LECTURE 10

Taxation and Efficiency

Introduction

- Are people unaffected by a tax increase if they pay zero in taxes afterwards?
  - No, consumption may have changed in response to the tax increase
  - Bundle consumed is less desirable
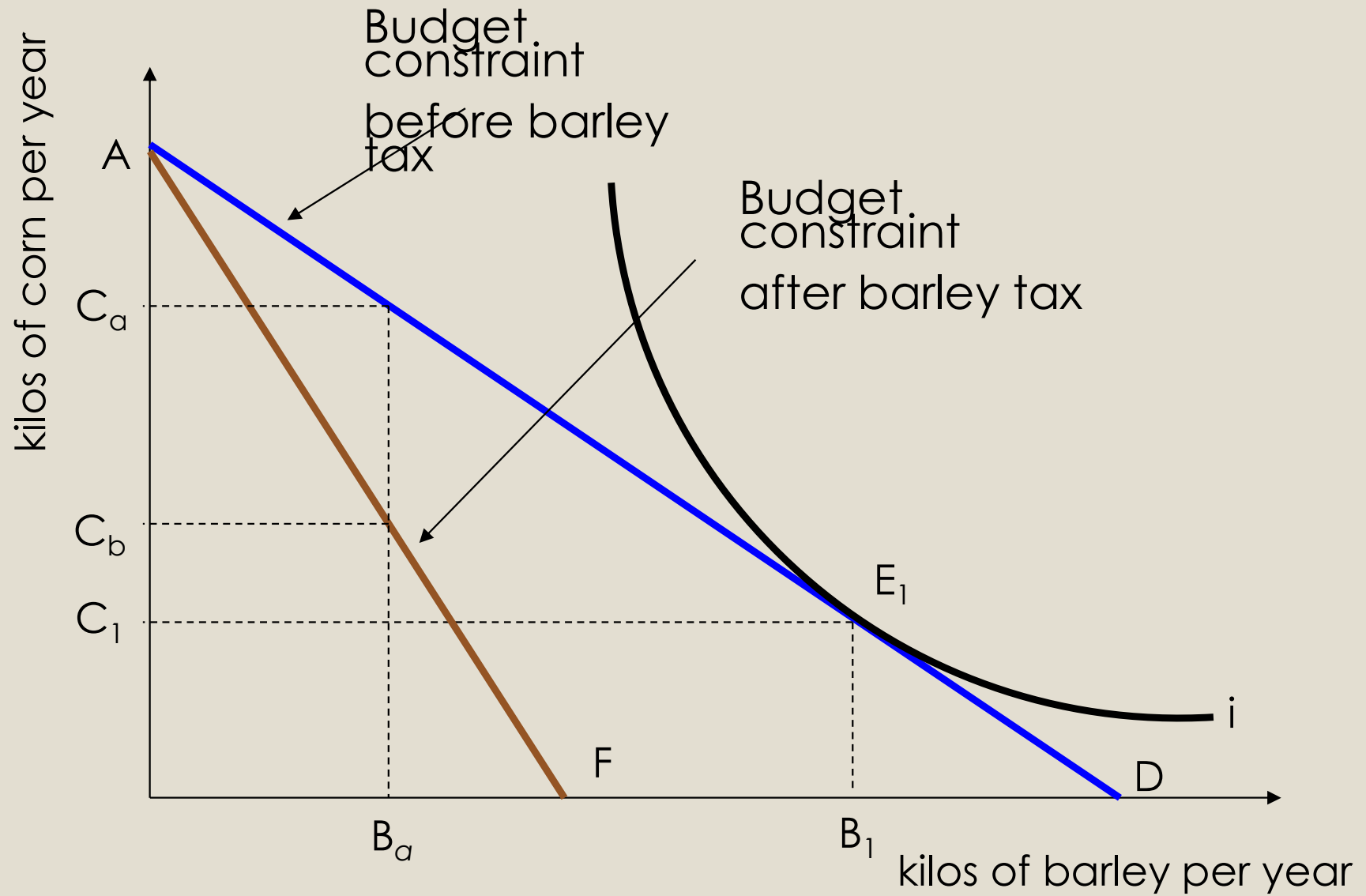- **Excess burden** is a loss of welfare above and beyond the tax revenues collected.

Excess Burden Defined

- Two commodities
    - Barley and corn
- Fixed income
- P_b and P_c are prices of goods
- No distortions such as externalities, imperfect competition, public goods, etc.

Excess Burden Defined

◦ Figure below shows the budget constraint *(AD)*, with utility maximized at bundle E_1.

◦ Ad-valorem tax levied on barley at rate t_b raises the price to $(1+t_b)P_b$, and rotates the budget constraint along the x-axis. The new budget constraint is *AF*.
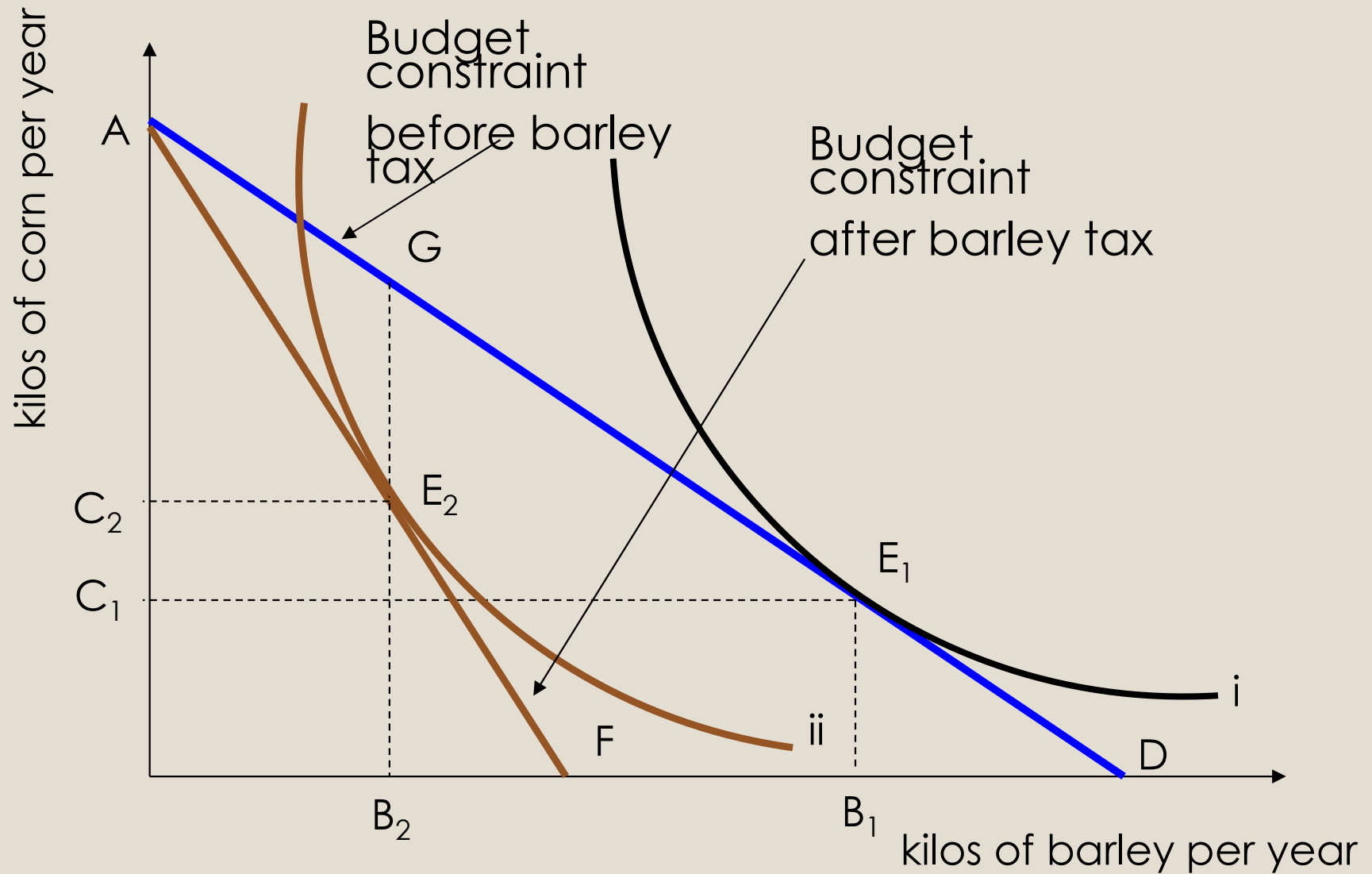
Excess Burden Defined

kilos of corn per year

Budget constraint before barley tax

Budget constraint after barley tax

A

C_a

C_b

C_1

E_1

i

F

D

B_a

B_1

kilos of barley per year

Excess Burden Defined

◦ At each consumption level of barley, the vertical distance between *AD* and *AF* shows tax payments in terms of forgone corn.

