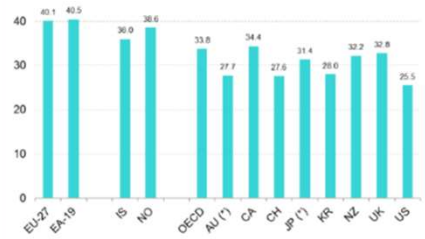
LECTURE 9

Taxation and Income Distribution

1

Some tax data

GRAPH 4: TAX REVENUE (INCLUDING COMPULSORY ACTUAL SOCIAL CONTRIBUTIONS), EU AND SELECTED COUNTRIES, 2020
(% of GDP)



(*) OECD data for Australia and Japan from 2019.
Source: European Commission, DG Taxation and Customs Union, based on Eurostat and OECD data (extracted May 2022)
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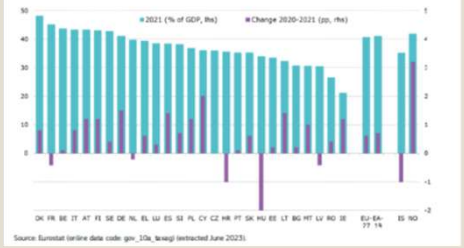
FIGURE 2: TAX REVENUE (INCLUDING COMPULSORY ACTUAL SOCIAL CONTRIBUTIONS), 2021 AND YEARLY CHANGE (% OF GDP LEFT, GDP PP RIGHT)



Source: Eurostat (online data code: gov_10a_taxag) (extracted June 2023).

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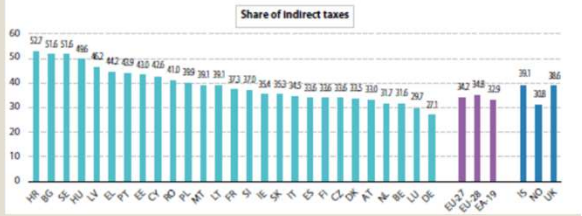
Graph 5: Structure of tax revenues by major type of taxes, 2019
(% of total tax revenues)



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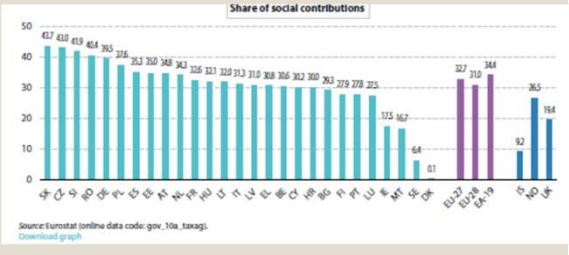

Source: Eurostat (online data code: gov_10a_taxag).
Download graph

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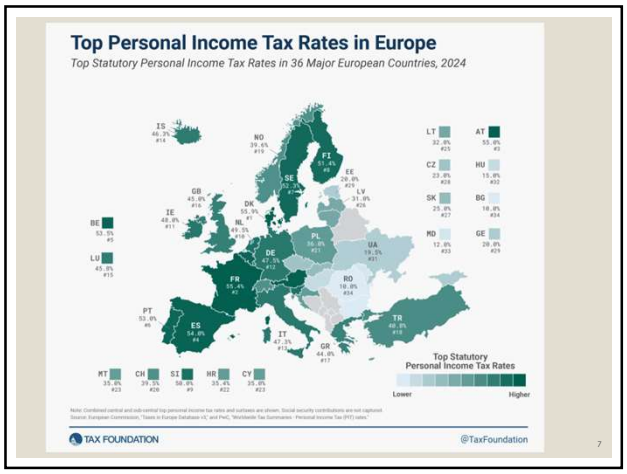

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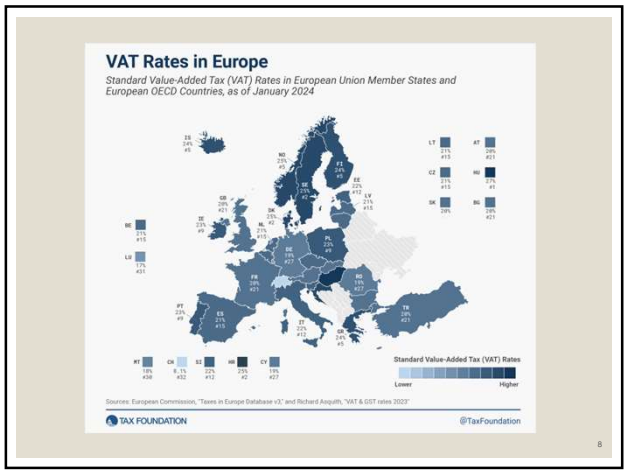

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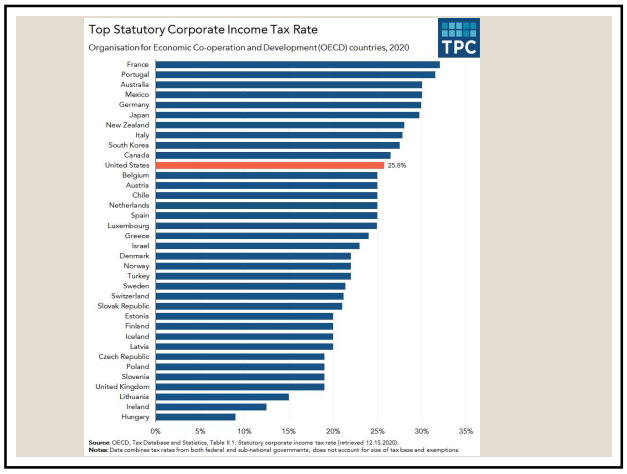

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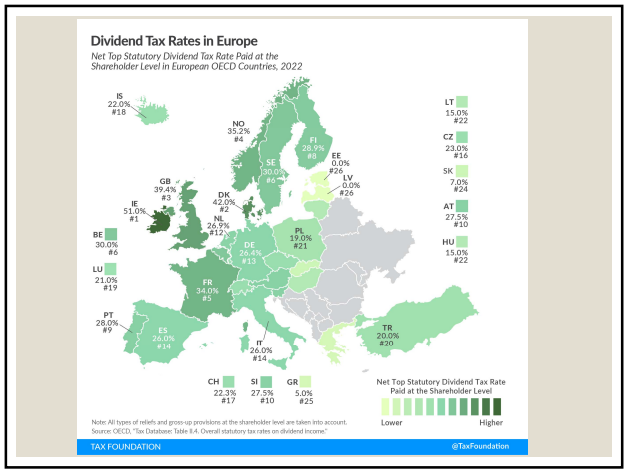

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Introduction

- Many policies center around whether the tax burden is distributed fairly.
- Not as simple as analyzing how much in taxes each person actually paid, because of tax-induced changes to price.

