C h a p t e r 11

2

ECONOMIC ANALYSIS OF TAXATION

Public Finance, 10th Edition

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Outline: Chapter 11 ECONOMIC ANALYSIS OF TAXATION

1. Lump-Sum Taxes: A Benchmark Standard for Comparison

2. The Impact of Taxes on Market Prices and Efficiency

3. Further Analysis of Tax Incidence

4. General Equilibrium Analysis of Excess Burden and Incidence of Taxes

5. Taxes, Government Expenditures, and the Distribution of Income

Lump-Sum Taxes

- Fixed sum that a person would pay per year, independent of that person's income, consumption of goods and services, or wealth
    - Do not prevent prices from equaling marginal social cost and benefit of any goods or services (MSC=MSB).
    - Reduce ability of consumers to purchase market goods and services and to save

- *Head tax* is a lump-sum tax that would require all adults to pay an equal amount each year to governing authorities.
    - Poll Tax in 1901-1939 (B.E. 2444-2482) – Bt 6/person
    - 1905 (B.E. 2448: Abolition of slavery in Thailand)
    - Unmarried male tax 1943-1945 (B.E. 2486-2488) – Bt 5/person

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Price-Distorting Tax

- One that causes net price received by sellers of a good or service to diverge from gross price paid by buyers

- *Individual excess burden of a tax* measures the loss in well-being to a taxpayer caused by the substitution effect of a price-distorting tax.

- Indifference curve analysis can be used to compare effects of lump-sum and price-distorting tax, each collecting the same amount.
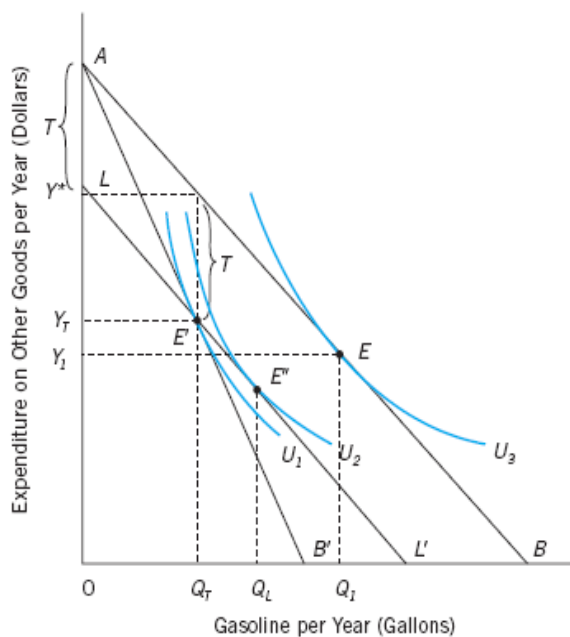
Price-Distorting Versus Lump-Sum Tax

11.1 A Price-Distorting Tax versus a Lump-Sum Tax

- A lump-sum tax that collects *T* in taxes from a person allows that person to attain <u>higher level of well-being</u> than a price-distorting tax that collects the same amount.

- The loss in well-being due to the substitution effect of the price-distorting tax is its excess burden.

Unit Tax

- A levy of a fixed amount per unit of a good exchanged in a market

  o Tax is <u>independent of price</u>, so if price rises, no more revenue would be collected per unit.

- Tax on Sellers

  o Sellers must cover the tax to avoid losses

  o Effect is equivalent to an increase in marginal cost to sellers that decreases supply

Unit Tax

E 11.2 Impact of a Unit Tax on Market Equilibrium
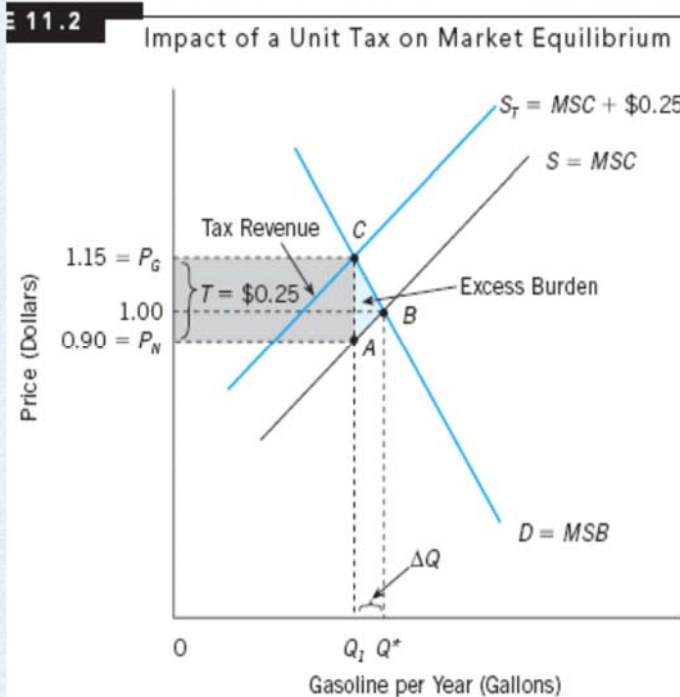
- A unit tax of 25 cents on gasoline collected from sellers decreases the market supply of the good and increases the price.