◦ Normalize P_C=1 so that vertical distance can be measured in either quantity of corn or dollars.

gkaplanoglou, public finance 2024-2025

Excess Burden Defined

Excess Burden Defined

◦ Figure above shows new optimizing choice with the higher prices along budget constraint *AF*.

◦ Utility maximized at bundle E_2.

◦ Vertical distance between old & new budget constraints is GE_2 is the "tax bill."

Excess Burden Defined

◦ Any tax will lower utility, but is there an alternative tax that raises the same revenue, GE_2, but entails a smaller utility loss? Or greater revenue with the same utility loss?

◦ If so, the tax on barley leads to excess burden.

Excess Burden Defined

kilos of corn per year

A

H

G

Tax Revenues

M

Equivalent variation

C_2

E_2

C_1

N

E_1

E_3

i

F

ii

I

D

B_2 B_3 B_1

kilos of barley per year

10

Excess Burden Defined

◦ ***Equivalent variation*** is the amount of income we would have to take away (before any tax was imposed) to induce a move to the lower indifference curve.

◦ Taking away income is equivalent to a parallel movement inward on the budget constraint.

◦ Budget constraint *HI* in Figure above shows this.

Excess Burden Defined

- ◦ Note that $ME_3=GN>GE_2$, but both give the consumer the same utility.

- ◦ Thus, the difference E_2N is the excess burden of the barley tax. The barley tax makes the person worse off by an amount that exceeds the revenue it generates.

Excess Burden Defined

- ◦ **Lump sum tax** is a tax that must be paid regardless of the taxpayer's behavior.

- ◦ Budget constraint *HI* satisfies this. Revenue yield exactly equals the equivalent variation.

  - ◦ *Conclusion: Lump sum tax has no excess burden.*

Questions and Answers

- Why aren't lump sum taxes widely used?
  - Construed as unfair because people's abilities to pay vary

- How do lump sum taxes relate to welfare economics?
  - The equilibrium conditions become:

$$MRS_{bc} = \frac{(1 + t_b)P_b}{P_c} > MRT_{bc} = \frac{P_b}{P_c}$$

Questions and Answers

◦ Intuitively, when MRS>MRT the marginal utility of substituting barley consumption for corn consumption exceeds the change in production costs from doing so.

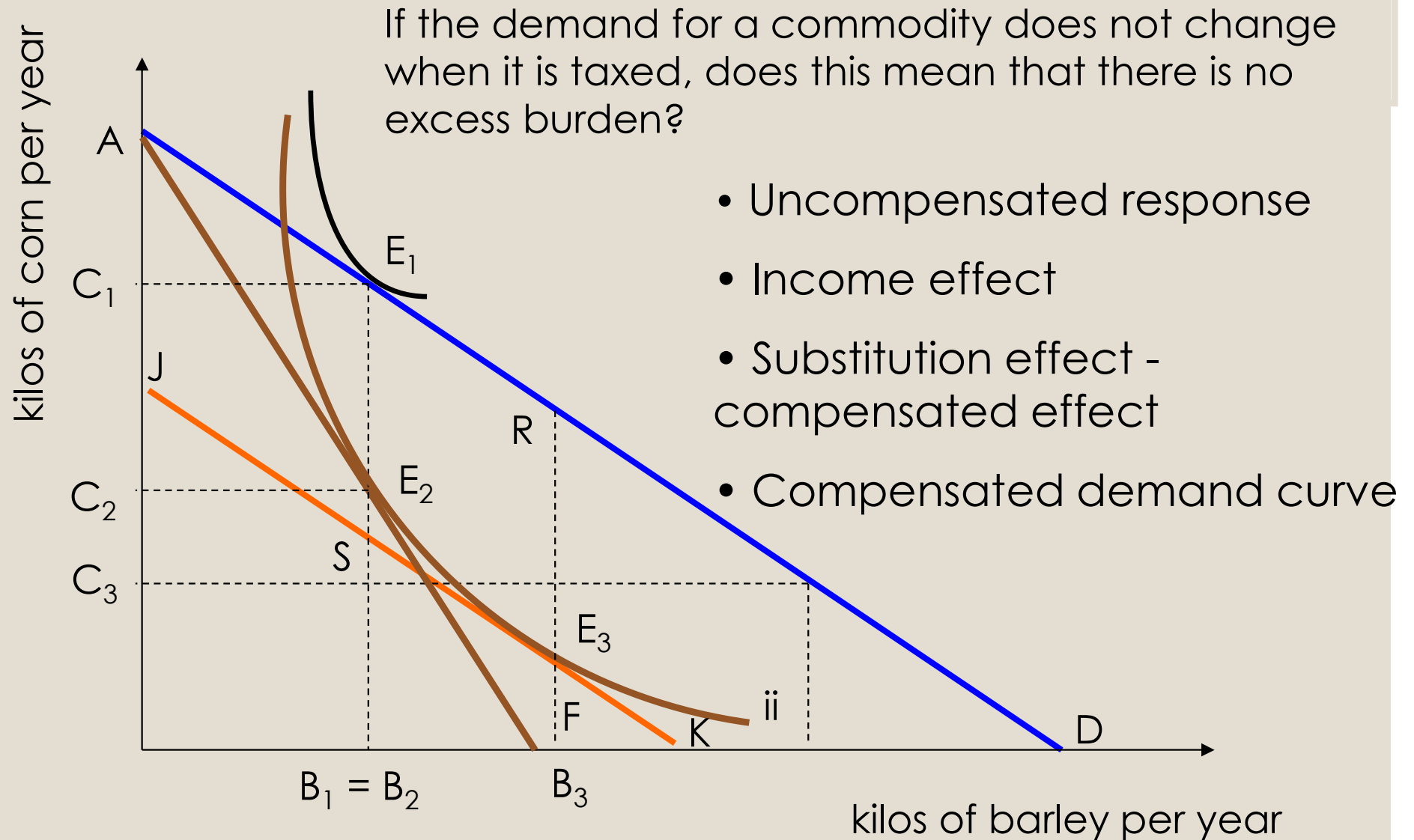◦ In the presence of the tax, there is no financial incentive to do so.

Questions and Answers

◦ Intuitively, when MRS>MRT the marginal utility of substituting barley consumption for corn consumption exceeds the change in production costs from doing so.

◦ In the presence of the tax, there is no financial incentive to do so.

Questions and Answers

- Does an income tax entail excess burden?
  - It usually does entail excess burden, if a third commodity, *leisure*, exists.

