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1. Welfare Economics

Public finance can be described as the public sector economics. Given the enormous diversity of the government's economic activities, a systematic framework is needed to assess the desirability of various government actions. The framework is called **welfare economics**. It compares alternative economic states to decide which is socially most desirable.

To explain this theory, we start with a simple pure **exchange economy**.
- Fixed supply of goods
- 2 individuals: Andy (A) & Britney (B)
- 2 goods: Food (F) & Clothing (C)

To depict the distribution of food and clothing between Andy and Britney, we use an **Edgeworth Box**. Any point within the Edgeworth Box represents some allocation of both goods between Andy and Britney.
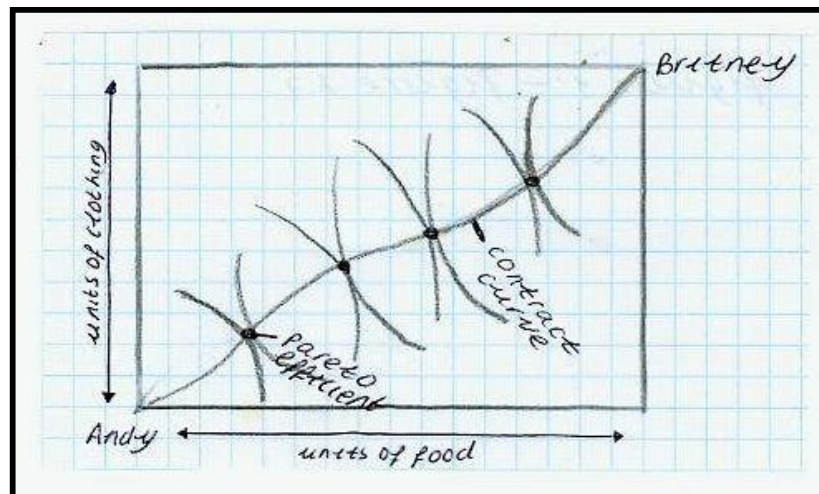
To represent the preferences of both individuals we use **indifference curves**, graphs showing combinations of goods for which a consumer is indifferent. Indifference curves with greater numbers represent higher levels of happiness (utility).

Given a set of alternative allocations and a set of individuals, a movement from one allocation to another that can make at least one individual better off, without making any other individual worse off, is called a **Pareto improvement**. An allocation of resources is **Pareto-efficient** when it is not possible to make someone better off without making someone else worse off (no further Pareto improvements can be made). Pareto efficiency is the economist's benchmark of efficient performance for an economy.

A whole set of Pareto-efficient points can be found in the Edgeworth Box. The locus of all the Pareto-efficient points is called the **contract curve**. As you can see, at a Pareto-efficient allocation the indifference curves are tangent – the slopes of the indifference curves are equal. In economic terms, the absolute slope of indifference curve equals the willingness to trade one commodity for the other. This is called the **marginal rate of substitution** (MRS).
We can conclude that Pareto efficiency requires equal MRS for all consumers:

$$MRS(f,c)_A = MRS(f,c)_B$$

So far we assumed that the production of the commodities was fixed (exchange economy). Now we will look at the production. The supply of the production factors is limited. The quantity of the two goods can change. More apples and less fig leaves can be produced, or more fig leaves and less apples.

The **production possibilities curve** shows the maximum quantity of one output that can be produced, given the amount of the other output. The slope of the production possibilities curve at any given point is called **the marginal rate of transformation** (MRT). It describes numerically the rate at which one good can be transformed into the other. It is useful to express the MRT in terms of **marginal cost** (MC) – the incremental production cost of one more unit of output.

$$MRT(f,c) = {}^{MC(f)}/_{MC(c)}$$

The new Pareto efficiency condition (with variable production) becomes:

$$MRT(f,c) = MRS(f,c)_{ANDY} = MRS(f,c)_{BRITNEY}$$

In words: the rate at which food can be transformed into clothing (MRT) must equal the rate at which consumers are willing to trade food for clothing (MRS).

First Fundamental Theorem of Welfare Economics
A Pareto-efficient allocation of resources emerges if:
- All consumers and producers act as perfect competitors (**perfect competition**). No one has market power.
- There exists a market for each and every commodity (**existence of markets**).

Under these assumptions, the **First Fundamental Theorem of Welfare Economics** tells us that a competitive economy automatically allocates resources efficiently, without any need for centralized direction. In a competitive market, all people face the same prices. Consumers and producers are so small relative to the market that they cannot affect the prices.

Proof of the first welfare theorem
Utility maximization requires:(1) **MRS(f,c) = P(f)/P(c)**
Remember the profit maximization condition: **P = MC**
So **MC(f)/MC(c) = P(f)/(P(c)**
But **MC(f)/MC(c) = MRT(f,c)**
Therefore (2) **MRT(f,c) = P(a) / P(c)**
Combining both formulas yields **MRS(f,c) = MRT(f,c)**

Because a competitive economy automatically allocates resources efficiently, it is hard to imagine what role the government plays in this economy. Things are really much more complicated than described in the First Theorem. The economic concept of efficiency is not the only thing that a society might care about. In particular, the theorem says nothing about the distributional equity of the outcome. Efficiency isn't everything; fairness matters to.

Fairness

The solution is to postulate a **social welfare function**, which embodies society's views on the relative deservedness of both individuals: $W = F(U_A, U_B)$.

A social welfare function leads to a set of indifference curves between people's utilities. Their downward slope indicates that if B's utility decreases, the only way to maintain a given level of social welfare is to increase A's utility, and vice versa.

The **utility possibility curve** is derived from the contract curve. It shows the maximum amount of one person's utility given the other individual's utility level. The points on the curve are Pareto-efficient, but represent very different distributions of real income. All points on or below the utility possibilities curve are attainable by society; all points above are unattainable.

Social welfare is maximized (a 'fair' distribution of utility) when the utility possibilities curve is tangent to the highest attainable utility indifference curve.

If society prefers an equal distribution of income to efficiency, an inefficient situation can be preferred. Government intervention may be necessary to achieve a "fair" distribution of utility. But how should the government intervene? The **Second Fundamental Theorem of Welfare Economics** states that a society can attain any Pareto-efficient allocation of resources by:

1. Assigning initial endowments fairly
2. Letting people freely trade

If necessary to ensure fairness, the government should redistribute income, but then step out of the way – no interference with prices or allocation.

Market failure
A second reason for government intervention is market failure. Failing to allocate resources efficiently may be caused by:

1. **Market power**: a firm with market power (monopoly, oligopoly, monopolistic competition) may be able to raise price above marginal cost by supplying less output than a competitor would (P>MC). An insufficient quantity of resources is devoted to the commodity.
2. **Non-existence of markets**: often a market fails to emerge, because of:

- **Asymmetric information**: one party in a transaction has information that is not available to another.
- **Externalities**: a situation in which one person's behavior affects the welfare of another in a way that is outside existing markets. The price system fails to provide correct signals about the opportunity cost of a commodity.
- **Public goods** (non-rival in consumption): the fact that one person consumes it does not prevent anyone else from doing so as well. The market mechanism may fail to force people to reveal their preferences for public goods, and possibly result in insufficient resources being devoted to them.

The fact that the market does not allocate resources perfectly does not necessarily mean the government can do better. Each case must be evaluated on its own merits.

Although the theory of welfare economics provides a coherent and useful framework for analyzing policy, it is not universally accepted:
- It aims to maximize people's utilities (other goals are possible).
- Individuals may not know their true preferences.
- It focuses on results and does not pay much attention to the processes used to achieve results.

The framework of welfare economics impels us to ask three key questions whenever a government activity is proposed:
1. Will it have desirable distributional consequences?
2. Will it enhance efficiency?
3. Can it be done at a reasonable cost?

If the answers to these questions is no, the market should probably be left alone.

2. Public goods

Definition of a public good

A **pure public good** (example = national security) has both these properties:

Consumption is **nonrival** – the additional resource cost of another person consuming the good is zero.

Consumption is **nonexcludable** – everyone consumes the same amount and it is impossible (or very expensive) to prevent anyone from consuming the good.

A **pure private good** (example = pizza) logically is both rival and excludable.

Several aspects of our definition of a public good are worth noting:

- Even though everyone consumes the same quantity, it need not to be valued equally by all. This depends on the preferences of the consumers. Everyone consumes same quantity, even those who don't want it.
- Classification as a public good is not an absolute. It depends on market conditions and the state of technology. Consumption of a public good can be rival or excludable to some extent (**impure public good)**.
- The terms private and public don't tell anything about which sector provides the item. Private goods are not necessarily provided exclusively by the private sector (**publicly provided private goods**, example = medical services). Public goods can be provided privately (example = fireworks).
- Public provision of a good does not necessarily mean that it is also produced by the public sector.

Efficient provision of public goods

The equilibrium in the market is found where supply and demand are equal. The demand curve of Andy shows the quantity of Food that he would be willing to consume at each price, other things being the same. To find the market demand curve of Food, we simply add together the units of Food each person demands at every price. This involves summing the horizontal distance between each of the private demand curves and the vertical axes at that price. This process is called **horizontal summation**. With a private good, there is no reason to expect all consumers consume the same amounts. A competitive market results in Pareto efficient allocation (first fundamental theorem of welfare economics):

$$MRS_A = MRS_B = MRT$$

However, a public good must be consumed in equal amounts. It makes no sense to derive the market demand by summing up the quantities of a public good that the individuals would consume at a given price. Because the prices can differ, we add the prices that each would be willing to pay for a given quantity. For a public good, then, the group willingness to pay is found by **vertical summation** of the individual demand curves.

Hence, the market equilibrium requires that the total valuation consumers place on the last unit provided (sum of MRS's) equal the incremental cost to society of providing it (MRT):

$$MRS_A + MRS_B = MRT$$

The difference in equilibrium can be explained by the prices for both private and public good. For standard private goods, everyone sees the same price and then people decide what quantity they want. For public goods, everyone sees the same quantity and people decide what price they are willing to pay.

In case of a private good, individuals will have no incentive to lie about their preferences (competition assures efficiency). However, in case of a public good people who do not pay cannot be excluded. Each individual has the incentive to understate his or her willingness to pay. Hence, the market may fall short of providing the efficient amount of the public good. This problem is called the **free rider** (someone who lets other people pay while enjoying the benefits himself) **problem**.

Market mechanisms are unlikely to provide nonrival goods efficiently, even if they are excludable. The only possible solution seems to be **perfect price discrimination**. If:
    You know each person's demand curve for a public good.
- It is not possible to transfer the good from one person to another.
Then you can charge each person an individual price based on the willingness to pay.

Privatization Debate
Privatization = taking services that are supplied by the government and turning them over to the private sector for provision and/or protection.

Sometimes the services provided by publicly provided goods can be obtained privately. But what is the right mix of public and private provision? Publicly and privately provided goods are inputs into the production of some output that people desire. What ultimately matters to people is the level of output, not the particular inputs used to produce it. In selecting the amount of inputs, there are several considerations:
- **Relative wage and material costs**
  The less expensive sector is to be preferred on efficiency grounds.
- **Administrative costs**
  The larger the community, the greater the advantage to being able to spread these costs.
- **Diversity of tastes**
  To the extent such diversity is present, private provision is more efficient because people can tailor their consumption to their own tastes.
- **Distributional issues**
  The community's notions of fairness may require that some commodities be

made available to everybody (**commodity egalitarianism**).