- The market price, P_G, paid by buyers increases from $1.00 to $1.15.

- After payment of the tax, the net price received by sellers , P_N, falls to 90 cents.

- If Q is the reduction in output due to the substitution effect of the tax, then the area ABC measures the excess burden of the tax.

Excess Burden of a Tax

- Tax prevents market interaction among buyers and sellers from automatically equating MSC and MSB, required to attain efficiency

- *Total excess burden of a tax* is additional cost to society over amount of dollars paid in a tax

  - Total excess burden of a unit tax is loss in well-being to buyers and sellers over what they would suffer under a lump-sum tax
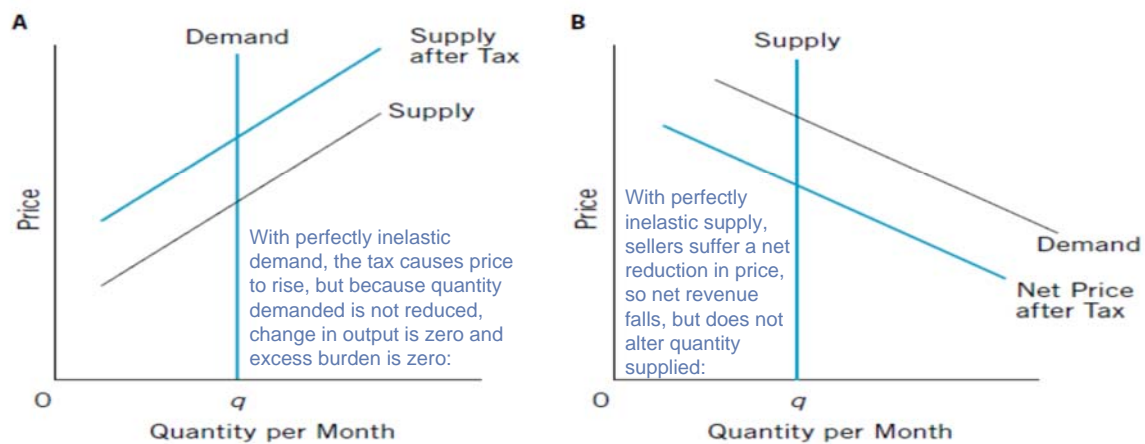
  - Formula for excess burden of a unit tax:

$$W = \frac{1}{2} T^2 \frac{Q^*}{P^*} \cdot \frac{E_S E_D}{E_S - E_D}$$

Excess Burden of a Tax

FIGURE 11.3 Excess Burden When Demand or Supply Is Perfectly Inelastic

The more inelastic the demand or the supply of a taxed item, the lower the excess burden.

As either the price elasticity of demand or the price elasticity of supply approaches zero, the excess burden of the tax approaches zero because the reduction in quantity sold as a result of the tax approaches zero.

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9

Efficiency-Loss Ratio

- Ratio of the excess burden of a tax to the tax revenue collected each year by that tax:

$$\frac{W}{R} = \frac{\text{Excess Burden}}{\text{Tax Revenue}}$$

- Sometimes called the "coefficient of inefficiency" of the tax

- Estimates of efficiency-loss ratios of different kinds of taxes useful in achieving minimization of total excess burden of taxation

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10

Incidence of a Tax

- *Incidence of a tax* – the <u>distribution of the burden</u> of paying a tax

- *Shifting of a tax* – the <u>transfer of the burden</u> of paying a tax from those who are legally liable for it to others
  - *Forward shifting* – transfer of a tax's burden from sellers who are liable for its payment <u>to buyers</u> as a result of an increase in the price of the good
  - *Backward shifting* – transfer of a tax's burden from buyers who are liable for its payment <u>to sellers</u> through a decrease in market price of the good

Ad Valorem Taxes

- Taxes levied as a percentage of the price of a good or service
  - Retail sales taxes
  - Payroll tax

- The higher the price of the taxed good or service, the greater the tax per unit.
  - $T = tP_G$ = Tax Revenue per Unit of Output
  - Loss due to excess burden of an ad valorem tax varies with the square of the tax rate