- If demand for a commodity is perfectly inelastic, is there excess burden?
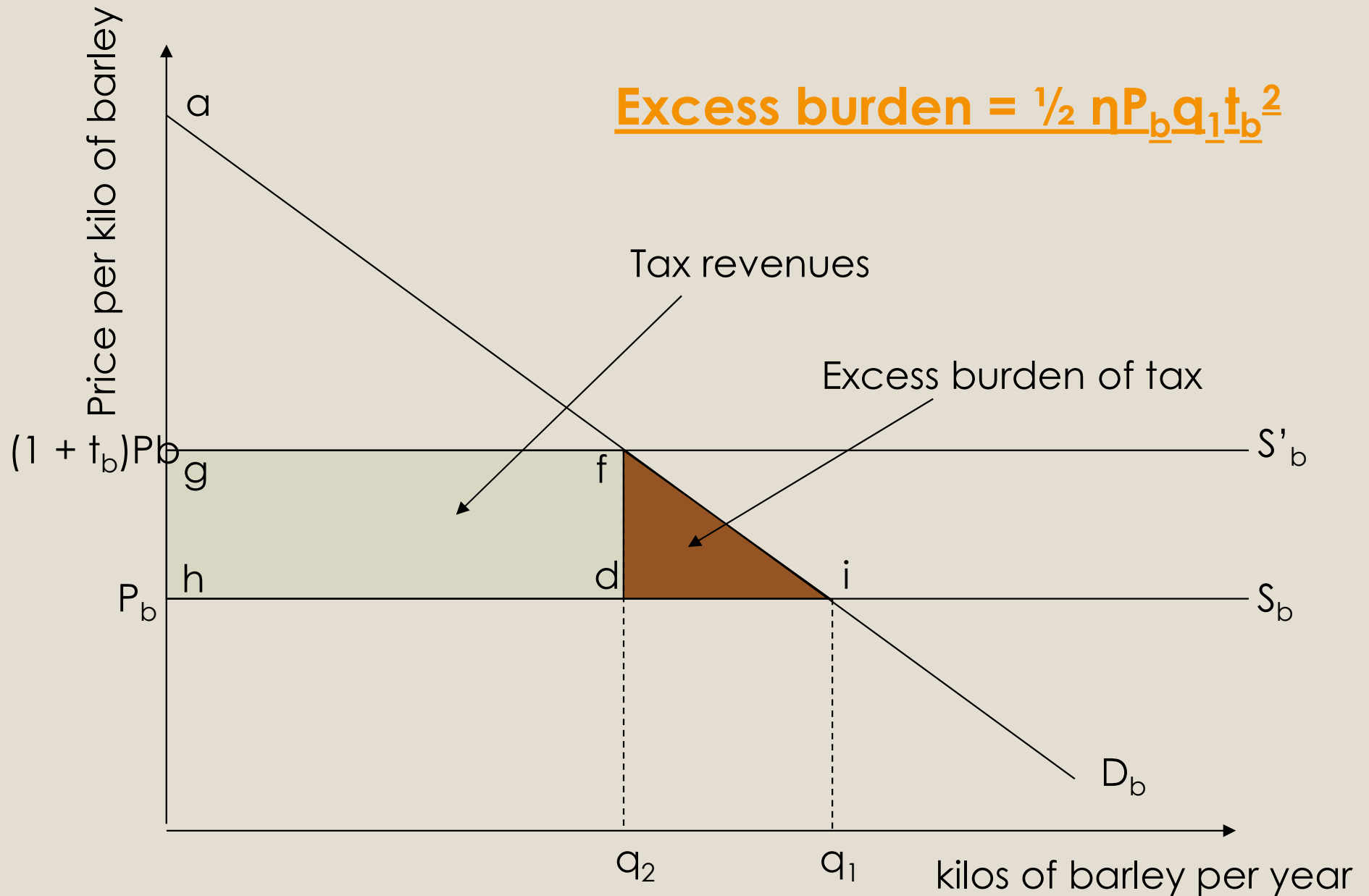 - Yes, see Figure below

Questions and Answers

If the demand for a commodity does not change when it is taxed, does this mean that there is no excess burden?

- Uncompensated response
- Income effect
- Substitution effect - compensated effect
- Compensated demand curve

kilos of corn per year

kilos of barley per year

A

C_1

J

C_2

C_3

S

E_1

R

E_2

E_3

F

K

ii

D

$B_1 = B_2$

B_3

Questions and Answers

- In Figure above, the ordinary (uncompensated) demand curve is inelastic – $B_1 = B_2$ when the price increases.

- But this is because the income effect offsets the substitution effect.

- The substitution effect is the part necessary to compute excess burden. The compensated demand curve (which holds utility constant as prices change) is the relevant one, and the elasticity for it is non-zero.

Excess Burden:
Measurement with Demand Curves

- Consider a *compensated* demand curve, such as the one in Figure below.

- Impose an ad-valorem tax on barley, so that its price increases to $(1+t_b)P_b$.

- Equivalent to the supply curve shifting upward.

Excess Burden:
Measurement with Demand Curves

Excess burden = $\frac{1}{2} \eta P_b q_1 t_b^2$

Price per kilo of barley

a

Tax revenues

Excess burden of tax

$(1 + t_b)P_b$ g   f   S'$_b$

P_b h   d   i   S$_b$

D$_b$

q_2 q_1

kilos of barley per year

Excess Burden:
Measurement with Demand Curves

◦ Excess burden equal to triangle *fid*.

◦ Through some mathematical manipulation, this can be expressed as:

$$EB = \frac{1}{2} |\eta| P_b q_t t_b^2$$

Excess Burden:
Measurement with Demand Curves

○ Implications of formula:

- ○ Higher (compensated) elasticities lead to larger excess burden
- ○ Excess burden increases with the **square** of the tax rate
- ○ The greater the initial expenditure on the taxed commodity, the larger the excess burden

Excess Burden:
Measurement with Demand Curves

- Consider the impact of a 50¢ per liter tax on the suppliers of gasoline, illustrated in **Figure below**