Introduction

- Two main concepts of how a tax is distributed:
  - ***Statutory incidence*** – who is legally responsible for tax
  - ***Economic incidence*** – the true change in the distribution of income induced by tax.
  - These two concepts differ because of ***tax shifting***.

Tax Incidence: General Remarks

- Only people can bear taxes
  - Business paying their fair share simply shifts the tax burden to different people
  - Can study people whose total income consists of different proportions of labor earnings, capital income, and so on.
  - Sometimes appropriate to study incidence of a tax across regions.

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Tax Incidence: General Remarks

- Both **Sources** and **Uses** of Income should be considered
  - Tax affects consumers, workers in industry, and owners of factors of production.
  - Economists often ignore the sources side

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Tax Incidence: General Remarks

- Incidence depends on how prices are determined
  - Industry structure matters
  - Short- versus long-run responses

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Tax Incidence: General Remarks

- Incidence depends on disposition of tax revenue
  - ***Balanced budget incidence*** computes the combined effects of levying taxes and government spending financed by those taxes.
  - ***Differential tax incidence*** compares the incidence of one tax to another, ignoring how the money is spent.
    - Often the comparison tax is a ***lump sum tax*** – a tax that does not depend on a person's behavior.

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Tax Incidence: General Remarks

- Tax progressiveness can be measured in a number of ways
  - A tax is often classified as:
    - **Progressive**
    - **Regressive**
    - **Proportional**
  - Proportional taxes are straightforward: ratio of taxes to income is constant regardless of income level.

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Tax Incidence: General Remarks

- Can define progressive (and regressive) taxes in a number of ways.
- Can compute in terms of
  - ***Average*** tax rate (ratio of total taxes total income) or
  - ***Marginal*** tax rate (tax rate on last euro of income)

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Tax Progressiveness can be measured in Several Ways

Tax Liabilities under a hypothetical tax system

Subtract 3.000 and tax the rest by 20%

Income	Tax Liability	Average Tax Rate	Marginal Tax Rate
€2,000	-€200	-0.10	0.2
3,000	0	0	0.2
5,000	400	0.08	0.2
10,000	1,400	0.14	0.2
30,000	5,400	0.18	0.2

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Tax Progressiveness can be measured in Several Ways

- Measuring how progressive a tax system is present additional difficulties. Consider two simple definitions.
  - The first one says that the greater the increase in average tax rates as income rises, the more progressive is the system.

$$v_1 = \frac{\frac{T_1}{I_1} - \frac{T_0}{I_0}}{I_1 - I_0}$$

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Tax Progressiveness can be measured in Several Ways

- The second one says a tax system is more progressive if its elasticity of tax revenues with respect to income is higher.
- Recall that an elasticity is defined in terms of percent change in one variable with respect to percent change in another one:

$$v_2 = \frac{\%\Delta T}{\%\Delta I} = \frac{\frac{(T_1 - T_0)}{T_0}}{\frac{(I_1 - I_0)}{I_0}}$$

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Tax Progressiveness can be measured in Several Ways

- These two measures, both of which make intuitive sense, may lead to different answers.
- Example: increasing all taxpayer's liability by 20%

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Tax Progressiveness can be measured in Several Ways

- Partial equilibrium models only examine the market in which the tax is imposed, and ignores other markets.
- Most appropriate when the taxed commodity is small relative to the economy as a whole.

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Tax Progressiveness can be measured in Several Ways

$$v_1 = \frac{\frac{T_1}{I_1} - \frac{T_0}{I_0}}{I_1 - I_0} \qquad v_2 = \frac{\frac{T_1 - T_0}{T_0}}{\frac{I_1 - I_0}{I_0}}$$

$$.00025 = \frac{\frac{300}{1000} - \frac{200}{800}}{1000 - 800} \qquad 2.0 = \frac{\frac{300 - 200}{200}}{\frac{1000 - 800}{800}}$$

$$.0003 = \frac{\frac{360}{1000} - \frac{240}{800}}{1000 - 800} \qquad 2.0 = \frac{\frac{360 - 240}{240}}{\frac{1000 - 800}{800}}$$

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An example of value added tax (VAT)

- Consider the manufacture and sale of any item, which in this case we will call a widget. In what follows, the term "gross margin" is used rather than "profit". Profit is the remainder of what is left after paying other costs, such as rent and personnel costs.
- **Without any tax**
- A widget manufacturer spends for example €1.00 on raw materials and uses them to make a widget.
- The widget is sold wholesale to a widget retailer for €1.20, making a gross profit of €0.20
- The widget retailer then sells the widget to a widget consumer for €1.50, making a gross profit of €0.30

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An example of value added tax (VAT)

- **With a 10% sales tax:**
- The manufacturer spends €1.00 for the raw materials, certifying it is not a final consumer.
- The manufacturer charges the retailer €1.20, checking that the retailer is not a consumer, leaving the same gross margin of €0.20.
- The retailer charges the consumer €1.50 + (€1.50 x 10%) = €1.65 and pays the government €0.15, leaving the gross margin of €0.30.
- So the consumer has paid 10% (€0.15) extra, compared to the no taxation scheme, and the government has collected this amount in taxation.
- The retailers have not paid any tax directly (it is the consumer who has paid the tax), but the retailer has to do the paperwork in order to correctly pass on to the government the sales tax it has collected. Suppliers and manufacturers only have the administrative burden of supplying correct certifications, and checking that their customers (retailers) aren't consumers.