Ad Valorem Taxes on Labor

URE 11.4 — Impact of an Ad Valorem Tax on Labor
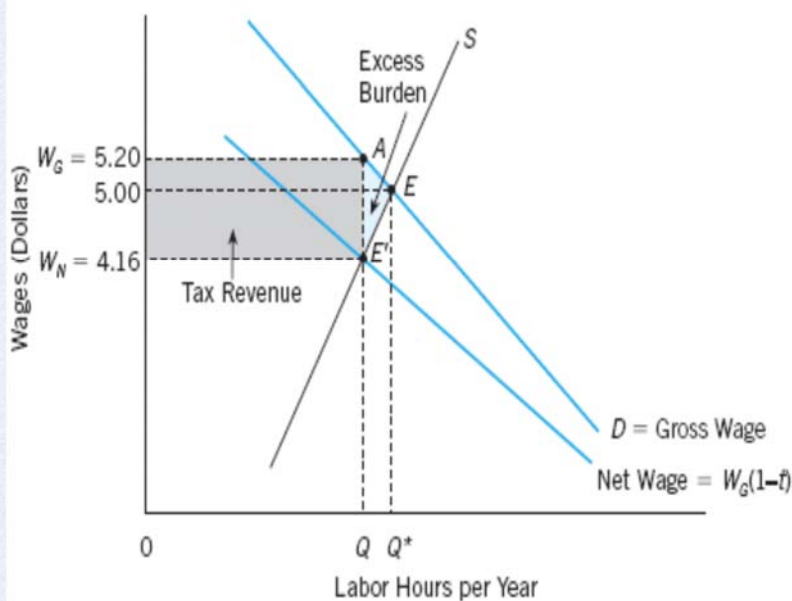
- A payroll tax equal to 20 percent of wages collected from workers decreases the wages received by workers from W_G to $W_N = W_G(1-t)$ for each hour worked per year.

- Workers respond to the reduction in their take-home wage by reducing the quantity of labor hours supplied per year.

- Part of the tax burden is shifted to employers as the market wage increases from $5.00 per hour to $5.20 per hour.

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3. The price elasticity of demand for wine is estimated to be 1 at all possible quantities. Currently, 200 million gallons of wine are sold per year, and the price averages $6 per bottle. Assuming that the price elasticity of supply of wine is 1 and the current tax rate is $1 per bottle, ① calculate the current excess burden of the tax on wine. Suppose the tax per bottle is increased to $2 per bottle. ② What will happen to the excess burden of the tax as a result of the tax increase? Under what circumstances can ③ a doubling of the tax on wine actually improve resource use in the United States, despite the increase in the excess burden of the tax?

Ans.

Because both the price elasticity of demand and of supply of wine is unity, the excess burden is

$$W = \frac{1}{2}T^2\frac{Q^*}{P^*}\cdot\frac{E_S E_D}{E_S - E_D}$$

① 1/2(200/6)(1/2) = $8,333,333 per year

If the tax rate goes up to two, the excess burden will quadruple to

② 1/2(4)(200/6)(1/2) = $33,333,333

③ If there are negative externalities associated with drinking wine, then the tax can actually improve resource use despite its high excess burden.

5. Suppose the supply of housing construction is infinitely elastic at a price of $150 per square foot. Currently 1 million square feet are built per month. If the price elasticity of demand for housing is 1, calculate the monthly excess burden of a 10 percent tax on housing construction. (Hint: Go to the appendix of this chapter and read the discussion of taxation of constant cost industries.) What is the monthly excess burden if the tax is 20 percent? Who will bear the incidence of the tax?

Ans.

The excess burden is
$$W = \frac{1}{2}T^2 \frac{Q^*}{P^*} \cdot \frac{E_S E_D}{E_S - E_D}$$

① $\quad 0.5(0.1)^2 * 150{,}000{,}000(-1) = -\$750{,}000$ per month.

If the tax rate is doubled to 20 percent, the excess burden quadruples to a loss of

② $\quad = \$3$ million per month.

③ Because the supply is perfectly elastic, the incidence of the tax is borne fully by the buyers. For a 10-percent tax, the market equilibrium price per square foot of construction will rise to $165. For a 20-percent tax, the market equilibrium price will rise to $180.