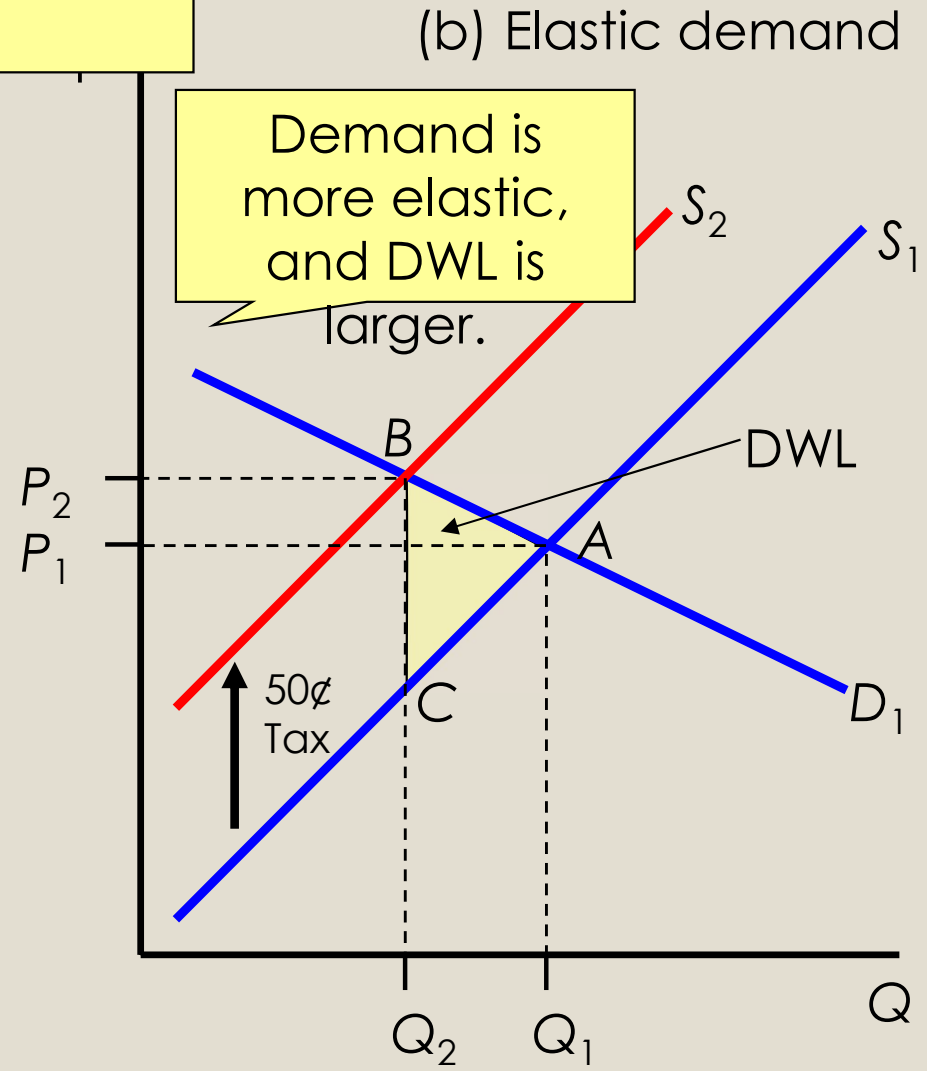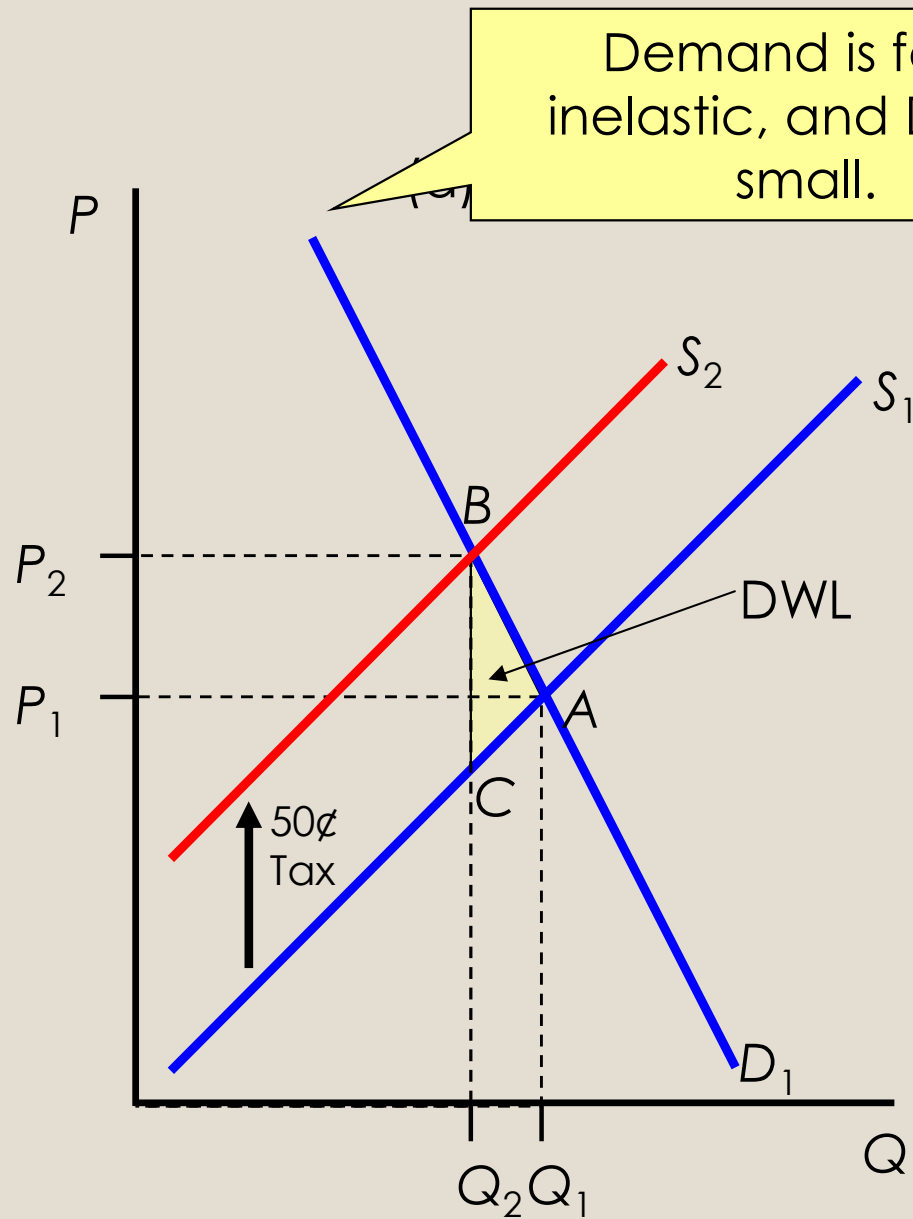# Excess Burden:
Measurement with Demand Curves
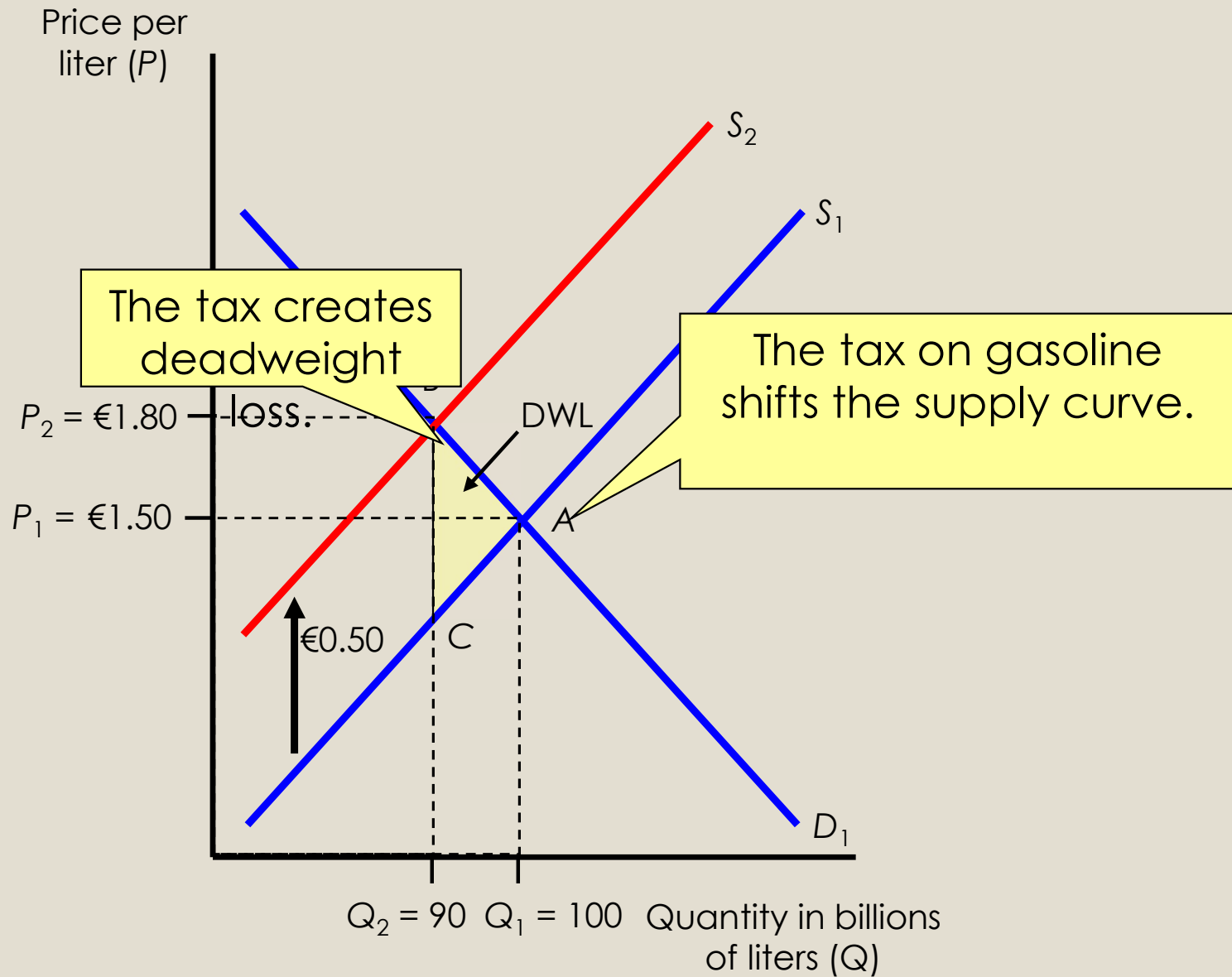
Excess Burden:
Measurement with Demand Curves

- Before the tax was imposed, 100 billion liters were sold. Afterwards, only 90 billion liters are sold.

