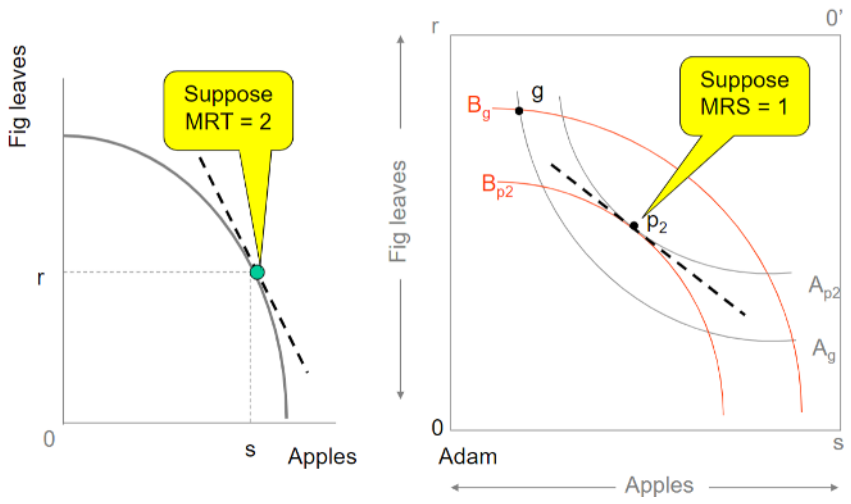
From Week 1 (public 1), we have already seen, how the **Pareto Efficient Allocation** is reached, as well how there can be different Pareto Efficient points represented by the **contract curve**

- We have assumed fixed total quantities of goods
- With the introduction of Production Possibility Frontier (PPF), we have seen that the economy can change allocation of inputs in production
- The equilibrium in this case will be:

$$MRS^A = MRS^B = MRT = \frac{P_x}{P_y}$$

- At this point, rate at which consumers are willing to trade one good for another is the same as the rate at which the economy can transform one good into another through production

If $MRS \neq MRT$, equilibrium is not reached



Notes:

- Different product mix leads to different shape of Edgeworth Box
- This implies that, comparing the two figures, a given consumption bundle for Adam (like point g) gives different consumption bundles to Britt

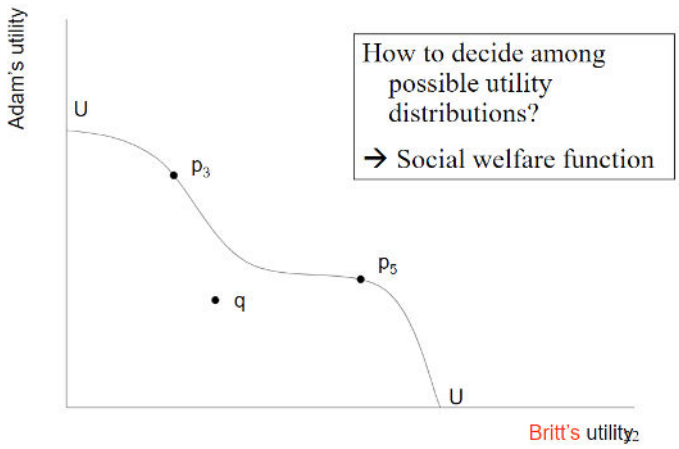
Second Fundamental Theorem of Welfare

Now that we know how reach max efficiency, what about **distribution**, which leads to the second Fundamental Theorem of Welfare:

- Any Pareto Efficient equilibrium can be attained by redistributing initial endowments.

Utility possibility curve

The Utility possibility curve is the same as the contract curve, but in this case it represents the utilities of the individuals in the exchange economy.



Social welfare function

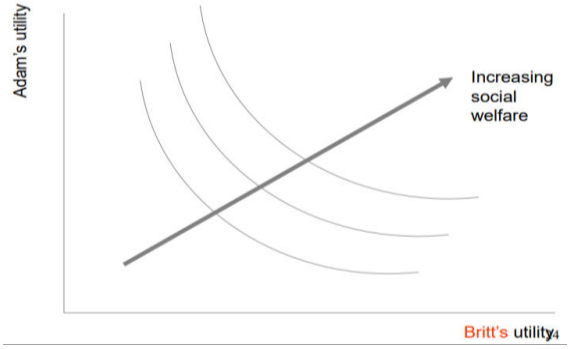
The **Social welfare function** reflects society's views on how the utilities of its members affect the well-being of society as a whole

$$W = F(U_{Adam}, U_{Britt})$$

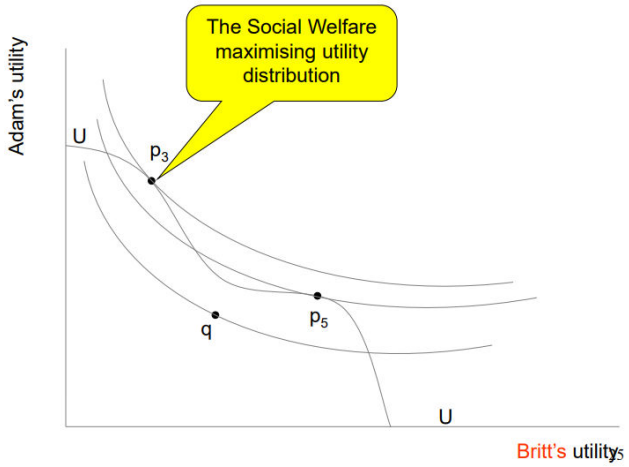
Examples of social welfare functions:

- Utilitarian or Additive: $W = U_{Adam} + U_{Britt}$
- Rawlsian: $W = min(U_{Adam}, U_{Britt})$

If you recall from last year Microeconomics 1, the indifference curves came from the **Utility function**, we can also plot the indifference curves for the Social Welfare function



Social welfare is maximised where the social indifference curve is tangent to the utility possibility curve



Second FTW: Redistribution of endowments can result in the social optimum. The outcome that maximises social welfare is also Pareto efficient.

- However, in reality redistribution is generally income redistribution
- Which can lead to **Trade-off between efficiency and distribution**, more on week 4 (public 4)

Public versus private provision of public goods

Public provision: the government fully or partially finances the provision of a good or service. Public provision does not necessarily mean that the government produces the good itself.

Choosing which goods to provide to the public:

- The market leads to the **under provision** of goods, due to free-rider behaviour.
- The government supply often leads to **overprovision**, because people tend to exaggerate their valuation of the good to get more for free.

Other issues:

- Public provision involves input and administrative cost
- Private provision can better cater individual tastes; however, it may lead to undesirable differences in consumption (e.g. in health care; education)

Commodity egalitarianism: When a community is based on fairness, it may consider that some commodities should be available to everybody.

Cost-benefit analysis with intangibles

Invest when discounted benefits B > discounted cost C
In the case of public investment, several special issues arise:

Example:
Which discount factor should the government use?

- The "risk free rate" or a different rate because society values future generations more.
- How do we take non-monetary intangibles into account? Including the subjective feelings of pride and happiness for example.

Valuing intangibles can be done by:

- Stated/hypothetical valuation: asking individuals how much they value a hypothetical project or change.
- Hedonic pricing: inferring valuations from market prices. For example, higher house prices near a beautiful park or clean streets can reveal how much people value these amenities.

A good example is the value of a life. Even though life may seem "priceless", decisions about safety still require us to put some value on it, for example when deciding how much to spend on road safety or when choosing between a safe or risky job.

Special Example - Quality-Adjusted Life Year (QALY): a measure of the value of a life-year adjusted for disabilities. QALYs are used to evaluate new medicines and treatments by comparing their health benefits with their costs.

Public versus private production

In some cases, the government not only finances the provision but also owns the factors of production (army, police, utilities until recently etc). Even when there is public provision, production can be carried out by private firms.

- Competition and the market environment may make private producers more efficient, resulting in cheaper production.
- However, private producers may have an incentive to reduce unobservable quality to increase profits **->** Less of a problem when there are multiple firms and firms have a long-time horizon as reputation becomes important

Concluding remarks

- There is no clear-cut answer as to whether public or private provision/production is preferable.
- Government intervention should be assessed based on whether it improves efficiency or addresses a market failure, its redistributional effects, and whether it can be implemented at reasonable cost, including tax distortions.

Applied microeconomics – IBEB – Lecture 4, week 2 (public 2) Externalities

Externalities

Externalities arise when activity of a consumer or producer affects utility/payoff of other people, outside the market mechanism:

- Negative externality: production/consumption harms others
- Positive externality: production/consumption benefits others

For example, smoking or driving can result in air pollution, which may harm the other parties in the environment around you (negative externality).
On the other hand, when you walk to work instead of by car, you are benefiting others by not crowding the roads during rush hour (positive externality).

Characteristics

1. Arise due to the lack of an explicit price (Missing market)
2. Can be caused by consumers and producers
3. Can be positive or negative
4. Public good is special case

Market failure:

- Negative externality: overproduction / overconsumption
- Positive externality: underproduction / underconsumption

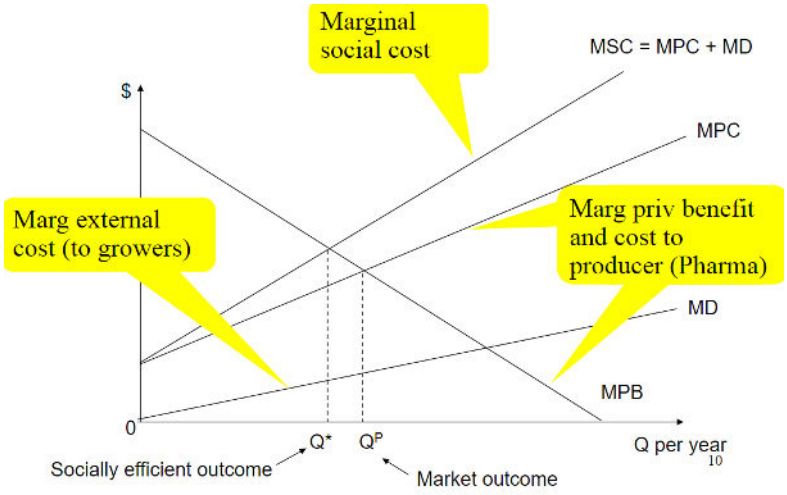
Market failure: Private and social optimum

Example: Negative production externality

- Pharma produces chemicals
- Production process pollutes river Rhine

- In Het Westland, water from the Rhine used to grow tomatoes and the pollution of the Rhine damages the tomatoes

Pharma's production affects the income of tomato growers. However, it does not take this damage into account as pollution is costless.
This results in the difference between the private and social optimum



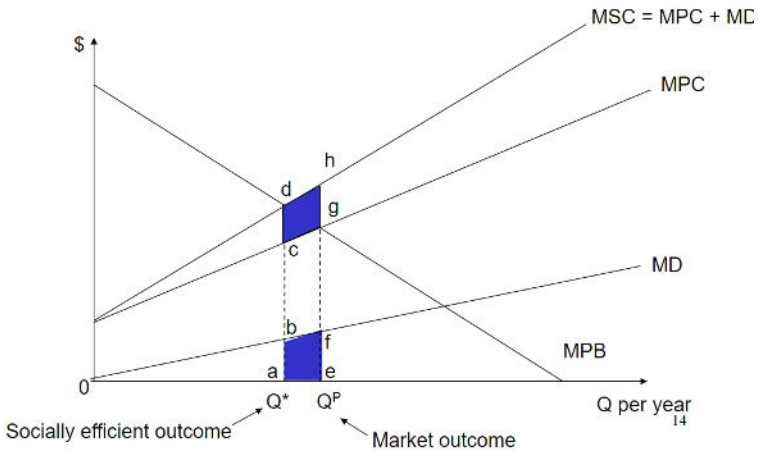
Market outcome:

- Pharma maximises profit at **Qp** where MPB = MPC
- Growers want Q = 0 (no damage)

Social optimum: MSB = MSC

- In this example, MSB = MPB and MSC = MPC + MD

Socially efficient production level = **Q*** (This is smaller than **Qp**)



Social gain in moving from **Qp to Q***

- Pharma loses profit: area **dcg**
- Growers gain from reduction in pollution: area **abfe**

Note: area **abfe** is the area below the MD (marginal external damage) curve between **Qp and Q***

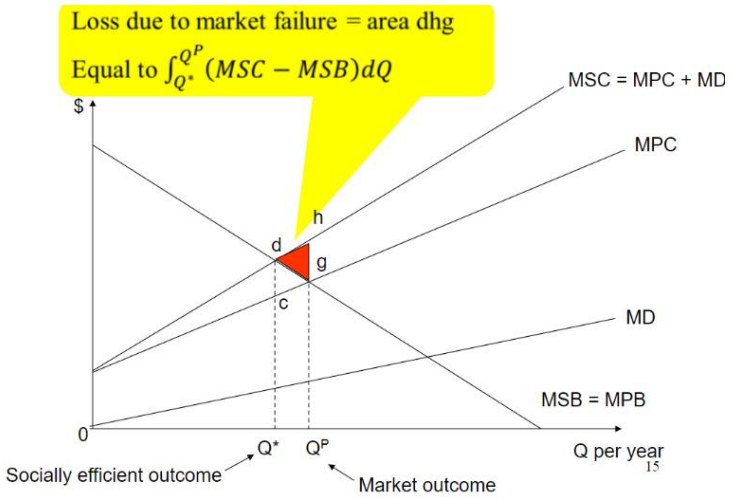
As MSC = MPC + MD, area **abfe** is equal to the area between the MSC and MPC curves between Qp and Q*

- area **abfe** = area **cdhg**

It follows that area **cdhg** > area **dcg**

- For each Q > Q*, MD > MPB – MPC

So, for each reduction in Q until Q*, gain growers > loss Pharma



Result discussion:
With externalities, market outcome is not socially efficient:

- Overproduction / overconsumption with negative externality.

Main cause: Missing market for side-effect of production/consumption (side-effects are not priced and, hence, are not taken into account)

Missing markets arise when property rights are not established (no one owns it), for example:

- Air (pollution)
- Public space (noise, filth, roads)
- Natural resources (rivers, forests, fish)

Internalising an externality: making the party causing the externality to take the external costs or benefits of its actions into account when making its decision.

Solution for Market failure due to externalities

Via private negotiations (Coase Theorem)

Coase theorem: under some conditions, private parties may arrive at the social optimum through negotiation, without government intervention

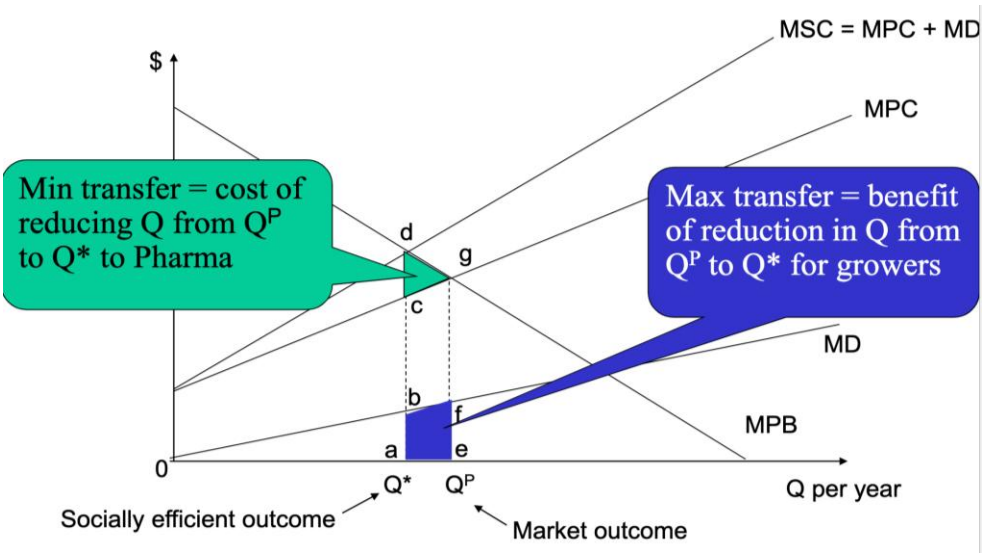
1. There are transferable **property rights** established and enforced (so that externalities can be internalised)
2. The transaction cost is sufficiently low (cost of arriving at a mutual agreement should be sufficiently low)

Note: the initial allocation of property rights does not affect efficiency (Q* is reached), but it does affect distribution.

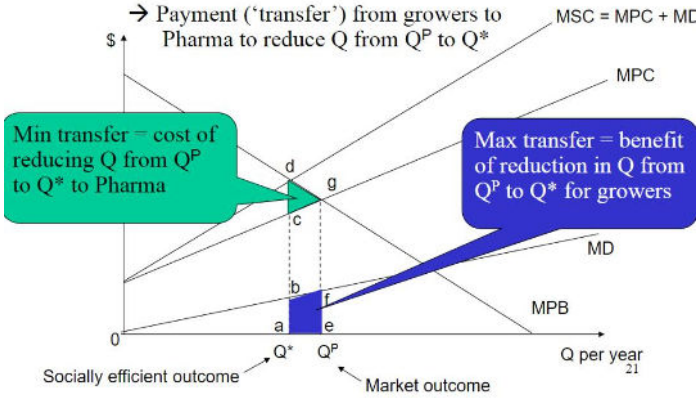
The outcome of Coase theorem is at the socially optimum Q*

- For a marginal reduction in Q, growers are maximally willing to pay marginal damage (MD)
- Pharma only accepts a marginal reduction in Q if the compensation is at least the loss in profit (MB – MPC)
- So, reduction in Q until MD = MB – MPC
- Hence, equilibrium has MD + MPC = MB, which only holds when Q = Q*

If Pharma owns the property right, growers are willing to compensate Pharma for reducing production. The minimum compensation Pharma accepts equals its lost profit, while the maximum growers are willing to pay equals their reduction in external damage.