Even in cases where public provision of a good is selected, a choice between public and private production must be made. There a two key factors in determining whether public or private production will be more efficient:

- **Market environment**
- **Incomplete contracts** – the extent to which complete contracts can be written with private sector service providers.
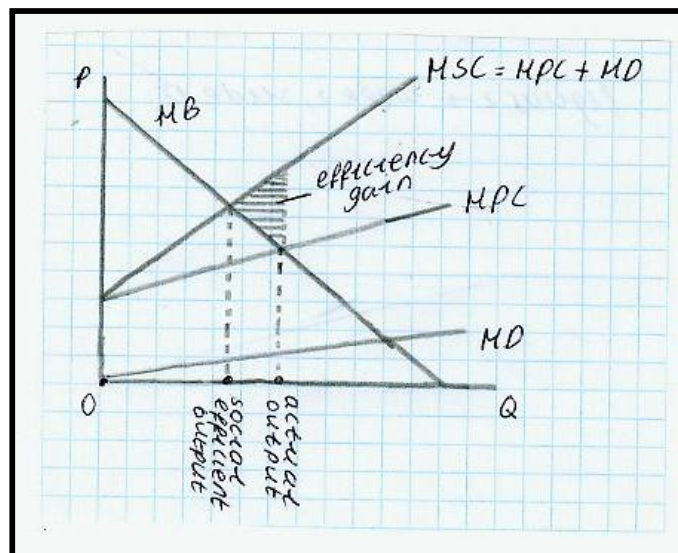
3. Externalities

When the activity of one entity (person or firm) directly affects the welfare of another in a way that is outside the market mechanism, the effect is called an **externality**. Unlike effects that are transmitted through market prices, externalities adversely affect economic efficiency.

Characteristics of externalities:
- They can be produced by consumers as well as firms
- Externalities are reciprocal in nature
- Externalities can be positive (example = vaccination)
- Public goods can be viewed as a special kind of externality - when an individual creates a positive externality with full effects felt by every person in the economy, the externality is a pure public good.

As long as someone owns a resource, its price reflects the value for alternative uses, and the resource is therefore used efficiently. An externality is the consequence of the absence of **property rights**. The private sector does not produce the socially efficient output level in case of externalities. By looking at producer and consumer surpluses we can prove that the society gains by reducing production:

It is difficult to identify and to value the effect of an externality like pollution:
- *What activities produce pollutants?*
  The types and quantities of pollution associated with various production processes are hard to identify (example = acid rain).
- *Which pollutants do harm?*
  Pinpointing a given pollutant's effect is difficult.

- *What is the value of the damage done?*
  It is a hard to calculate the dollar value of the damage. Pollution is generally not bought and sold in explicit markets. The use of a willingness-to-pay measure can be questioned. People may be ignorant about the effects of an externality and underestimate the value of reducing it.

The inefficient allocation caused by an externality can be avoided. An efficient output can be achieved by both private and public responses.

Private responses

1. Bargaining
When property rights are assigned, individuals may respond to the externality by bargaining with each other. In this way the gain is divided over the involved parties. The **Coase Theorem** states that no matter who is assigned the property rights, an efficient solution will be achieved if both:
- the bargaining costs are low;
- the owner can identify the polluter.

This theory implies that once property rights are established, no government intervention is required to deal with externalities.

2. Mergers
Another way to deal with an externality is to internalize it by combining the involved parties. In effect, by failing to act together companies are often throwing away money. The market, then, provides a strong incentive for the firms to merge.

3, Social conventions
Individuals cannot merge to internalize externalities. Certain social conventions can be viewed as attempts to force people to take into account the externalities they generate. Often moral precepts induce people to emphasize with others (example = turn of mobile phones in class). These precepts correct for the absence of missing markets.

Public responses

1. Pigouvian tax
A natural solution is to levy a tax on the polluter that makes up for the fact that some of his inputs are prices too low. A Pigouvian tax is a tax levied on each unit of a polluter's output in an amount just equal to the marginal damage it inflicts at the efficient level of output. Such a tax gives the producer a private incentive to produce the efficient output.

Practical problems in implementing a Pigouvian tax:
    What is the marginal damage (= tax rate)?
    • Who pollutes and how much?

However, an imperfect Pigouvian tax is often better than none at all.
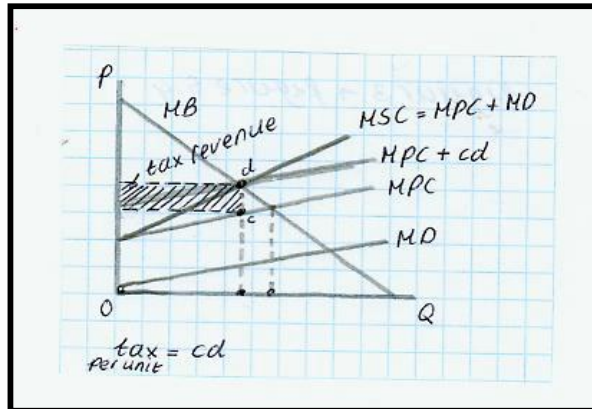

2. Pigouvian subsidy
A subsidy for pollution not produced can induce producers to pollute at the efficient
level. A Pigouvian subsidy
A subsidy also leads to the efficient production level, but it has different distributional
consequences compared to a Pigouvian tax (SEE FIGURE).

Practical problems of a Pigouvian subsidy:
    • Polluters and the amount of pollution are hard to identify.
    • Subsidy may attract more factories, because a subsidy increases the profits.
      Eventually, total pollution, then, will increase.
    • Subsidizing polluters is often ethically undesirable.
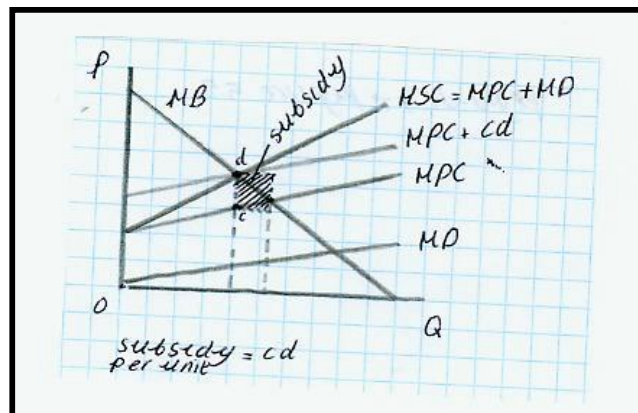
3. Creating a market

The government can sell permits with socially efficient output and permissions to pollute go to the firms with the highest bids (example = CO2 emission rights). The price paid for permission to pollute measures the value to producers of being able to pollute. The main advantage of this permit approach is that it reduces uncertainty about the ultimate level of pollution.

4. Regulation

Under regulation, each polluter must reduce pollution by a certain amount or else face legal sanctions. Regulation is likely to be inefficient when there are multiple firms that differ from each other, because the social value of pollution reduction varies across firms, locations and the populace. Regulation that mandates all firms to cut back by equal amounts (either in absolute or proportional terms) leads to some firms producing too much and others too little.

Positive externalities

The analysis of positive externalities is similar to that of negative externalities. Efficiency requires the marginal cost to equal the social marginal benefit. When an entity produces positive externalities, the market underprovides the good. This can be corrected by an appropriate Pigouvian subsidy.

However, requests for such subsidies must be viewed cautiously:

- Subsidy has to be financed by taxes. This means a redistribution of income *and* a distortion of the market which is taxed.
- The fact that an activity is beneficial does not always mean that a subsidy is required for efficiency – only if the market is imperfect.
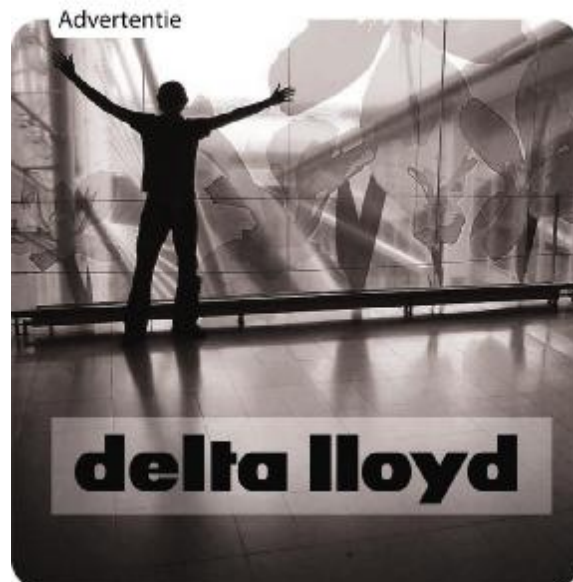
4. Public choice

Till now, we questioned ourselves what kind of actions the government should take. In this chapter we will look at who decides what the government actually does. This chapter applies economic principles to the analysis of political decision making, a field known as **political economy**. Most economic theories assume that the government acts in the interest of society, but political economy theories assume that politicians are self-interested.

- Selfishness does not necessarily lead to inefficient outcomes. If the market for political decisions works perfect, we should see an efficient outcome.
- While the maximization assumption may not be totally accurate, it provides a good starting point for analysis.

We will examine how political decisions are being made in both a direct and a representative democracy.

Direct democracy
Democratic societies use various different voting procedures to decide on public expenditures:

1. Unanimity
Lindahl stated that if a vote were taken on whether to provide an efficient quantity of the good, consent would be unanimous as long there was a suitable tax system to finance it. In this **Lindahl procedure**, each individual faces a personalized price per unit of public good, which depends on his or her tax share. The tax shares are referred to as **Lindahl prices**. Lindahl's procedure has two main problems:
- Free rider problem – people hide their true preferences.
- Getting everyone's consent involves enormous decision-making costs.

2. Majority voting
With a majority voting rule, one more than half of the voters must favor a measure to gain approval. But if there are more than 2 options to choose from, majority decision rules do not always yield such clear-cut results. Although each individual voter's preferences are consistent, the community's could be not. This is called the **voting paradox**.

It depends on the question if a voter has single-peaked or double-peaked preferences. A **peak** in an individual's preferences is a point at which all the neighboring points are lower. A voter had **single-peaked preferences** if his utility consistently falls when he moves from his favored outcome in all directions. He has **multi-peaked preferences** if, as he moves away from his favored outcome, the utility goes down, but then goes up again. If all voters' preferences are single peaked, no voting paradox occurs.
With more voting options, the ultimate outcome depends on the order in which the

votes are taken. This opens the opportunity of **agenda manipulation** – organizing the order of votes to assure a favorable outcome. A related problem is that paired voting can go on forever without reaching a decision. This process of **cycling** can continue indefinitely.

The **median voter theorem** states that as long as all preferences are single peaked, the outcome of majority voting reflects the preferences of the median voter. The **median voter** is the voter whose preferences lie in the middle of all voters' preferences. Half the voters want more than the median voter wants, half want less.

3. Logrolling

Logrolling systems allow people to trade votes and hence register how strongly they feel about various issues. The effect on general welfare is unclear. The main disadvantage is that it leads to wasteful public expenditures. Logrolling is likely to result in special-interest gains not sufficient to outweigh general losses. The main advantage is that it allows voters express the intensity of their preferences by trading votes.

Arrow's impossibility theorem

In a democratic society, a collective decision-making rule should satisfy the following ethical criteria:

- It must produce decisions, whatever the configuration of votes' preferences.
- It must be able to rank all outcomes
- It must be responsive to individuals' preferences
- It must be consistent
- It must be independent of irrelevant alternatives
- Dictatorship is ruled out

Arrow's impossibility theorem states that it is impossible to find a rule which satisfies all of these criteria. This means that democracies are inherently prone to make inconsistent decisions.

Representative democracy

Explanations of government behaviour in a representative democracy require studying the interaction of elected politicians, public employees, and special-interest groups.

1. Elected politicians

Often, citizens elect politicians who make decisions on their behalf. The median voter theorem helps explain how these representatives set their positions. It pays candidates to place themselves as close as possible to the position of the median voter. Still several issues require careful examination:

- Single-dimensional rankings – it should be possible to rank political beliefs along a single spectrum.
- Ideology – they ideology of the politicians also plays an important role
- Personality – voters not only base their vote on the issues

- Leadership – voters' preferences can be influenced by the politicians themselves.
- Decision to vote – not every eligible citizen chooses to exercise his or her franchise.