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An example of value added tax (VAT)

- **With a 10% VAT:**
- The manufacturer spends €1.10 (€1 + (€1 × 10%)) for the raw materials, and the seller of the raw materials pays the government €0.10.
- The manufacturer charges the retailer €1.32 (€1.20 + (€1.20 × 10%)) and pays the government €0.02 (€0.12 minus €0.10), leaving the same gross margin of €0.20 (€1.32 – €1.10 – €0.02 = €0.20).
- The retailer charges the consumer €1.65 (€1.50 + (€1.50 × 10%)) and pays the government €0.03 (€0.15 minus €0.12), leaving the same gross margin of €0.30 (€1.65 – €1.32 – €0.03 = €0.30).
- Note that the taxes paid by both the manufacturer and the retailer to the government are 10% of the values added by their respective business practices (e.g. the value added by the manufacturer is €1.20 minus €1.00, thus the tax payable by the manufacturer is (€1.20 – €1.00) × 10% = €0.02).

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An example of value added tax (VAT)

- With VAT, the consumer has paid, and the government received, the same euro amount as with a sales tax.
- The businesses have not incurred any tax themselves. Their obligation is limited to assuming the necessary paperwork in order to pass on to the government the difference between what they collect in VAT (output tax, an 11th of their sales) and what they spend in VAT (input VAT, an 11th of their expenditure on goods and services subject to VAT).
- However they are freed from any obligation to request certifications from purchasers who are not end users, and of providing such certifications to their suppliers.

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An example of value added tax (VAT)

- On the other hand, they incur increased accounting costs for collecting the tax, which are not reimbursed by the taxing authority. For example, wholesale companies now have to hire staff and accountants to handle the VAT paperwork, which would not be required if they were collecting sales tax instead.
- If you calculate the added overhead required to collect VAT, businesses collecting VAT have less profits overall than businesses collecting sales tax.

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An example of value added tax (VAT)

- The advantage of the VAT system over the sales tax system is that under sales tax, the seller has no incentive to disbelieve a purchaser who says it is not a final user. That is to say the payer of the tax has no incentive to collect the tax. Under VAT, all sellers collect tax and pay it to the government. A purchaser has an incentive to deduct input VAT, but must prove it has the right to do so, which is usually achieved by holding an invoice quoting the VAT paid on the purchase, and indicating the VAT registration number of the supplier.

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Partial Equilibrium Models: Per-unit taxes

- ***Unit taxes*** are levied as a fixed amount per unit of commodity sold
  - Taxes on cigarettes, for example, is 50 cents per pack.
- Assume perfect competition.

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The three rules of tax incidence

- There are three basic rules for figuring out who ultimately bears the burden of paying a tax.
  - ***The statutory burden of a tax does not describe who really bears the tax.***
  - ***The side of the market on which the tax is imposed is irrelevant to the distribution of tax burdens.***
  - ***Parties with inelastic supply or demand bear the burden of a tax.***

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The three rules of tax incidence: The statutory burden does not describe who really bears the tax

- ***Statutory incidence*** is the burden of the tax borne by the party that sends the check to the government.
  - For example, the government could impose a 50¢ per gallon tax on suppliers of gasoline.
- ***Economic incidence*** is the burden of taxation measured by the change in resources available to any economic agent as a result of taxation.
  - If gas stations raise gasoline prices by 25¢ per gallon as a result, then consumers are bearing half of the tax.

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The three rules of tax incidence: The statutory burden does not describe who really bears the tax

- When a tax is imposed on producers, they will raise prices to some extent to offset this tax burden.
  - Producer tax burden = (pretax price – posttax price) + tax payments of producers
- When a tax is imposed on consumers, they are not willing to pay as much for a good, so prices fall. The tax burden for consumers is:
  - Consumer tax burden = (posttax price – pretax price) + tax payments of consumers

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Partial Equilibrium Models: Per-unit taxes

- **Consider the impact of a 50¢ per liter tax on suppliers of gasoline.**

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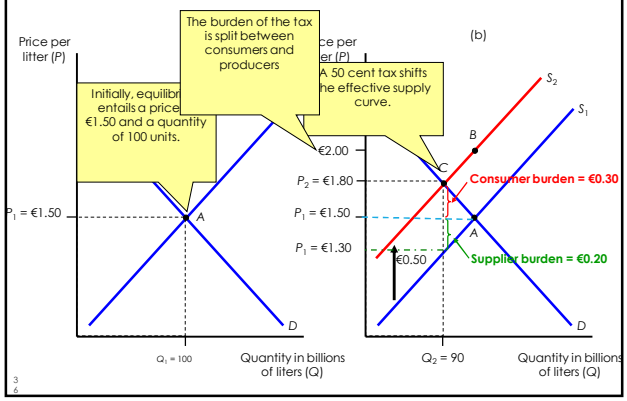
Partial Equilibrium Models: Per-unit taxes



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Partial Equilibrium Models: Per-unit taxes

- The initial market equilibrium is 100 billion litters sold at €1.50 per litter.
- The 50¢ tax raises the marginal costs of production for the firm, shifting the supply curve up to S_2.
- At the original market price, there is now excess demand of 20 billion liters; the price is bid up to €1.80, where there is neither a shortage nor a surplus.