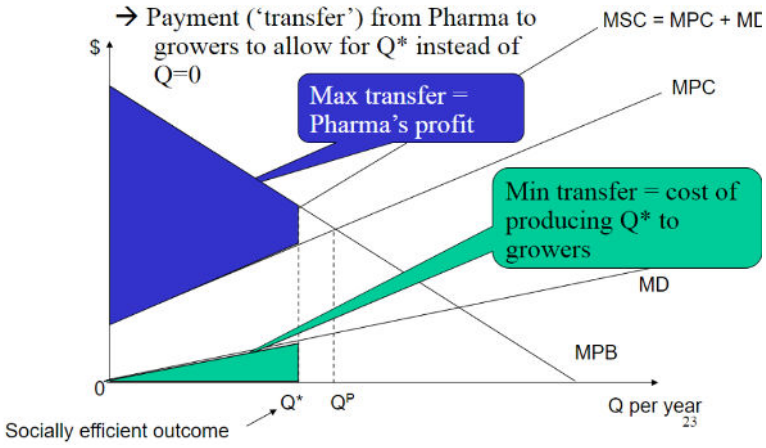
If Pharma owns property rights



If growers have property rights

The same argumentation holds (the same level of Q is resulted, only now transferred from Pharma to growers).

⇨ Allocation of property rights does not affect efficiency but does affect distribution.



Negotiations require low transaction cost, meaning that agreements should be easy to arrive at and to enforce

- Few parties involved.
- No asymmetric information

If the transaction cost is too high, there would be no or limited negotiations. In this case, who owns property rights does affect efficiency

Via public intervention

Pigouvian tax/subsidy

Externality arises because prices do not reflect all social costs and benefits.

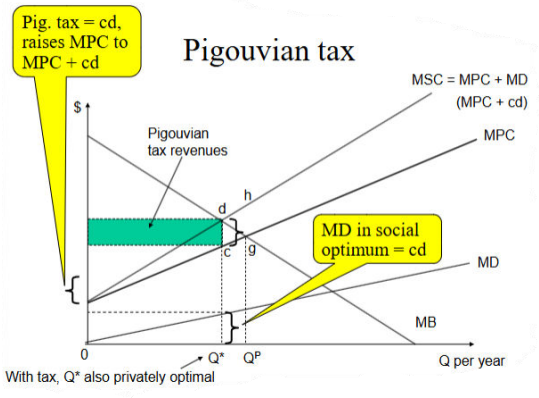
⇨ **Solution:** change prices faced by producer of externality using Pigouvian tax/ subsidy

Pigouvian tax = MEC (also MD) at optimum quantity Q*

Facing tax t, Pharma sets output such that MB = MPC + t
When t equals MD at Q*, Pharma chooses Q such that MB = MPC + MD (Q*)
Which only holds at Q = Q*, the socially efficient level of Q!

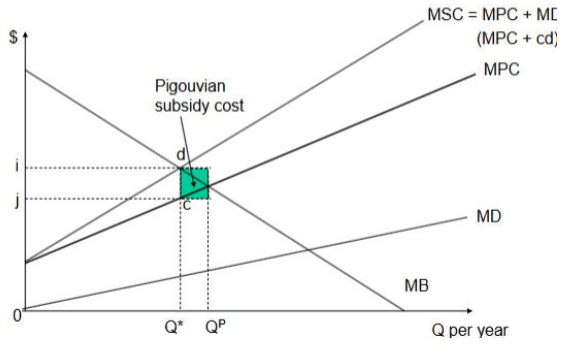
Tax revenue: tQ
Lost profits Pharma: tQ* + area cdg
Reduction in External Damage: cdhg
Efficiency gain: area dhg

- As you can see below MEC at Q* = cd
- So now MPC = original MPC + cd



Pigouvian subsidy = MEC at optimum quantity Q*

- As you can see below MEC at Q* = cd
- Subsidy acts as an opportunity cost; they can either produce and get no subsidy or not produce and get subsidy
- Subsidy (cd) is higher than the profit of the firm from $\boldsymbol{Q^P}$ $\boldsymbol{to}$ $\boldsymbol{Q^*}$



- Both yield socially efficient level Q*
- Both require that the government has (full) information on all costs and benefits.
- In practice, optimal level of tax/subsidy is a difficult but important question (Lots of room for government failure)

The main difference is their distributional effects: with a tax, the polluter pays the government; with a subsidy, the government pays the polluter for reducing the externality.

Regulation

- Restrict or even forbid production/consumption
- Enforcing production standards (safety, environmental)
- Affect property rights/decision rights

This requires lots of information

Cap and trade

- This system is a combination of regulation and Pigouvian tax
- Impose maximum on total emission (cap)
- Give/sell emission permits to producers
- Allow producers to trade permits
- Price of permit that arises on the market serves as an opportunity cost of emission
- Example: EU Emissions Trading System

Market options (Merging)

As a last note, there is the possibility for two companies to merge. If we are in a scenario where two companies are producing, and one has a negative externality effect on the other, then through a merger these two companies can internalise the externality and increase the profits they are making.

Concluding remarks

Externalities arise when consumption/production has direct effect on utility of others

⇨ Outside the market mechanism

Result: From a (social) efficiency perspective,

- Too much consumption / production with neg. externality
- Too little consumption / production with pos. externality

How to improve:

- Private bargaining (Coase Theorem)
- Merging
- Pigouvian tax or subsidy
- Regulate

Applied microeconomics – IBEB – Lecture 5, week 2 (personnel 2) Efficiency and extensions

Why do we analyse models?

1. Answer practical questions – normative nature
2. Understanding the world better - positive nature
3. Social welfare - normative nature
4. Can we do better? - From society's perspective

For this Lecture we have the same assumption and variables as in week 1 (personnel 1) model, the only addition is the **'Participation constraint'**, and make base pay a variable chosen by the principal instead of being fixed at a*. We assume there is no minimum wage in the economy.

Timeline of the Principal-Agent problem

1. Principal designs and offers the contract, chooses (a, b)
2. Agent decides whether to accept the contract, **'Participation constraint'**
3. If agent accepted, then the agent chooses effort, e
4. Agent gets paid and profits are realised

Note: for the same reason as in Week 1 (Personnel 1) we need to work with backward induction

3. Agent chooses e:

$$U = a + bkE - \frac{1}{2}\Theta E^2$$

And optimal effort

$$E = \frac{bk}{\Theta}$$

2. Participation constraint V

- The agent decided whether to accept the job or go for an alternative option that gives him/her **utility of V**

For the agent to accept the contract (not change company), U>V:

$$U \geq V$$

$$a + bkE - \frac{1}{2}\theta E^2 \geq V$$

$$a + bk\frac{bk}{\Theta} - \frac{1}{2}\theta\left(\frac{bk}{\theta}\right)^2 \geq V$$

Solving for a yield:

$$a = V - \frac{1}{2}\cdot\frac{b^2k^2}{\Theta}$$

Note: we use '=' as this the amount that agent is indifferent between job or alternative option, meaning this is the minimum a

- We see that the wage (a) increases in V this means that when the utility of the worker at the outside option increases, the wage required to keep him will also increase

3. Principal chooses (a, b):

Now with the optimal level of effort (E) and the optimal wage (a), we can get the b and find the exact function for a

$$\pi = pQ - Y$$

$$\pi = pke - a - bke$$

$$\pi = pk(\frac{bk}{\Theta}) - (V - \frac{1}{2} * \frac{b^2k^2}{\Theta}) - bk(\frac{bk}{\Theta})$$

Maximising with respect to b yields:

$$\pi' = (\frac{pk^2}{\Theta}) - (\frac{bk^2}{\Theta}) = 0$$

$$p - b = 0 \Rightarrow p = b$$

$$a = V - \frac{1}{2}\cdot\frac{p^2k^2}{\Theta}$$

After maximising b, we get that it is equal to the price. This means that the employer achieves maximum profits when giving the entire marginal benefits of the product to the agent.

Social welfare and efficiency

We will now look at the efficiency of the previous model and make it more realistic by adding extensions. We will check whether the outcomes of this model maximise social benefits.

Social welfare function = SW = $U + \pi$ (sum of utilities of all players involved)

We then get:

$$SW = pQ - y + y - \frac{1}{2}\Theta E^2$$

Plugging in the optimal effort:

$$SW = p(k\frac{bk}{\Theta}) - \frac{1}{2}\Theta * \frac{b^2k^2}{\Theta^2}$$

Now maximising with respect to b:

$$SW' = pk\frac{k}{\theta} - b\frac{k^2}{\theta}$$
$$SW' = p - b = 0$$
$$b = p$$

From this, we can conclude that the social and private choices are aligned
⇒ agent chooses effort $E = \frac{bk}{\Theta}$, same effort level he chooses privately.

Applied microeconomics – IBEB – Lecture 6, week 2 (public 2.5) Education and common resource problem

Education

First, let us consider an important fact: education is **NOT a public good**. Education is in fact a private good. The reasons are the following:

- Education is a rival since the more students there are the higher the cost and the benefit is lower. Thus, the MC of an additional student is not equal to zero
- If legally permitted, education can be excludable by law, by entrance requirements or by cost

From the individuals' perspective, education is an investment, because:

- It has a cost of both the actual tuition fees and the earnings that the person foregoes (to pursue (higher) education)
- There are future benefits of education, which include a potential higher income and productivity and knowledge that is intrinsically valuable

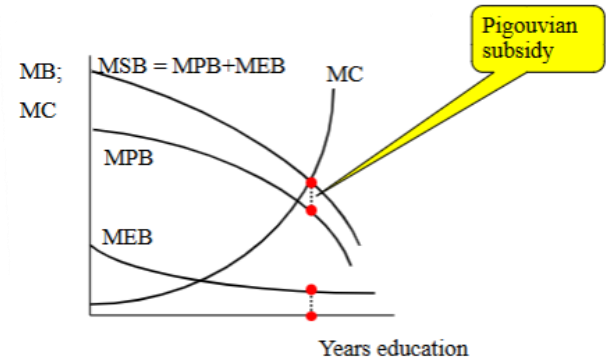
Now the question we are investigating has really become: **why is there so much public involvement in (the provision of) education?**

Education leads to positive externalities

We have already looked extensively into what negative externalities are, in this case we have **positive externality**, which unlike the negative one,

- We have **MEB** and **MSB**, instead of MEC and MSC
- Since individuals only consider MPB, without a subsidy the level of education is inefficiently low
- A Pigouvian subsidy equal to MEB at the socially efficient level can internalise the positive externality

⇒ MSB = MPB + MEB



Note: Only positive externality if Social benefit > private benefit

- Those with a higher education, on average, have a higher wage; therefore, they are also in a higher tax bracket and results in a higher income tax, making government's revenue significantly increase.
- When a bigger proportion of the population is highly educated, society as a whole is prone to making better informed and educated participation in public issues, which benefits all members of that society (for example in voting).
- There is also the Spillover effect of knowledge. For example, in a population, the highly educated will share their knowledge with the lower educated possibly in daily interactions (transmission of knowledge).

Access to higher education

- Wealthy students can pay out-of-pocket, poor students have to find a loan
- Loans for human-capital investment are risky for banks because there is no collateral → banks charge high interest rates. The problem is enhanced by asymmetric information.
- This can result in the reduced enrolment for the less wealthy students, or (too) large student debt.
- The government can on the other hand do better (this is a line of argumentation, not absolute truth) by providing student loans with lower interest rates and longer payback schedules.
- These can be paid off through higher income and productivity later (people are in a higher tax bracket implying government gain in revenues).

Asymmetric information in education: students and parents may have difficulty observing the quality of education, giving schools scope for moral hazard. Government regulation and inspection may therefore help preserve quality or shut down poor-quality schools.

Distributional issues regarding fairness, equality and paternalism

The **social norm** is that we desire equal opportunities based on forecasting independent of the subject's background, family, or wealth. This is related to **Commodity Egalitarianism,** which argues that distributional concerns may justify ensuring access to certain important goods, such as education, regardless of an individual's family background or income.

The way to maximize efficiency implies that more education should be provided for smart students. However, this creates unequal opportunities. From a distributional perspective, we would need to invest more education to the low-ability students. It does not necessarily follow that tuition fees should be lower for everyone, however.

How will people respond to higher tuition fees?

Higher tuition fees can:

- strengthen incentives to graduate within the nominal duration, potentially reducing procrastination but also valuable extracurricular activities
- induce students to work more alongside their studies, potentially reducing study time.

Public provision of education: to conclude

- The key market failure is **positive externalities**.
- The magnitude of these externalities largely determines the **optimal subsidy/tuition fee**.
- Estimating the magnitude of the externality is therefore an important empirical question.
- Distributional arguments are less clear-cut.

Should the public sector or private sector provide education?

Arguments for relying on the **private sector**: schools can decide on the quality/cost of education which would be optimal due to competition in the market. And if the cost is larger than the voucher (subsidy) then the parents would have to pay out of their own wealth.

Counter Arguments for private education:

1. Parents may be unable to judge the quality of the education
2. The market for education would potentially end up with the wealthy gaining a better education (distributional inequality).
3. Positive peer effects may be reduced. Students benefit from interacting with motivated/high-performing peers, but increased segregation between schools may reduce these benefits.

On the other hand, the publicly provided schools may **crowd out** the private sector by simply not leaving any room for the private sector to derive profits and so potentially leaving the educational system at a lower rate of profit than with competition.

The common-pool problem

Common pool problem arises when resources are rival but non-excludable:

- The non-excludable property of these resources is due to insufficiently defined or unenforced property rights
- The rival property implies that the marginal cost of more producers or consumers is positive and not zero

This often leads to the overcrowding of the resources because the individual may fail to take into account the preferences or the costs/benefits of the other individuals using the resource (**Tragedy of the Commons**).

Example: Fishing community

Ork is a fishing community with N citizens who only care about money, each citizen can:

- Undertake some paid work at wage **'w'**

- Rent a boat at cost **'c'**, and go fishing
  - Number of fish the fisher catches, 'F', decreases in the number of fishing boats 'B' on the lake, **F(B)**, where **F'(B) < 0**
  - Market price is 1 per fish
    - Revenue from fishing is F(B)
    - All efficiency effects on producer's side, no effects on CS

When each citizen decides independently:

$$F(B^P) - c - w = 0$$

Socially efficient number of Boats:

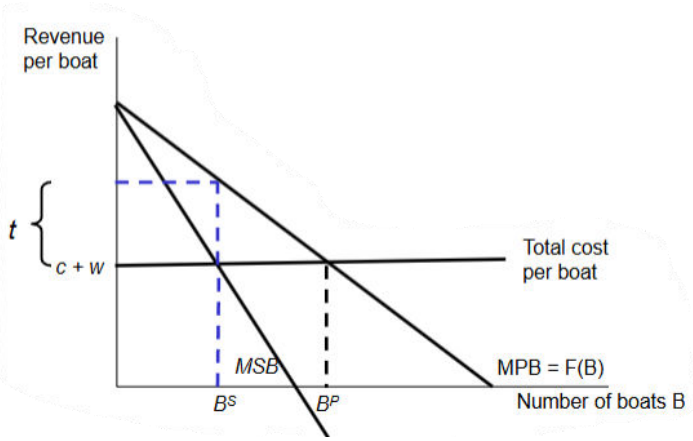
$$SW = B^S(F(B^S) - c) + (N - B^S)w$$

- Max w.r.t B

$$F(B^S) - c - w + B^S F'(B^S) = 0$$

As $B^S F'(B^S) < 0$, we have that $B^P > B^S$:

- Because in deciding between working and fishing, individuals do not take into account that the presence of their boat on the lake reduce the quantity of fish caught by others
  → negative externality



Ways to reach **socially efficient B^S**:

- Pigouvian tax per boat
  - $t = -B^S F'(B^S)$
- Fish quota
- Governance by community: (Elinor Ostrom, 2009)

Elinor Ostrom (winner 2009 Nobel-prize Economics) has shown that small communities can create their own governance arrangements to overcome common-pool problems, often through implicit agreements/contracts → **Coase theorem**.

Applied microeconomics – IBEB – lecture 7, week 3 (public 3) Asymmetric information

Imperfect Information

- all parties face uncertainty, such as uncertainty about a company's future stock price.