2. Public employees

The decisions of politicians are carried out by civil servants, bureaucrats. Public employees have an important impact on the development and implementation of economic policy. The goals from the bureaucrats will sometimes differ from the public good. They often focus on reputation, power, patronage, etc. The **Niskanen model** suggests that these goals are positively related with the size of the bureaucrat's budget. Bureaucrats attempt to maximize the size of their agencies' budgets, resulting in oversupply of the service. They have the power to influence this output decision, because of their informational advantage.

3. Special interests

People with common interests can exercise disproportionate power by acting together. Special interest groups can form on the basis of income source, income size, industry, region, or personal characteristics. These groups can manipulate the political system to redistribute income towards them. This is called **rent-seeking**.
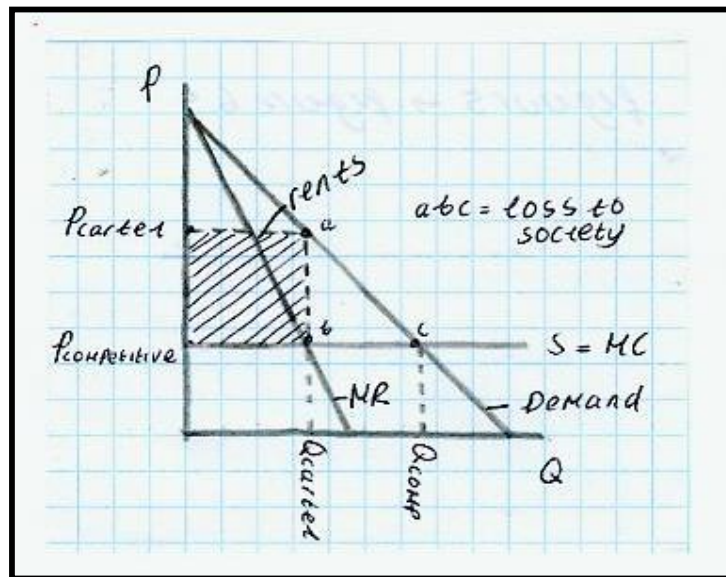
There are also other groups that affect government fiscal decisions:
- Judiciary – through court decisions.
- Journalists – by bringing certain issues to public attention.
- Experts – information is potentially an important source of power.

Government growth

The concern about political economy issues has been stimulated by the growth of the government. There are different explanations for the growth of the government. The most prominent theories follow:

- **Citizen preferences –** growth in government expenditure is an expression of the preferences of the citizenry.
- **Marxist view** – growth in government expenditure depends to the political economic system. In the Marxist model, the private sector tends to overproduce, so the capitalist-controlled government must expand its expenditures in order to absorb this production.
- **Chance events** – external shocks to the economic and social systems require higher level of government expenditure.
- **Change in social attitudes** – social trends encouraging personal self-assertiveness lead people to make extravagant demands on the political system.
- **Income redistribution** – government grows because low-income individuals use the political system to redistribute income towards themselves.

Many people want to control the growth in government. Proposals include encouraging private sector competition, reforming the budget process, and constitutional amendments.

5. Income redistribution

This chapter presents a framework for thinking about the normative and positive aspects of government income redistribution policy.

First, it is important to see why there are large disparities in income. Within the developed countries, wage differentials are the most important reason. Differences in property income (interest, dividends) account for only a small portion of income inequality. A key factor driving the increase in inequality is an increase in the financial returns to education.

Measuring the extent of poverty is hard to do. It is therefore very important to know the conventions use to construct the income data:
- The income is based on cash-receipts (no **in-kind transfers** – payments in commodities or services as opposed to cash.
- The official figures ignore taxes. Tax redistribution is not reflected in the numbers.
- Income is measured annually. However, even annual measures may not reflect an individual's true economic position. Income can fluctuate.
- There are problems in defining the unit of observation. The figures ignore changes in household composition. It is hard to account for economies of scale.

Welfare economics posits that society's welfare depends on the well-being of its members. This means welfare is a function of all individuals' utilities (**utilitarianism**):

Utilitarian social welfare function: $\quad$ **$W = F(U_1, U_2, \dots , U_n)$**

A change that makes someone better off without making anyone else worse off increases social welfare (not necessarily a Pareto improvement, because some people may be worse off). In other words, income should be redistributed as long as it increases W.

Additive social welfare function: $\quad$ **$W = U_1 + U_2 + \dots + U_n$**

If: $\quad$ 1. Individuals have identical utility functions only depending on income
$\qquad$ 2. Marginal utility of income diminishes
$\qquad$ 3. Total income is fixed
Then the government should redistribute income so as to obtain complete equality.

However, these are strong assumptions and weakening them gives radically different results. Obviously, you can question the assumptions:
- It is a reasonable guess that utility functions are identical, but they do not only depend on income (often also on for instance leisure)
- It is probably that marginal utility of income diminishes. If it does not, the redistribution cannot change social welfare.
- Total amount of income is not fixed. If an individual's utility depends on leisure, redistribution makes working less attractive, so there is less income to redistribute.

The additive social welfare function assumed that society is indifferent to the distribution of utilities. Not every utilitarian social welfare function carries this implication:

Maximin criterion: $\quad\quad$ **W = Minimum ($U_1, U_2, \ldots, U_n$)**

In this equation, social welfare depends only on the utility of the person who has the lowest utility. The best income distribution maximizes the utility of the person who has the lowest utility. This means society's only concern is the poorest person.
John Rawls claimed that the maximin criterion has a claim to ethical validity. If people are risk-averse and don't know their future position in society (**original position**), they will choose maximin as an insurance against disastrous outcomes. However, the analysis is controversial, because the welfare of other persons also matters and people are not always totally risk-averse.

Because of the assumption that each individual's utility depends only on income, redistribution was never a Pareto improvement. Redistribution can actually be a Pareto improvement:
- If high income individuals are altruistic, their utilities depend not only on their incomes but those of the poor as well. Income redistribution can be seen as a public good – everyone derives utility from the redistribution, but government coercion is needed to accomplish redistribution.
- There is always some chance that you will become poor. An income distribution policy is a bit like an insurance against future poverty.
- Income distribution creates social stability. If poor people become too poor, the may engage in antisocial activities such as crime.

After deciding whether the government should redistribute income, the next question is how to do it. The government influences income redistribution through its taxation as well as its expenditure policies. The impact of expenditure policy on the redistribution of real income is referred to as **expenditure incidence**. This is difficult to determine, because:
- **Relative price effects**

An expenditure programme sets off a chain of price changes that affects the income of people both in their role as consumers of goods and as suppliers of inputs. The problem is that it is very hard to trace all the price changes. Economists generally focus on the prices in the markets that are directly affected.

- **Public goods**
  For public goods, the impact on the income distribution is unknown, because people do not reveal how they value public goods.
- **In-kind transfers**
  Many government programs provide goods and services instead of cash. If recipients would prefer to consume less, the value of the in-kind transfer is less than the market price. We cannot know for certain if an in-kind transfer is valued less than a direct income transfer. The answer has to be found by empirical analysis. Another problem is that in-kind transfers often entail substantial administrative costs, which reduces efficiency.

Reasons for in-kind transfers:
- **Paternalism**
  Politicians seem to know better what is good for people.
- **Commodity egalitarianism**
  Some services must be equally accessible to everyone.
- **Administrative feasibility**
  An in-kind transfer leads to less fraud than with a money transfer. In-kind transfers may discourage ineligible persons from applying because they are less willing to lie to obtain a commodity they do not really want.
- **Political attractiveness**
  In-kind transfers help not only the beneficiary but also the producers of the favoured commodity.

6. Cost benefit analysis

Social welfare functions are generally not much help for the day-to-day problems of project evaluation. However, welfare economics does provide the basis for **cost-benefit analysis** – a set of practical procedures for evaluating potential projects. In this way resources can be allocated to a project as long as the marginal social benefit exceeds the marginal social cost.

To compare costs and benefits in different time periods, their **present value** must be computed. The present value is the value today of a given amount of money to be paid or received in the future. To find the value of money today one year in the future, you multiply by one plus the interest rate. To find the value of money one year in the future today, you divide plus one plus the interest rate.

Future value of one amount: $FV = \$R \times (1+r)^T$

Present value of one amount: $PV = \$R / (1+r)^T$

Present value of an income stream: $PV = R_0 + R_1/(1+r) + R_2/(1+r)^2 + \ldots + R_T/(1/r)^t$

R = investment
r = interest rate (discount factor)
T = time (in years)

The dollar values R can both be nominal or real amounts. With nominal amounts, the market interest rate increases by an amount approximately equal to the expected rate of inflation from r percent to (r+ π) percent.

Present value of an income stream (nominal terms)

$$PV = R0 + \frac{(1+\pi)R_1}{(1+\pi)(1+r)} + \frac{(1+\pi)R_2}{(1+\pi)(1+r)^1} + \cdots + \frac{(1+\pi)R_2}{(1+\pi)(1+r)^T}$$

The moral of the story is that you obtain the same answer whether real of nominal magnitudes are used. It is crucial, however, to use both consistently. Then inflation cancels out.

A project is admissible only if its net return is positive – benefits exceed costs. In project evaluation, the calculation of the **net present value** of a project can be useful.

Net present value:

$$NPV = B_0 - C_0 + \frac{(B_1 - C_1)}{(1+r)} + \ldots + \frac{(B_T - C_T)}{(1+r)^T}$$

B = benefits, C = costs, r = discount rate, T = time (years)

The **net present value criteria** for project evaluation are that:
- A project is admissible only if NPV > 0
- When two projects are mutually exclusive, choose the one with the higher NPV

Several criteria other than the present value are often used for project evaluation:
- **Internal rate of return (p)**
  The internal rate of return (p) is the discount rate that makes the NPV=0. The project is admissible is admissible if the internal rate of return exceeds the actual discount rate (p > r). When two projects are mutually exclusive, choose the one with the higher value of p. However, if projects differ in size, the internal rate of return can be misleading. A big project with a low p may make more money than a small one with a high p.
- **Benefit-cost ratio = B/C (NPV_{BENEFITS}/NPV_{COSTS})**
  A project is admissible if the benefit-cost ratio exceeds one. However, the ratio is useless in comparing different projects. By manipulating definitions of costs or benefits, any project can be given a high B/C (e.g. a benefit is a cost reduction)

Choosing the discount rate is critical in cost-benefit analyses. The discount rate reflects opportunity costs, so it depends on where the money for the project comes from. In public sector analyses, there are three possible measures for the discount rate:
- **Before-tax private rate of return**
  Money is extracted from private sector investment. The opportunity cost of the government project equals the rate of return in the private sector.
- **After-tax private rate of return**
  Money is extracted from consumption. Because the after-tax rate of return measures what an individual loses when consumption is reduced, dollars that come at the expense of consumption should be discounted by the after-tax rate of return.
  Because funds for the public sector reduce both private sector consumption and investment, a natural solution is to use a weighted average of both.
- **Social discount rate**
  Measure the valuation that society places on consumption that is sacrificed in the present. The social discount rate may be lower than the market rates of return for several reasons:
  - Concern for future generations
  The public sector should care about the future generations as well. The private sector ignores future generations and is only concerned with its own welfare.
  - Paternalism
  People may not know their own best interests. The government forces them to consume less in the present en, in return, they have more in the future (and they will be thankful afterwards).
  - Market inefficiency
  Investments can create positive externalities and will be underprovided by

private markets.

It appears that it is hard to pick one the right discount rate for the public sector. The best procedure is a **sensitivity analysis**. It evaluates the present value of a project over a range of different discount rates and examines whether or not the present value stays positive for all reasonable values of r.

Valuing public benefits and costs

In private firms, benefits are the revenues received and costs are they payments for inputs. This is more complicated for the government because market prices may not reflect social benefits and costs. There are several possibilities for measuring the benefits and costs in the public sector:

1. Market prices

If the government uses inputs/produces outputs that are traded in competitive private markets, market prices should be used. Market prices reflect the marginal costs of production and the marginal value to consumers.