- Recall that the demand curve represents the social marginal benefit of gasoline consumption, while the supply curve represents the social marginal cost.
  - **SMB=SMC** at 100 billion liters

- Production less than that amount results in deadweight loss. Beneficial trades are not made because of the 50¢ per liter tax.

Excess Burden:
Measurement with Demand Curves

- The efficiency consequences would be identical regardless of which side of the market the tax is imposed on.

- Just as price elasticities of supply and demand determine the distribution of the tax burden, they also determine the inefficiency of taxation.

- Higher elasticities imply bigger changes in quantities, and larger deadweight loss.

- **Figure below** illustrates that deadweight loss rises with elasticities.

(a)

Demand is fairly inelastic, and DWL is small.

(b) Elastic demand

Demand is more elastic, and DWL is larger.

Excess Burden:
Measurement with Demand Curves

- With inelastic demand, there is a large change in market prices with consumers bearing most of the tax, but little change in quantity.

- With more elastic demand, market prices change more modestly and the supplier bears more of the tax. The reduction in quantity is greater, as is the deadweight loss triangle.
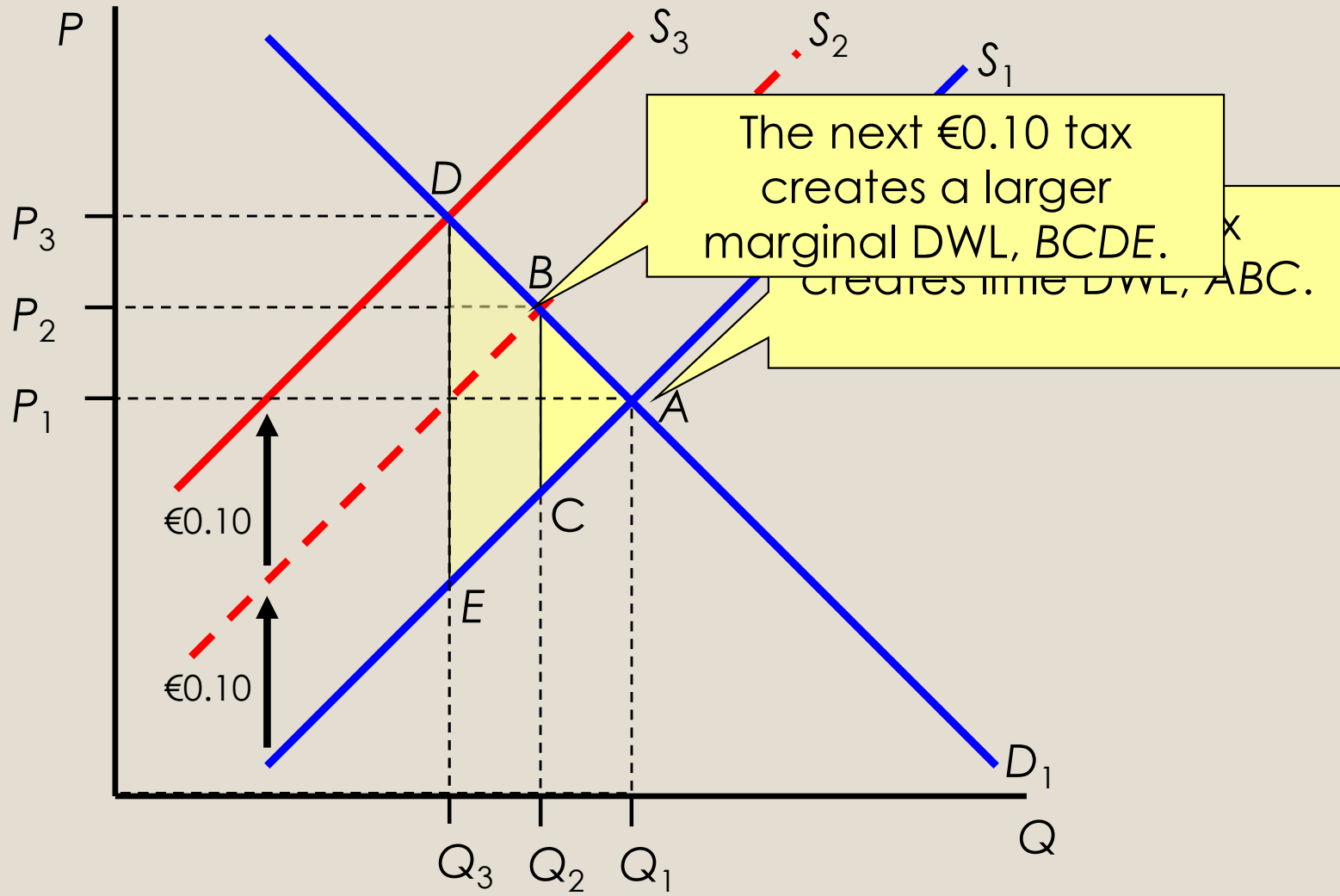
Excess Burden:
Measurement with Demand Curves

◦ The inefficiency of any tax is determined by the extent to which consumers and producers change their behavior to avoid the tax.

◦ Deadweight loss is caused by individuals and firms making inefficient consumption and production choices in order to avoid taxation.

Excess Burden

- This point about DWL rising with the square of the tax rate can be illustrated graphically.