2 main types of asymmetric information

- Hidden actions, leads to **moral hazard**: Non-verifiable actions that harm others in transaction
- Hidden characteristics, leads to **adverse selection**: One party has better information on given aspect of transaction

Moral hazard

- Undertaking **non-verifiable**, socially inefficient actions
- Actions are beneficial to the person choosing them, but the cost it imposes on others **in transaction** are higher than this benefit (Individually rational but socially inefficient)
- Examples: employee slacking off, unhealthy living by individuals with health insurance

Leads to reduced efficiency of transaction, and may even completely obstruct transaction

- Main difference between externalities and Moral Hazard is that these are non-verifiable

If action is **verifiable**, they will reach the efficient outcome, as firm knows who will be driving unsafely, thus the outcome is to rent only to safe drivers

Rent-a-scooter

	Safe driving	Unsafe driving
Exp. Cost to firm	50	100
Value to Consumer	70	90

If this > 120, then outcome is efficient

- Since it's non-verifiable, firms anticipate consumer will drive unsafely, so they demand price ≥ 100, however consumer value is lower, so they won't rent
- Outcome: No rental at all

Moral hazard can lead to market failure: As actions are not observable, market price does not reflect all cost and benefits

Note 1:

- If **private gain > cost to others**: Action is efficient, and price adjusts to cover cost
- If **private gain < cost to others**: Efficiency suffers. All parties involved could benefit from a commitment not to engage in socially inefficient actions. However, non-verifiability makes such a commitment impossible.

Note 2: Moral hazard implies hurting others for personal gain. In reality, not everyone always engages in moral hazard

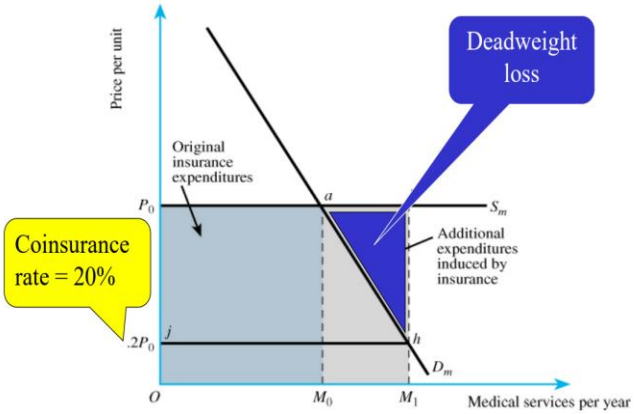
Other examples of moral hazard (increasing consumption when the other party pays)

- More visits to physician by insured person
- Too much risk-taking by banks as they anticipate bailouts

Another example of moral hazard: Increased 'Consumption' when other party pays (partially)

- Coinsurance 20%, means that consumer only pay 20% of healthcare costs
- If there was no insurance the market equilibrium will be at point **a**, so **M0**, however, with insurance this leads to more demand for healthcare (consumer engage in less safe actions as they know they are insured) which leads to **h**, so **M1**
- This causes the total healthcare consumption to increase

- Consumer surplus is only the area (triangle) below the demand curve and above **0.2P0**, because it is the difference between max WTP and actual pay
- As you can see from points beyond **M0**, there is an amount that **P0 > MB** for the consumer, this means that the **'private gain < cost to society'**
- Which leads to inefficiency as there is **'Deadweight loss'**



Note: Negotiating as in the Coase theorem does not apply for moral hazard as it does not meet the criteria "low transaction cost" (actions are non-verifiable)

⇨ Contracts cannot provide commitment

How can private parties improve efficiency

- **Monitoring:** Random checks of activities, inspection. However, this is costly
- **Pay-for-performance:** Piece-rates. However, this may lead to inefficient risk-sharing or distortions, if there's no perfect link between the actions and measured performance
- **Regulation:** Limits to insurance coverage, rigid working hours. However, this restricts the value of the transaction
- **Implicit contracts/reputation:** If you engage in moral hazard, I will never interact with you again. This requires that actions are observable and that the future sufficiently important
- **Professional ethics/social norms:** If I engage in moral hazard, I feel bad about myself.

Adverse selection

- Hidden characteristics: Some parties in a transaction have better information about characteristics that affect the value of the transaction than others
- Consequence: uninformed people **cannot offer different prices** for 'good types' and 'bad types' of trading partners
- The informed parties **self-select** themselves into and out of transactions in such a way that the uninformed side gets the least valuable trading partners
- Profitable transactions are not undertaken resulting in inefficiencies.
- Example: Quality of second-hand items, probability of repaying loans

Adverse selection example

Rent-a-scooter
Two types of consumers: safe and unsafe
Consumer knows which type, firm only knows p(safe) = 50%

	Safe type	Unsafe type
Exp. Cost to firm	50	100
Value to consumer	70	120

Efficient outcome: Both types rents scooter
Real Outcome: Only unsafe types rent scooter: adverse selection

⇨ If both type would rent, expected cost is 75, so price ≥ 75
⇨ But safe type won't rent at that price
⇨ So we are left with only the unsafe type

Another example of adverse selection: Second hand cars

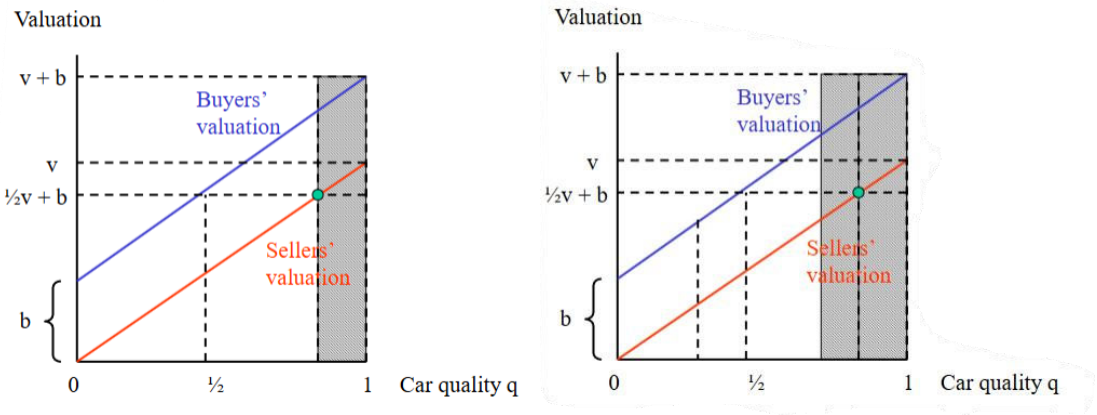
Market for second-hand cars:

- **Quality (q)** is Uniformly distributed between 0 and 1
- As many buyers as seller, all risk-neutral
- Sellers know the quality of their own car, they value it at vq
- Buyers do not know the quality of a given car; they value it at vq + b

- Where b is such that $0 \leq b < 0.5v$

Note: Price the same for all cars (independent of q), as buyers do not know quality (q)

- Maximum price buyers are willing to pay is $\frac{1}{2}V + b$, because buyers expect the average quality to be $\frac{1}{2}V$ since it is uniformly distributed between 0 and 1
- However, at that price some sellers with high quality cars refuse to sell, meaning the ones left are of lower quality
- Buyers anticipate this and WTP decreases even more, however this means that even more sellers leave
- Fraction of the car that could have been traded is not traded (**inefficiency**),
  - because buyers don't know the quality, so they are only WTP lower amount,
  - however, this causes higher quality cars to leave, leaving only the low quality, thus **adverse selection**



If we follow the logic from explanation above, the buyers will keep on decreasing WTP, which again makes sellers leave, this goes on and no trade will happen

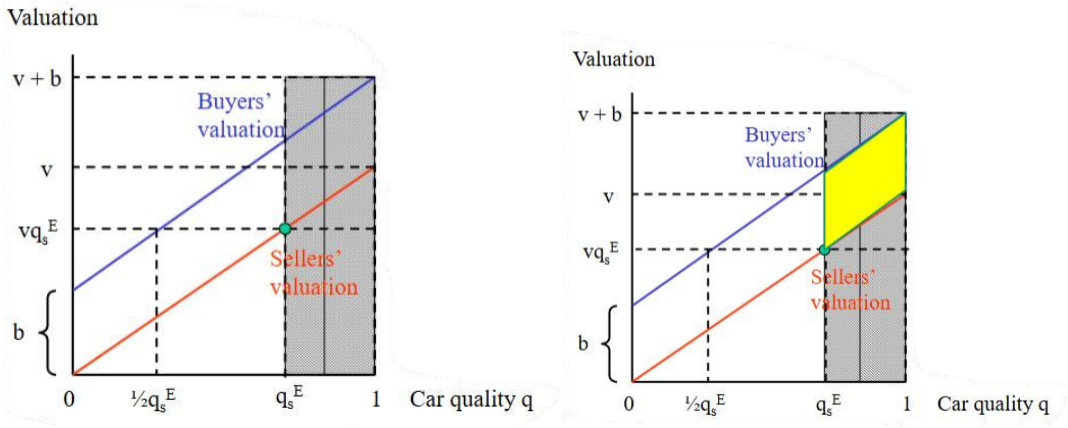
- However, there is an equilibrium
- There will be a point at which buyers WTP = sellers' valuations of their car denoted by $\boldsymbol{q_S^E}$
  - For which seller is indifferent between selling or not

$$\frac{1}{2}vq_S^E + b = vq_S^E$$

Rewrite this equilibrium condition to: $q_S^E = \frac{2b}{v}$

Hence, in equilibrium, only cars with quality $q_S^E \leq \frac{2b}{v}$

We can quantify the **efficiency loss** (yellow area) = $b \cdot (1 - q_S^E) \cdot total\ Nº\ of\ cars$



Note:

- In equilibrium, only part of the cars is traded, which is inefficient.
- More cars traded if the difference between the valuation of buyers and sellers is large (b is high)
- The buyers can only trade with sellers with relatively bad quality cars -> adverse selection

Conclusion: Hidden characteristics harm efficiency, because:

1. Price/contract cannot depend on the type of informed party
2. The informed party self-selects into transactions such that the types that yield low value to the uninformed party are more likely to join
3. Uninformed parties are hesitant to engage in transactions

Note: The key assumption here is that the informed people are not honestly revealing their type

Possible solutions by private parties

- **Tests, expert opinions and peer reviews** (But this is costly)
- **Offer multiple contracts** where the uninformed party may induce the informed parties to self-select (additional insurance, offering fixed and variable wage)
- **High-quality informed parties signal their quality** (warrantees, diplomas and certificates) but this is costly
- **Implicit contracts/establishing a reputation for honesty:** If you ever lie to me, I will never interact with you again. This requires that information gets revealed later and that the future is sufficiently important.

Government intervention

Note that inefficiencies arise from private parties lacking information. However, the government also faces an identical lack of information!

⇨ Therefore, there is no easy solution through government intervention.

Some measures that may reduce inefficiency:

- Make some actions illegal, with penalties (fraud, speeding)
- Make participation mandatory (car & health insurance)
- Help to provide information (quality standards, inspection)
- Public production (poverty insurance)

Application: insurance

In many insurance markets, both **moral hazard** and **adverse selection** play a role. This is because risk-averse people dislike uncertainty in their income/wealth, which implies that risk-averse people prefer a certain income over an uncertain income with the same average.

Mathematically risk aversion implies concave utility from income

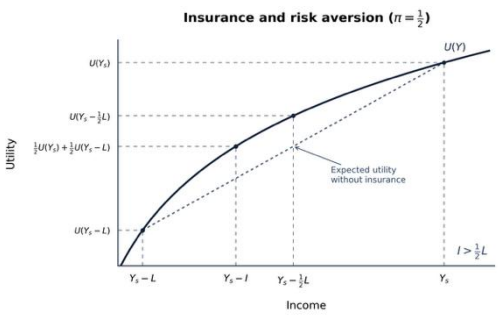
$U(Y); U'(Y) > 0; U''(Y) < 0$

Suppose income Ys, Loss L with probability π

Then: $(1-\pi)U(Ys) + \pi U(Ys - L) < U(Ys - \pi L)$

Average Utility

Utility of average income



Consumer is willing to pay up to I for insurance that pays out L in case of a loss.

Note: $I > \frac{1}{2L}$

Insurance works by pooling many uncorrelated risks

- if everyone pays expected (= average) loss in advance, then by the law of large numbers, this should be about enough to compensate those who actually 'lose'.
- risks must be uncorrelated, no private insurance for natural disasters
- However, insurance can come with two main problems, namely:

Moral hazard → The probability and size of loss depend on choices/behaviour. After acquiring insurance, some individuals may alter their behaviour, increasing the anticipated loss. Example below:

- Viola has income Y = 625, healthcare cost H = 225, 50% of sick
- U = $\sqrt{C}$, where C = Y – H, consumption
- If she exercises, 40% of sick, but Utility cost of 0.4
- Will she exercise? **Yes, $\boldsymbol{EU^{ne} < EU^{e}}$**

$$EU^{ne} = \frac{1}{2}\sqrt{625} + \frac{1}{2}\sqrt{625 - 225} = 22.5$$
$$EU^{e} = \frac{3}{5}\sqrt{625} + \frac{2}{5}\sqrt{625 - 225} - 0.4 = 22.6$$

If we introduce insurance:

- Insurance assumes Viola will exercise
- **Premium I = $\boldsymbol{\frac{2}{5} \cdot 225 = 90}$**, they will pay 225 to viola if she gets sick
- Will Viola accept insurance? **Yes, $\boldsymbol{U^{e} > EU^{e}}$**

$$U^{e} = \sqrt{625 - 90} - 0.4 = 22.73 > EU^{e} = 22.6$$

- However, Viola now has insurance she does not exercise
- So Insurance anticipates this and **premium I = $\boldsymbol{\frac{1}{2} \cdot 225 = 112.5}$**
- Will she accept insurance? **Yes, $\boldsymbol{U^{ne} > EU^{e}}$**

$$U^{ne} = \sqrt{625 - 112.5} = 22.64 > EU^{e} = 22.6$$

However, she would be better off if she could (credibly) commit to exercise, $\boldsymbol{U^{e} > U^{ne}}$

Adverse selection → People may be better knowledgeable than insurance companies about the factors that influence projected loss, and insurance is more valuable for those who anticipate substantial losses. Example below:

- We introduce Caroline to the example discussed in Moral Hazard
- All the same, except she has only 10% of sick
- If Insurer can distinguish between the two premium Caroline = 0.1 * 225 = 22.5
- Will Caroline take the insurance? **Yes** $\boldsymbol{U_I > EU_{NI}}$

$$U_I = \sqrt{625 - 22.5} = 24.55 > 24.5 = 0.9 \cdot \sqrt{625} + 0.1 \cdot \sqrt{625 - 225} = EU_{NI}$$

- Now suppose insurer cannot distinguish, **premium = 0.3 · 225 = 67.5**

$$U_I = \sqrt{625 - 67.5} = 23.61 < 24.5 = EU_{NI}$$

However, Caroline will not take up the insurance, thus **Adverse selection**:

- Insurer cannot offer different 'prices'
- Only the most costly sister willing to pay

As shown above, probability and/or level of loss may be affected by individuals' characteristics or behaviour, which leads to the case of adverse selection and moral hazard. This results in market failures:

- Markets do provide some insurance, but are not efficient
- Markets do not provide insurance at all

Risk selection

On average, groups of people differ in how much they claim from their insurance company. Therefore, on efficiency grounds, **risk-selection reduces the adverse selection problem:**

- Charge higher insurance premiums to relatively high-risk groups.
- Young people and people in densely populated area pay higher car insurance premium
- Older people pay more for health insurance

Clearly, this is only possible with observable characteristics.

However, you get into **distributional and ethical issues:**

- Should overweight people pay more for health insurance?

- Should people be tested on HIV before a health insurance premium is being determined?

⇨ There is a trade-off between efficiency and distribution.

The Current Dutch Solution: 'Basisverzekering'

- Minimum set of insured treatments
- Every citizen is required to have at least this insurance (reduces adverse selection)
- Insurers obligated to accept everyone who wants this minimum insurance. One rate for all clients
  ➔ No risk selection for the basisverzekering
- Insurers who take up a large proportion of high-risk clients are compensated

Concluding remarks

Asymmetric information may strongly reduce market efficiency

- Moral hazard: individuals take non-verifiable actions that are individually rational but socially inefficient
- Adverse selection: uninformed parties interact with the 'worst' fraction of the parties with better info on characteristics of transaction.