Tax Incidence and Liability for Tax
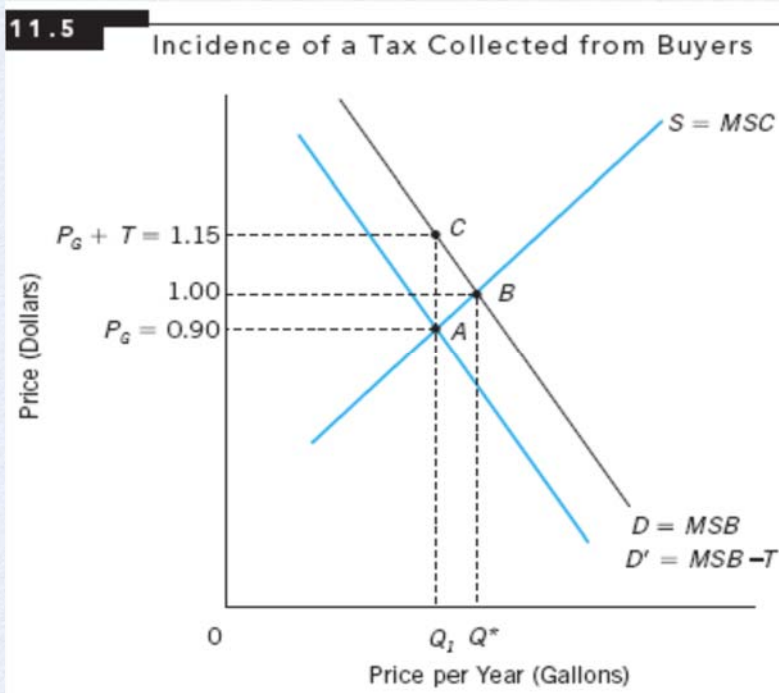
- The incidence of a tax is independent of whether it is collected from buyers or sellers.

- Here, a 25 cent unit tax on gasoline is collected from buyers. This causes a decrease in the demand for the good. The market price received by sellers falls to 90 cents per gallon.

- The total price paid by buyers, including the tax, goes up to $1.15.

- This results in exactly the same distribution of tax burden that prevailed when the tax was collected from sellers (see Figure 11.2).
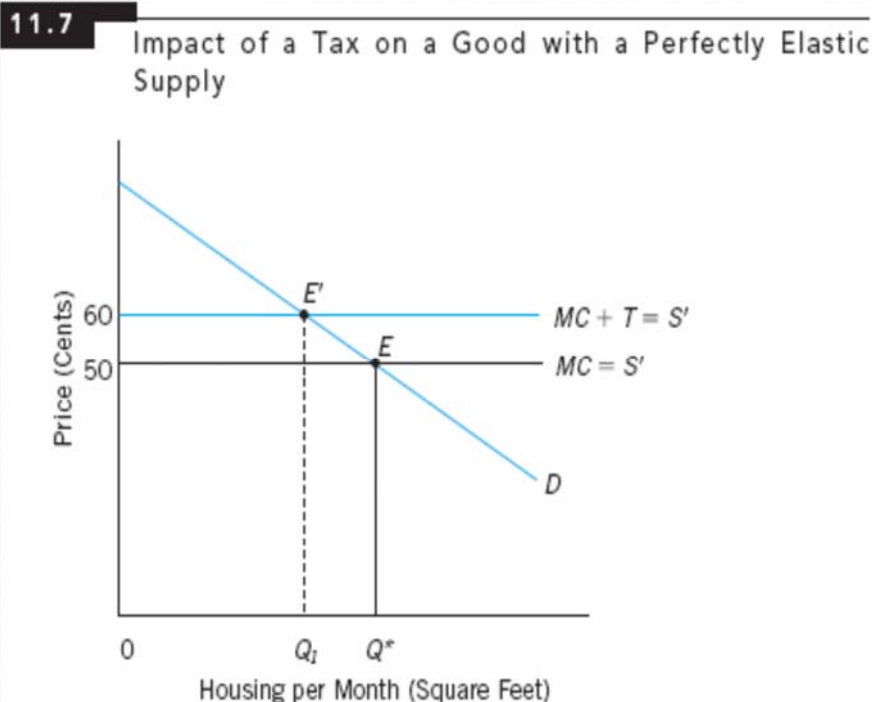
Tax Incidence and Price Elasticities