- *Marginal deadweight loss* is the increase in deadweight loss per unit increase in the tax.
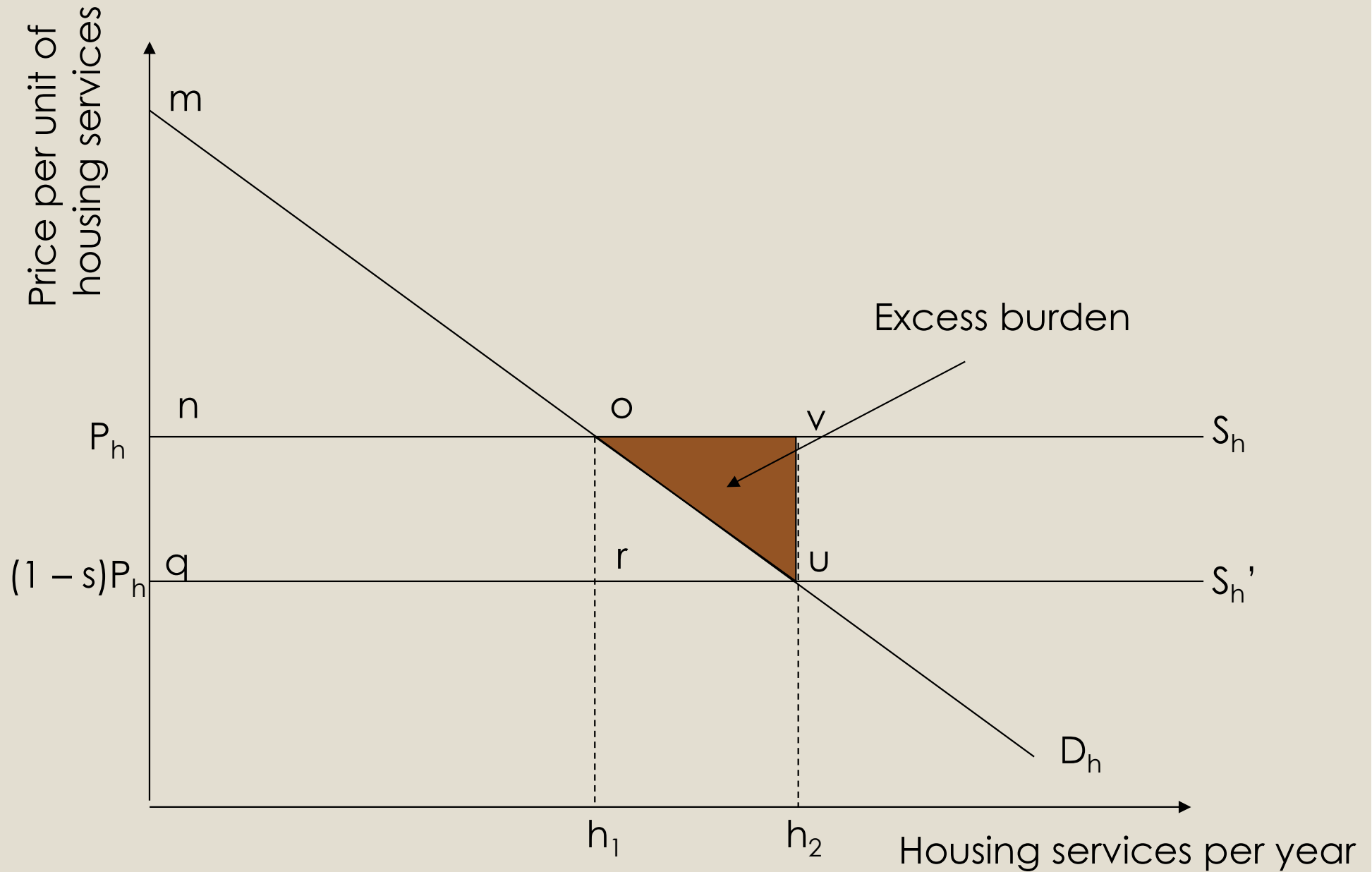
- See **Figure below**.

Excess Burden

Excess Burden

- As the tax rate doubles, from 10¢ to 20¢, the deadweight loss triangle quadruples.

- The area *DBCE* is three times larger than *BAC*. The total deadweight loss from the 20¢ tax is *DAE*.

- As the market moves farther and farther from the competitive equilibrium, there is a widening gap between demand and supply. The loss of these higher surplus trades means marginal DWL gets larger.
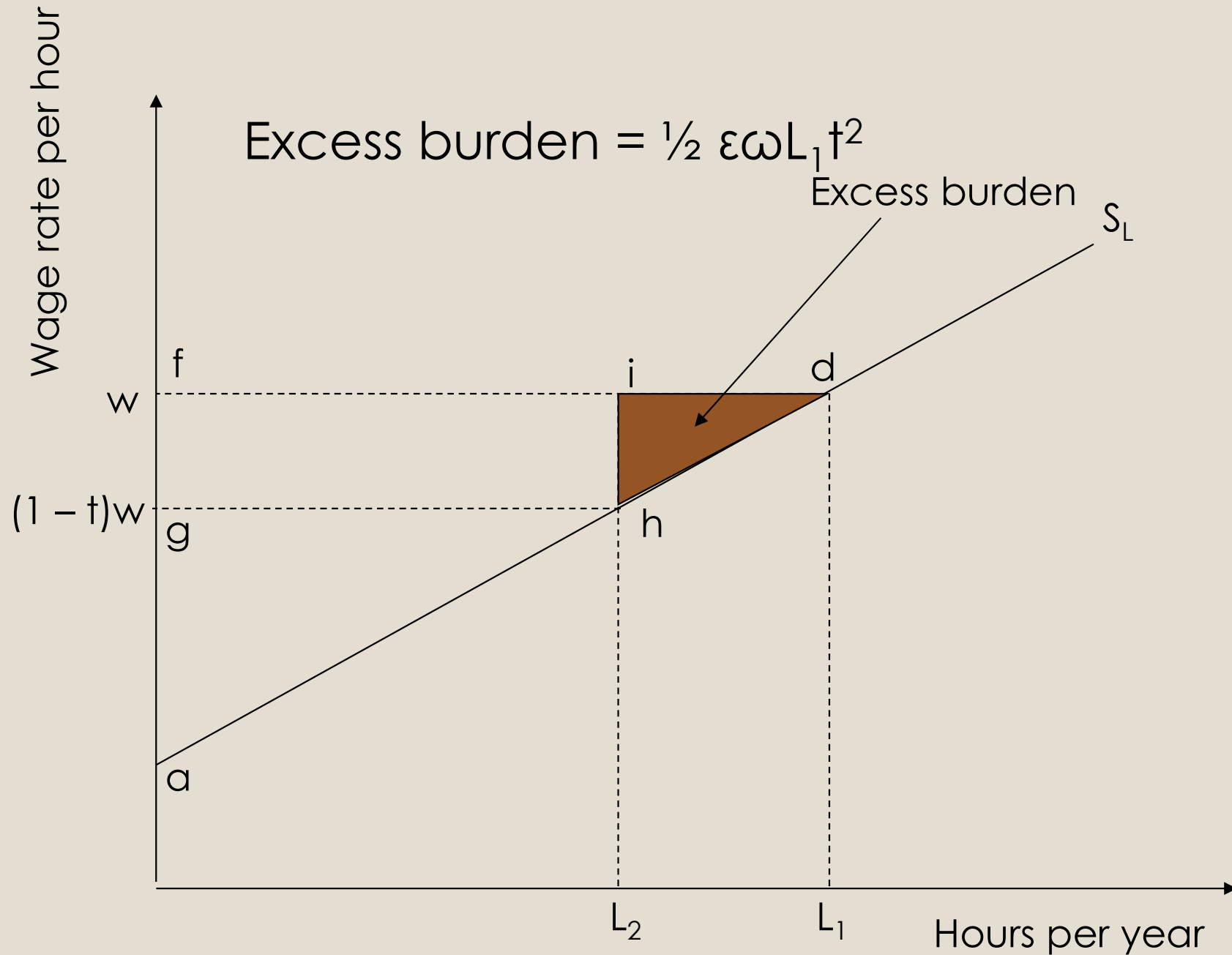
Excess Burden

◦ The fact that DWL rises with the square of the tax rate also implies that government should not raise and lower taxes, but rather set a long-run tax rate that will meet its budget needs on average.

◦ For example, to finance a war, it is more efficient to raise the rate by a small amount for many years, rather than a large amount for one year (and run deficits in the short-run).