Potential private solutions to this market failure:

- Signalling and screening. But: costly
- Limiting possible choices/actions

Potential public solutions:

- Regulation (information disclosure; mandatory insurance)
- Public production (NHS in the UK poverty insurance)

Applied microeconomics – IBEB – lecture 8, week 3 (personnel 3)
Pay for performance in practice

Empirical data

To perform verification of the model we have analysed up until now, the most crucial requirement is to have good data

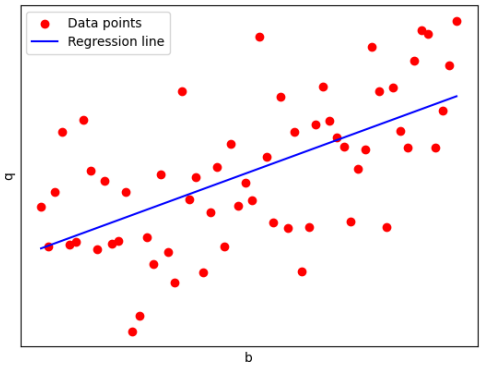
- Our goal is to check whether out hypotheses of increasing bonus (b) indeed lead to an increase in quantity (q)
- However, data on **'e'** is very difficult to find
- But we can find **'q'**

$$q = ke = \frac{bk}{\theta}$$

- So we can find $\frac{dq}{db}$, which is precisely what we want to know, what is the increase in q due to a unit increase in b

One we have the data on **'q'** and **'b'**:

- We plot the data, in a **scatterplot**
  - Independent: b
  - Dependent: q
- Run a **regression**



Possible problems

When you use empirical data, you must be careful of not committing to main errors:

- **Reserved causality**: the cause and effect of a relationship is swapped
  - E.g.: Maybe q is what causes b to increase
- **Omitted variable bias**: When you do not take into account an important variable that can affect the result of the regression
  - E.g.: One group of inspiring managers and a group of not-inspiring managers,
    - The not-inspiring uses bonus, but inspiring doesn't use bonus
    - If you run the regression and don't take into account, the charisma of the managers, this can get you incorrect results

Solution: Randomised experiment

With large enough data, we can randomise the selection, and separate into 2 groups

- Control: with no bonus
- Treatment: with bonus

Crucial the division is random, this way according to the **'Law of large numbers'**, the two groups are likely to be similar in all characteristics, including the distribution of inspiring and uninspiring managers

Shirking: Young and Old worker

Young worker	**Old worker**

Each period, worker decides whether to work hard or to shirk

- Shirking is detected by the employer with a probability of **'π'**
- If shirking is detected, worker is fired and does not receive the wage

Older worker (condition for not shirking)**:**

- Utility of working hard: $\mathrm{U} = \mathrm{W} - \mathrm{C}$
- Utility of shirking: $U^S = (1-\pi)\mathrm{W} + \pi \cdot 0$

$$\mathrm{W} - \mathrm{C} \geq (1-\pi)\mathrm{W} + \pi \cdot 0$$
$$W \geq \frac{c}{\pi}$$

- Lower prob. of detection, higher W, as lower π means it is easier to shirk

Young worker (condition for not shirking):

- Keeping the job yields **utility V**, as unlike old worker he still a while till retirement
- Utility of working hard: $\mathrm{U} = \mathrm{W} + \mathrm{V} - \mathrm{C}$
- Utility of shirking: $U^S = (1-\pi)(\mathrm{W}+\mathrm{V}) + \pi \cdot 0$

$$\mathrm{W} + \mathrm{V} - \mathrm{C} \geq (1-\pi)(\mathrm{W}+\mathrm{V}) + \pi \cdot 0$$
$$W \geq \frac{c}{\pi} - V$$

- Young workers require less W to make them not shirk as they have intrinsic motivation V to keep the job

Applied microeconomics – IBEB – lecture 9, week 4 (public 4) Redistribution

Redistribution

Redistribution: Altering the distribution of a good (e.g. income) over individuals (or households), this is not just about money:

- Life expectancy
- Infant mortality
- Literacy
- Child labour

E.g: The rich being taxed and the poor being subsidised, redistribution from young to the old and the healthy to the sick.

Reasons for redistribution

Normative answer: Because 'society' prefers a different distribution than the market generates:

Redistribution aims to "Promote Greatest Good for Greatest Number" (Bentham)

Using Utilitarian Social Welfare Function:

$$SW = U_1 + U_2 + \ldots + U_n)$$

Assuming:

- Utility of individuals depends only on their income
- Utility function exhibit diminishing marginal utility of income:

$$U'(Y) > 0; U''(Y) < 0$$

- Total amount of income is **fixed**

Recall the Second Fundamental Theorem: Any Pareto-efficient allocation of goods (and, hence, utility) can be obtained through reallocation of resources

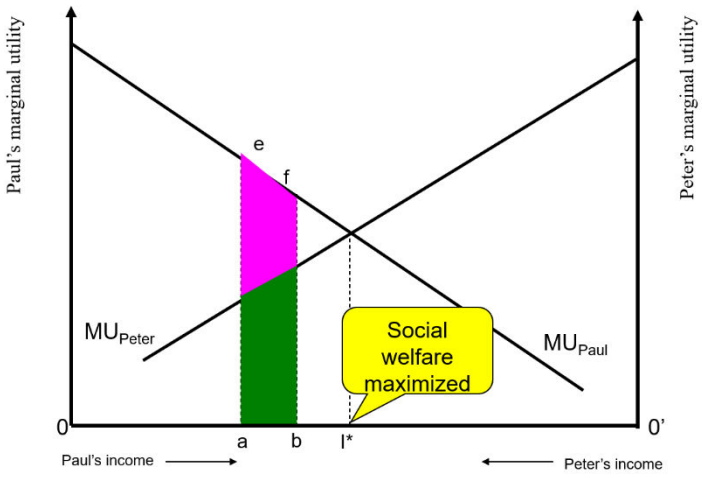
- **Optimal distribution** means: $MU_1(I_1) = MU_2(I_2) = MU_n(I_n)$

If we assume that individuals have **identical utility function**, then the optimal distribution is **'complete equality'**

- If $\boldsymbol{U_1(I) = U_2(I)\ for\ all\ I}$ and $\boldsymbol{U'' < 0}$
- $\boldsymbol{MU_1(I_1) = MU_2(I_2)\ if\ and\ only\ if\ I_1 = I_2}$

Under our assumptions when Paul's income is less than Peters, if we redistribute:

- Paul gains pink + green area
- Peter loses green area
- Society's total (utilitarian) welfare increases by the pink area, because the gain in Paul's utility exceeds the loss in Peter's utility.
- To maximise the Social welfare, we require the MU of both to be equal, which happens at I*
- Meaning equal income



Other theories of distributive justice:

- Rawls (minimax and 'veil of ignorance'): W = MIN (U1, U2, ..., Un)
- Egalitarianism
- Capabilities approach (Sen)
- Libertarianism

Reason for government intervention

Reason for private redistribution: Altruism (e.g. charities)

$$U_1 = F(I_1, U_2(I_2)) \Rightarrow$$ **Pareto-efficient redistribution**

- Better term **"Pareto-improving redistribution"**, because not only the person that receives the donation is better off but the person that gives it also gets utility

Reason of public redistribution: Use framework (Is there market failure on "market for redistribution")

1. Welfare state as a public good
- The rich also benefit from alleviating poverty, but there is a large free-rider problem
- Government enforces contributions
- Scale effects: defining who is poor and administration costs

2. Externalities of poverty
- Effect of poverty on the well-being of others
- Spillover effects

3. Incomplete information
- People may be too positive about risk of becoming poor (Paternalism)

4. Redistribution as poverty insurance
- Prevent market failure due to asymmetric information: Large moral hazard and adverse selection problems in private poverty insurance (e.g: Government can impose fines for fraud, rules for job search)

Efficiency effects of redistribution

According to the second fundamental theorem of welfare, efficiency can be separated from redistribution. However, in practice, redistribution affects efficiency, by affecting people's behaviour and choices.

Cash vs. in-kind benefits

In-kind benefits are when payment by the government is in the form of commodities or services rather than cash.

- The problem with these is that while there is a theoretical argument for the distribution of cash (people can use it more specifically to increase their utilities)
- the government is often seen distributing in kind benefits such as food stamps.
- The government in this case is engaging in paternal action (for example by making an alcoholic parent buy food for the family rather than alcohol).
- However, this is less efficient because the consumption choices of the individuals now are much more limited and potentially cannot reach the social optimum.

The crowding out of private redistribution

If, as is common, there is mandatory participation in these redistributive programmes via the government, then this may **crowd out** the private market. For example, the public social security program may discourage the saving of money for retirement. As well as the lower contributions to charity because we are already helping the poor through the government programmes.

Can redistribution improve efficiency?

- Productivity may improve due to better nutrition
- Recent paper (oa by Sendil Mullainathan) show that poverty causally reduces quality of people's decision-making
- The main idea is that by redistributing we may prevent an even larger decrease efficiency due to factors of not redistributing, such as poverty

The effect on the labour supply

Generally, the programs that are implemented are means-tested.

- This means that the eligibility of an individual to the programme is dependent upon their income.

However, means-tested benefits may reduce labour-supply incentives because benefits are withdrawn as earnings increase.

- Essentially this has led to a decrease in benefits as income increases, which function similarly (in effect) to an income tax that starts out positively.

The effect on worker incentive

The implementation of the redistributive programme will often change a worker's choice between leisure and work because it effectively puts a kink into the budget constraint of the worker. This may lead to a higher utility level when working less (depends on the utility function).

Example to illustrate

Consider the choice between working and leisure. Suppose utility U (y, L) increases in income y and in number of hours of leisure L.

Individuals have an hourly wage **w** and **T** hours to divide between work and leisure

⇨ Earnings **E = w (T – L)**. When **no redistribution, y = E**

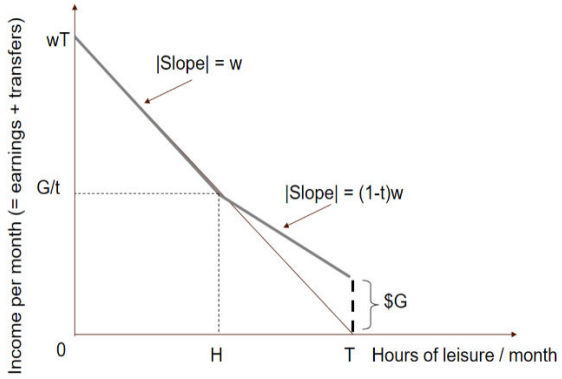
Basic structure of welfare program:

- Grant **G** in case of no earnings
- Rate **t** at which the grant is reduced per euro of recipients' earnings E
- Actual Benefit B received: **B = G – tE → B = 0 if E ≥ G/t**

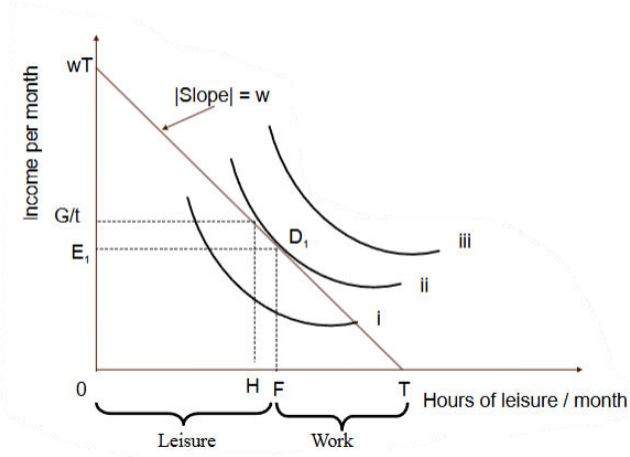
Variations:

- First X euro of earnings are free
- Different t for different earnings brackets

The long straight line is the normal budget constraint when there is no welfare program

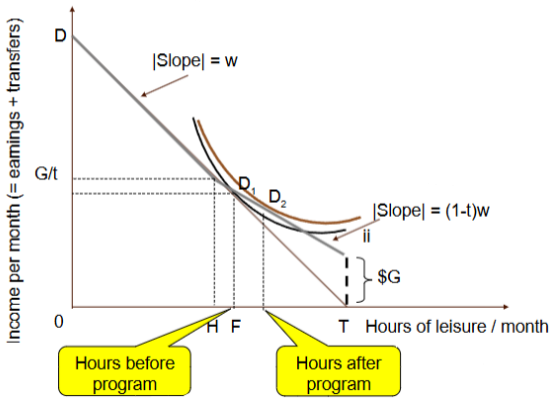


The small, kinked line is the budget constraint with the addition of the welfare program



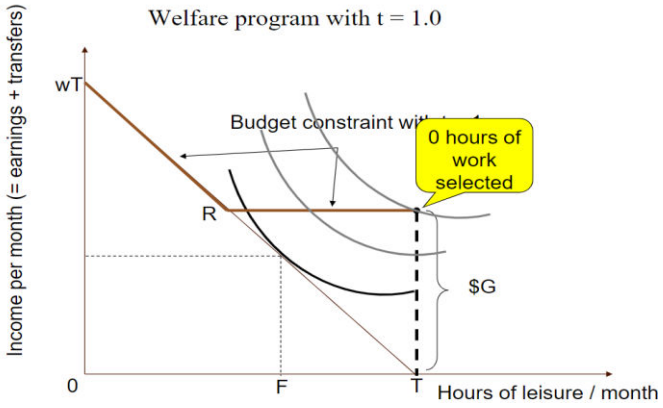
As always with indifference curve we can see which point the worker will choose, in this case D1

If we do the same for our new budget constraint, we see that instead of D1, the worker chooses D2, this shows a decrease in labour supply

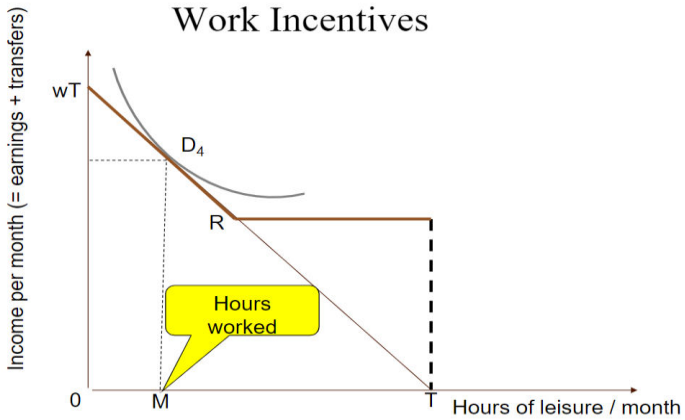


Now with a more extreme example where t = 1, while the worker is in the benefit-receiving range, an additional hour of work produces no increase in disposable income**.** That is why there is no marginal financial incentive to work.

$$(1-\mathrm{t})\mathrm{w} = (1-1)\mathrm{w} = 0$$



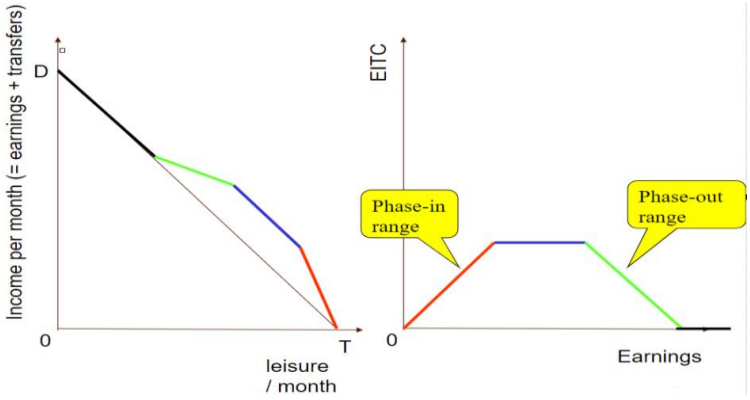
The negative effect of redistribution on efficiency depends on how strongly people respond (substitution effect). This relates to the labour supply elasticity.



Subsidising earnings: earned income tax credit

Earned income tax credit (EITC) is a subsidy through reduction in income tax

- They give tax breaks based on your income
- And if the EITC exceeds your tax liability, they refund you the difference
- Used as an instrument to redistribute towards the working poor
- Efficiency effects: Subsidy is a negative marginal tax rate!
    - Stronger incentive to increase earnings in phase-in range.
    - However, in phase-out range, there is a high marginal tax rate



Work incentives: mathematical example

No Welfare benefit program

- Hourly wage w = 15 €
- Total number of hours available per month T = 720
- Bob decides how many hours to work, he has utility:

$$U = Y + 9000\ln(L)$$

- Where Y = income; L = leisure (hours)

Budget constraint:

$$Y = 15(720 - L) \quad \rightarrow \quad Y = 10800 - 15L$$

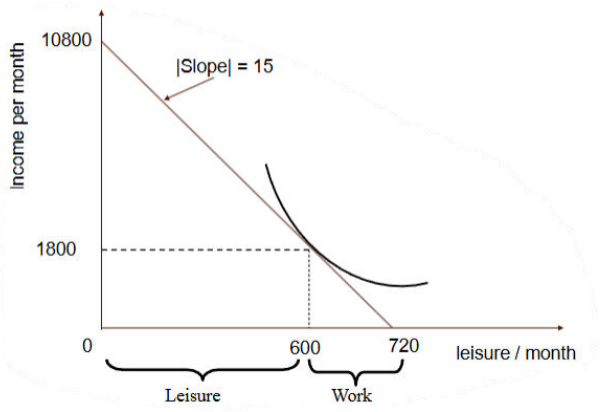
We want to **Max U** w.r.t **L** and **Y**, subject to budget constraint → Use Lagrange

$$L = Y + 9000\ln(L) + \lambda(10800 - 15L - Y)$$

$$\frac{dL}{dY} = 1 - \lambda = 0 \qquad \frac{dL}{dL} = \frac{9000}{L} - 15\lambda = 0 \qquad \frac{dL}{d\lambda} = 10800 - 15L - Y = 0$$

- Combining the first 2 gives 9000 = 15L → L = 600

- Substitute L = 600 into third give Y = 1800



Now with Welfare benefit program

- Grant = 450
- Each euro in earning reduces benefit B by 10 cents: t = 0.1

$$\mathrm{B} = 450 - 0.1\mathrm{E}$$

- This means B = 0, when earnings E ≥ 4500, when hours worked ≥ 4500/15 = 300, or when L ≤ 720 -300 = 420

Bob's new budget constraint:

- For L ≤ 420, same as old: Y = 10800 – 15L
- For L > 420, now with welfare benefit, increase in L by 1 reduces Y by **0.9 · 1 5 = 13.5, instead of 15**