2. Shadow prices

However, often market imperfections exist and the prices for the commodities don't reflect its marginal costs anymore. The **shadow price** of such a commodity is its underlying social marginal cost. It is the price adjusted for market imperfections (like a monopoly, taxes or unemployment) and it depends on how the economy responds to the government intervention.

3. Consumer surplus

If large government projects change equilibrium prices, the consumer surplus can be used to measure the benefits. The consumer surplus reflects the amount by which the sum that individuals would have been willing to pay exceeds the sum the actually have to pay.

4. Inferences from economic behaviour

For non-traded commodities, there is no market data available. The value can sometimes be inferred by observing people's behaviour. In this way people's willingness to pay for such commodities can be estimated.

- **Value of time**
  A common way of to estimate the value of time is to take advantage of the theory of leisure-income choice. People work up to the point where the subjective value of leisure is equal to the income they gain from one hour of work. However, often people can't choose their hours of work and not all uses of time from a job are equivalent.
- **Value of life**
  The value of life can be estimated for instance by examining the difference in wages for dangerous and safe jobs or the market prices for safety devices – how

much people are willing to pay to reduce the probability of death.

Often, (future) costs and benefits are uncertain and risky. In such a case it is best to convert them into **certainty equivalents** – the amount of certain income the individual would be willing to trade for the set of uncertain outcomes generated by the project. Certain intangible benefits and costs simply cannot be measured. It is hard to attain these benefits, but the best possibilities seem to be:

- Exclude them in a cost-benefit analysis and then calculate how large they must be to reverse the decision.
- **Cost-effectiveness analysis**: a systematic study of the costs of the various alternatives to find the cheapest way possible.

Tresh (2002) has noted some other common errors in cost-benefit analysis:

- **Chain-reaction game**
  Secondary benefits are included to make a proposal appear more favourable, without including the corresponding secondary costs. It counts as benefits changes that are merely transfers.
- **Labor game**
  Wages are viewed as benefits rather than costs of the project, because the project 'creates' employment.
- **Double-counting game**
  Some benefits are erroneously counted twice.

Distributional considerations
There is a discussion about giving consideration to the question of who receives the benefits and bears the costs of a public sector project.

- Some argue that if the net present value of a project is positive, it should be undertaken regardless of who gains and loses. This is because as long as the NPV is positive, the gainers could compensate the losers and still enjoy a net increase in utility (potential Pareto improvement). This notion is called the **Hicks-Kaldor criterion**.
- Others oppose that because the goal of the government is to maximize social welfare, the distributional implications of a project should be taken into account.

7. Taxation and equity

The **statutory incidence** of a tax indicates who is legally responsible for the tax. However, this tells us nothing about who really pays the tax, because prices may change in response to the tax. The **economic incidence** of a tax is the change in the distribution of private real income induced by a tax. It tells us who really bears the burden. The extent to which statutory and economic incidence differ is called the amount of **tax shifting**.

General remarks about tax incidence:

1. Only people can bear taxes
From an economist's point of view only people can bear taxes. For the purpose of incidence analysis, there are different classifications:
- **Functional distribution of income –** the way income is distributed among people when they are classified according to the inputs they supply to the production process.
- **Size distribution of income –** the way that income is distributed across different income classes.

2. Both sources and uses of income should be considered
Economists often ignore effects on the sources side when considering a tax on a commodity and ignore the uses side when analyzing a tax on an input.

3. Incidence depends on how prices are determined
Different models of price determination may give quite different answers to the question of who really bears a tax. The question how taxes change prices is closely related to the time dimension of the analysis. It takes time for prices to change. This means that the short- and long-run incidence of a tax may differ.

4. Incidence depends on the disposition of tax revenues
Depending on the policy being considered, one of the following incidences can be examined:
- **Balanced-budget incidence**
  It computes the combined effects of levying taxes and government spending financed by those taxes. However, taxes are usually not earmarked for particular expenditures. Some studies assume that the government spends the tax revenue exactly the same as the consumers would if they had received the money.
- **Differential tax incidence**
  It abstracts from how the government will spend the money. The idea is to examine how incidence differs when one tax is replaced with another, holding the government budget constant.

The basis of the comparison ('the other tax') is often assumed to be a **lump sum tax –** a tax for which the individual's liability does not depend upon behaviour.

- **Absolute tax incidence**
  It examines the effects of a tax when there is no change in either other taxes or government expenditure.

5. Tax progressiveness can be measured in several ways

Often a tax is characterized as proportional, progressive, or regressive.

Proportional = the ratio of taxes paid to income (**average tax rate**) is constant regardless of income level.

Progressive = an individual's average tax rate increases with income.

Regressive = an individual's average tax rate decreases with income.

Confusion arises because some people think of progressiveness in terms of the **marginal tax rate** – the change in taxes paid with respect to a change in income. It equals the tax paid on the last euro.

Measuring the tax progressiveness is a hard task. We consider two simple options:

- **Progressiveness = (difference in average tax rate) / (difference in income)**
 The greater the increase in average tax rates as income increases, the more progressive the system.
- **Progressiveness = (% change in tax revenues) / (% change in income)**
  One tax system is more progressive than another if its elasticity of tax revenues with respect to income is higher.

Knowing how prices are determined is critical to the analysis of how taxes change the income distribution. We can apply two models: partial equilibrium models and general equilibrium models.

Partial equilibrium models of price determination are models that only look at the market in which the tax is imposed and ignore the ramifications in other markets. We first assume that the market is perfect competitive. We study both the incidences of a **unit tax** (fixed amount per unit of a commodity) and an **ad valorem tax** (percentage of the commodity price).
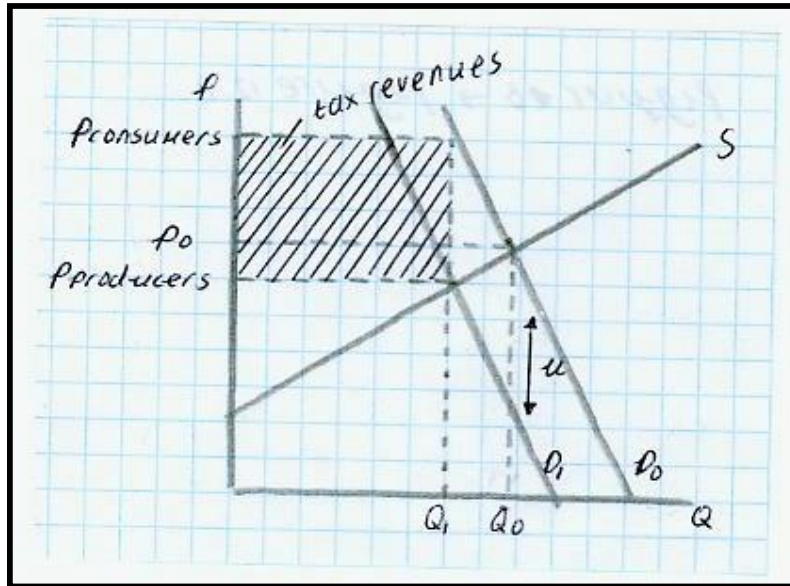
In the presence of a unit tax, the price paid by consumers (price gross of tax) and the price received by suppliers (price net of tax) differ. The conclusion of the model is the tax makes both producers and consumers worse off. They split the tax is a sense that the increase in the consumer price (Pconumers – P0) and the decrease in producer price (P0 – Pproducers) just add up to $u.

The analysis has two important implications:
- The incidence of a unit tax is independent of whether it is levied on consumers or producers. What matters is the size of the disparity the tax introduces between the price paid by consumers and the price received by producers. The tax-induced difference between the price paid by consumers and the price received by producers is referred to as the **tax wedge**.
- The incidence of a unit tax depends on the elasticities of supply and demand. The more elastic the demand curve, the less the tax borne by consumers. Similarly, the more elastic the supply curve, the less the tax borne by producers. There are two extreme cases:
  - Inelastic demand: consumer bears the full burden
  - Inelastic supply: producers bear the full burden

The analysis of an ad valorem tax, a tax with a rate given as a proportion of the price, is very similar to that of unit taxes. Instead of moving the curve down by the same absolute amount for each quantity, the ad valorem tax lowers it by the same proportion.

Until now, we assumed that markets were competitive. There are other possibilities:
- **Monopoly**
  The analysis for a monopoly is similar. Despite its market power, a monopolist is generally made worse off by a unit tax on the product it sells. As before, the

precise share of the burden borne by the consumers depends on the elasticity of the demand schedule.
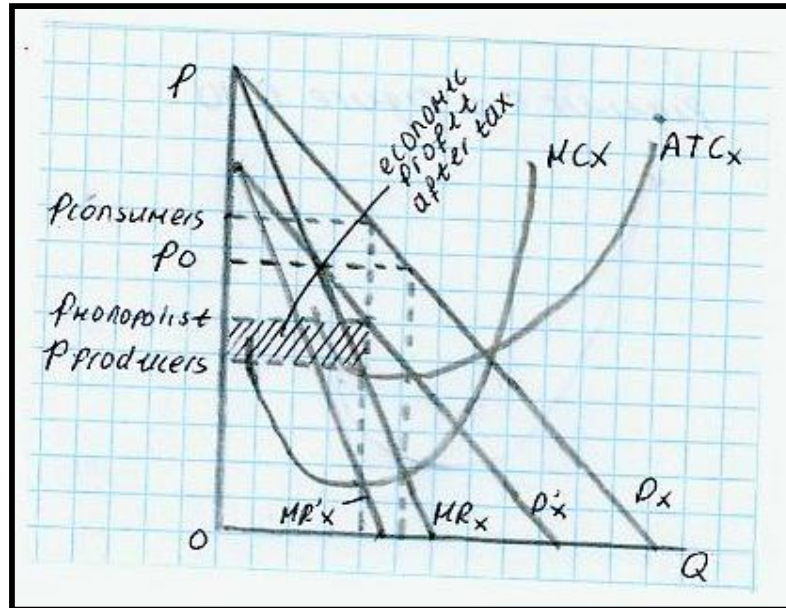
- **Oligopoly**
  There is no well-developed theory of tax incidence in an oligopoly, because relative price changes are unknown. We can only say that the ideal situation for firms is a **cartel solution** – firms jointly produce the output that maximizes the profits of the entire industry. However, each firm has an incentive to cheat n that agreement. So the output in an oligopolistic market is often higher that the cartel solution.

The analysis of taxes on the factors of productions is similar to that of a commodity tax. A tax on **economic profits** cannot be shifted; it is borne only by the owners of a firm. In the short-run, a proportional tax affects neither marginal cost nor marginal revenues. There, the output and the price stay the same. Because the price paid by consumers doesn't change, the tax is completely absorbed by the firms. In the long-run, a tax on economic profits has no yield, because economics profits are zero.

One special case is examined: the tax on land. We can say that land is durable and fixed in supply. The price of land equals the net present value of future returns. At the time tax is imposed, the price of land falls by the present value of all future tax payments.
This process by which a stream of taxes becomes incorporated into the price of an asset in referred to as **capitalization**. It implies that the present owner pays the burden of the tax forever.
When a tax is imposed on a sector that is large relative to the economy, looking only at that particular market may not be enough. **General equilibrium analysis** takes into

account the ways in which various markets are interrelated. These analyses often employ a two-sector (Manufacturing [M] +Food [F]), two-factor model (Capital [K] + Labor [L]). This framework allows for nine possible taxes:

- Capital tax for either sector M or sector F (1+2)
- Labor tax for either sector M or sector F (3+4)
- Consumption tax on either good M or good F (5+6)
- Tax on either labor or capital (in both sectors) (7+8)
- General income tax (9)

The first 4 taxes are called **partial factor taxes** – levied on a factor is only one of its uses.