◦ This notion can be thought of as "tax smoothing," similar to the notion of individual consumption smoothing.
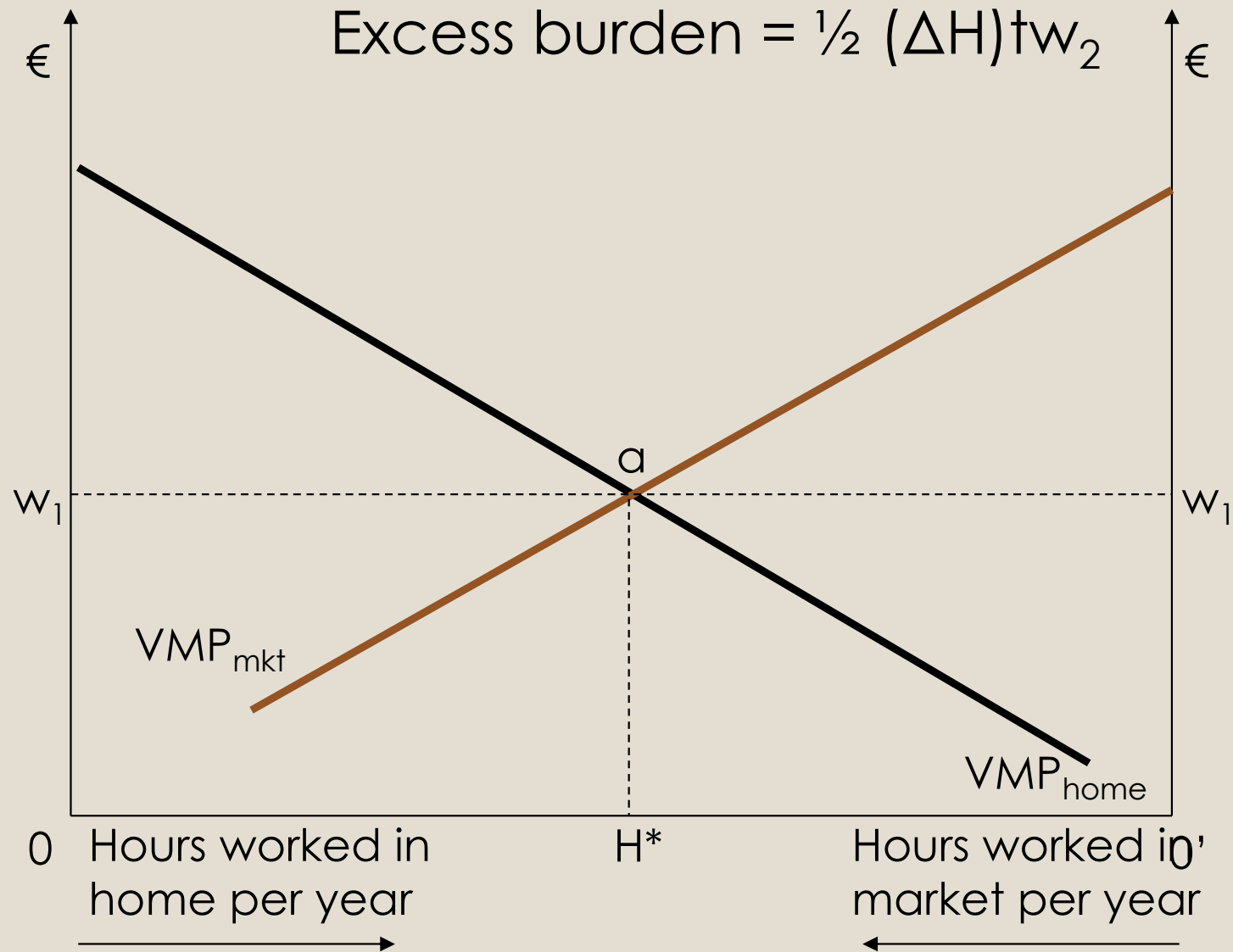
Excess Burden of a Subsidy

Price per unit of housing services

m

n   o   v S_h

P_h

Excess burden

q r   u S_h'

$(1-s)P_h$

D_h

h_1 h_2

Housing services per year

Excess Burden of Income Taxation

Excess burden = $\frac{1}{2} \varepsilon \omega L_1 t^2$

Differential Taxation of Inputs

- Some inputs are taxed differently depending on where they are used:
  - Capital used in the corporate sector is subject to a higher tax rate than capital used in the noncorporate sector.
  - Labor used in the household is untaxed
- Figure below measures the efficiency cost

Differential Taxation of Inputs

Excess burden $= \frac{1}{2}(\Delta H)tw_2$

w_1 a w_1

VMP_{mkt}

VMP_{home}

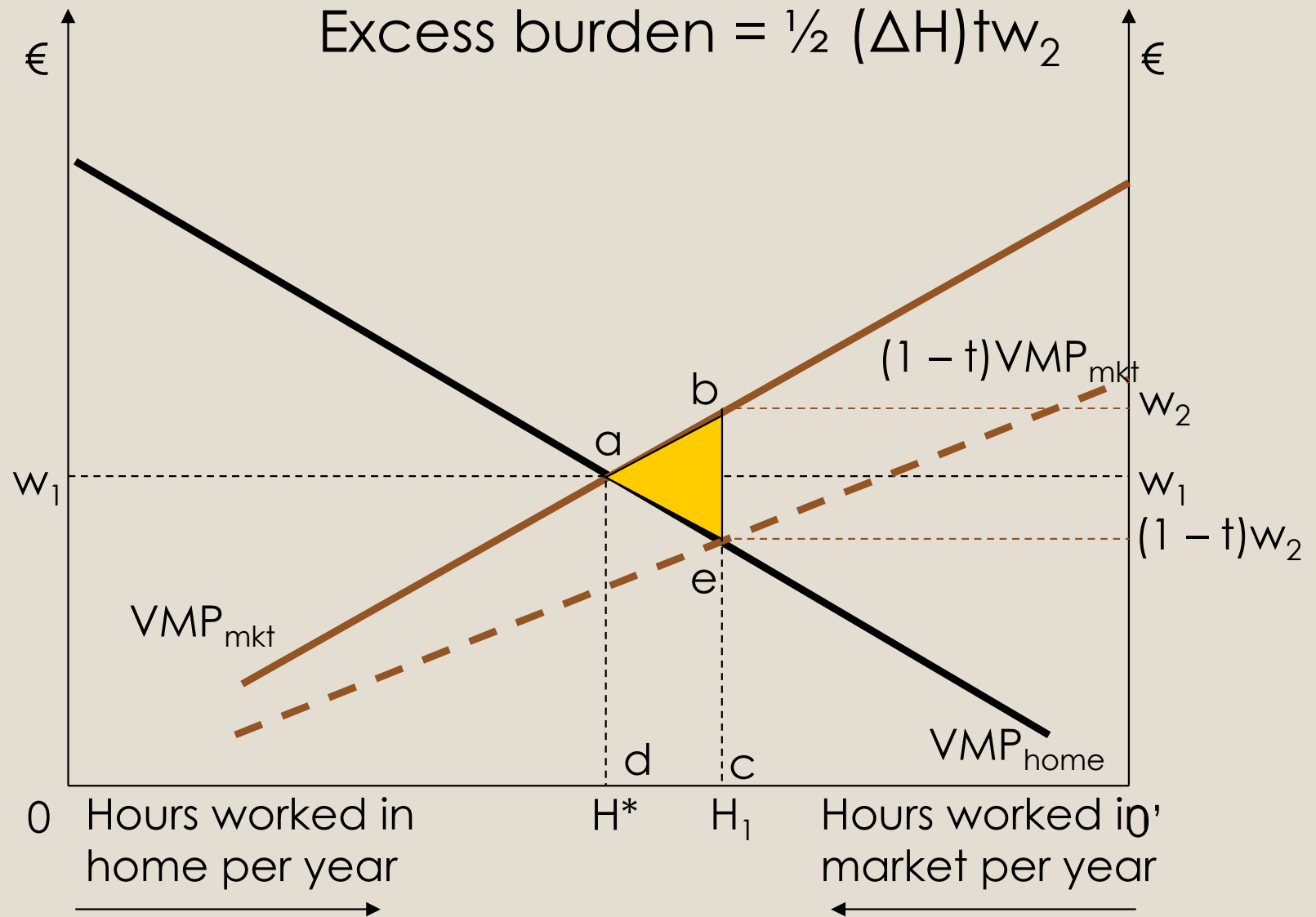0   Hours worked in home per year   H*   Hours worked in market per year   0'

Differential Taxation of Inputs

◦ In this figure, total amount of labor is fixed at OO'. Moving along the x-axis simply shifts labor from the labor market to the household sector.

◦ *VMP* is the *value of marginal product*, or the dollar value of the additional input produced from an hour of work.

◦ *VMP* declines with hours worked in a sector. Optimal allocation of hours equates margins, such that OH* is spent in household production, and O'H* is spent in the market.

Differential Taxation of Inputs

○ If a tax is levied on market work, but not household production, then the "effective" VMP curve for market work rotates downward.

○ Figure below shows the effects.