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Partial Equilibrium Models: Per-unit taxes

- The gasoline tax has two effects:
  - It changes the market price
  - Producers must now pay a tax to the government
- Recall that
  - Consumer tax burden = (posttax price – pretax price) + tax payments of consumers
  - Consumer tax burden = (€1.80 - €1.50) + 0 = 30¢
  - Producer tax burden = (pretax price – posttax price) + tax payments of producers
  - Producer tax burden = (€1.50 - €1.80) + €0.50 = 20¢

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Partial Equilibrium Models: Per-unit taxes

- This analysis reveals that the true burden on producers is not 50¢, but some smaller number, because part of the burden is borne by consumers in the form of a higher price.
- The ***tax wedge*** is the difference between what consumers pay and what producers receive from a transaction.
  - The wedge in this case is the difference between the €1.80 consumers pay and the €1.30 producers receive.

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Partial Equilibrium Models: Per-unit taxes

- The second question to examine is whether imposing the tax on the consumers, rather than producers, will change the analysis.
- **Figure below** illustrates the impact of a 50¢ per liter tax on demanders of gasoline.

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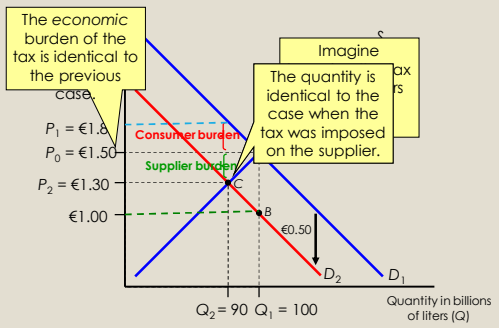
Partial Equilibrium Models: Per-unit taxes



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Partial Equilibrium Models: Per-unit taxes

- The initial market equilibrium is 100 billion liters sold at €1.50 per liter.
- Although the *overall* willingness to pay for a unit of gasoline is unchanged, the 50¢ tax lowers the consumers' willingness to pay *producers* by 50¢ (since consumers must pay the government). Thus, the demand curve shifts to D_2.
- At the original market price, there is now excess supply of gasoline; producers lower their price until €1.30, where there is neither a shortage nor a surplus.

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Partial Equilibrium Models: Per-unit taxes

- As before, the new gasoline tax has two effects:
  - It changes the market price
  - Consumers must now pay a tax to the government
- Consumer tax burden = (posttax price – pretax price) + tax payments of consumers
  - Consumer tax burden = (€1.30 - €1.50) + €0.50 = 30¢
- Producer tax burden = (pretax price – posttax price) + tax payments of producers
  - Producer tax burden = (€1.50 - €1.30) + 0 = 20¢

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Partial Equilibrium Models: Per-unit taxes

- Note that these tax burdens are identical to the burdens when the tax was levied on producers.
- This illustrates an important lesson – the side on which the tax is imposed is irrelevant for the distribution of tax burdens.

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Partial Equilibrium Models: Per-unit taxes

- While there is only one market price when a tax is imposed, there are two different prices that economists track.
- The ***gross price*** is the price in the market.
- The ***after-tax price*** is the gross price minus the amount of the tax (if producers pay the tax) or plus the amount of the tax (if consumers pay the tax).

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A more general example

- Suppose the market for champagne is characterized by the following supply and demand curves:

$$Q_S = 20 + 2P$$
$$Q_D = 100 - 2P$$

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A more general example

- If the government imposes a per-unit tax on demanders of €8 per unit, the tax creates a wedge between what demanders pay and suppliers get. Before the tax, we can rewrite the system as:

$$Q_S = 20 + 2P_S$$
$$Q_D = 100 - 2P_D$$
$$P_S = P_D$$

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A more general example

- After the tax, suppliers receive €8 less per pack than demanders pay. Therefore:

$$P_S = P_D - \tau_D$$
$$P_S = P_D - 8$$

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A more general example

- Solving the initial system (before the tax) gives a price of *P=20* and *Q=60*. Solving the system after the tax gives:

$$Q_S = Q_D' \Rightarrow 20 + 2(P_D - 8) = 100 - 2P_D$$
$$P_D = 24, P_S = 16, Q = 52$$

A more general example

- In this case, the statutory incidence falls 100% on the demanders, but the economic incidence is 50% on demanders and 50% on suppliers:

$$\frac{P_D - P_0}{\tau} = \frac{24 - 20}{8} = 5$$

Partial Equilibrium Models: Taxes on suppliers vs. demanders

- In our previous numerical example, the tax on demanders led to the following relationship:

$$P_S = P_D - \tau_D \Rightarrow P_S = P_D - 8$$

- If we instead taxed suppliers, this relationship would instead be:

$$P_D = P_S + \tau_S \Rightarrow P_D = P_S + 8 \Rightarrow P_S = P_D - 8$$

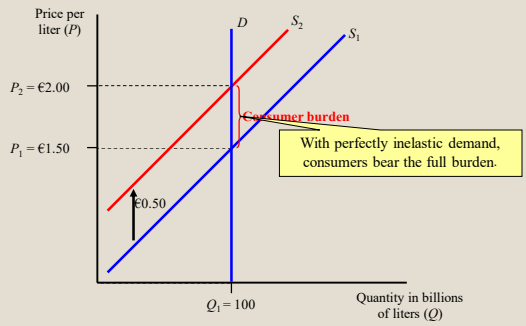
Partial Equilibrium Models: Taxes on suppliers vs. demanders

- Clearly, these equations identical to each other. The same quantity and prices will emerge as before.
- Implication: ***The statutory incidence of a tax tells us nothing about the economic incidence of it.***

Partial Equilibrium Models: Elasticities

- ***Incidence of a unit tax depends on the elasticities of supply and demand.***
- In general, the more elastic the demand curve, the less of the tax is borne by consumers, *ceteris paribus*.
  - Elasticities provide a measure of an economic agent's ability to "escape" the tax.
  - The more elastic the demand, the easier it is for consumers to turn to other products when the price goes up. Thus, suppliers must bear more of tax.