.6

The More Inelastic the Demand, the Greater the Portion of a Tax Borne by Buyers
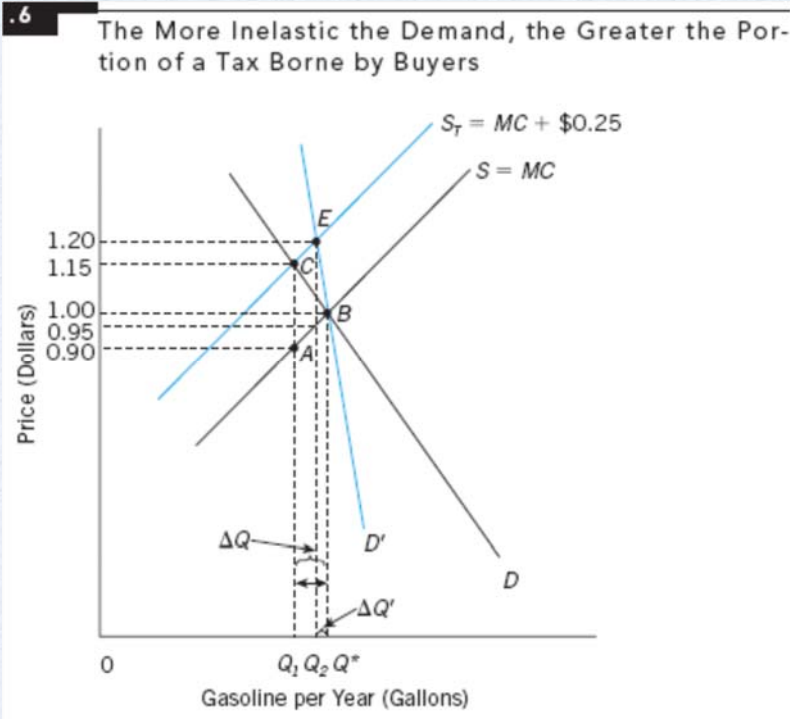
- The demand curve D' is more inelastic than the demand curve D at each possible price.

- As a result, the same unit of tax of 25 cents would result in a <u>greater increase in market price</u>, when demand is D'.

- More of the tax is shifted to buyers when the more inelastic demand prevails.

Whoever is less elastic, the more tax he has to pay
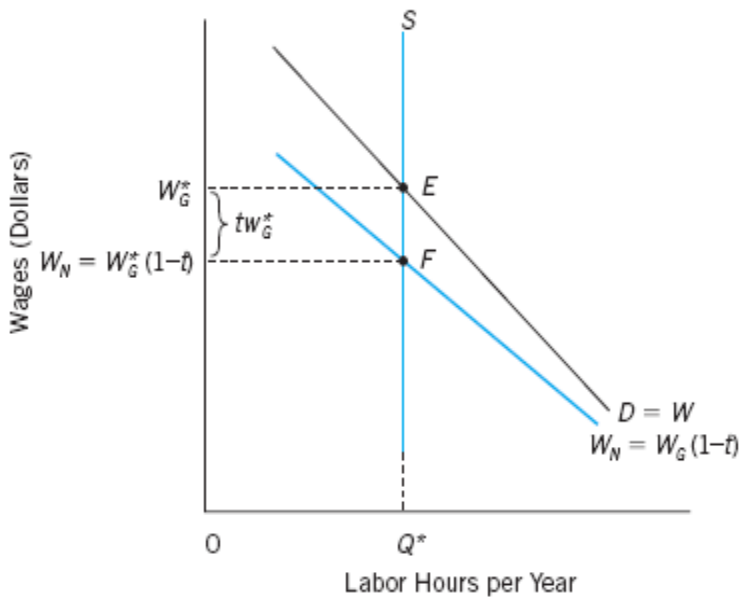
17

Tax Incidence and Price Elasticities

11.7

Impact of a Tax on a Good with a Perfectly Elastic Supply

- A tax on a good in <u>perfectly elastic supply</u> collected from sellers is fully shifted to buyers.

18

Tax Incidence and Price Elasticities

11.8
Tax incidence When Market Supply Is Perfectly Inelastic
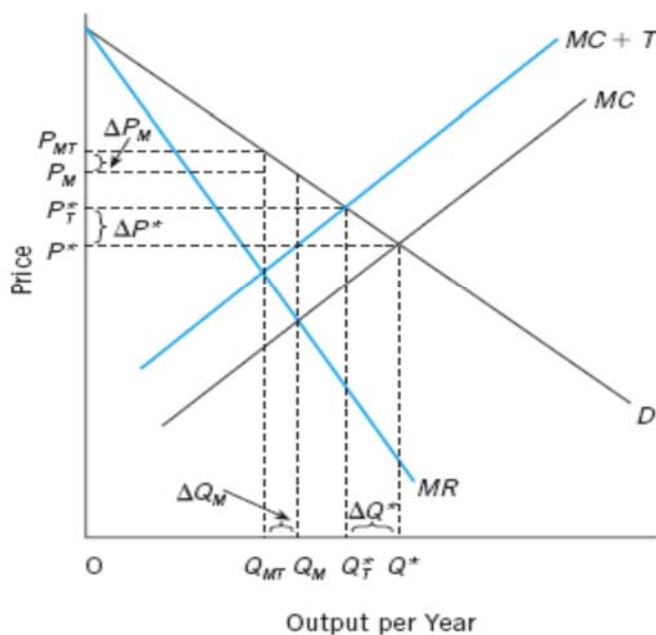
- If the supply of labor hours were perfectly inelastic, a payroll tax would decrease the net wage by the full amount of the tax per hour.