Any two sets of taxes that generate the same changes in relative prices have equivalent incidence effects:

The **Harberger model** is a prominent method for analyzing tax incidence with general equilibrium models. The main assumptions of this model are:

- Perfect competition, profit maximization and prices are perfectly flexible.
- Constant returns to scale
- One sector capital intensive, another labor intensive
  Production technologies differ with respect to the ease with which capital can be substituted for labor (**elasticity of substitution**) and the ratio's in which capital and labor are employed.
- Mobile production factors and the total supply of capital and labor are fixed.
- No savings
- All consumers have identical preferences
- Differential tax incidence: study the effect of substituting one tax for another.

We will use the Harberger model to analyse several different taxes:

- **Commodity tax** (on food) – the relative price of food increases. This leads to less food and more manufactures that are produced. If food is more capital-

intensive than manufactures, the relative demand for capital decreases. This will decrease the relative price of capital. In other words, a tax on the output of a sector causes a decline in the relative price of the input used intensively in that sector.

- **Income tax** - equivalent to a set of taxes on capital and labor. Because factor supply is fixed the tax cannot be shifted and it is borne in proportion to people's initial incomes.
- **General tax on labor -** taxed in both sectors, so there are no possibilities to escape the tax by migration to the other sector. Because the total supply of factor supply is fixed, labor bears the entire burden.
- **Partial factor tax**

  When capital used in the manufacturing sector only is taxed, there are two effects:

a. Output effect
Price of manufactures rises, which decreases the quantity demanded.
b. Factor substitution effect
Capital becomes more expensive in the manufacturing sector, producers will use less capital and more labor.

The output effect is ambiguous with respect to the final effect on the relative prices of capital and labor. As long as factors are mobile between uses, a tax on a given factor in one sector ultimately affects the return to both factors in both sectors.

Changing some assumptions has important implications for the tax incidence:
- **Differences in individual's tastes** – when consumers don't have the same preferences, tax-induced changes in the distribution of income change aggregate spending decisions and hence relative prices and incomes.
- **Immobile factors**

  If a factor is immobile the taxed factor bears the whole burden, because the factor cannot escape taxation by migrating to another sector.
- **Variable factor supplies**

  Supplies to both capital and labor are variable in the long run. A general tax on capital decreases the capital-labor ratio, and the return to labor will fall (labor has less capital to work with). In this way, a general tax on capital can hurt labor.

8. Efficient taxation

Because a tax distorts economic decisions, it creates an **excess burden** (or welfare cost/deadweight cost): a loss of welfare above and beyond the tax revenues collected.
The Pareto efficiency condition stated: **MRS = MRT**
With a tax, the marginal rate of substitution becomes: **MRS = (1+t)P**
Profit-maximizing firms set the MRT at: **MRT = P**
As long as t is not 0, the efficient allocation of resources is violated. Tax drives a **wedge** between the consumer price and the price received by producers.
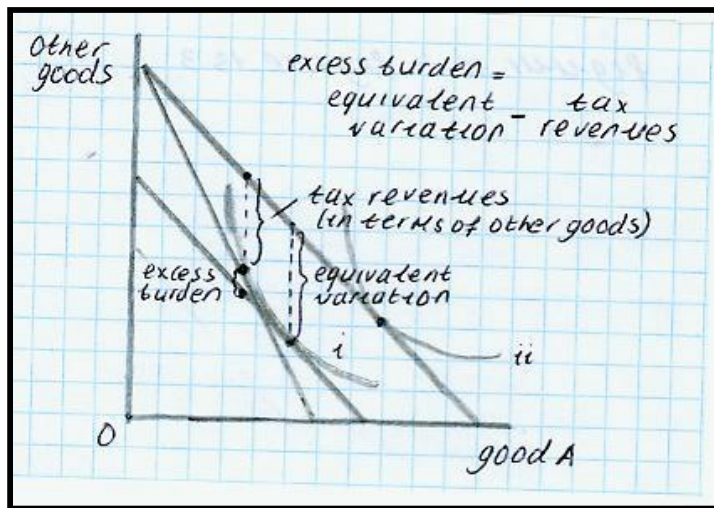

Obviously, a tax puts you on a lower indifference curve. The important question is whether the tax inflicts a greater utility loss than is necessary to raise revenues. If so, the tax has an excess burden. We can measure this with the **equivalent variation** – the change in income that has the same effect on utility as a change in the price of a commodity. It is a reduction in income that shifts the budget line downwards until it touches the lower indifference curve. If the equivalent variation exceeds the taxes collected, there is an excess burden.

Not every tax entails an excess burden. A **lump sum tax** – a certain amount that must be paid regardless of the taxpayer's behavior – does not change the price ratios. A lump sum tax is just a parallel shift of the budget line. Because the revenue yield of a lump sum tax equals its equivalent variation, a lump sum tax has no excess burden. Lump sum taxes are unattractive as policy tools. Because the amount of income individuals earn is at least in part under their control and people's choices affect their incomes, the income-based tax is not a lump sum tax. It reduces the price of leisure.

A tax creates two kinds of responses:
- **Uncompensated response** – it shows that consumption changes because of the tax and incorporates effects due to both losing income (**income effect**) and the tax-induced change in relative prices.
- **Compensated response** – the tendency of an individual to consume more of one good and less of another because of a change in the two goods' relative prices (**substitution effect**).

An ordinary demand curve depicts the uncompensated change in the quantity of a commodity demanded when price changes. A **compensated demand curve** removes the income effect and the consumer remains on same indifference curve. Only the substitution effect is reflected. The compensated demand curve is important because only the compensated response affects the MRS. This means excess burden depends on movement along the compensated demand curve.
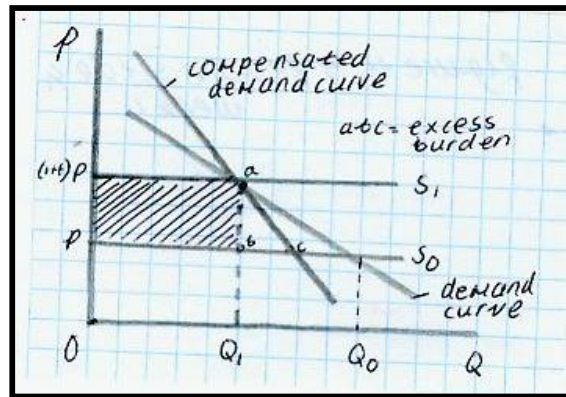
The excess burden can then be measured (η = absolute value of the compensated price elasticity of demand):

Excess burden = $\frac{1}{2} \times (Qc-Q1) \times \Delta p$

$\Delta p = (1+t)p - p = t \times p$

$\eta = (\Delta Q/Q) / (\Delta p/p)$ à $\Delta Q = (\eta \times Q) \times (\Delta p/p) = \eta \times Q \times t$

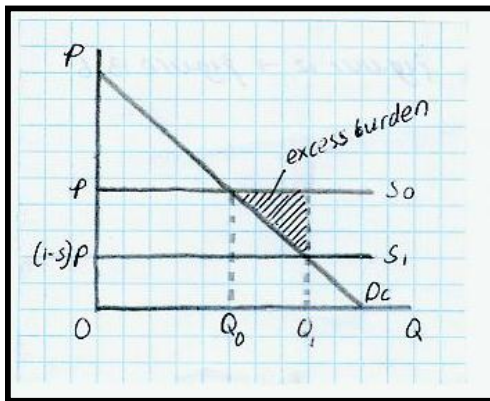Excess burden = $\frac{1}{2} \times \eta \times Q \times p \times t^2$

When the supply curve is upward sloping, the excess burden also depends on the compensated price elasticity of supply (ε):

Excess burden = $\frac{1}{2} \times 1/(1/\eta+1/\varepsilon) \times Q \times p \times t^2$

This analysis assumed no distortions in the economy other than the tax. In reality, when a tax is introduced, there are already other distortions. For instance with negative externalities, a Pigouvian tax can even improve welfare.

A subsidy is just a negative tax, and is also associated with an excess burden, because

people are encouraged to consume goods valued less than the marginal social cost of production. The theory of excess burden applies just as well to factors of production.
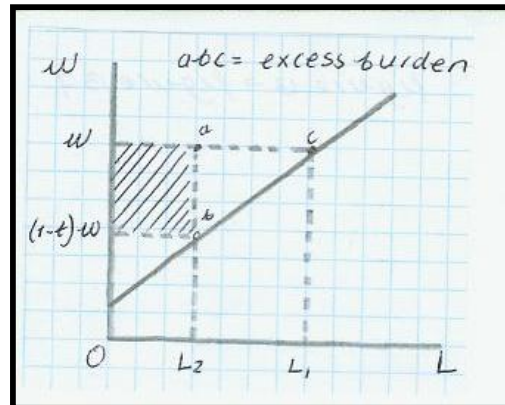
SUBSIDY   **LABOR**

The differential taxation of inputs creates an excess burden. Such inputs are used 'too little' in taxed activities, and 'too much' in untaxed activities. Whenever a factor is taxed differently in different uses, it leads to misallocation of factors between sector and hence an excess burden.

9. Efficient and equitable taxation

The theory of optimal commodity taxation needs a government's goal. We assume that the only goal is to finance the state's expenditures with a minimum of excess burden and without using any lump sum taxes.

*One individual consumes commodities X and Y as well as leisure (L). w=wage rate. T=**time endowment** (maximum numbers of hours per year an individual can work.*

No tax: $w(T-L) = P_xX + P_yY$

à $wT = P_xX + P_yY$

With tax (t): $wT = (1+t)P_xX + (1+t)P_yY + (1+t)wL$

à $1/(1+t) \times wT = P_xX + P_yY + wL$

A tax at the same rate on all commodities, including leisure, is equivalent to a lump sum tax and has no excess burden. However, putting a tax on leisure time is impossible. Only the commodities ca be taxed and therefore some excess burden is inevitable. It might seem that the solution is to tax the commodities at the same rate (**neutral taxation**), but this is in general not efficient.

To minimize overall excess burden, the marginal excess burden of the last dollar of revenue raised from each commodity must be the same. Otherwise, it would be possible to lower overall excess burden by raising the rate on the commodity with the smaller excess burden.

Ramsey rule: $(\Delta X)/X_1 = (\Delta Y)/Y_1$

The **Ramsey rule** states that to minimize excess burden, tax rates should be set so that the proportional reduction in the quantity demanded of each good is the same. When goods are unrelated in consumption the Ramsey rule implies that relative tax rates should be inversely related for the compensated demand elasticities (**inverse elasticity rule**). Efficient taxation requires that relatively high rates of taxation be levied on relatively inelastic goods.

**Inverse elasticity rule:** $t_x / t_y = \eta_y / \eta_x$

The **Corlett-Hague rule** (implication): when there are two commodities, efficient taxation requires taxing the commodity that is complementary to leisure at a relatively high rate.

Efficiency is not the only criterion. Fairness is also important. A tax system should have

a **vertical equity** – it should distribute burdens fairly across people with different abilities to pay. If society has distributional goals, departures from efficient taxation rule may be appropriate.

Sometimes the government itself is the producer of a good or service. Then the government should directly choose a price to be paid, a **user fee**. Choosing optimal user fees is quite similar to choosing optimal taxes. In the optimal tax problem, the government sets the price indirectly by the choice of the tax rate. With a user fee, this is done directly.