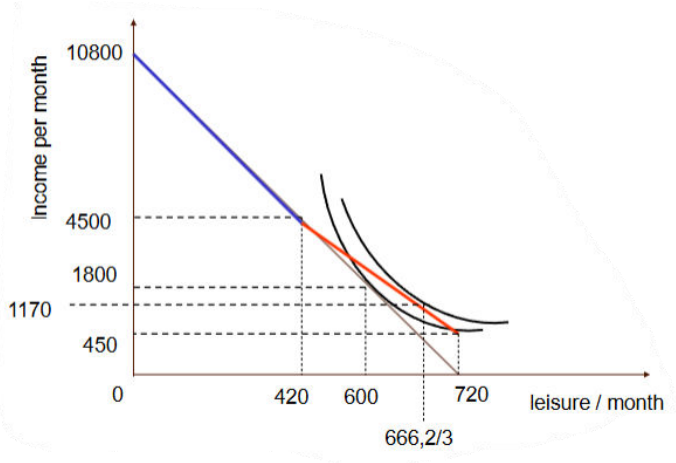
$$Y = 450 + 13.5(720 - L) \quad \rightarrow \quad Y = 10170 - 13.5L$$

Again, max U, use Lagrange:

$$L = Y + 9000\ln(L) + \lambda(10170 - 13.5L - Y)$$

$$\frac{dL}{dY} = 1 - \lambda = 0 \qquad \frac{dL}{dL} = \frac{9000}{L} - 13.5\lambda = 0 \qquad \frac{dL}{d\lambda} = 10170 - 13.5L - Y = 0$$

- Combining the first 2 gives 9000 = 13.5L $\rightarrow$ $L = 666\frac{2}{3}$
- Substitute $L = 666\frac{2}{3}$ into third give Y = 1170



Comparing before and after implementing benefit program

- Before:
  - L = 600
  - Y = 1800
  - U = 59372.4, apply the utility formula
- After:
  - $\mathrm{L} = 666\frac{2}{3}$
  - $\mathrm{Y} = 1170$
  - U = 59690.6
- We see that the worker is better off with the benefit program

Now suppose it would be possible to transfer B = 370 directly to individual, without affecting net benefit of work

Then, outcome results in utility U=59742.4
-> Welfare program's effect on work incentive effects reduces efficiency

Concluding remarks

Redistribution arises when society dislikes distribution generated through market

Market failure in redistribution:

- Poverty externalities / welfare state as public good
- Asymmetric information in poverty insurance

Efficiency effects of government intervention:

- Most anti-poverty programmes are means-tested
  - ➔ Negative effect on incentives to generate earnings
  - ➔ Trade-off between (re)distribution and efficiency

Applied microeconomics – IBEB – lecture 10, week 4 (personnel 4) Non-classical motivators

Problems with incentives

Pay enough or don't pay at all

In the experiments ***Pay enough or don't pay at all***:

- Lab experiments with university students
- IQ test with 40 questions
- 4 groups with different incentives (no groups knows that there are other groups)
- **All groups** are paid 10€ participation fee

Group	Incentive	Outcome (average number of questions answered correctly)
Control	No incentive, only 10€	28
T1	0.03€ per correct answer	23
T2	0.30 € per correct answer	35
T3	1€ per correct answer	34

From the result we can see two interesting outcomes that can be hard to understand with the standard economics theory:

- **Control > T1**, even though there is incentive for T1
- **T2 > T3**, even though T3's incentives are much higher

Possible explanation

- **T2 > T3**, this might be because of ceiling effect, where we have reached the maximum average capacity of the university student, that is the highest score they can get with their knowledge, which is why the difference is only 1

- **Control > T1**, when no incentives they might get utility from helping (altruism) with the research, but with incentives they don't get altruism, and only a monetary incentive, which has lower effect compared to altruistic scenario

Another example: When there is no fine, parents tend to feel sorry for the teacher having to stay late to wait for them to pick up their children, so they would try to come early. But when there is a low fine, they get it as a signal that it is not that bad to come late, and it turns out that more parents came late than before the fine was introduced.

As suggested by the study of Gneezy, U. (2003) – The W effect of incentives, to some extent, a small fine/reward would have a counter effect: **people would perform worse when there is a small fine or reward associated with their performance**. Fine and reward are only worth it when these are sufficiently high.

High school charity

In the second part of the study, high school students were asked to work (with a base payment) for a charity. Their job is to go door to door, asking people to raise money for the charity. Again, without them knowing, they are divided into three groups with different treatments.

Group	Incentive	Outcome (average amount raised)
Control	No bonus	80
T1	1% commission	50
T2	10% commission	73

Here, the observed result (that the outcome decreases with the introduction of bonus as incentive) is also difficult to understand from the classical theory's perspective.

These results raise two questions:

1. Why is it the case that people work (quite well) with no incentive?
2. Why do people sometimes respond to incentives in a negative way?

Non-monetary incentives

One of the intrinsic motivations that we must consider is **public image concerns** (*what would others think of me?*). The lecturer discusses an experimental study conducted by Ariely, Bracha and Meier. (2009) in ***Doing Good or Doing Well? Image Motivation and Monetary Incentives in Behaving Prosocially***. In this experiment, students are

asked to do some tasks, where for each well-done task they have done, a small amount of money is transferred to a charity. The students are divided into four groups (without knowing about the groups other than their own). To study how public image motivation influences the participants' performance, the study varies the image motivation by varying observability and bonus given out of the outcome. The study results are as follows:

Group	Treatment	Outcome
1	Unobserved individual output, no bonus	517
2	Unobserved individual output, bonus	737
3	Observed individual output, no bonus	900
4	Observed individual output, bonus	814

It turns out that people perform better when their outcome is observed by the public. When not being observed, the result is as expected that a bonus increases the outcome. However, when being observed by other people, participants perform worse when they are given a bonus out of the total amount they made for the charity. The reason behind this is that the "image" motivation decreases when others can see that there is also some monetary incentive for the participants.

Prospect theory

According to **prospect theory**, people usually behave with their current **reference point** (of well-being) in mind, we can use income as example, this point is affected by:

- Recent experience (previous income)
- Goal (income you want to achieve)
- Social context (income of people near you)

We shall use a study as an example to illustrate:

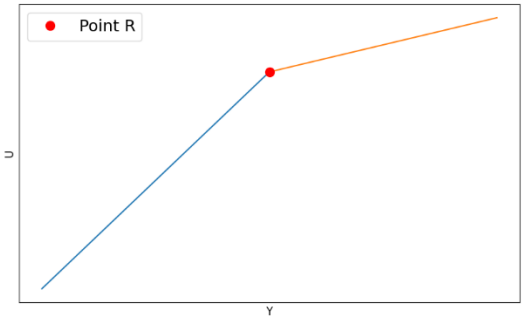
"Why you can't find taxi in the rain"

This study conducted by Farber (2015), suggests that taxi drivers tend to have a reference point of daily income, the example goes as follows

- When it starts raining taxi drivers go out, so supply grows with demand
- However just after a few hours there is almost no taxis on the road
- This is because as it is raining demand is higher, so for drivers they reach their reference point of daily income faster than usual

This example is illustrated in the following graph:

- Before reaching the reference point R, the utility U they get from increase income Y is really high
- But once they reach R, they don't care so much about income Y



Fryer et al. (2012) also illustrate loss aversion with a field experiment on incentivising teachers to perform better. Based on the idea of exploiting loss averse employees, the experiment divides the teachers into three groups. All else (relatively) equal, these groups of teachers are incentivized as follows: For groups 2 and 3, the expected value of the incentive is the same, but we observe different outcomes. This is explained that the teachers' performance is better when the incentive is framed as a loss rather than a gain. When the teachers get the $4000 upfront, their reference points apparently increase, and the utility loss from having to pay back this amount would be larger than the utility gained with the $8000 bonus from the initial reference points.

Group	Incentive	Outcome
1	No incentive	-
2	$8000 bonus at the end of the year if they perform well.	Better than no incentive
3	$4000 bonus at the beginning of the year. At the end of the year, they would have to pay the $4000 back if they do not perform well.	Best in the three cases

Reciprocity

Reciprocity means that people tend to do something in return after getting something. This can be both positive and negative. A positive example would be gift-giving or doing someone a favour. Keep in mind that this also directly correlates to image concerns. If a person's behaviour is visible to others, they are more likely to be reciprocal. A negative example would be revenge.

When we apply this to our principal-agent model, we can see that an agent might feel the need to do something for the principal (e.g. put in a lot of effort) to receive a high wage, even if the agent does not get a bonus on his high effort.

Trust Game

1. Principal chooses a
2. Agent chooses effort e

Positive reciprocity → $\frac{de}{da} > 0$

No responsiveness → $\frac{de}{da} = 0$

Negative relationship → $\frac{de}{da} < 0$

Applied microeconomics – IBEB – lecture 11, week 4 (personnel 5) Hiring and training

Risky vs. Safe employee example

Suppose a firm hire employees, however these can either be risky or safe employees:

- Safe employees: bring 200,000 for sure.
- Risky employees: 50% bring 500,000 (**star**) and 50% lose 100,000 (**disaster**).

If we calculate the EV, we see that they are equivalent in terms of EV

- **EV of safe** = 200,000
- **EV if risky** = 0.5(500,000) + 0.5(-100,000) = 200,000

Now suppose we have the same scenario but with many periods (until n):

- In this scenario if firm have a disaster, they can just fire them after 1 period.
- Assume for now that after hiring in period 1 they cannot hire again.

Period 1	Period 2	Period 3 . . .	Period n

- **EV of safe for n period** = 200,000n
- **EV of risky for n period** = 0.5(500,000)n + 0.5(-100,000) = 250,000n – 50,000

In other words, for firm choosing risky is better than choosing safe as long as:

$$250{,}000n - 50{,}000 > 200{,}000n$$

$$\mathbf{n > 1}$$

- So as long as the number of periods is larger than 1 the firm should choose the risky one in hopes of get the **star.**
- Shorter future: play safe.
- Longer future: take more risk.

Variations such as hiring after firing or adding firing cost could be implemented which can affect the decision of the firm

Adverse selection

Suppose there are 2 types of workers a firm can hire, productive and less productive, however the firm cannot tell which one is which.

- You can think of outside wage as the amount minimum amount that is required for the worker to choose this firm than any other alternative.
- To know which one is better for the firm we can look at the profit function.

	Output per month	Outside wage per month
Productive	6 units	18
Less productive	4 units	16

- Productive worker total production: Q = 6N $\rightarrow$ $N = \frac{Q}{6}$
- Less productive workers total production: Q = 4N $\rightarrow$ $N = \frac{Q}{4}$

$\Pi = P \cdot Q - wN$

- w is the wage
- N is the total number of workers

Profits when hiring productive workers = $P \cdot Q - 18\left(\frac{Q}{6}\right) = P \cdot Q - 3Q$

Profits when hiring Less productive workers = $P \cdot Q - 16\left(\frac{Q}{4}\right) = P \cdot Q - 4Q$

- As you can see from the cost function, the marginal cost of the Less productive are higher, thus firm will want to hire the productive ones.
- However, they cannot identify them; one possible solution is the implementation of incentives that will make a self-selection that is optimal for the firm.

The firm instead of offering a salary, they can pay based on **piece rate**, meaning based on the amount that they produce.

- They can pay 3 per unit the worker produces.
- For **Productive** workers = $3 \cdot 6 = 18$, they are **willing to work for the firm**
- For **Less productive** workers = $3 \cdot 4 = 12$, **outside pay is higher**, so no firm

As you can see incentives not only can be used to **motivate**, but also to make the less attractive workers to **self-select** out.

Skilled vs. unskilled with probation period

Suppose there are 2 types of workers and 2 periods:

- **Skilled workers**: with outside option of wage = W_S
- **Unskilled workers:** with outside option of wage = W_U
- **Note:** $W_S > W_U$

Probationary period	Post-probationary period

Note: Assume length of both periods are equal

- Skilled worker always passes probation.
- Unskilled worker passes probation with probability "p" where 0 < p < 1

The firm wants the skilled worker, however for this, 2 conditions are necessary:

- The pay for the **Skilled** worker needs to be **higher** than outside option.

$$W_1 + W_2 \geq 2W_s$$

- The pay for **unskilled** worker needs to be **lower** than outside option.

$$W_1 + pW_2 + (1-p)W_U < 2W_U$$

If p = 0, Unskilled never passes the probation:

- $W_1 + W_2 \geq 2W_s$
- $W_1 + W_U < 2W_U \quad \rightarrow \quad W_1 < W_U$

In this case wage during probation should be lower than outside wage, however, to attract the skilled worker the wage for second period should be high enough to make up for low wage in period 1.

If p = 1: Unskilled always passes the probation:

- $W_1 + W_2 \geq 2W_s$
- $W_1 + W_2 < 2W_U$

In this case it is impossible to keep the unskilled out, because we have assumed that $W_S > W_U$, therefore the conditions above cannot be met.

Training

Employers often train the workers with 'on the job training', this often comes in 2 forms:

- General training:
  - If the employer pays, when workers finish the training, they might go to work for other firms, due to higher wages
  - Employer anticipates this, so they might decide not to offer any training
  - Solution: Employees pay for the training
- Firm-specific training:
  - As the name suggests it trains employees on skills that they can only use in that specific firm
  - So, no worries of employees leaving

Example

There are 2 period, and firm can decide to train (or not) the employee **with Firm-specific training**, so that he/she is more productive in period 2:

- Assume **outside/firm wages** for both periods is 50
- **With training** Productivity value of employee increases from **50 to 80**
- Training starts period 1 and ends at the start of period 2
- **Cost of training** = 20

No training value: 50	No training value: 50
With training value: 50	With training value: 80

The gain for the firm of training the worker is 80-50 = 30, so they should train
However, after the training the employee might decide to ask for higher wages, which can lead to 2 possible scenarios:

- Firm refuse:
  - Employee keeps on working for the firm
  - Or employee's utility is so affected by the refusal, that they decide to work for other firm, even though **Outside wage (50) = Firm's wage (50)**
- Firm accepts, split half, so 15 each (can be any proportion):
  - However, if the firm anticipates this in period 1, then he will also ask the employee to pay half of the training cost
  - If so, firm total = 50 – 10 + 80 - 15 = 105
  - Employee total gain = 50 - 10 + 50 + 15 = 105

We see that they are both better off than with no training

Applied microeconomics – IBEB – lecture 12, week 5 (public 5)
Taxation: incidence and distortion

Purposes of tax revenue

Tax revenue is needed for financing:

- Public provision of goods
- Anti-poverty measures (redistribution)
- Pigouvian subsidies
- Input cost of government.

Evaluation of taxes can be done by looking at efficiency and distribution.

Efficiency goals:

- Minimising distortionary effects
- Correcting market failure in case of externalities

Distribution (or incidence) of tax burden:

- Who suffers (and how much) in society. Such an evaluation determines whether tax is distributed
    - through horizontal equity (equal people pay equal taxes) or
    - through vertical differentiation (citizens who are better off pay more taxes)

General remarks on taxation

1. Only people can bear the tax burden (Tax on firms or capital are paid by owners)
2. Two types of taxes: **unit tax** (fixed amount for every unit produced) and **ad valorem tax** (levied as a percentage of price)
3. Distinguish between average and marginal tax rate. For example,
    - No income tax for the first 5000 euro income, and a 25% tax on income Y for the amount over 5000 euro.
        - $T = 0.25(Y - 5000)$

- If income is 25.000 euro, then total tax paid is T = 0.25(25000-5000) = 5000
    - Average tax rate =T/Y = 5000/25000 = 0.2
    - Marginal tax rate = 0.25

4. Progressiveness of tax is measured by the **average** tax rate.
    - Progressive tax: Average tax rate increases in income
    - Regressive tax: Average tax rate decreases in income
    - Proportional tax: Average tax rate is constant in income

Universal Basic Income

Universal basic income: The public pension that doesn't depend on the individual's age (Everyone gets an amount B with no conditions).

Taxes: proportional, marginal tax rate t
Earnings: Y

➔ Taxes T = tY

'Net payment' to the government:
A=tY-B **-›** Negative income tax

➔ Progressive?

➔ If $\frac{A}{Y}$ increases in Y

➔ $\frac{tY-B}{Y} = t - \frac{B}{Y}$
Derivative wrt Y: $\frac{B}{Y^2} > 0$

➔ Progressive

UBI does not have the phase-out distortion unlike the benefit scheme, which creates additional work disincentive/substitution effect.