Partial Equilibrium Models: Elasticities



Partial Equilibrium Models: Elasticities

- The new equilibrium market price is €2.00, a full 50¢ higher than the original price.
- Consumer tax burden = (posttax price – pretax price) + tax payments of consumers
  - Consumer tax burden = (€2.00 - €1.50) + 0 = 50¢
- Producer tax burden = (pretax price – posttax price) + tax payments of producers
  - Producer tax burden = (€1.50 - €2.00) + 50¢ = 0

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Partial Equilibrium Models: Elasticities

- Note that even though the tax was legally imposed on the producer, the full burden of the tax is borne by the consumer.
- ***Full shifting*** is when one party in a transaction bears all of the tax burden.
  - With perfectly inelastic demand, consumers bear all of the tax burden.

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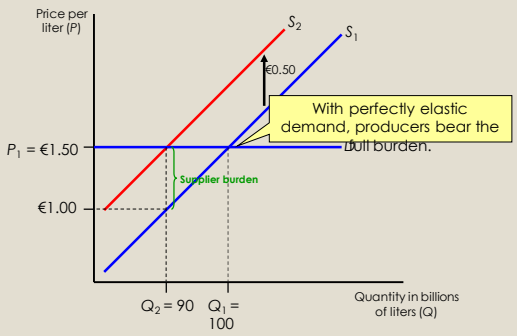
Partial Equilibrium Models: Elasticities



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Partial Equilibrium Models: Elasticities

- The new equilibrium market price is €1.50, the same as the original price.
- Consumer tax burden = (posttax price – pretax price) + tax payments of consumers
  - Consumer tax burden = (€1.50 - €1.50) + 0 = 0
- Producer tax burden = (pretax price – posttax price) + tax payments of producers
  - Producer tax burden = (€1.50 - €1.50) + 50¢ = 50¢

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Partial Equilibrium Models: Elasticities

- In this case, the producer bears the full burden of the tax, because consumers will simply stop purchasing the product if prices are raised.
- These extreme cases illustrate a general point:
  - ***Parties with inelastic supply or demand bear taxes; parties with elastic supply or demand avoid them.***
  - Demand is more elastic when there are many good substitutes (for example, fast food at restaurants). Demand is less elastic when there are few substitutes (for example, insulin medication).
  - Supply is more elastic when suppliers have more alternative uses to which their resources can be put.

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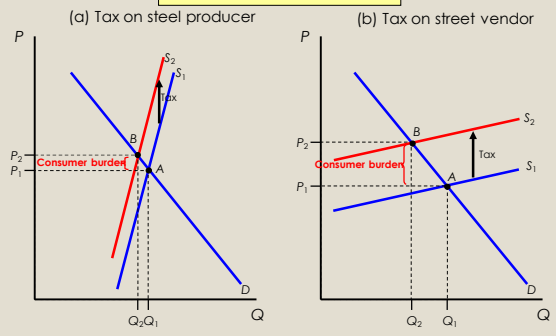
Partial Equilibrium Models: Elasticities

More elastic supply, larger consumer burden.



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Partial Equilibrium Models: Elasticities

- As illustrated in **panel a**, when a tax is levied on an inelastic supplier – the steel firm that is committed to a level of production by its fixed capital investment – the consumer pays very little of the tax, and the producer almost all of it.
- In the second panel, with elastic supply, the consumer bears almost all of the tax.

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Partial Equilibrium Models: Elasticities

- Finally, it is important to note that even though quantities change dramatically with perfectly elastic demand, the focus of tax incidence is on prices, not quantities.
- We ignore quantities because at both the old and new equilibria, consumers are indifferent between buying the taxed good and spending the money elsewhere.

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Partial Equilibrium Models: Ad-valorem Tax

- An ***ad-valorem tax*** is a tax with a rate given in *proportion* to the price.
- A good example is the sales tax.
- Graphical analysis is fairly similar to the case we had before.
- Instead of moving the demand curve down by the same absolute amount for each quantity, move it down by the same proportion.

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Partial Equilibrium Models: Ad-valorem Tax

- Figure below shows an ad-valorem tax levied on demanders.
- As with the per-unit tax, the demand curve as perceived by suppliers has changed, and the same analysis is used to find equilibrium quantity and prices.

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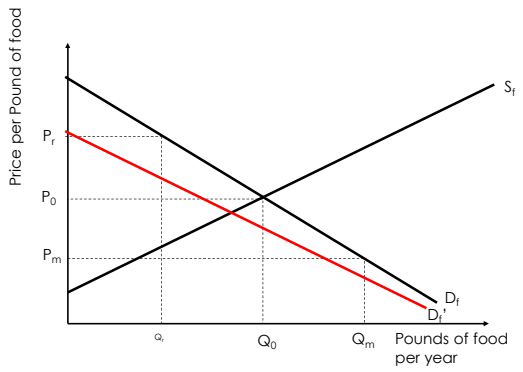
Partial Equilibrium Models: Ad-valorem Tax



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Numerical Example

- Returning to our previous example, with a per-unit tax on demanders the system was written as:

$$Q_S = 20 + 2P_S$$
$$Q_D = 100 - 2P_D$$
$$P_S = P_D - \tau_D$$

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Numerical Example

- Now, with an ad-valorem tax (τ_D), the system is written as:

$$Q_S = 20 + 2P_S$$
$$Q_D = 100 - 2P_D$$
$$P_S = (1 - \tau_D)P_D$$

Numerical Example

- If the ad-valorem tax on demanders was 10%, then relationship between prices is:

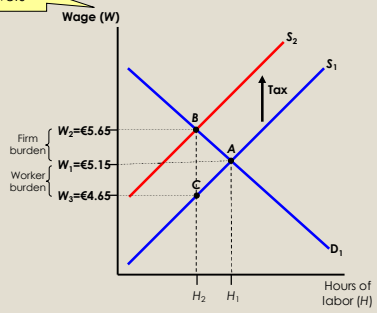
$$P_S = 0.9P_D \Rightarrow$$
$$Q_S = Q_D \Rightarrow 20 + 2(0.9P_D) = 100 - 2P_D$$
$$P_D = 21.05, P_S = 18.95, Q = 57.89$$

Tax incidence in factor markets

- Consider the labor market illustrated in figure below, before and after a tax on workers (the suppliers of labor) is imposed.