Shifting Under Monopoly

11.9
Shifting Under Monopoly

- A monopolist would shift less of a given unit tax forward than would be the case if the same output were produced by a competitive industry assuming a linear demand curve.

1. The annual demand for liquor in a certain state is given by the following equation:

$$Q_D = 500,000 - 20,000P$$

where P is the price per gallon and Q_D is quantity of gallons demanded per year. The supply of liquor is given by the equation

$$Q_S = 30,000P$$

① Solve for the equilibrium annual quantity and price of liquor. Suppose that a $1-per-gallon tax is levied on the price of liquor received by sellers. Use both graphic and algebraic ② techniques to show the impact of the tax on market equilibrium. ③ Calculate the excess burden of the tax, the amount of revenues collected, and the incidence of the tax between buyers and sellers.

Ans.

① The equilibrium price is $10 per gallon. The equilibrium quantity is 300,000 gallons per year.

② After a $1 per gallon tax is imposed on sellers, the supply curve is described by the equation Qs = $30,000(P – 1). Solving for the new equilibrium price by setting quantity demanded equal to quantity supplied gives P = $10.60. The net price received by sellers after paying the unit tax is therefore $9.60. The new equilibrium quantity is therefore $288,000. Assuming no income effects, the excess burden of the tax will be 0.5(12,000) = $6,000 per year. The incidence of the tax will be shared by buyers and sellers of liquor.

③ Assuming no income effects, the excess burden of the tax will be EB=0.5(12,000) = $6,000 per year. The incidence of the tax will be shared by buyers and sellers of liquor.


Minimizing Excess Burden

- In order to minimize excess burden associated with sale and excise taxes, tax authorities must tax various goods at differing rates rather than uniform rates.

- For example, food and clothing
  - Assume food more inelastic than clothing
  - Demand for each independent of the price of the other
  - When price of either good changes, demand curve for the other does not shift

Minimizing Excess Burden

**FIGURE 11.10** — Multimarket Analysis of Excess Burden
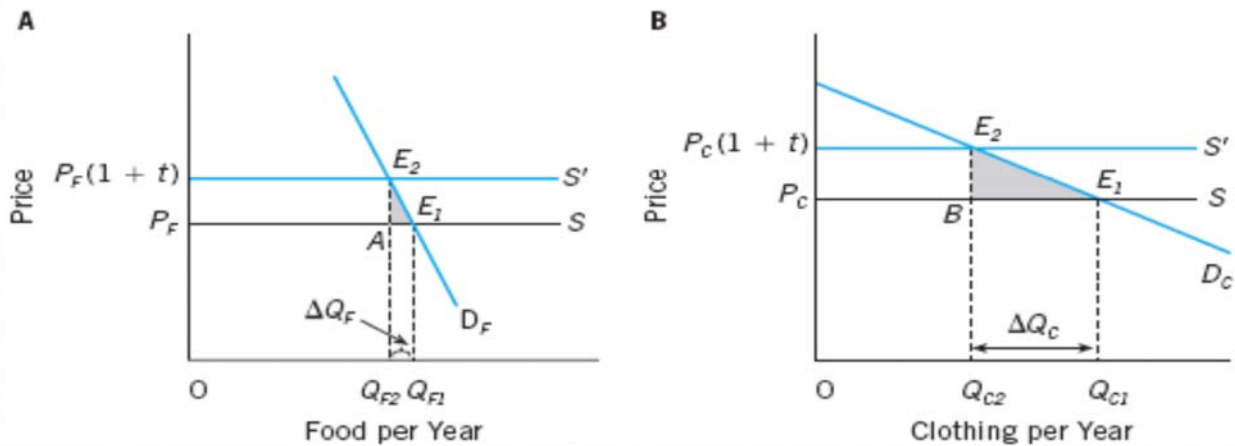
- A flat-rate sales tax of *t* percent levied on both food and clothing results in greater excess burden in the clothing market as shown in B than in the food market as shown in A.
- Total excess burden can be reduced by increasing the tax rate on food and lowering the tax rate on clothing until the marginal increase in the excess burden in the food market equals the marginal decrease in excess burden in the clothing market.