Incidence: distribution of tax burden

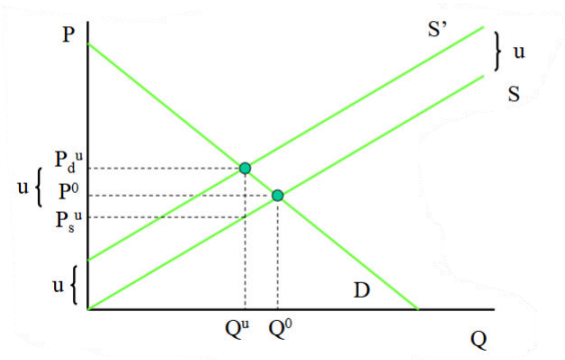
- **Statutory incidence:** Who pays? (legal incidence of the tax)
- **Economic incidence**: Who bears the tax burden? Which groups are made worse off by the tax

Economic incidence is completely independent of statutory incidence (**Tax shifting**)

Tax in partial equilibrium

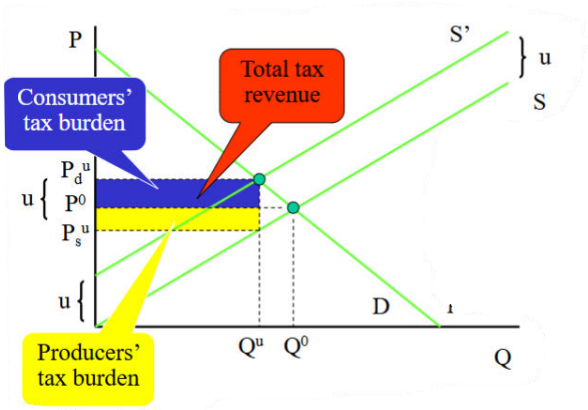
Suppose a tax of **'u'** is levied on the supplier, for the same amount the seller is only willing to sell for a higher price

- The supply curve shifts and a new equilibrium is achieved at Qu



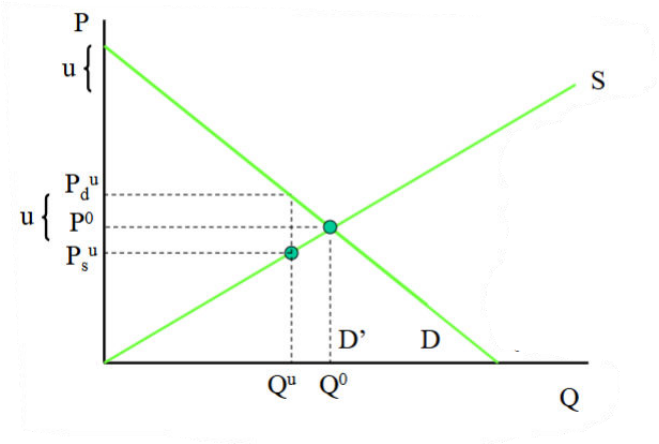
If we compare this new equilibrium with the old one we see that:

- Consumers pay higher price, effectively the blue area is the tax on consumers
- Suppliers keep less, effectively the yellow area is the tax on suppliers
- And the tax revenue is the addition of these 2 areas



Now suppose the tax is levied on the consumers,

- We reach a new equilibrium, but we can see that in the new equilibrium, we have the same quantities as in the case when suppliers pay
- The same goes on the tax burden, the distribution is the same as in the case above



Intuitive explanation

- Difference between consumer and producer price is unit tax: Pd = Ps + u
- Qd decreases in consumer price
- Qs increases in producer price
- Only one point where Qd=Qs and Pd=Ps + u

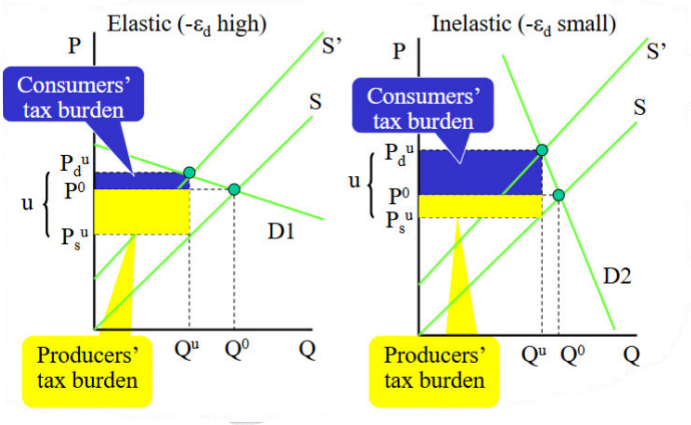
Determinant of distribution of tax burden

Elasticity of demand and supply determines the distribution of tax burden

$$\varepsilon = \left|\frac{dQ}{dP}\frac{P}{Q}\right|$$

The more elastic, the lower the share of the tax burden.
Elasticities tend to be larger in long-run than in short-run

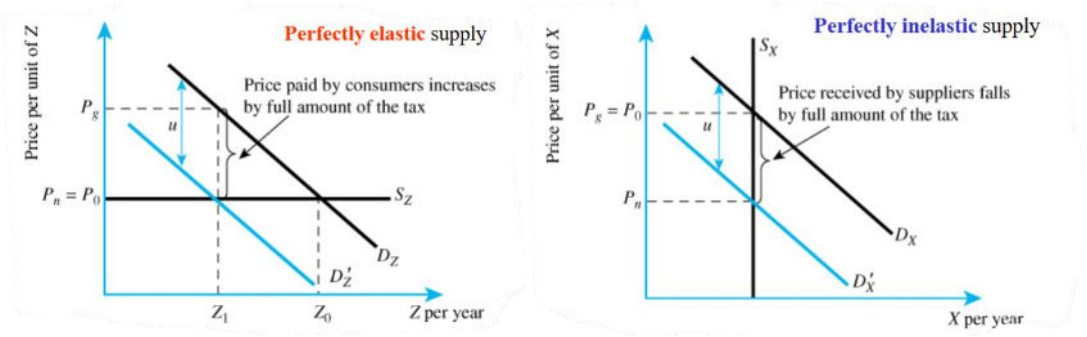
- Both elasticity of demand and supply work the same



More extreme example such as **'Perfectly elastic'** or **'Perfectly inelastic'**

- Perfectly elastic supply means that full burden of the tax is on the consumers,

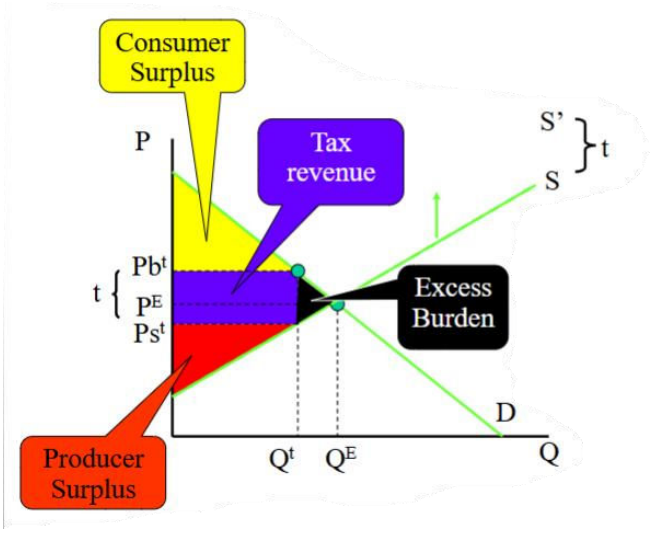
- Perfectly inelastic supply means that full burden of the tax in on the suppliers



Efficiency effect of taxations

When the government imposes a tax, the taxes are not lost. They are transferred to the government.

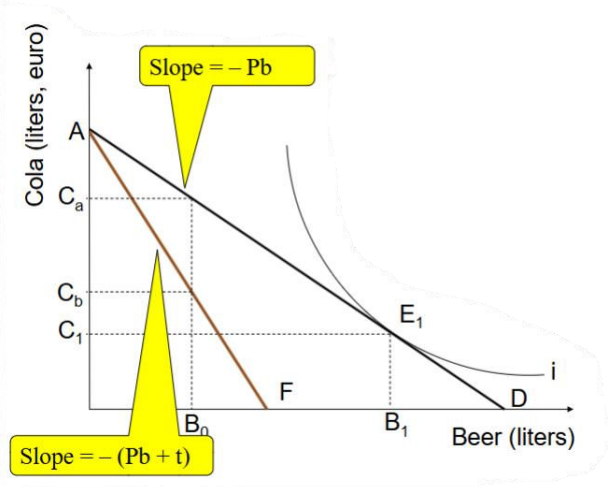
- However, imposing a tax causes a loss to producer and consumer surplus (Excess burden).
- Original equilibrium: MRS = MRT = Px/Py.
- With unit tax: Consumer's MRS goes to (Px+t)/Py whereas the MRT remains at (Px-t)/Py => MRS no longer equals the MRT and we are not at an efficient equilibrium.



The efficiency effects on an individual level

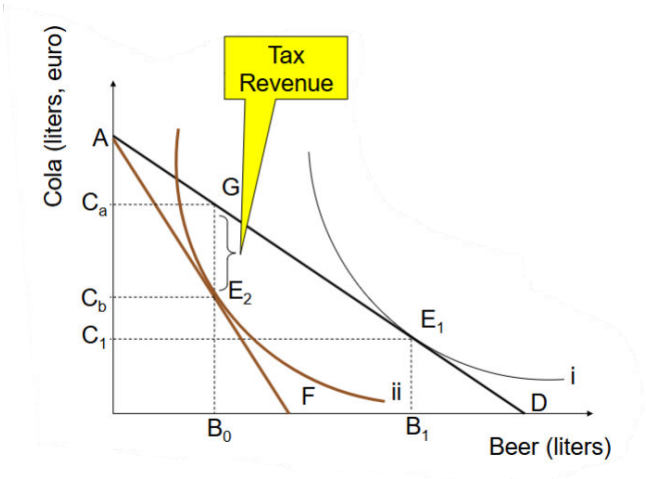
To analyse the efficiency effect of a tax we shall the rational consumption model to illustrate:

- We assume Beer supply is perfectly elastic, meaning full burden of tax fall on the consumer
- Suppose Ana can either buy Cola or beer; there is a unit tax **'t'** on beer
- So now new price of beer is **Pb + t, so we have a new budget constraint**
- At the original budget constraint, we have that the Ana would have chosen **bundle E1**



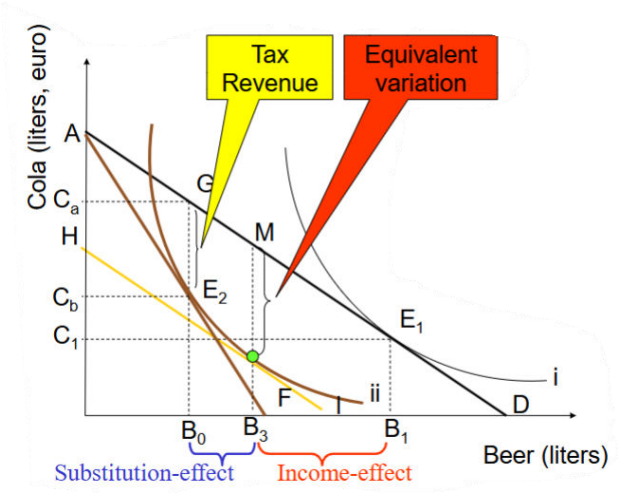
Suppose for the new budget constraint the indifference curve is ii

- In this case Ana chooses **E2**
- We can also see that for amount **B0** of beer, Ana would have been able to get **Ca** of cola, but due to the tax, she now can only get **Cb** of cola
- In other words, the tax revenue is distance **CaCb (or GE2)** times the unit tax
- The question is whether the beer tax inflicts a greater utility loss than is necessary to raise revenue **GE2**



To do find out we need to identify the **'equivalent variation (EV)':**

- The change in income that has the same effect on utility as a change in the price of a commodity (in this case due to taxes)
- All we have to do is move line AD until it is tangent with indifference curve ii, (line HI)
    - We see that if we do so, the **EV > tax revenue <-> utility loss > tax revenue**
    - And the **difference** is the amount of **excess burden** as a result of SW reduction



As you can see the tax induces 2 effects, the income and substitution:

- **Income effect:** Lower purchasing power so they buy less, up to point of EV
- **Substitution effect:** Now beer is more expensive, so Ana buys more of Cola, she substitutes beer for cola
    - Relative price of the goods increases => consumer shifts consumption away towards other, non-taxed goods

In other words, with substitution effect taxes distorts behaviour and thus leads to excess burden, as people shift from taxed goods to non-taxed alternatives

Lump sum tax

Lump Sum Taxes: A tax without excess burden

- They do not distort behaviour
- Substitution effect is 0.
- Example: "head tax", meaning that if you have a head, you pay this tax
  - ⇨ Impossible to reduce taxes through change in behaviour.

Is income tax a lump-sum tax? **No!**
Before tax: Y = (T-L) w
After tax: Y = (T-L) (1-t) w

➔ The higher t, the more attractive leisure relative to work

Exercise

Utility $U = \sqrt{C} + 4\sqrt{B}$;
Budget = 90; P_C=1; P_B=2; t_B=2
Supply of B perfectly elastic

Determine excess burden of tax t_B ind. level

1. Actual situation after tax. P_b=4
Lagrange: $\sqrt{C} + 4\sqrt{B} - \lambda(4\mathrm{B} + \mathrm{C} - 90)$
$\Rightarrow$ Outcome: B=18, C=18
$\Rightarrow$ Tax revenue $= 2 * 18 = 36$

2. Take away T such that Utility = Utility_{tax}

Y = 90-T
Lagrange: $\sqrt{C} + 4\sqrt{B} - \lambda(2\mathrm{B} + \mathrm{C} - 90 + \mathrm{T})$
$\Rightarrow C = \frac{(90-\mathrm{T})}{9}, B = 4\frac{(90-\mathrm{T})}{9}$

U_{tax}: $\sqrt{18} + 4\sqrt{18} = 5\sqrt{18}$

U_{EV}: $\sqrt{\frac{90-T}{9}} + 4\sqrt{\frac{90-T}{9}}$

$U_{tax} = U_{EV} \Rightarrow T=40$

Excess Burden = Equivalent variation – Tax revenue
Excess Burden = 40 – 36= 4
$\Leftrightarrow$ Excess Burden = 4

Concluding remarks

- Statutory incidence (who pays) has nothing to do with who bears tax burden
  ➔ tax shifting
- Economic incidence depends on elasticities
  ➔ The more elastic, the lower the share of the tax burden
- When taxes distort behaviour (and almost all taxes do), then tax revenue < loss in efficiency: **Excess Burden**
- If no distortion in behaviour: **'lump-sum tax'**

Applied microeconomics – IBEB – lecture 13, week 5 (personnel 6) Monopsony and efficiency wages

Monopsony

Monopsony is a market structure in which a single buyer dominates and has significant power, which is due to low elasticity of labour supply to the firm, example to illustrate:

- A town with only 1 restaurant, and no other alternatives
- This means that all the chefs in the town can only work there
- So, the restaurant has the power to decrease the wages of chefs, and still retaining them

Derivation of model

We build a model of a firm's profit depending on the wage that it pays its workers.

$$Profit = (Q - W) \cdot N(W)$$

- Q: production value per employee
- W: wage paid to each employee
- N(W): number of the firm's workers, when wage = W
- N'(W) > 0, this is an increasing function

Profit maximising wage level w.r.t W, F.O.C:

$$-N(W) + (Q - W) \cdot \frac{dN}{dW} = 0$$

We see that an additional unit in W, has a cost and a benefit

- MC due to having to pay one extra W for each current employee
- MB of the value that new employee, that is attracted by the by the extra W

If we multiply all the terms by $\frac{W}{N(W)}$, we get:

$$-N(W) \cdot \frac{W}{N(W)} + (Q - W) \cdot \frac{dN}{dW} \cdot \frac{W}{N(W)} = 0$$

The terms $\frac{dN}{dW} \cdot \frac{W}{N(W)}$ is the wage elasticity of the labour supply (denoted by η)

- It measures the percentage change in the quantity of labour demanded (N) resulting from a one percent change in the wage rate (W)
- If we make W the subject, we will get to the following equation:

$$W = \frac{\eta}{1 + \eta} \cdot Q$$

When η is extremely big (tends to infinity), $\frac{\eta}{1+\eta}$ tends to 1,

- and therefore, W is equal to Q (what a worker brings to the firm) in this case.
- This is when there is a lot of competition (perfect competition) where employers compete for workers.

Consider another case when η = 1, then W = 0.5Q.

- This shows that the higher wage elasticity of workers is, the higher wages are (in optimal state).

Hence, in extreme conditions:

1. When labour supply is completely inelastic (η = 0): Profit-maximising wage is also 0
   - Cutting the offered wage will not cause any workers to leave. Employees will stay even if wages are 0.
2. When workers are paid their full productivity (w = Q): labour supply is infinitely elastic.
   - Cutting wages by a little bit will cause ALL employees to quit. In this situation, firms will have to earn zero profits and pay employees their full profits.

Simple implication in reality:

- In small villages, there are not many employers, whereas in the city, there are often large numbers of employers.
- The competition for workers in the city is much more intense, and workers of a particular occupation would have much more choices of which employers to work for in the city. Therefore, companies in the city cannot pay low wages, otherwise no worker would work for them.

Shapiro-Stiglitz model

Worker chooses between

Working hard: w-c
Shirking: (1-p) w + pU_{alt}

- w: fixed wage
- c: cost of effort
- p: probability that the worker who shirks gets detected
- U_{alt}: alternative utility the worker gets if he loses the job (getting another job; being unemployed)

$$\Longrightarrow w - c \geq (1-p)w + pUalt$$

$$\Leftrightarrow\ pw \geq\ pUalt\ + c$$

$$divide\ by\ p\colon\ w \geq\ Ualt\ +\ c/p$$

⟹ c/p: The harder it is to detect shirking, the higher the wage must be to motivate the worker to work hard.
⟹ U_{alt}: The higher the worker's alternative utility, the higher the wage required to prevent shirking, because being fired is less costly to the worker.

$$Ualt \uparrow\ when\ unemployment\ is\ low$$

$$Ualt \downarrow\ when\ unemployment\ is\ high$$

Can it be an equilibrium that workers always shirk?