Tax incidence in factor markets

A tax on workers (the "suppliers" of labor), lowers wages.



Tax incidence in factor markets

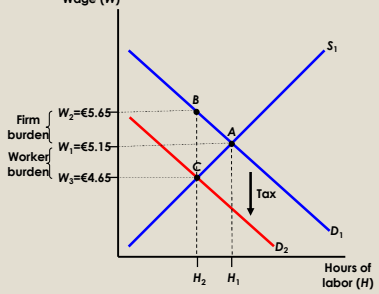
- The €1 per hour tax lowers the return to work at every amount of labor.
- Thus, individuals require a €1 rise in their wages to supply any amount of labor, and the supply curve shifts upward.
- With labor demand unchanged, the new equilibrium wage is €5.65. In this case, the tax is borne equally by workers and firms.

Tax incidence in factor markets

- Now consider the labor market illustrated in Figure below, where a tax on firms (the demanders of labor) is imposed

Tax incidence in factor markets

A tax on firms (the "demanders" of labor), also lowers wages.



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Tax incidence in factor markets

- With the tax on firms, the demand curve shifts downward to D_2, and market wages fall to €4.65.
- The firm pays workers 50¢ less than the original €5.15, but must send €1 to the government. In effect, they are paying a wage of €5.65.
- As in output markets, the tax incidence of a payroll tax shows that it makes no difference on which side of the market it is levied, and the economic burden can differ from the statutory burden.

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Tax incidence in factor markets

- This analysis will not be correct if there are impediments to wage adjustments, however.
- The ***minimum wage*** is a legally mandated minimum amount that workers must be paid for each hour of work.
  - Suppose that the current minimum wage is €5 per hour.

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Tax incidence in factor markets

- With a minimum wage, wages cannot fully adjust, so the incidence will be different.
- Consider, first, Figure below, which imposes the tax on workers.

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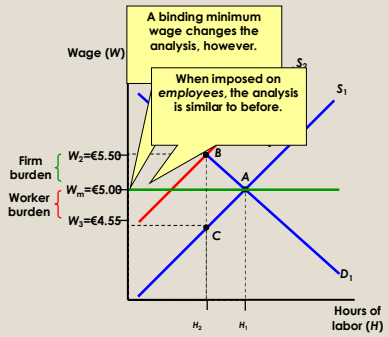
Tax incidence in factor markets

A binding minimum wage changes the analysis, however.

When imposed on *employees*, the analysis is similar to before.



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Tax incidence in factor markets

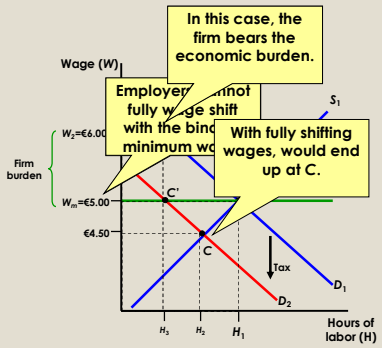
- With a tax on workers, the labor supply curve shifts upward as before. Workers are paid €5.00 per hour, but are forced to pay €1 of that to the government for taxes.
- The incidence is borne in the same manner as when there was no minimum wage.

78

Tax incidence in factor markets

- Now consider, Figure below, which imposes the tax on firms.

Tax incidence in factor markets



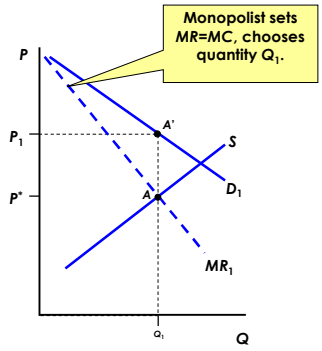
Tax incidence in factor markets

- With a tax on firms, the labor demand curve shifts downward. Without wage impediments, the market wage would fall from €5.15 to €4.65, and the firm would also pay €1 to the government. Hours of work would be H_2.
- With the minimum wage, wages cannot adjust downward, so the firm instead demands H_3<H_2 hours of labor, pays €5.00 per hour, and also pays €1 to the government. ***The economic burden of the tax falls on the firm.***

Partial Equilibrium Models: Imperfect competition

- The analysis has so far focused on competitive markets.
- ***Monopoly markets*** are markets in which there is only one supplier of a good.
  - Monopolists are price makers, not price takers.
- **Figure below** shows the determination of equilibrium in monopoly markets.

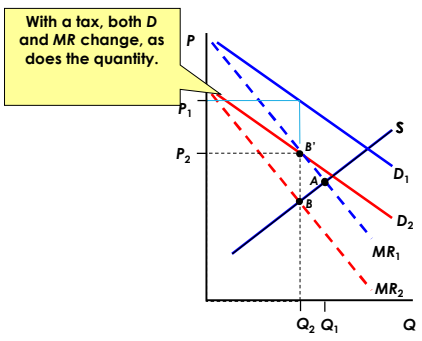
Partial Equilibrium Models: Imperfect competition



Partial Equilibrium Models: Imperfect competition

- Unlike a perfect competitor, the monopolist faces a downward sloping marginal revenue curve, because it must lower its price on all units to sell another unit.
- The marginal revenue curve, MR_1, is therefore everywhere below the demand curve. Setting MR_1=MC, the quantity Q_1 initially maximizes profits.
- Now consider a tax on consumers, illustrated in Figure below.

Partial Equilibrium Models:
Imperfect competition



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Partial Equilibrium Models:
Imperfect competition

- The tax on consumers shifts the demand curve downward to D_2, and the associated marginal revenue curve to MR_2.
- Setting MR_2=MC, the quantity Q_2 now maximizes profits.
- The monopolist's price falls from P_1 to P_2, so it bears some of the tax, just as a competitive firm does.
- The three rules of tax incidence continue to apply for a monopolist.