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23

Multimarket Analysis of Incidence

**FIGURE 11.11** — Multimarket Analysis of Incidence
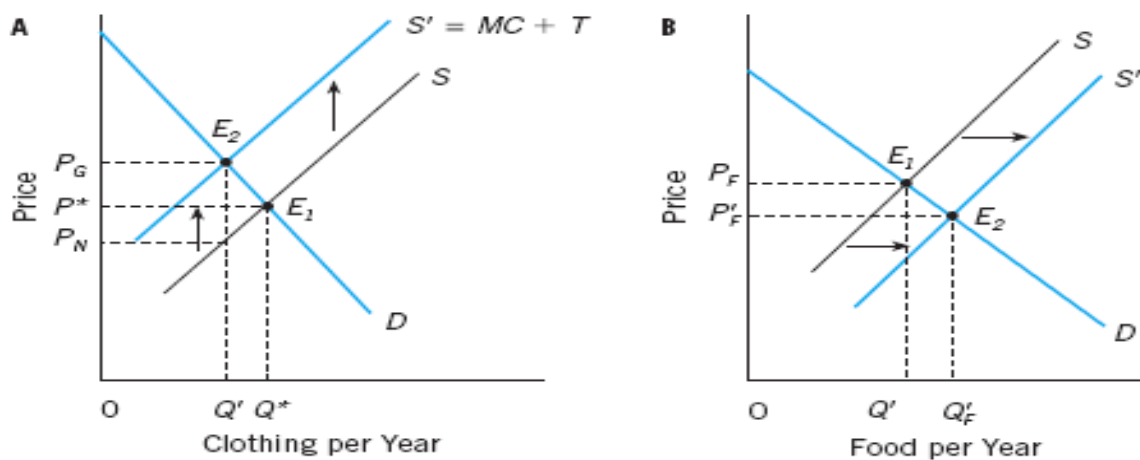
A tax on output in one market can affect prices in other markets. Here, the tax induced increase in the price of clothing causes inputs to flow into the food industry.
This increases the supply of food and decreases its market price.

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24

2. Figure 11.11 shows that a tax on clothing can reduce the price of food. Suppose that after the tax on clothing consumption is imposed, another tax is levied on the consumption of food. For example, the consumption of both commodities could be ① subject to a tax of five percent. <u>Show how the conclusions of the analysis in the</u> ② <u>text are modified when the same tax is present in both markets.</u> <u>Analyze the incidence of the tax</u>. In your answer, assume that the tax revenue is returned in equal lump-sum transfers to all citizens.

FIGURE 11.11   Multimarket Analysis of Incidence
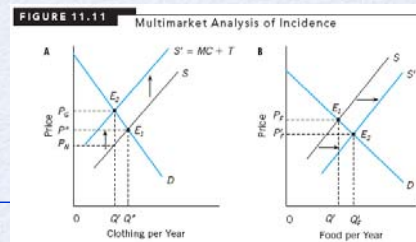
Ans.

① The additional tax on clothing will decrease the supply of clothing and cause resources to flow into food production.

The price of food will fall, while the price of clothing will rise.

② Assuming that the tax revenue is returned, the incidence of the tax will depend <u>entirely on the changes in the prices of food and clothing</u>, which will depend both on the <u>elasticities</u> of supply and of demand for these items.

Concepts of Incidence

- Incidence of a specific government policy refers to the <u>resulting change in distribution of income</u> available for private use attributable to that policy.

- Three concepts of incidence that relate to government taxes and expenditures are:

  1. *Budget incidence* – evaluates effects of both <u>government expenditure and tax policies</u> on distribution of income in the private sector
  2. *Expenditure incidence* – evaluates effects of alternative government expenditure projects on distribution of income
  3. *Differential tax incidence* – resulting change in distribution of income when <u>one type of tax is substituted</u> for some alternative tax, yielding equivalent revenue, while both mix and level of government expenditures are held constant