Decreasing average costs often lead to public sector production. Under these circumstances it is likely that there is a **natural monopoly**. A monopolist produces an inefficient output, because its price is higher than its marginal costs (MR=MC). This inefficiency and the fact that the society may not approve the existence of a monopoly provide a justification for government production.
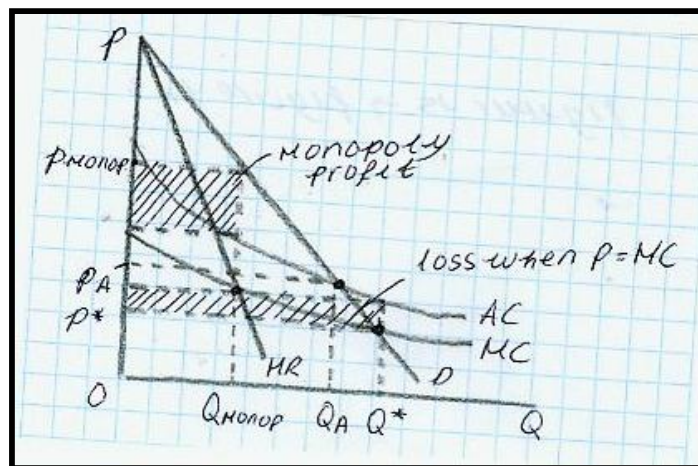
However, at the point of P=MC, the price is less than the average costs which means the government will have to incur losses. There are several solutions for this problem:

• **Average cost pricing**

Price equals average cost (P=AC), no profits/losses. But still falls short of the efficient amount.

• **Marginal cost pricing with lump sum taxes**

Price equals marginal cost (P=MC). Financing the deficit with lump sum taxes on the rest of the society guarantees that no new inefficiencies are generated by meeting the deficit. But lump sum taxes are generally unavailable, and there is a widespread belief that fairness requires consumers of a publicly provided service to pay for it (**benefits-received principle**).

• A Ramsey solution

The government has to raise a certain amount of revenue, by setting the user fees so that demand for each commodity is reduced proportionately.

Now we are going to focus on how progressive an income tax should be. The goal of the theory of optimal income taxation is to provide a systematic way for thinking about the right amount of tax progressivity.

Edgeworth's model (optimal income taxation) assumptions:
1. The goal is to make the sum of individuals' utilities as high as possible.
   Maximize $W = U_1 + U_2 + \ldots + U_n$
2. Individuals have identical utility functions that depend only on their incomes and they exhibit diminishing marginal utility of income.
3. The total amount of income in fixed.

These assumptions imply that taxes should be set so that the after-tax distribution of income is as equal as possible. Edgeworth's model reflects a very progressive tax structure. Marginal tax rates on high income individuals are 100%.

However, the assumption that income is fixed is not realistic. The process of allocating the tax burden involves distorting work decisions and creating excess burdens. That is why the total amount of real income available will be reduced.

The model of **Stern** takes these work incentives in account.

Tax revenues = -α + t x Income   (*t=marginal tax rate*)

This is a **linear income tax schedule** (or flat income tax) – the geometric interpretation is a straight line. Note that the schedule is still progressive in the sense that the higher an individual's income, the higher the proportion of income paid in taxes. The optimal income tax problem is to find the best combinations of α and t – the values that maximize social welfare. The more elastic the supply of labor, the lower the optimal value of t, other things being the same. One limitation of Stern's analysis is that it constraints the income tax system to have only one single marginal tax rate.

Unless the government can credibly promise not to renege, it cannot conduct the fully efficient tax policy. This phenomenon is called the **time inconsistency of optimal policy** –the stated policy is inconsistent with the government's incentives over time, and taxpayers realize this fact. In this way, policy recommendations based on optimal tax logic may actually reduce welfare.

We just argued that an efficient tax is one with a small excess burden. But tax systems may be evaluated by standards other than those of optimal tax theory:

1. Horizontal equity
People in equal positions should be treated equally. The difficulty is to measure these equal positions. Because work effort is at least to some extend under people's control, two individuals with different incomes may actually be in equal positions. It seems that the wage rate gives a better reflection of equal positions rather than income. However, wage rate has problems too: (1) investments in human capital can influence the wage rate. (2) wage rate per hour is often hard to measure. An alternative is to measure it in utilities.

The **utility definition of horizontal equity:**
- If two people have the same utility level before the tax, they should also be equally well off with taxation.
- Taxes should not alter the utility ordering.

However, as long as tastes for leisure differ, any income tax violates the utility definition of horizontal equity. People in different occupations pay unequal taxes (due to amenities that are not taxable), but there is no horizontal inequity, because of adjustments in the before-tax wage. The process of migrating between jobs continues until the net returns are equal (demand and supply of labor).

The conclusion is that a preexisting tax structure cannot involve horizontal inequity. All horizontal inequities arise from changes in tax laws, because individuals make commitments based on the existing laws that are difficult or impossible to reverse.

2. Cost of administration
The assumption that collecting taxes involves no costs is clearly false. The choice of tax and subsidy systems should take account of administrative and compliance costs. The trick is to find the best trade-off between excess burden and administrative costs. Any reduction in excess burden that arise from differentiating the tax rates must be compared to the incremental administrative costs.

3. Incentives for tax evasion
Tax avoidance = change your behavior to reduce your tax liability (legal).
Tax evasion = failing to pay legally due taxes (illegal).

Positive analysis of tax evasion
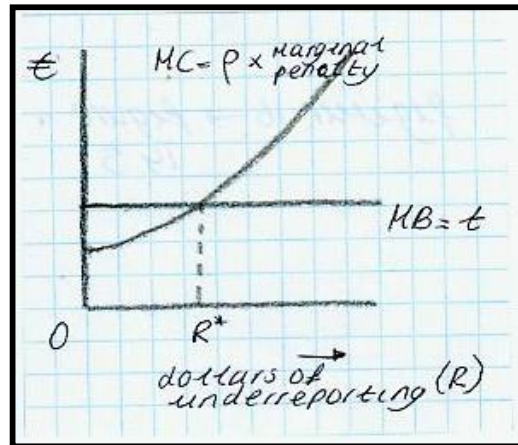
ρ = *probability of being audited, R= amount hidden for tax authorities*

Assume that you know the value of ρ and the penalty schedule. You make the decision by comparing the marginal costs and benefits of cheating. The optimal amount of cheating is where the two schedules cross. If the marginal cost of cheating exceed the marginal benefit for all positive values, the optimum of cheating equals zero. Still this model ignores some potentially important considerations:

- **Physic costs of cheating** – tax evasion makes people feel guilty
- **Risk aversion** – many people only care about expected income, and risk per se does not bother them.
- **Work choices** – the tax system may affect hours of work and job choices and stimulate the **underground economy –** economic activities that are either illegal, or legal, but hidden from tax authorities.
- **Changing probabilities of audit** – actually the audit probabilities depend on occupation and the size of the reported income.

Normative analysis of tax evasion

Consider two situations:

- **Society cares about the welfare of tax evaders**
  The existence of an underground economy can raise social welfare. In this case, leaving the underground economy intact might be desirable if society has egalitarian income redistribution objectives.
- **Evaders are given no weight in the social welfare function**
  The goal is to eliminate cheating at lowest administrative costs. Marginal cost of cheating is the product of penalty rate and probability of detection. The probability of detection depends on the amount of recourses devoted to tax administration. Still the government can raise the marginal cost by setting really high penalties, but in reality we often see a just retribution, because society also cares about the process by which the result is achieved.

10. The personal income tax

Computation of tax liability:

> Income from all taxable sources
> - Certain expenses incurred in earning that income
> = **Adjusted gross income (AGI)**
> - Exemptions and deductions
> = **Taxable income**

After the calculation of the taxable income (the amount of income subject to tax), the final step is to calculate the amount due. A **rate schedule** indicates the tax liability associated with each level of taxable income.

In an income tax, the definition of 'income' is essential. However, the law provides no definition. Public finance economists often use the **Haig-Simons (H-S) definition**: income is the money value of the net increase in an individual's power to consume during a period. This criterion requires the inclusion of all sources of potential increases in consumption, regardless of whether the actual consumption takes place, and regardless of the form in which the consumption occurs.

Included items in H-S income:
Wages and salaries, business profits, rents royalties, dividends, interest, employer pension contributions and insurance purchases, transfer payments, capital gains/losses (realized and unrealized) and income in kind.

Practical and conceptual problems:
- Only income net of business expenses increases potential consumption power. However, distinguishing between consumption expenditures and costs of obtaining income can be hard.
- Capital gains/losses (particularly when they are unrealized) and the imputed income from durable goods may be very difficult to measure.
- In-kind receipts are not easy to value.

No definition of income can make the administration of an income tax simple and straightforward. The Haig-Simons seems very attractive for policymakers:
1. **Fairness**
   People with equal incomes should pay equal taxes. This means the tax base must include all sources of income.
2. **Efficiency**
   It treats all forms of income the same and does not distort the pattern of economic activity (neutrality).

However, critics can argue that it guarantees neither fair nor efficient outcomes. As

long as people's abilities to earn income differ, the H-S criterion cannot produce fair outcomes. Besides that, it does not follow that equal tax rates on all income, regardless of source, would be most efficient. Efficiency is enhanced when relatively high taxes are imposed on those activities with relatively inelastic supply. This means that neutrality generally does not minimize excess burden.

11. Personal taxation and behavior

The effect of taxation on labor supply
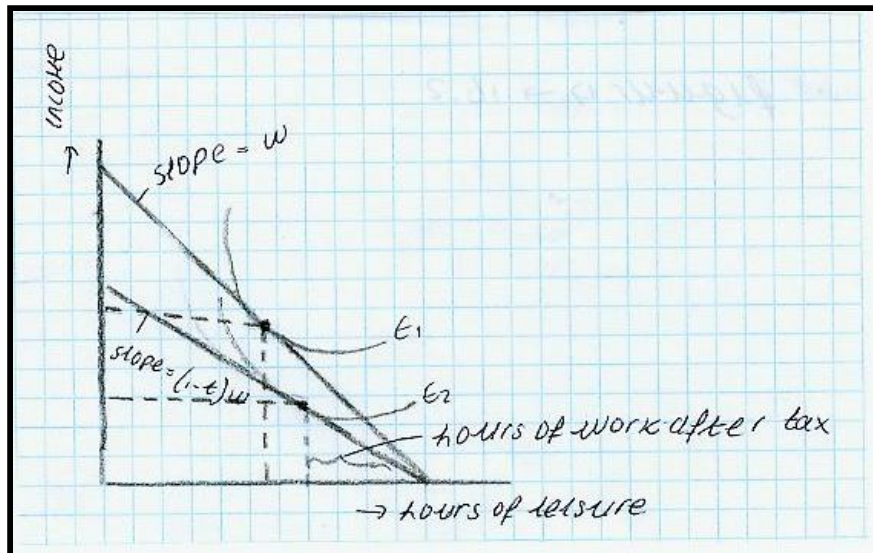
A proportional tax reduces the reward for working an hour to (1-t)w and therefore it lowers the labor supply curve. But we cannot conclude that every individual always reduces labor supply in response to a proportional tax. Depending on a person's tastes, he will work more, less or the same amount.

We can distinguish two effects generated by the tax:
- **Substitution effect** – opportunity costs of leisure go down which creates a tendency to substitute leisure for work (effect decreases labor supply).
- **Income effect** – if you assume that leisure is a normal good, the loss in income leads to a reduction in the consumption of leisure. And a decrease in income leads to an increase in work (effect increases labor supply).

The two effects work in opposite directions.

The analysis of a progressive tax is very similar to that of a proportional tax. Because of the increasing marginal tax rates, the individual in confronted with different slopes of the budget constraint. The opportunity cost of an hour leisure decrease when income increases.

Econometric studies indicate some general tendencies: prime age males vary their hours only slightly in response to tax changes, while married women are quite sensitive to variations in the after-tax wage rate.

Demand side considerations

Changes in the supply of labor might have effect on the demand side. An increase in labor supply lowers the before-tax wage. This mitigates the original increase in the after-tax wage, so that the final increase in hours of work is less than originally guessed.

Some people fear that taxes induce people to invest too little in **human capital** – investments that people make in themselves to increase their productivity.