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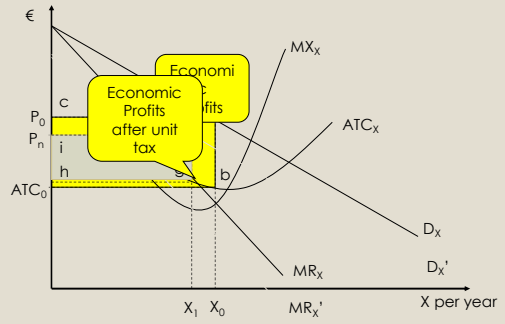
Partial Equilibrium Models:
Imperfect competition



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Tax incidence models: extensions

- Most markets fall somewhere between perfect competition and monopoly.
- ***Oligopoly markets*** are markets in which firms have some market power in setting prices, but not as much as a monopolist.
  - There is less consensus on how to model these markets.
  - Economists tend to assume the tax incidence results apply in these markets as well.

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Partial Equilibrium Models:
Profits taxes

- Firms can be taxed on ***economic profits***, defined as the return to the owners of the firm in excess of the opportunity costs of the factors used in production.
- For profit-maximizing firms, proportional profit taxes cannot be shifted.
  - Intuition: the same price-quantity combination that initially maximized profits initially still does. Output does not change.

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Partial Equilibrium Models:
Capitalization

- Special issues arise when *land* is taxed.
  - Fixed supply, immobile, durable
  - Assume annual rental rate is $€R_t$ at time t.
  - If market for land is competitive, its value is simply equal to the present discounted value of rental payments:

$$P_R = €R_0 + €R_1/(1 + r) + €R_2/(1 + r)^2 + \ldots + €R_T/(1 + r)^T$$

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Partial Equilibrium Models: Capitalization

- Assume a tax of €u_t is then imposed in each period t. The returns on owning land therefore fall, and purchasers take this into account. Thus, the price falls to:

$$P_R' = €(R_0 - u_0) + €(R_1 - u_1)/(1 + r) + €(R_2 - u_2)/(1 + r)^2 + \ldots + €(R_T - u_T)/(1 + r)$$

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Partial Equilibrium Models: Capitalization

- The difference in these prices is simply the present discounted value of tax payments:

$$P_R - P'_R = u_0 + u_1/(1 + r) + u_2/(1 + r)^2 + \ldots + u_T/(1 + r)^T$$

- **At the time the tax is imposed (not collected), the price of the land falls by the present value of all future tax payments, a process known as *capitalization*.**

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Partial Equilibrium Models: Capitalization

- The person who bears the full burden of the tax *forever* is the landlord at the time the tax is levied.
- Future landlords write the checks to the tax authority, but these payments are not a "burden" because they paid a lower price for the land from the current landlord.
- Also works the other way, when a new benefit is announced (e.g., better schools).

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General Equilibrium Models

- Looking at one particular market may be insufficient when a sector is large enough relative to the economy as a whole.
- ***General equilibrium analysis*** takes into account the ways in which various markets are interrelated.
  - Accounts for both inputs and output, and related commodities

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General Equilibrium Models

- Consider the demand for restaurant meals in a single town, as illustrated in **Figure below**.
- The demand for such meals is likely to be highly elastic.

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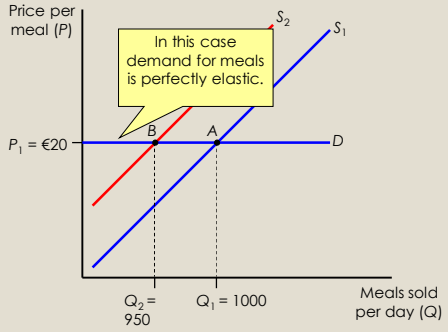
General Equilibrium Models



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General Equilibrium Models

- In such a case, a €1 tax on firms shifts the supply curve, and the firm bears the full burden of the tax.
- But in reality, firms are not self-functioning entities, but are a technology for combining capital and labor to produce an output.
  - With a restaurant, capital is best viewed as *financial* capital – the money that buys physical capital inputs like the building, the ovens, tables, etc.

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General Equilibrium Models

- The €1 tax on meals is borne by the firm, meaning that it is borne by the factors of production (labor and capital).
- We move back to the input market in **Figure below**.

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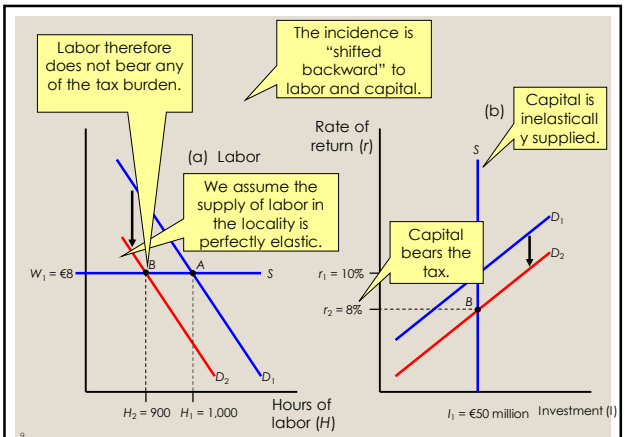

99

General Equilibrium Models

- As illustrated, the supply of labor (restaurant workers) is perfectly elastic, because those workers can easily find a job in another locality.
- The tax on output, restaurant meals, would reduce the firm's demand for labor, reducing the number of workers hired, but not their wage rate.
- On the other hand, in the short-run, the supply of capital is likely to be fixed. The firm's demand for capital shifts in, lowering the rate of return on capital.
  - In the short run, the owners of capital bear the tax in the form of a lower return on their investment.