Lorenz Curve
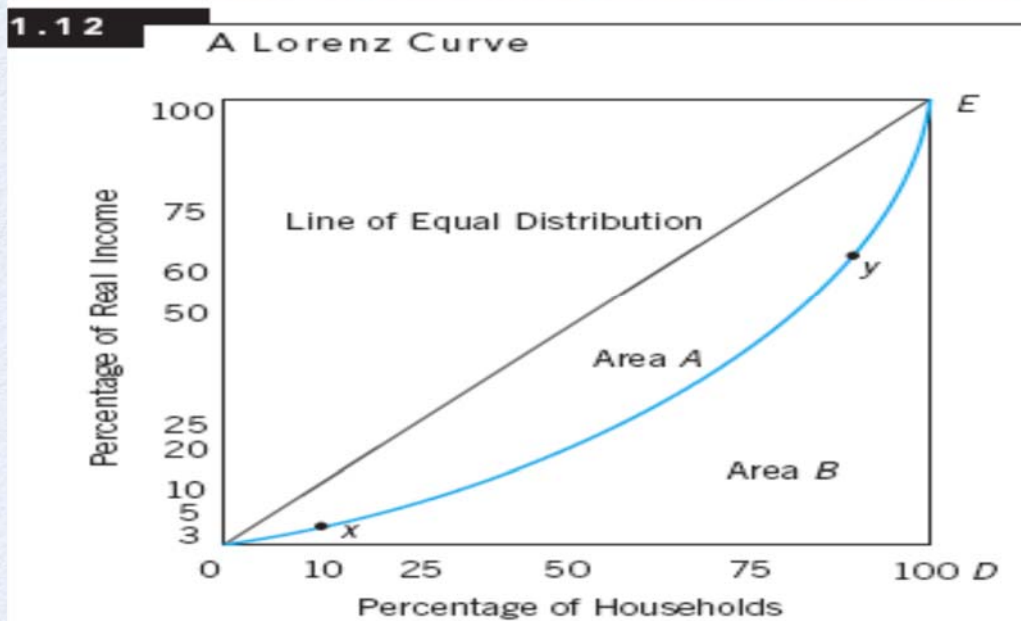
A Lorenz curve shows how a nation's actual income distribution deviates from a perfectly equal income distribution.

27

The Gini Coefficient

- Summary index of the information contained in a Lorenz curve

- Measures the <u>degree of inequality</u> for any income distribution by calculating the ratio of the area between the Lorenz curve corresponding to that distribution and the 45-degree line to the total area under the 45-degree line.

- So, for previous Lorenz curve:

$$G = \frac{\text{Area } A}{\text{Area } A + \text{Area } B}$$

28

Effective Tax Rates

- <u>Given progressive nature of federal taxes</u> overall, they are likely to shift the Lorenz curve inward and contribute to reducing income inequality in the U.S.

TABLE 11.1 Effective Tax Rates for All Federal Taxes, 1998 and 2003

INCOME CATEGORY	EFFECTIVE TAX RATE (PERCENT) 1998	EFFECTIVE TAX RATE (PERCENT) 2003
Lowest Quintile	4.5	4.8
Second Quintile	13.3	9.8
Third Quintile	18.9	13.6
Fourth Quintile	22.1	17.7
Highest Quintile	28.7	25.0

Source: Congressional Budget Office.

Thailand 2009

Q1 = 21.6
Q2 = 23.5
Q3 = 25.0
Q4 = 26.6
Q5 = 26.0

Effective Tax Rates

DECILE	Effective Tax Rates for All Taxes Collected by the General Government (THOUSAND BAHT)		
	Direct Taxes	Indirect Taxes	Total
0-10%	3.81	12.86	21.57
11-20%	5.11	12.21	21.63
21-30%	5.97	12.72	22.93
31-40%	6.4	13.35	23.97
41-50%	7.05	12.96	24.01
51-60%	7.6	14.24	25.97
61-70%	8.48	14.39	26.85
71-80%	9.31	13.42	26.32
81-90%	10.04	12.23	25.47
91-100%	15.3	9.09	26.55
TOTAL	10.92	11.62	25.71

Source: Aemkulwat, Chairat, 2013, "Tax Incidence and Inequality and Inequality in Thailand: 1988-2009" research sponsored by the Faculty of Economics, Chulalongkorn University. (in Thai).

4. Suppose you had to design a system of taxation for a republic of the former Soviet Union that was transforming its economy into a modern Western-style mixed economy. ①<u>What criteria would you consider to minimize the excess burden</u> of the system of taxation? ②<u>Why would a uniform system of sales taxes likely have a higher excess burden</u> than a system of excise taxes in which tax rates varied among taxed products? ③<u>What would be the possible distortions</u> resulting from a tax system that only taxed consumption of goods and services and did not tax leisure activities? ④<u>Why would a very efficient tax system</u> be unlikely to gain broad political support in the republic?

Ans.

① ② To minimize the excess burden, a second-best type tax system would vary tax rates according to elasticities of demand and supply of taxed items.

A Lorenz curve shows how a nation's actual income distribution deviates from a perfectly equal income distribution.

③ ④ The tax system could encourage work by levying high taxes on commodities that would be <u>complementary with leisure</u>.

Recap: Chapter 11 ECONOMIC ANALYSIS OF TAXATION

- Lump-Sum Taxes: A Benchmark Standard for Comparison

- The Impact of Taxes on Market Prices and Efficiency

- Further Analysis of Tax Incidence

- General Equilibrium Analysis of Excess Burden and Incidence of Taxes

- Taxes, Government Expenditures, and the Distribution of Income