Differential Taxation of Inputs

Excess burden = $\frac{1}{2}(\Delta H)tw_2$

$(1-t)VMP_{mkt}$

w_2

w_1

$(1-t)w_2$

VMP_{mkt}

a

b

e

d

c

H^*

H_1

VMP_{home}

0 Hours worked in home per year

0' Hours worked in market per year

Differential Taxation of Inputs

- People shift hours into non-market work.
  - Household production increases from OH^* to OH_t, while market work decreases from $O'H^*$ to $O'H_t$.
- Excess burden equal to *abe*.

Appendix A – Formula for Excess Burden
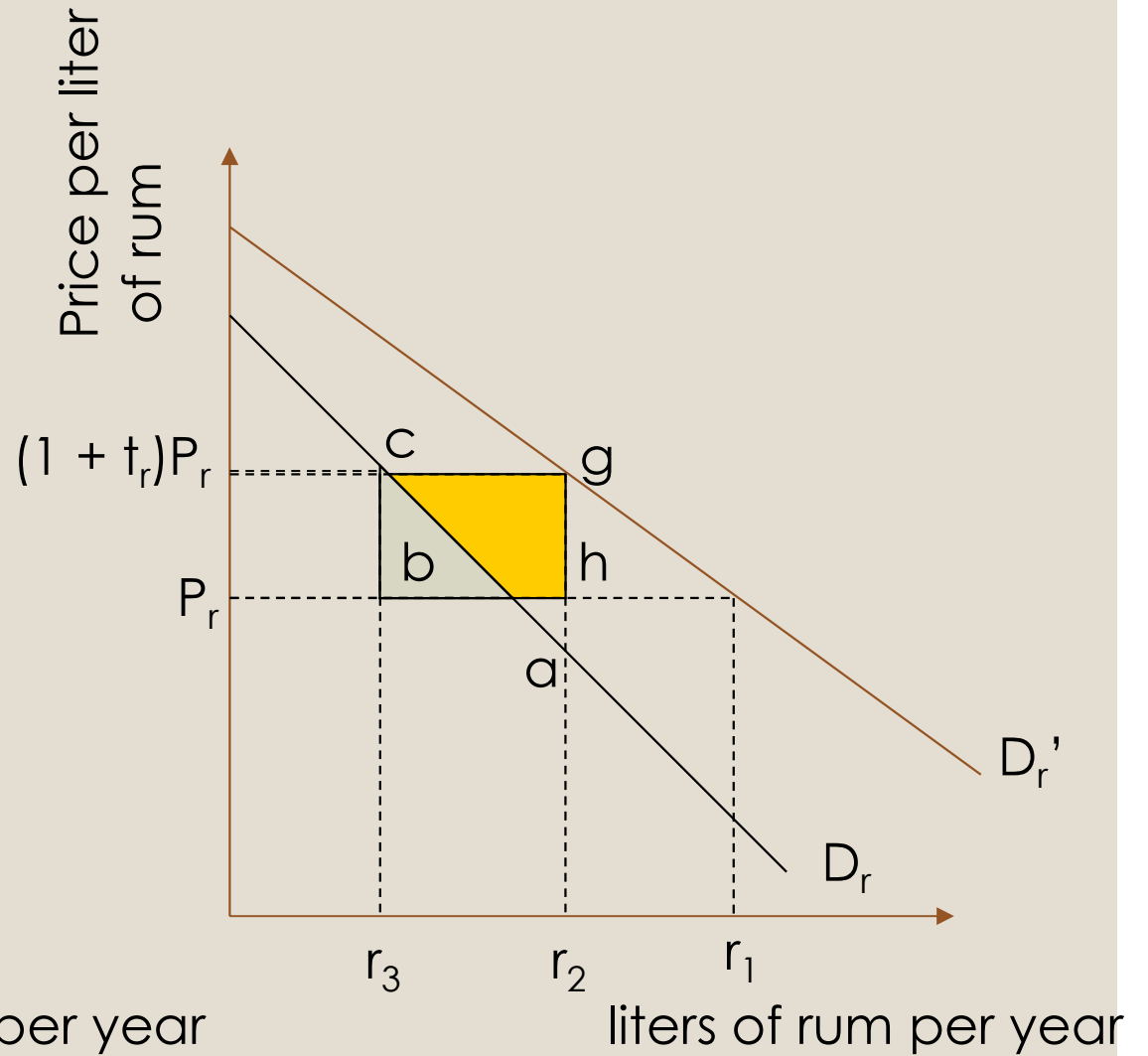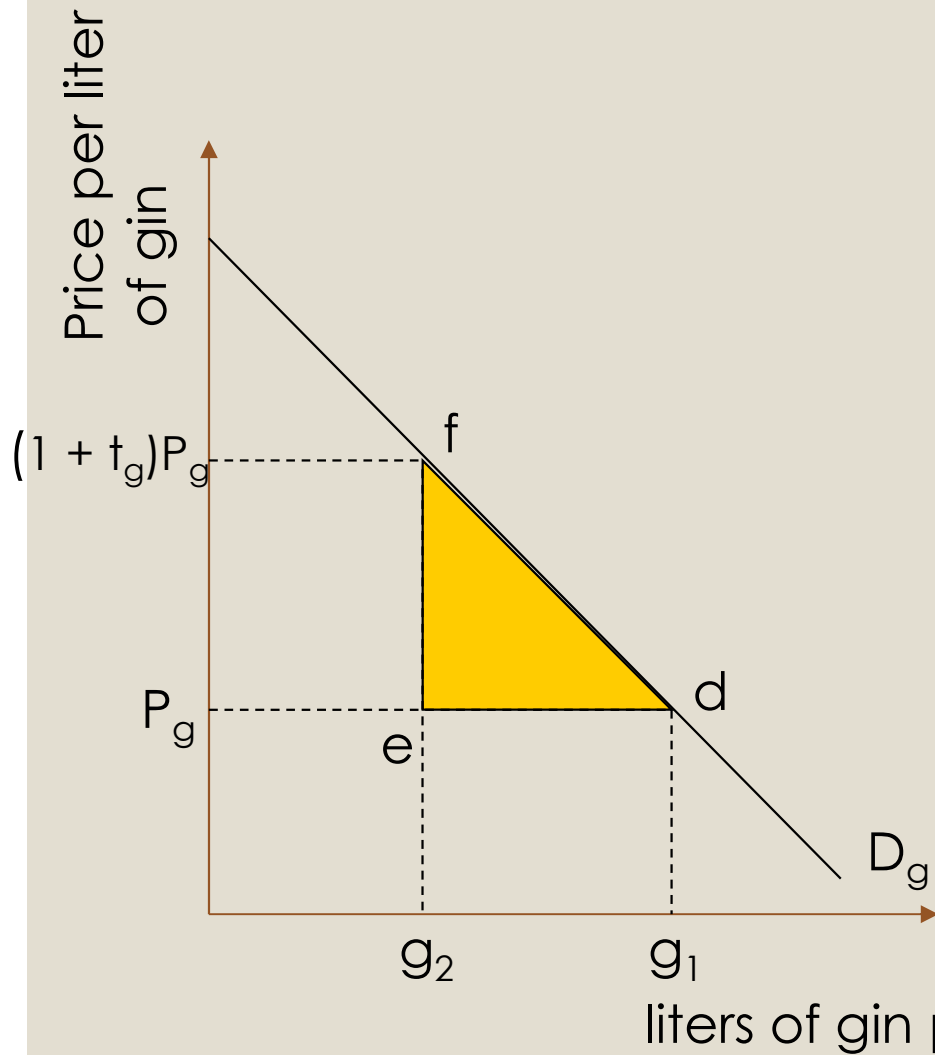
Recap of Taxation and Efficiency

- ◦ Excess Burden Defined

- ◦ Questions and Answers

- ◦ Excess Burden Measurement with Demand Curves

- ◦ Differential Taxation of Inputs