*B=present value of the extra earnings, C=cost in forgone wages, t=marginal tax rate*
  Without taxes: **B - C > 0**
  With proportional taxes: **(1-t)B – (1-t)C = (1-t)(C-B) > 0**

A proportional tax reduces the benefits and costs in the same proportion and therefore has no effect on human capital investment.

This simple model about human capital investment ignores several considerations: Labor supply is assumed to be fixed. But if the tax induces to work more, it makes human capital investment more attractive. The returns to human capital investment cannot be known with certainty. Some human capital investments involve costs other than forgone interest. Other aspects of the tax system (for instance the taxes on the return to physical investments) can affect human capital investments. When a tax system is progressive, the benefits and the costs of human capital investments may be taxed at different rates.

Government revenues do not always increase if tax rates go up. The tax collected per hour can be very high, but the number of hours can drop so much that the product of the tax rate and hours is lower than before. The tax rate-tax relationship is called the **Laffer curve**. The shape of a Laffer curve is determined by the elasticity of labor with respect to the net wage.
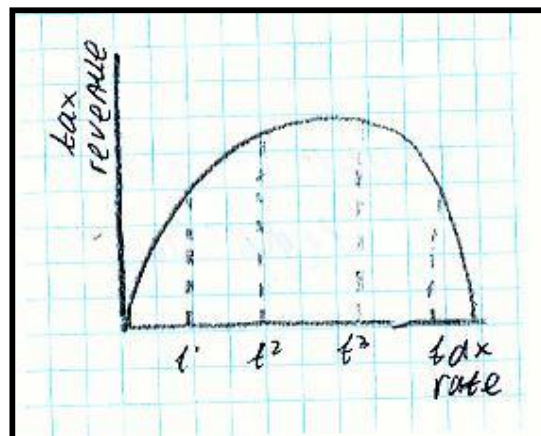
Also saving behavior may be affected by taxation. Most analyses are based on the **life**

cycle model in which the individual's consumption and saving decisions are the result of a planning process that considers their lifetime economic circumstances. This means the amount that you save also depends on the expected income in the future and the received income in the past.
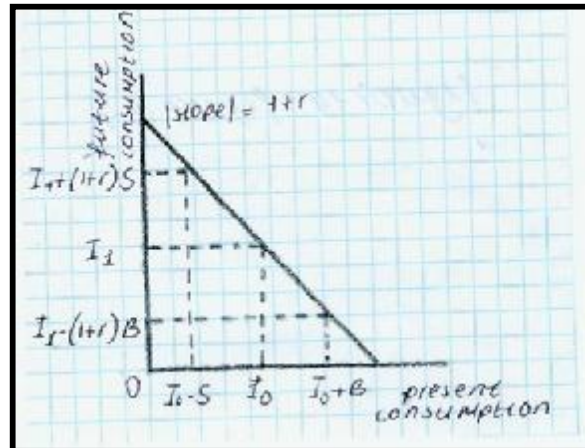
I0=current income, I1=future income, S=saved amount, B=borrowed amount, r =rate of return

The slope of the budget line (1+r) represents the opportunity cost of one good in terms of another. The cost of 1 unit of consumption in the present is (1=r) units of forgone consumption in the future. This is called an **intertemporal budget constraint** because it shows the trade-off between consumption across time. The exact position on the budget constraint depends on an individual's preferences between future and present consumption. If you superimpose some indifference curves, you can examine which point of the budget constraint lies on the highest attainable indifference curve,

There are three combinations available to this budget constraint:
- Consume all income as it comes (I0 = I1) à **endowment point**
- Consume less than current income (**save**)
  The future income increases to I1+ (1+r)S, because the saved amount can be invested against a rate of return r.
- Consume more than current income (**borrow**)
  The future income decreases to I1- (1+r)B, because he has to pay back B plus the interest.

Now we will consider how the amount of changes, when a proportional tax on interest is introduced. We have two possibilities:

1. Deductible interest payments and taxable interest receipts
Tax reduces the rate of interest received by savers from r to (1-t)r. The effective rate to be paid for borrowing is (1-t)r. This results in the slope of the budget constraint which is [1+(1-t)r]. Savings do not always fall when an interest tax is   introduced. It depends on the individual's preferences (indifference curves).
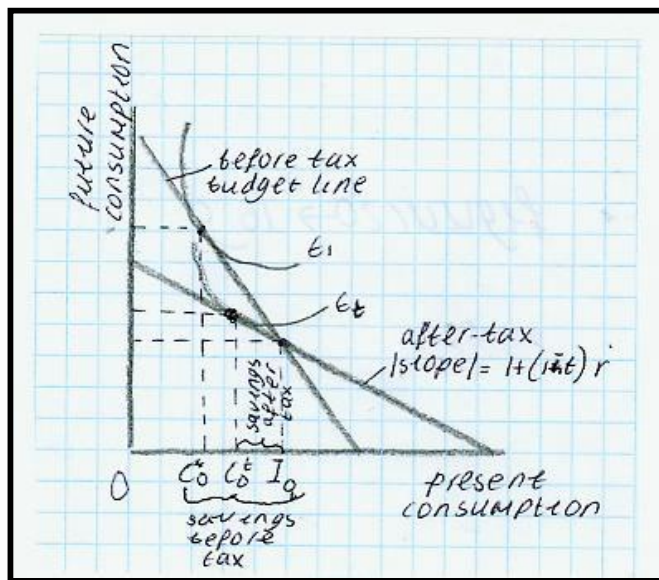
2. Non-deductible interest payments and taxable interest receipts
To the left of the endowment point, the opportunity of increasing present consumption with 1 unit equals [1+(1-t)r] units of future consumption. However, to the right of the endowment point, the opportunity cost of increasing current consumption with 1 unit is (1+r) units. This is because interest is non-deductible, so the tax system does not affect the cost of borrowing.
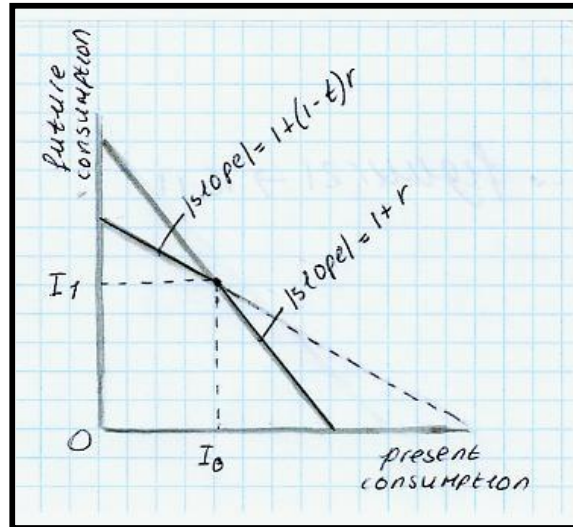
Actually this two-period model ignores some real-world complications:
- The analysis is couched in real terms
- The returns to different assets are taxed at different rates
- The model only examines the private saving, not the social saving (government and private).

Taxes may affect not only the total amount of wealth that people accumulate but the assets in which that wealth is held as well (**portfolio composition**).An often used argument is that low taxes increase risky investments. **Tobin** has developed a theoretical work on the relation between taxes and portfolio composition. He states that the investment decision is based on two characteristics expected return and risk. Investors prefer safer assets that are expected to yield high returns. The typical investor holds a combination of both risky and safe assets to suit tastes concerning risk and return.

If a proportional tax is levied on the return to capital assets, (**full loss offset** assumed – all losses can be deducted from taxable income) the expected return of risky investments drops, but also lessens its riskiness. The net effect of these conflicting tendencies has not been empirically resolved.

12. Corporation tax

A **corporation** is a form of business organization in which ownership is usually represented by transferable stock certificates. Stockholders have limited liability (limited to they amount they have invested). Corporations are independent legal entities. This means that it must pay tax on its income.

Justification for a separate corporation tax:

- Corporations are really distinct entities.
- The corporation receives a number of special privileges from society (like limited liability). Corporation tax can be seen as a user fee for this benefit.
- Corporation tax protects the integrity of the personal income tax. Otherwise it creates opportunities for personal tax avoidance.

Defining taxable corporate income:
- Income should be measured net of the expenses incurred in earning it.
- Interest payments are deducted, but dividends are not.
- The decrease in value of an asset, **economic depreciation**, is an economic cost to the firm, and should be deducted over the **tax life** of the asset. Schemes that allow firms to write off assets faster than true economic depreciation are referred to as **accelerated depreciation**. If a firm deducts the asset's full cost at the time of acquisition it is called **expensing**.
- A while ago, the tax code included an **investment tax credit** (**ITC**), which permitted a firm to subtract some portion of the purchase price of an asset from its tax liability at the time it was acquired. However, the investment tax credit is eliminated since 1986.

Corporate profits may be retained by the firm or paid out as dividends. Because dividends are not deductible from taxable corporate income, they are subject to the corporate income tax. If dividends received by stockholders are treated as ordinary income (and thus taxed at individual's marginal income tax rate), the dividends are subject to **double taxation**. Income generated by increases in the value of stock (capital gain) is treated preferentially for tax purposes. The tax system thus creates incentives for firms to retain earnings rather than pay them out as dividends.

The effective rate of corporate tax (approx. 46%) is higher than the statutory tax rate (approx. 35%), because computing the effective rate requires considering the effects of interest deductibility, depreciation allowances and inflation.

There are two general views on the incidence and excess burden of a corporation tax:

1. **Tax on corporate capital**

   Since the opportunity cost of capital is included in the tax base, it can be argues to view the corporation tax as a tax on capital used in the corporate sector (partial factor tax). The tax leads to a migration of capital from the corporate sector until after-tax rates of return are equal throughout the economy. The rate of return to capital is depressed so that all owners of capital (both sectors) are affected. The extend to which capital and labor bear the ultimate burden of the tax depends on the technologies used, as well as the structure of consumers' demands. In this case, the corporation tax diverts capital from its productive uses and creates an excess burden.

2. **Tax on economic profits**

   As long as a firm maximizes profits, a tax on them induces no changes in firm behavior. There is no way to shift the tax and it is borne by the owners of the firm. It generates no misallocation of resources, so the excess burden is zero. However, this view is often wrong. The base for the profit tax is computed by subtracting from gross earnings the value of all inputs. No such deduction is allowed. **Stiglitz** argued that there are circumstances in which the corporation tax is equivalent to an economic profits tax, but his theory assumes that firms finance their additional projects only by borrowing.

The corporation tax influences some important types of corporate decisions:

1. **Total physical investment**

   We can use three different models to examine whether accelerated depreciation and the investment tax credit stimulate investment demand:

   - **Accelerator model –** the ratio of capital to output is assumed fixed. This means that the amount of investment depends only on the quantity of output, making the user cost irrelevant.
   - **Neoclassical model** – firms can choose between different technologies. Capital demands on the **user cost of capital** – the cost the firm incurs as a consequence of owning an asset. The user cost of capital indicates the rate of return a project must attain to be profitable. To the extent that tax policy reduces the cost of capital, it can increase the amount of capital that firms desire and so will increase investment.
   - **Cash flow model** – the higher the cash flow (difference between revenues and expenditures for inputs), the greater the capacity of investment. Internal funds play a key role in this model.

2. Types of assets
The tax system affects the types of assets purchased by firms as well as the total volume of investment (e.g. encourage purchase of assets with generous depreciation allowances).

3. Corporate finance
Reasons for paying dividends:
Dividend payments signal the firm's financial strength.
Not all investors face the same marginal tax rate. Dividends are attractive for investors with low marginal tax rates (**clientele effect**).
One factor that determines the desired amount of retained earnings is the opportunity cost in terms of after-tax dividends paid to stockholders. When the opportunity cost of retained earnings decreases, dividend payments go down.

A firm has two options for raising money:

- Borrow money (issue debt)
- Issue shares of stock (equity)

The tax law has a bias towards debt financing, because interest payments are deductible from taxable income, while dividends are not. So the interest deductibility provides a strong incentive to debt financing. However, increasing the proportion of debt may lead to larger bankruptcy costs.