Assumption: economy with no unemployment and identical jobs throughout the economy (same w, same c):
$Ualt\ =\ w\ -\ c\ \Longrightarrow w =\ Ualt\ +\ c$
Insert in the derived minimum wage equation: $Ualt + c\ =\ Ualt\ +\ c/p$
$\Leftrightarrow\ c/p\ = c \Leftrightarrow\ cp\ = c$
Divide by c: $p = 1$ ⇒ with no unemployment and identical jobs, the worker will only choose to work hard if shirking is detected with certainty

And so, the answer to our question is YES

Applied microeconomics – IBEB – lecture 14, week 6 (public 6) - Optimal taxation

Minimising the excess burden

Main question: How to set rates on different commodities or input factors such that we raise R in tax revenue at minimal total Excess Burden?

Assume that we are in a world with the goods **X**, **Y** and leisure **L**, as well as a fixed number of hours available **T** and a wage **w**.

Budget constraint without tax: $wT = P_x X + P_Y Y + wL$
Budget constraint with tax on all commodities, including leisure **L**:

$$wT = (1+t)P_x X + (1+t)P_Y Y + (1+t)wL \rightarrow w\frac{T}{1+t} = P_x X + P_Y Y + wL$$

$$\Leftrightarrow \frac{w}{1+t}(T-L) = P_x X + P_Y Y \; + \; wL$$

This is as if the tax reduces time endowment T

- Whatever the individual does, it is not possible to reduce amount of tax paid
- No change in relative prices, so no distortions (no substitution effects)
- Therefore, if we could tax all commodities including Leisure, there would be no excess burden

However, it is not possible to tax leisure → only tax good X and Y

- Budget constraint:

$$wT = (1+t)P_x X + (1+t)P_Y Y + wL$$

$$\frac{w}{1+t}(T-L) = P_x X + P_Y Y$$

This changes relative prices (of leisure versus X and Y); hence, leading to distortions, which in turn lead to excess burden.

Conclusion

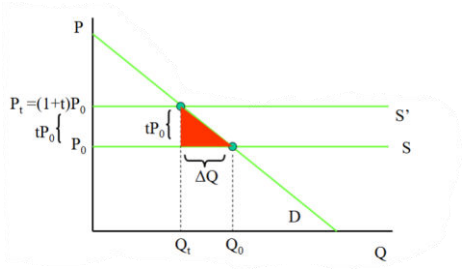
Hence, given our goal, we focus on taxing commodities

- ⇨ Now, the question becomes: Which commodities should we tax and at which rate?

Inverse elasticity rule (Ramsey rule)

Excess burden can be minimised using the Ramsey Rule.
Simplifying assumptions:

1. Supply curves are perfectly elastic/horizontal (all effects on a market run through the demand and constant marginal costs).
2. Cross-price elasticities are 0, such that goods are neither substitutes nor complements (the effects of a certain tax on a good are contained in this good's market).



Excess burden

$$EB = \frac{1}{2}(tP_0)(\Delta Q)$$

- tP0 is the change in consumer price: ΔP
- ΔQ is the change in equilibrium quantity

Elasticity of demand

$$\varepsilon_D = \left|\frac{P_0}{Q_0}\frac{dQ}{dP}\right|$$

Using $tP_0 = \Delta P$, we rewrite this to $\Delta Q = \varepsilon_D t Q_0$

Substituting this into EB gives:

$$EB = \frac{1}{2}\varepsilon_D Q_0 P_0 t^2$$

Two important results:

1. EB increases in demand elasticity. The larger the elasticity of demand, the larger the distortion and excess burden
2. EB increases quadratically in tax rate. A higher tax rate implies a higher increase in the EB if the tax rate increases (The Marginal Excess Burden is increasing in t)

Therefore, we can minimise the excess burden (quadratic in tax) by spreading this tax across several markets (to keep the specific tax rates lower).

- ⇨ Ideal to tax high elasticity markets with a low tax, and low elasticity markets with a high tax.

Optimal tax rate: Marginal excess burden of revenue should be **equal across commodities**.

To get R_x on the market for good X, the ad valorem tax rate should be:

$$t_X = \frac{R_X}{P_X Q_X}$$

Marginal tax revenue raises tax by this amount

$$\frac{\delta t_X}{\delta R_X} = \frac{1}{P_X Q_X}$$

The effect of a marginal increase in t_X on EB_X is the derivative w.r.t 't' of EB equation:

$$EB = \frac{1}{2}\varepsilon_D Q_0 P_0 t^2$$

$$\frac{\delta EB_X}{\delta t_X} = \varepsilon_X P_X Q_X t_X$$

We know that the Marginal Excess Burden is the change in the Excess burden for every change in the amount of revenue we wish to collect

- ⇨ By combining the 2 marginals above

$$MEB = \frac{dEB_X}{dR_X} = \frac{1}{P_X Q_X} * \varepsilon_X P_X Q_X t_X = \varepsilon_X t_X$$

$$MEB = \varepsilon_X t_X$$

So, MEB increases in elasticity and in the tax rate

Total excess burden is minimal when Marginal Excess Burdens of all goods are equal

$$MEB_x = MEB_y \quad \Rightarrow \quad \varepsilon_x t_x = \varepsilon_y t_y \quad \Rightarrow \quad \frac{t_x}{t_y} = \frac{\varepsilon_y}{\varepsilon_x}$$

So, the ratio of tax rates is **inversely proportional** to ratio in elasticities

⇨ The higher elasticity, the lower the tax rate

Ramsey rule can also be derived using **Lagrange**:

- Objective: Minimise total Excess Burden
- Constraint: Raise R in tax revenue

Reality

Current Dutch practice:

- Most goods have VAT-tax of 21%, except for some primary goods (like food), which have 9% VAT

This deviates from our **Ramsey rule** conclusion, because:

- Primary goods such as food tend to have relatively inelastic demand, so the Ramsey rule would suggest taxing them relatively heavily.
- In reality, primary goods are taxed at a lower rate because the Ramsey rule ignores **distributional concerns**: necessities make up a larger share of the expenditure of lower-income households.

Government intervention and excess burden

What are the implications for the fact that raising taxes
lead to reductions in efficiency?

⇒ Excess burden is a cost to society, and hence, should be taken into account in a cost benefit analysis

Example:

- Construction cost: 4.7 billion euro
- Economic cost: 4.7 bn + **EB of raising 4.7 bn euro**
    - (Benefits: unknown)

Similarly: Level of subsidy on education

- Optimal level: marginal benefits of the last euro of a subsidy = marginal cost of the subsidy

- Marginal benefit: higher efficiency because of positive externality
- Marginal cost: 1 + Marginal excess burden of raising one more euro of tax revenue
  → Referred to as **Marginal Cost of Public Funds (MCPF)**

Estimates of the MCPF depend on labour elasticities and existing tax levels.
- In OECD countries, the Marginal Cost of Public Funds (MCPF) is approximately 1.2 to 1.3.
- Also relevant for redistribution: MCPF of 1.5 implies that the last redistributed euro reduces efficiency by 50 cents.

Qualification by Jacobs (2018):
- Governments could use lump-sum taxes to raise marginal tax revenue, which would avoid distortions but perform poorly in terms of redistribution
- In practice, governments use distortionary taxes, suggesting that the redistributive gains are considered to offset their marginal excess burden (assuming a SW-maximising government)

The evaluation of taxes

Gregory Mankiw's criteria for tax system evaluation:

1. **Efficiency:** Are distortions in individual choices caused by changes in relative prices minimised?
2. **Egalitarianism:** Is the distribution of income more equal after taxes? (ethical point of view → SW-function)
3. **Intergenerational Equity:** the revenue from the taxes should be such that the current generation does not burden the future generations with increased debt (currently a large problem with high government debt and an ageing population).

(4. **Stabilisation:** can taxes and government expenditures be used to dampen the business cycle (Keynesian perspective)? Proponents suggest that timely increase and decrease in net expenditure can dampen the business cycle and help maintain production capacity. However, the opposition argues that often the government acts rather late or undertakes projects that fail cost-benefit analysis, and the business cycle ends up being more extreme).

Depending on which of these categories is prioritised, there is a **trade-off** in the taxes implemented (**distribution vs. efficiency**) as criteria 1, 2, and 3 demonstrate:

- Some policies are **good for efficiency but bad for distribution**, e.g. fat taxes, energy taxes, and strict benefit eligibility rules.
- Other policies are **bad for efficiency but good for distribution**, e.g. progressive income taxes and low tax rates on food.

Applied microeconomics – IBEB – lecture 15, week 6 (personnel 7) - Competition in the workplace

Tournament theory

Assumptions

- There is a fixed number of prizes
- Relative performance matters for who wins

Promotion system
(relative performance-based system)

A simplified model

Consider a firm employing **2 identical employees** (i and j) in **2 periods**. Assume that in **period 2, agents no longer exert effort thus, no production**. This assumption is for simplicity.

To create a competitive working environment, the firm promises to give a promotion (with value **Z**) in the second period for a worker based on the workers' performance in the first period.

- ⇨ Winner will receive salary **B = W + Z**
- ⇨ Loser will just receive **W**.

Promotion decisions of the firm are based on the workers' relative performance, which depends on effort exerted and on luck. When worker's luck follows a uniform distribution, the **probability** of worker **i** to be promoted can be described by:

$$r_i = 0.5 + \pi(e_i - e_j).$$

- $e_i - e_j$ is the indicator of relative performance
- If the two workers work equally hard, both will have a promotion probability of 0.5, $e_i = e_j$
- When worker i works harder than j ($e_i > e_j$), worker i has a higher chance (not certain) of getting the promotion.
- Π parameter shows the importance of relative effort in getting the promotion
- When π is too small (π=0), promotion decisions only depend on luck, lottery, and not on how much more (or less) effort you exert compared to others

The optimal wage scheme of the model

Timeline:

1. Principal designs the promotion system
2. Agent decides to accept the job or not
3. If they accept, each chooses effort

To analyse this, we will use **backward induction**

3. Effort choice

We start by determining worker's effort for all wage schemes, taken as given willingness to participate.

The worker's function of Expected utility is given by:

$$E(U_i) = W + p_i(W + Z) + (1 - p_i)W - 0.5\theta {e_i}^2$$

If we simplify, we get:

$$E(U_i) = 2W + p_i Z - 0.5\theta {e_i}^2$$

As $p_i = 0.5 + \pi(e_i - e_j)$, we would have

$$E(U_i) = 2W + [0.5 + \pi(e_i - e_j)] * Z - 0.5\theta {e_i}^2$$

The worker would maximise his utility

⇨ Taking the FOC for optimal effort, we would obtain:

$$e_i = \frac{\pi Z}{\theta}$$

- The higher the promotion wage Z, the more e will be exerted
- The more worker dislike exerting effort θ, the lower e is
- The more important the relative effort exerted is the higher the e

Same analysis for worker j:

$$e_j = \frac{\pi Z}{\theta}$$

2. Participation constraint

Next, agent decides whether to accept the contract. Hence, we have to derive the level of the base salary necessary to attract workers for all wage schemes, using the result of effort.

Expected lifetime (two periods) utility from working for this firm is given by:

$$2W + (0.5 + \pi(e_i - e_j))Z - 0.5\theta e_i^2$$

Let V denote the expected lifetime utility per period of the next best alternative to this job. So, the worker will only take the job (participation constraint) if:

$$2W + (0.5 + \pi(e_i - e_j))Z - 0.5\theta e_i^2 \geq 2V$$ (2V, because we have 2 periods)

As we have found out earlier, the two workers' optimal choice of effort. Plugging these in, we would have:

$$2W + [0.5 + \pi(\pi Z/\theta - \pi Z/\theta)]Z - 0.5\theta(\pi Z/\theta)^2 \geq 2V$$ (since workers are identical)

$$W \geq V - \frac{1}{4}Z + \frac{1}{4}\theta\left(\frac{\pi Z}{\theta}\right)^2$$

1. Principal chooses W and Z

Find the wage scheme that maximises profits, using the results on optimal effort and base salary.

Assume **price = R** and **Q = e** (for simplicity). The firm's profit would then be given by:

$$\text{Profit} = 2R(e_i - e_j) - Z - 4W,$$ (2R, 4W = 2periods, 2 workers)

Substituting worker participation constraint W and the worker's effort choice e into the profit function, we would have:

$$profits = 2R\left(\frac{\pi Z}{\theta}\right) - Z - 4(V - \frac{1}{4}Z + \frac{1}{4}\theta\left(\frac{\pi Z}{\theta}\right)^2$$
$$= 2R\left(\frac{\pi Z}{\theta}\right) - 4V - \frac{\pi^2 Z^2}{\theta}$$

FOC (maximising w.r.t Z):

$$= 2R\frac{\pi}{\theta} - 2\frac{\pi^2 Z}{\theta} = 0 \qquad \rightarrow \qquad Z = \frac{R}{\pi}$$

Substitute $Z = \frac{R}{\pi}$ into optimal effort $e = \frac{\pi Z}{\theta}$, we would have $e = \frac{R}{\theta}$

- Optimal promotion bonus Z increases with price R, which increases the e
- Z decreases with π, because the higher it is the more effort will be exerted, which increases the cost of effort

If you remember in **week 2**, when we have the piece-rate, with **absolute performance**, we got the **same results:** $e = \frac{b}{\theta}$

- Principal to be indifferent between a tournament setup and a bonus or piece-rate scheme.

Extensions

However, for example, if we include measurement costs, we would expect these to be higher in the piece-rate model (where everyone must be observed) than in the tournament model (only the middle performers are likely to be closely observed)

- **Common luck effect**: Tournament model less affected by the common luck effect, because it's based on relative performance rather than absolute.
- **Collusion:** workers might make an agreement of both not working more, all dependent on the credibility and commitment of agreement

One downside of the internal competition model is that there is an incentive for workers to want their colleagues to fail, which may make the working environment worse and negatively affect profits.

Applied microeconomics – IBEB – lecture 16, week 6 (personnel 8)- Discrimination

In this lecture we will look into the following questions:

- What is discrimination?
- How can we measure it?
- What type of discrimination exists?
- What are the consequences of discrimination?
- What are the policy (employers, government) implications

Discrimination is the unequal treatment of different types of groups of people, due to a systematic difference such as age, race, gender…

Discrimination in the labour market can be tested by submitting multiple fake job applications with the same qualifications, CV and motivations, but only changing a specific aspect that could give rise to discrimination (age, gender, ethnicity, religion…).

⇨ This kind of study is called an **Audit studies (correspondence study).**

Causes of discrimination

1. **Tastes based**

- When recruiters/managers prefer to surround themselves with certain types of people and discriminate to satisfy their preference (utility).
- Hiring managers may have preferences that favour people who they can easily identify with in a group, such as those who look like them or are of the same race and/or gender.

2. **Statistical discrimination**

- Occurs when employers use beliefs about the average productivity of different demographic groups to evaluate individual applicants, rather than relying solely on their individual characteristics.

- Can become a *self-fulfilling prophecy*, because there is a lesser incentive for the discriminated group to invest in gaining the skills. Magnifies the statistical differences over time.

3. **Biased beliefs**

- Beliefs based on false assumptions or untrue statistics (e.g. men are better at programming than women; when, in reality, a study proved that there is no significant difference in the skills between genders)

To test whether discrimination is conscious or unconscious, we use an implicit association test. The test measures how quickly a person associates different groups with positive or negative concepts.

Consequences of discrimination

Tastes based and incorrect beliefs: Often costly to the employer. Leads to lower profitability and productivity because suboptimal selection of workers can happen. It also reduces the discriminated worker's productivity (because of lack of career prospects or other aspects), thus confirming the bias and enlarging the problem.