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General Equilibrium Models

- In the longer-run, the supply of capital is not inelastic.
  - Investors can close or sell the restaurant, take their money, and invest it elsewhere.
  - In the long-run, capital is likely to be perfectly elastic as there are many good substitutes for investing in a particular restaurant in a particular town.

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General Equilibrium Models

- If both labor and capital are highly elastic in the long run, who bears the tax?
- The one additional inelastic factor in the restaurant production process is *land*.
  - The supply is clearly fixed.
  - When both labor and capital can avoid the tax, the only way restaurants can stay open is if they pay a lower rent on their land.

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General Equilibrium Models

- The scope of a tax matters for tax incidence as well. Consider imposing a restaurant tax on the entire state rather than just a city.
- Demand in the output market is less elastic; consumers bear some of the burden.
- Labor supply is less elastic as well.
- The scope of the tax matters to incidence analysis because it determines which elasticities are relevant to the analysis: taxes that are broader based are harder to avoid than taxes that are narrower, so the response of producers and consumers to the tax will be smaller and more inelastic.

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General Equilibrium Models

- There are also potentially spillovers into other output markets from the restaurant tax, not just input markets.
- Consider the statewide restaurant tax that raises the price of meals:
  - It has an income effect for consumers.
  - It increases consumption of goods that are substitutes for restaurant meals, such as meals at home.
  - It decreases consumption of goods that are complements for restaurant meals, such as valets (car-parking attendants).
- A complete general equilibrium analysis must account for the effects in these other markets.

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General Equilibrium Models: Tax equivalence

t_{KF} = a tax on capital used in the production of food

t_{KM} = a tax on capital used in the production of manufactures

t_{LF} = a tax on labor used in the production of food

t_{LM} = a tax on labor used in the production of manufactures

t_F = a tax on the consumption of food

t_M = a tax on consumption of manufactures

t_K = a tax on capital in both sectors

t_L = a tax on labor in both sectors

t = a general income tax

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General Equilibrium Models: Tax equivalence

- Nine possible ad-valorem taxes in such a model:
- Four ***partial factor taxes***
  - t_{KF}=tax on capital used in production of food
  - t_{KM}=tax on capital used in production of manufactures
  - t_{LF}=tax on labor used in production of food
  - t_{LM}=tax on labor used in production of manufactures

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General Equilibrium Models: Tax equivalence

- Five other possible ad-valorem taxes:
  - Two consumption taxes (on food and manufactures)
    - t_F=tax on consumption of food
    - t_M=tax on consumption of manufactures
  - Two factor taxes
    - t_K=tax on capital in both sectors
    - t_L=tax on labor in both sectors
  - Income tax
    - t=general income tax

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General Equilibrium Models: Tax equivalence

- Certain combinations of these nine taxes are equivalent to others.
  - Equal consumption taxes equivalent to an income tax.
  - Equal factor taxes equivalent to an income tax.
  - Equal partial factor taxes equivalent to a consumption tax on that commodity.

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General Equilibrium Models: Tax equivalence

- Certain combinations of these nine taxes are equivalent to others.
  - Equal consumption taxes equivalent to an income tax.
  - Equal factor taxes equivalent to an income tax.
  - Equal partial factor taxes equivalent to a consumption tax on that commodity.

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General Equilibrium Models: Tax equivalence

- Partial factor taxes

t_{KF}	and	t_{LF}	are equivalent to	t_F
and		and		and
t_{KM}	and	t_{LM}	are equivalent to	t_M
are		are		are
equivalent		equivalent		equivalent
to		to		to
t_K	and	t_L	are equivalent to	t

Source: McLure [1971].

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General Equilibrium Models: Tax equivalence

- Apply GE models to tax incidence. Principal assumptions include:
  - ***Technology:*** Constant returns to scale, production may differ with respect to elasticity of substitution (either capital intensive or labor intensive).
  - ***Behavior of factor suppliers:*** Labor and capital perfectly mobile (net return equalized across sectors).
  - ***Market structure***: Perfectly competitive
  - ***Total factor supplies***: Fixed (but mobile across sector)
  - ***Consumer preferences***: Identical
  - ***Tax incidence framework***: Differential tax incidence

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General Equilibrium Models: Tax equivalence

- Commodity tax: A tax on food leads to …
  - Relative price of food increasing
  - Consumers substitute away from food and toward manufactures
  - Less food produced, more manufactures produced
  - As food production falls, labor and capital relocate toward manufacturing
  - Because labor-capital ratios differ across sectors, relative prices of inputs have to change for manufacturing to be willing to absorb unemployed factors.

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General Equilibrium Models: Harberger Model

- Commodity tax: A tax on food leads to …
  - If food production is relatively capital intensive, relatively large amounts of capital must be absorbed by manufacturing.
    - Relative price of capital falls (including capital already used in manufacturing)
    - All capital is relatively worse off, not just capital used in the food sector.
  - In general, tax on the *output* of a particular sector induces a decline in the relative price of the *input* that is used intensively in that sector.

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General Equilibrium Models: Harberger Model

- Conclusion: food tax tends to hurt people who receive a relatively large proportion of income from capital.
- Would also hurt those who consume a large proportion of food (if dropped identical preferences).

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General Equilibrium Models: Harberger Model

- Income tax: Since it is equivalent to set of taxes on labor and capital at same rate, and factors are fixed, income tax cannot be shifted.
- Labor tax: No incentive to switch use between sectors, labor bears full burden.
- Partial factor tax: Two initial effects –
  - *Output effect*
  - *Factor substitution effect*
- See Figure below for flowchart of effects.

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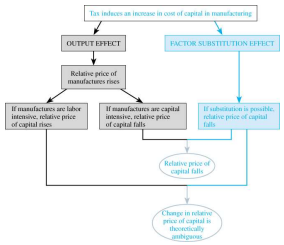
General Equilibrium Models: Harberger Model



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Recap of Taxation and Income Distribution

- Partial Equilibrium Analysis
  - Per unit taxes
  - Ad valorem taxes
- General Equilibrium Analysis

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