The taxation of multinational companies
Multinational corporations are subject to tax at the standard rate on their global taxable income, including income earned abroad. A credit is then allowed for foreign taxes paid. There are some complications in the foreign-source taxation:
- **Subsidiary status**
Profits earned by a **subsidiary** (a foreign company owned by a firm, but incorporated abroad) are taxed only if returned (**repatriated**). So earnings retained abroad can be kept out of reach for the tax system.
- **Income allocation**
The procedure for allocating income between domestic and foreign operations is called the **arm's length system**. The taxable profits of each entity are computed as its own sales minus its own costs. This creates opportunities for tax avoidance because it is often not clear how to allocate costs to various locations. By transfer-pricing firms subsidiaries transfer resources (patents) to another. However, it is hard to decide whether or not the payment is excessive.

If we want to evaluate the tax treatment of multinational firms, we can distinguish two objectives:
1. **Maximization of world income**
The before tax rate of return on the last dollar invested in each country (marginal rate of return) is the same (r foreign = r domestic). Investors allocate their

capital across countries so that the after-tax marginal return in each country is equal: (1-t foreign) x r foreign = (1-t domestic) x r domestic
An efficient allocation of capital from a global point of view requires that capital must be taxed at the same rate wherever it is located.

2. Maximization of national income
National maximization requires that marginal rates of return are measured from the domestic point of view. The marginal rate of return abroad = (1-t foreign) x r foreign. Maximization of national income requires:
(1-t foreign) x r foreign = r domestic
If national income maximization is the goal, the before-tax marginal rate of return on foreign investment is higher than it would be if global income maximization were the goal. From a national point of view, world income maximization results in too much investment abroad.

Proposals to integrate personal and corporate income:

- **Full integration** (or the **partnership method**)
Owners of stock are liable for their own part, and would be taxed on their share of corporate income as if they were partners.
- **Dividend relief**
Dividends are only taxed once, either by allowing a deduction at the corporate level or by exclusion at the individual level.
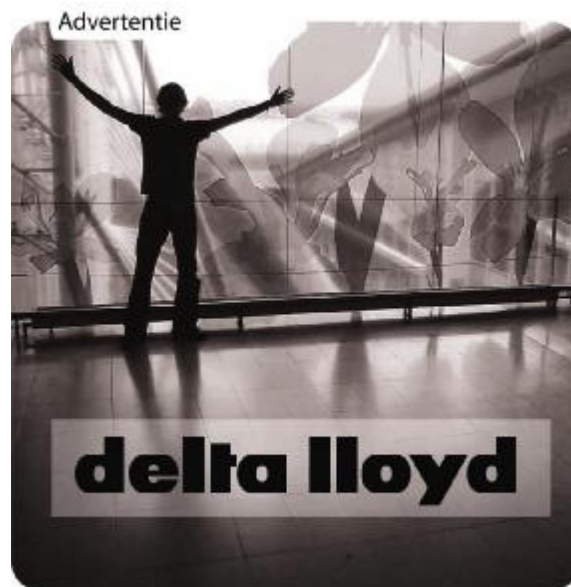
13. Deficit finance

Borrowing is an important method of government finance. The **deficit** during a time period is the excess of spending over revenues. If revenues exceed expenditures, there is a **surplus**.
Because you need to take in account all revenues and expenditures, you should include the **on-budget deficit** (on-budget activities) and the **off-budget deficit** (off-budget activities) to arrive at the total deficit. The **debt** at a given point is the sum of past deficits and surpluses.

Official figures concerning the size of government deficits, surpluses and debts must be viewed with caution for several reasons:
- State and local governments also have large amounts of debt outstanding.
- Inflation erodes the real value of the debt. The official deficit/surplus does not reflect this fact.
- The federal government lumps together capital (durable items) and current (consumed within the year) expenditures. Standard accounting procedures require that only annual depreciation of durable assets be included in the expenditures, not their entire purchase price.
- Tangible assets owned by the government should also be taken into account.
- Government's implicit obligations to pay money in the future should also be considered.

Because the legal burden of debt is on future generations, it doesn't mean that they bear the real burden. There are different views on this issue:
- **Lerner's view**
  If you assume that the government borrows from its own citizens (**internal debt**), it creates no burden for the future generation. Members of the future generation simply owe it to each other (intragenerational transfer).
  If the government borrows from abroad (**external debt**), the future generation bears a burden. To the extent that the project's return is less than the marginal cost, the future generation is worse off.
  In Lerner's model a generation is defined as everyone who is alive at a given time.
- **Overlapping generations model**
  If you define a generation as everyone who was born at about the same time, several generations coexist simultaneously. In this model, debt finance can produce a real burden on future generations. By comparing the net taxes paid by different generations, one can get a sense of how government policy distributes income across generations (**general accounting**).
- **Neoclassical model**
  When the government initiates a project, whether financed by taxes or borrowing, resources are removed from the public sector. If you assume that when the government borrows, it competes for funds with individuals and firms who want the

money for their own investment projects (**crowding out hypothesis** – private investment get crowded out), debt finance leaves the future generations with a smaller capital stock. The debt imposes a burden on future generations is this way.

- **Ricardian model**

Voluntary transfers across generations undo the effects of debt policy, so that crowding out does not occur and tax and debt finance are essentially equivalent. The form of government finance is irrelevant.

Several factors influence whether a given government expenditure should be financed by taxes or debt. The **benefits-received principle** states that the beneficiaries of a particular government spending program should have to pay for it. If a project will benefit future generations, then having them pay for it via loan finance is appropriate. To analyse whether debt or finance tax generates a higher excess burden, you must realize that every increase in government spending must ultimately be financed by an increase in taxes. It is just a choice between the time of the taxes. With debt finance, many small payments are made over time to finance the interest due on the debt.

As we still know, the excess burden increases with the square of the tax rate. When the tax rate doubles, the excess burden quadruples. If you look at it this way, it seems that a series of small tax increases generates a smaller excess burden that one large tax increase. However, this conclusion ignores the possibility for the crowding out effect. If crowding out occurs, the conclusion may be reversed.

14. Multigovernment public finance

A **federal system** consists of different levels of government that provide public goods and services and have some scope for making decisions. The field of **fiscal federalism** examines the roles of the different levels of government and the way in which they interact with each other.

The **centralization ratio** reflects the proportion of total direct government expenditures made by the central government. However, if local and state government spending is constrained by the central government, the centralization ratio underestimates the true extent of centralization in the system.

When we look at community formation, it is easy to think of a community as a **club** (a voluntary association of people who band together to share some kind of benefit). The optimal community is one in which the number of members and the level of services simultaneously satisfy the condition that the marginal cost equal corresponding marginal benefit.

The ability of individuals to move among jurisdictions produces a market-like solution to the local public goods problem (Tiebout model). Individuals locate in the community that offers the bundle of public services and taxes they like the best. It is a market mechanism with the proportional tax on property as the price and the package of local public goods as the quantity. Key conditions of the Tiebout model:
- Government activities generate no externalities
- Individuals are completely mobile
- People have perfect information on community's public services and taxes
- There are enough different communities
- The cost per unit of public services is constant
- Public services are financed by a proportional property tax
- Communities can enact **exclusionary zoning laws** (statutes that prohibit certain uses of land).

Advantages of decentralization:
- **Tailoring outputs to local tastes**
  Individuals with similar tastes for public goods group together, so communities provide the types and quantities of public goods desired by their inhabitants. Besides this, a local government has a greater democratic responsiveness and can better fit to citizen's preferences than the central government.
- **Fostering intergovernmental competition**
  The threat of citizens 'voting with their feet', and going to other communities creates an incentive for burocrats to produce more efficiently.
- **Experimentation and innovation in locally provided goods and services**
  A system of diverse governments enhances the chances that new solutions to

problems will be sought. Smaller governments can act a innovation laboratory for taxes and public goods.

Disadvantages of decentralization:
- **Efficiency aspects on the expenditure side**
  Communities impose externalities on each other. If each community cares only about its members, these externalities are overlooked. Moreover, for certain public goods, the cost per person falls as the number of users increases. In this way, a central government copes with greater economies of scale.
- **Efficiency aspects on the taxation side**
  Taxes levied by decentralized communities are unlikely to be efficient from a national point of view. Communities are likely to select taxes on the basis of whether they can shift them to outsiders. The perceived marginal cost are then less than the marginal social cost, which results in an inefficiently large amount of local public goods. Besides this there can also be economies of scale in the collection of taxes.
- **Equity aspects**
  People's decision to locate somewhere is influenced by the available tax-welfare package. If the local income redistribution is unstable, this can lead to a downward inner-city spiral. Eventually the redistributive program has to be abandoned.

An individual's **property tax** is the product of the tax rate and the property's **assessed value** (the value assigned to the property). The ratio of the assessed value to market value is called the **assessment ratio**. Assessment ratios differ across properties and that is why properties can have the same nominal tax rate, but different effective rates.

There are three views on the incidence of a property tax:
1. **Property tax as an excise tax on land and structures**
   The incidence of the tax is determined by the shapes of the relevant supply and demand schedules.
   - Land à fixed, so a perfectly vertical supply curve
     Landowners bear the entire burden of a tax levied on it (for all time, because prospective land owners take into account the future stream of tax liabilities).
   - Structures à The construction industry can obtain all the capital it demands at market price, so a perfectly horizontal supply curve.
     The burden is shifted entirely to tenants.
2. **Property tax as an general capital tax with different rates**
   a. General tax effect
     Assume that a property tax is just a uniform tax on capital. While capital supply is fixed in the short-run, the property tax falls entirely on the owners of capital. Since the proportion of income from capital tends to

increase with income, the tax seems to be progressive.
  b. Excise tax effect
      Property tax is a set of excise taxes on capital. Capital tends to migrate from areas where it faces a high tax rate to those where the rate is low. The process continues until after-tax rates of return are equal. The impact on the other factor depends in part on their mobility.
  c. Long-run effect
      The supply of capital is not fixed and depends on the tax rate. If the property tax decreases, the supply of capital, the productivity of labor and the real wage will fall.
3. **Property tax as a user fee for local public services**
      The property tax is just the cost of purchasing public services. So the property tax is more like a user fee for public services.

Why in the property tax so unpopular?
  1. It is often levied on an estimated value
  2. It is highly visible
  3. It is perceived as being regressive
  4. People can't do anything against other taxes

A better reform of the property tax seems to be the **personal net worth tax** – a tax based on the difference between the market value of all taxpayer's assets and liabilities. However, this would undoubtedly have to be administered by the federal government while a property tax provides a local government with considerable fiscal autonomy.

Federal grants are a very important source of revenue to states and localities. Grants help finance activities that run practically the entire gamut of government functions. Grants from the central government to states and localities provide a way of correcting the mismatch between where the tax is collected and where it is demanded.

A grant's structure influences its economic impact:

1. Conditional grants (categorical grants)
Grants for which the donor specifies the purposes for which the recipient can use the funds.
- **Matching grant** – for every dollar given by the donor to support a particular activity, a certain sum must expended by the recipient.
- **Matching closed-ended grant** - to put a ceiling on the cost, the donor specifies the maximum amount that it will contribute.
- **Nonmatching grant** - the donor gives a fixed sum of money with the stipulation that it be spend on the public good.

2. Unconditional grants

The federal government gives the community an unrestricted lump sum grant (**revenue sharing**).

Contrary to what one might aspect, almost all studies conclude that a dollar received by the community in the form of a grant results in a greater public spending than a dollar increase in community income. This is called the **flypaper effect**, because the money seems to stick in the sector where it initially hits. A possible reason can be that bureaucrats seek to maximize the sizes of their budgets and have no incentive to inform the citizens about the true level of grant funding, which makes the citizens unaware of the true budget constraint.