Statistical discrimination: Higher profitability and productivity, especially when there are a large number of employees and the trends are more evident

How to reduce discrimination

1. Provide more detailed and complete information about the job applicant

2. Anonymous application: make certain parts of an application that shouldn't influence the outcome anonymous (e.g. name, ethnicity, religion, age, gender)

3. Give sufficient time and resources to recruiters: biases are increased by time pressure and stress (which leads to relying on stereotypes)

4. Monitor/select recruiters through tests such as the implicit association test

5. Make the recruiter aware of the biases that they might fall into consciously or not

6. Contact hypothesis: Contact creates a positive attitude towards people that are different from you

7. Make discrimination costly: eg by imposing penalties if discriminate

Applied microeconomics – IBEB – lecture 17, week 7 (public 7) - Collective decision-making

So far, we looked at **normative** analysis of government:
- What should be done, from a social welfare perspective?
- Takes government as 'serving society'

In this lecture**: positive** analysis of government intervention
- How are decisions made in practice?
- Decision-makers act in their own self-interest and have different preferences
- Government failures

The normative idea that government intervention is good is limited by problems in collective decision-making, such as government failure

Four main reasons for government failure:
1. Imperfect political representation and problems with aggregating preferences
2. A lack of information about individuals' preferences and firms' production processes
3. Rent-seeking and corruption
4. Limited or misaligned incentives in case of public production (lack of profit motive makes public organisations less responsive)

Individual preferences in collective decisions

The main idea of the following example is that 'people want different collective decisions/actions
- Meaning Collective decision-making is often about making interpersonal trade-offs, when one benefits and the other loses

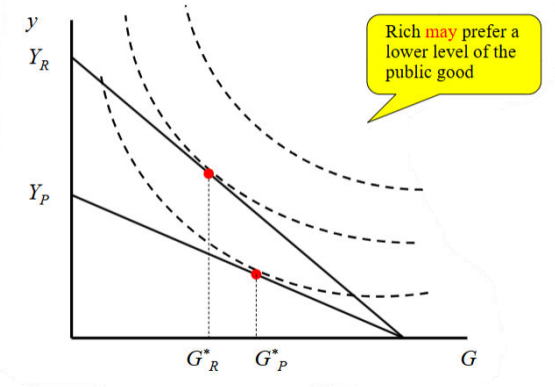
Suppose government spends G euro on public goods, financed by proportional tax t
- Assume there are N individual, with income Y_i average in Y_m
- so, we have that $G = tN \cdot Y_m$, thus we have $t = \frac{G}{NY_m}$

- Individual taxes increase in income: $tY_i = \frac{GY_i}{NY_m}$, this means $\frac{\partial Y_i}{\partial G} = \frac{Y_i}{NY_m}$
    - In other words, higher income means higher taxes

Now suppose 2 people with same preferences, but different income
Higher income yields:

- Higher demand if public good is normal good
- Lower demand, due to higher 'price' per unit due to tax

This results in rich people preferring less G than poor, depending on the income and substitution effect



Note: with different preferences, rich people may prefer a higher G than poor

Collective decision-making procedures

Collective decision-making methods

Whenever there is disagreement about an action or decision, we use collective decision-making to at least get an outcome

1. **Dictatorships** (social planning)
2. **Direct democracy** (unanimity and majority voting)
3. **Representative democracy** (politicians)
4. **Constitutional democracy** (rule of law)

Direct democracy

Everyone is involved
Unanimity rule: Everyone has to agree in order to implement a decision

- This can theoretically be done through **Lindahl prices** (individuals pay for public goods according to their marginal benefits.)

- Problems: Strategic misrepresentation of preferences and too costly to determine individual tax shares

Majority voting: It can either be 'Simple majority voting' or 'Qualified majority voting'

- Simple majority: The option that gets 50% plus 1 vote is chosen
- Qualified majority: Some other %, that is higher than 50%

Problems with majority voting:

- Repression of minorities
- Voting paradox (individually transitive preferences do not translate to collectively transitive preferences)

Pairwise majority voting

	Charles	Liz	Don
First	S	B	M
Second	B	M	S
Third	M	S	B

Majority voting:
- Bar vs Soccer: 1-2
- Soccer vs Movie: 1-2
- Movie vs Bar: 1-2

→ Collective ordering:
- Bar ≺ Soccer ≺Movie ≺ Bar ≺ Soccer ≺ ….

→Ordering *not transitive*!

We put 2 options against each other and count the number of votes, the one with more votes is preferred

- The problem in this example is that individually the preference ordering is transitive but when we apply Pairwise majority voting, for collective decision making we see that transitivity is violated

Problem, suppose Charles has the power to decide the order of the votes:

- He wants Soccer, and the only way to eliminate soccer is with movies
- So, he can make that 'Movie vs. Bar' comes first, then the outcome is Soccer

The scenario we have just seem is one in which we assume **Sincere voting,** where everyone is honest and votes for their option 1

- However, we can also have **Strategic voting**
- Liz hates Soccer the most and anticipates that Soccer is going to win if she votes sincerely
- In this case, she can vote for Movie, this way the outcome will be Movie instead of Soccer

Sincere vs strategic voting: since people know that someone is setting the agenda, the people might be incentivized to not vote sincerely in the first round in order to get a more desired outcome later.

Note: voting paradox does not always arise

Decision-making procedures/rules

Five criteria for an ideal collective decision-making procedure:

1. **Unrestricted domain** (all individual preferences allowed).
2. **Pareto-criterium** (if all prefer X to Y then the voting system should return X).
3. **Non-Dictatorship**
4. **Transitivity** (if X>Y and Y>Z then X>Z).
5. **Independence of Irrelevant Alternatives** (if for options [X,Y] X>Y then adding an option Z should not change X>Y).

Arrow's impossibility theorem

Arrow's Impossibility Theorem: it is not possible to find a decision-making procedure that always fulfils all these criteria

⇨ Implies that a direct democracy cannot prevent "unreasonable outcomes".

Majority voting produces a stable outcome when preferences are single-peaked. The policy options lie on a common scale, and each voter has one most preferred option (their *peak*). Options farther from that peak are less preferred. The **median voter's preferred option** then wins a pairwise vote against any other option.

Representative democracy

In representative democracy, the voting is outsourced to professional politicians. This has several **benefits**:

- It is **too costly** to have a referendum for each decision
- Information collection may be too expensive for the individual, so having professionals makes it easier. They also have more expertise in the matter

However, there are several **problems** with this as well:

- Politicians may not know citizen's preferences.
- Politicians may also not be willing to inform themselves and end up misrepresenting information.
- Politicians may not make decisions in the interest of citizens but in their own interest instead

Main institutions to mitigate all these problems:

- Elections & media (if it works well)

Rent-seeking is the idea that firms/small groups of citizens that have large stakes, they have an incentive use resources to sway the decision to their favour

- Corruption
- Lobbying

Why is rent-seeking a problem?

1. Resources used for unproductive activities → inefficient
2. May distort decisions away from optimum → regulatory capture

A (potential) positive aspect: information collection. When lobbyists try to influence politicians, they may provide information about its costs, benefits, or practical effects.

Integrated Exercise

Suppose society has three equally sized groups: rich (R), middle class (M), and poor (P). The government chooses investment (*I*) in a public transport network, funded by a lump-sum tax. Each group's utility is

$$\mathrm{U_R} = \mathrm{y_R} + 4\sqrt{\mathrm{I}}, \qquad \mathrm{U_M} = \mathrm{y_M} + 6\sqrt{\mathrm{I}}, \qquad \mathrm{U_P} = \mathrm{y_P} + 10\sqrt{\mathrm{I}}$$

where yi is income after tax

What is socially efficient level of *I*?

- Marginal Cost = 1
- Marginal Benefit: $\mathrm{M}U_R = \frac{2}{\sqrt{I}},\ MU_M = \frac{3}{\sqrt{I}},\ MU_P = \frac{5}{\sqrt{I}}$
- Social marginal benefit: $\sum_i MU_i = \frac{10}{\sqrt{I}}$
- MSB=MSC gives *I*=100

If tax distortions (not modelled) raise the marginal cost of public funds to 1.2, the optimal level falls to:

$$\frac{10}{\sqrt{I}} = 1.2$$

I = 69.44

Now suppose the rich pay 1/2, the middle class 1/3, and the poor 1/6 of the investment cost (neglect tax distortions).

This does not affect the efficient level of *I,* given there are no income effects (marginal utility of income equals to 1 for all groups)

But: groups want different levels of *I*:

- Optimum for rich: $\max_{\mathrm{I}} \mathrm{U_R} = \mathrm{Y_R} - \frac{1}{2}\mathrm{I} + 4\sqrt{\mathrm{I}}$
- FOC: $(-\frac{1}{2} + \frac{2}{\sqrt{\mathrm{I}}} = 0)$
- Hence, I_R = 16
- Similarly, I_M = 81, I_P = 900

Suppose SW-function has larger weight for utility of P than for M and R → SW-maximizing level of *I > 100*

Suppose: $\mathrm{SW} = \alpha_\mathrm{R}\mathrm{U_R} + \alpha_\mathrm{M}\mathrm{U_M} + \alpha_\mathrm{P}\mathrm{U_P}, \qquad \alpha_\mathrm{R} = 1, \quad \alpha_\mathrm{M} = 1, \quad \alpha_\mathrm{P} = 3$
Then *I = 225*
Check yourself by maximizing:

$$\max_{\mathrm{I}} \mathrm{SW} = \left(\mathrm{Y_R} - \frac{1}{2}\mathrm{I} + 4\sqrt{\mathrm{I}}\right) + \left(\mathrm{Y_M} - \frac{1}{3}\mathrm{I} + 6\sqrt{\mathrm{I}}\right) + 3\left(\mathrm{Y_P} - \frac{1}{6}\mathrm{I} + 10\sqrt{\mathrm{I}}\right)$$

Now consider voting:
Outcome of majority vote *I* = 81

- ➔ Preferences are single-peaked
- ➔ And middle class is median voter

Hence, also outcome two-party representative democracy → not efficient and not SW-maximizing

Rent-seeking:
Rich want lower *I*
For reduction in *I* from 81 to 16, rich are willing to pay up to:

$$U_R(16) - U_R(81) = \left(Y_R - \frac{1}{2}(16) + 4\sqrt{16}\right) - \left(Y_R - \frac{1}{2}(81) + 4\sqrt{81}\right) = 12.5$$

So, rich (maximally) willing to spend 12.5 million on 'convincing' politician to choose I = 16 rather than I = 81

Note: Rich willing to spend even more if politician would otherwise choose socially efficient I = 100 (→ 18 million) or SW-maximizing I = 225 (→ 60.5 million)

Concluding remarks

- **Positive analysis** examines how collective decisions are actually made.
- People try to influence decisions in their own favour; outcomes can depend on the decision rule.
- This helps explain why some harmful policies are adopted and some beneficial policies are not.
- Similar problems arise in organisations: committees make collective decisions, and efforts to gain promotion can be a form of rent seeking.

Applied microeconomics – IBEB – lecture 18, week 7 (personnel 9)- Teams

Workers' behaviour under team performance-based pay

Consider a simple model where **two** identical people work together, as a **team**, where we have:

- $Q = e_1 + e_2$
- $w_i = \frac{1}{2}p \cdot Q$
- $U_i = w_i - \frac{1}{2}e_i^2$ where negative part is the cost of effort
- $Price(p) = 10$

If Workers were to choose effort level **independently**:

- $U_1 = \frac{1}{2}(10)(e_1 + e_2) - \frac{1}{2}e_1^2$

$F.O.C$:

- $\frac{1}{2}(10) - e_1 = 0$
- $e_1 = e_2 = 5$, note workers are identical
- $w_1 = \frac{1}{2}(10) \cdot (5 + 5) = 50$
- $U_1 = 100 - \frac{1}{2}(10^2) = 37.5$

If we had a **Social planner** who maximises social welfare:

- $SW = U_1 + U_2$
- $SW = \frac{1}{2}(10)(e_1 + e_2) - \frac{1}{2}e_1^2 + \frac{1}{2}(10)(e_1 + e_2) - \frac{1}{2}e_2^2$

$F.O.C$:

- $10 - e_1 = 0$
- $10 - e_2 = 0$
- $U_1 = U_2 = 100 - \frac{1}{2}(10^2) = 50$

As you can see if the workers put in more effort, they will gain more utility, however when they make the choice independently, they do not take into account the fact that their choice also affect the other worker, so they **underwork/underprovide**, think back to **positive externalities** and **'Free riding'**

An empirical study

Orange picking

Randomised controlled trial with 2 schemes

- Individual rewards, $wage\ per\ worker = 5€\ per\ orange\ \cdot\ amount\ in\ 1\ basket$
- Team rewards, $wage\ per\ worker = \frac{amount\ in\ 2\ baskets \cdot 5€\ per\ orange}{2}$

We want to see whether the productivity of Individual work with individual rewards is different from Teamwork and Team rewards, the result is as follows:

- Individual productivity is 94Kg
- Team productivity is 70Kg

This shows that there is free riding in Team rewards scheme as productivity reduces

- **Synergy benefits:** when 2 or more workers work together the productivity may increase due to sharing of knowledge or division of work
- In other words, the effect of free riding might have been even higher, than we have anticipated

Team performance-based incentives with N workers

Suppose now instead of 2 workers we had N number of workers:

- $Q = e_i + (N-1)e_j$
- $w_i = \frac{1}{N}(10) \cdot Q$
- $U_i = \frac{1}{N} \cdot 10 \cdot \left(e_i + (N-1)e_j\right) - \frac{1}{2}e_i^2$

F.O.C:

- $\frac{1}{N} \cdot 10 - e_i = 0 \rightarrow e_i = \frac{10}{N}$
- $Total\ Q = N \cdot \frac{10}{N}$

This result tells us that free-riding is so severe that increasing the N have no effect on Production Q

Possible solutions to free riding

1. Change the rule regarding workers' wages.

- Worker 1 gets share ϕ of revenue
- Worker 2 gets share 1 - ϕ of revenue

$$U = \phi\, 10(e_1 + e_2) - \frac{1}{2}{e_1}^2$$

$$\frac{\delta U_1}{\delta e_1} = 10\phi - e_1 = 0 \rightarrow e_1 = 10\phi \; and \; e_2 = 10(1-\phi)$$

However, notice that total effort e1+e2 is still equal to 10, same as when the workers chose effort independently

2. Very high team bonus

$$U = b(e_1 + e_2) - \frac{1}{2}{e_1}^2 + a$$

$$\frac{\delta U_1}{\delta e_1} = b - e_1 = 0$$

$\Leftrightarrow e_1 = b \rightarrow$ the principal can set b=10 (social optimum)

3. Very ambitious principal

If Q=20 ⇒ Income = 100
Else ⇒ Income = 0

Suppose worker 2 exerts no effort
Worker 1:

No effort $\Rightarrow U = 0$

$$e_1 = 10 \Rightarrow U = 0 - \frac{1}{2}10^2 = -50$$

$$e_1 = 20 \Rightarrow U = 100 - \frac{1}{2}20^2 = -100$$

Now suppose worker 2 exerts effort $e_2 = 10$
Worker 1:

$$e_1 = 10 \Rightarrow U = 100 - \frac{1}{2}10^2 = 50$$

Very ambitious principal: payoff table

Each worker earns 100 only if total output Q = 20; otherwise income is 0.

Worker 1 / Worker 2	$e_2 = 0$	$e_2 = 10$
$e_1 = 0$	(0, 0)	(0, −50)
$e_1 = 10$	(−50, 0)	(50, 50)

Payoffs: (Worker 1 utility, Worker 2 utility), with $U_i = \text{income}_i - \frac{1}{2}e_i^2$.

Thus, (10,10) is an equilibrium and achieves the socially optimal effort level.

However, (0,0) is also an equilibrium. If the other worker exerts no effort, reaching Q=20 alone as we saw would cost $\frac{1}{2}20^2 = 200$, more than the income of 100. The ambitious target can therefore motivate both workers, but only if each expects the other to contribute.

4. Trust that you get your Fair share:

- $\frac{e_1}{e_1+e_2} = 'fairshare'\ of\ total\ output\ for\ worker\ 1$

$$U_1 = \frac{e_1}{e_1 + e_2} 10(e_1 + e_2) - \frac{1}{2}{e_1}^2$$

Maximising this gives $e_1 = 10$, which is the level of effort in the social optimum

5. Altruism

$$U_1 = w_1 - \frac{1}{2}e_1^2 + \mu\left(w_2 - \frac{1}{2}e_2^2\right)$$

μ – altruism parameter

$\mu > 0 \rightarrow$ worker 1 cares about worker 2
$\mu = 0 \rightarrow$ worker 1 is an egoist
$\mu < 0 \rightarrow$ spite: the individual gains utility when others are worse-off

$$U_1 = \frac{1}{2}10(e_1 + e_2) - \frac{1}{2}e_1^2 + \mu\left(\frac{1}{2}10(e_1 + e_2) - \frac{1}{2}e_2^2\right)$$

Maximising this this yields $e_1 = 5 + 5\,\mu$. So, when $\mu = 1$ (worker 1 cares about worker 2 as much as about himself) $\rightarrow e_1 = 10 \rightarrow$ social optimum

References

Delfgaauw, J. (2026). Lecture 1 [PowerPoint slides]. Retrieved from: Public economics week 1: Applied Microeconomics

Delfgaauw, J. (2026). Lecture 1.5 [PowerPoint slides]. Retrieved from: Public economics week 1: Applied Microeconomics

Delfgaauw, J. (2026). Lecture 2 [PowerPoint slides]. Retrieved from Public economics week 2: Applied Microeconomics

Delfgaauw, J. (2026). Lecture 2.5 [PowerPoint slides]. Retrieved from: Public economics week 2: Applied Microeconomics

Delfgaauw, J. (2026). Lecture 3 [PowerPoint slides]. Retrieved from: Public economics week 3: Applied Microeconomics

Delfgaauw, J. (2026). Lecture 4 [PowerPoint slides]. Retrieved from: Public Economics week 4: Applied Microeconomics

Delfgaauw, J. (2026). Lecture 5 [PowerPoint slides]. Retrieved from: Public Economics week 5: Applied Microeconomics

Delfgaauw, J. (2026). Lecture 6 [PowerPoint slides]. Retrieved from: Public economics week 6: Applied Microeconomics

Delfgaauw, J. (2026). Lecture 7 [PowerPoint slides]. Retrieved from: Public economics week 7: Applied Microeconomics

Dur, R. (2026). Personnel economics lectures.