Microeconomics

Monetary assessment

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Structure

Introduction

- Household theory
- Theory of the firm
- Perfect competition and welfare theory
  - Perfect competition
  - The first welfare theorem
  - **Monetary assessment of environmental impacts**
- Types of markets
- External effects and public goods

Pareto-optimal review

Overview

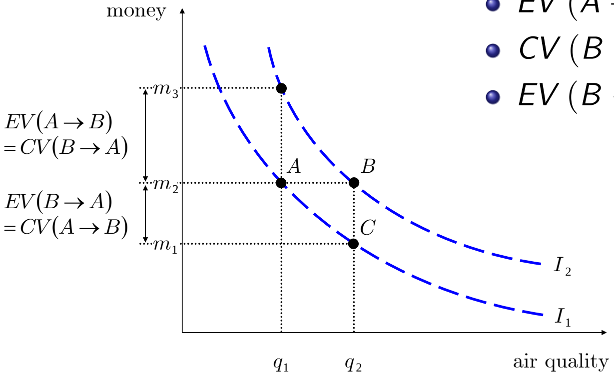
- Compensating and equivalent variation
  - Definitions
  - Example: air pollution
  - Willingness to pay and compensation claim
  - Example: price change
- Consumer and producer surplus
  - Compensating or equivalent variation?
  - Consumer surplus from the perspective of inverse demand
  - Producer surplus
- Welfare theory based on consumer and producer surplus
  - Minimum prices
  - Quantity tax

Compensating and equivalent variation
Definitions

- Compensating variation CV: change in income **as a compensation for** a change in environment (in the largest sense).
- Equivalent variation EV: change in income **instead of** a change in environment (in the largest sense).

Compensating and equivalent variation

Example: air pollution



- $CV(A \to B) = m_2 - m_1$
- $EV(A \to B) = m_3 - m_2$
- $CV(B \to A) = m_3 - m_2$
- $EV(B \to A) = m_2 - m_1$

Compensating and equivalent variation

Example: air pollution

Increase in quality $q_1 \to q_2$ for income m_2, i.e., $A \to B$

- Compensating variation:
  Change and payment for change; initial utility remains the same:

$$U^A = U(m_2, q_1) = U(m_2 - CV(A \to B), q_2)$$

- Equivalent variation:
  No change and payment instead of change:

$$U^B = U(m_2 + EV(A \to B), q_1) = U(m_2, q_2)$$

Compensating and equivalent variation

Willingness to pay and compensation claim

The amount of money that establishes indifference between two economic situations

- increases income. $\Longrightarrow$ compensation claim
- decreases income. $\Longrightarrow$ willingness to pay

Problem

What does marginal willingness to pay mean in the context of indifference curves? Compensating or equivalent variation?

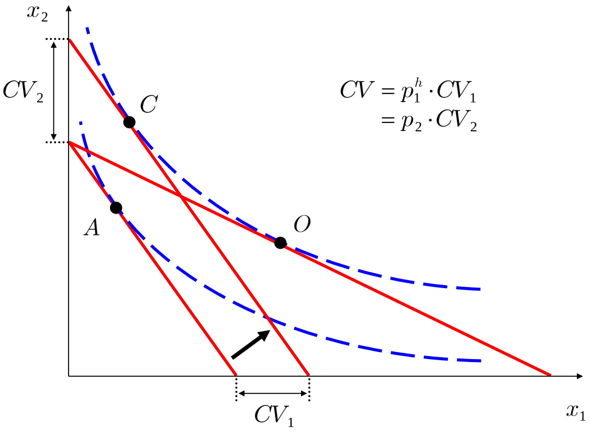
Compensating and equivalent variation

Willingness to pay and compensation claim

	willingness to pay	**compensation claim**
environmental improvement	How much would you pay at most for an improvement? $CV\,(A \to B)$	Which sum would you pay at most if the improvement did not happen? $EV\,(A \to B)$
environmental deterioration	How much would you pay at most to prevent the deterioration? $EV\,(B \to A)$	What would you request as compensation for the deterioration? $CV\,(B \to A)$

Compensating variation

Example: price change of good 1



- Initial situation point O
- Price increase good 1
- Parallel shift of the new budget line to the old indifference curve
- CV real versus
- CV nominal

Compensating var. for a price decrease of good 1

Cobb-Douglas utility function:

$$U(x_1, x_2) = x_1^a x_2^{1-a} \qquad (0 < a < 1)$$

$CV\left(p_1^h \to p_1^n\right)$ is defined implicitly by

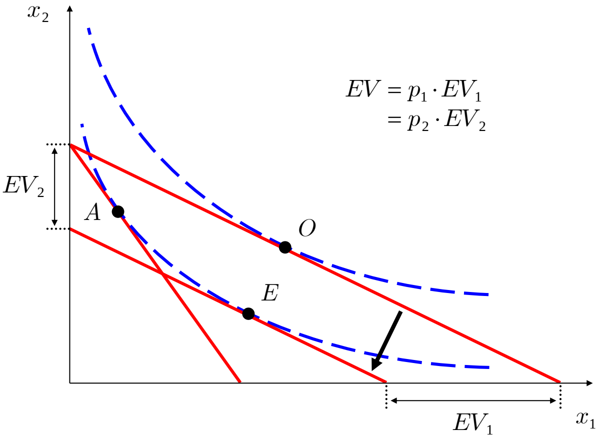
$$\underbrace{\left(a\frac{m}{p_1^h}\right)^a \left((1-a)\frac{m}{p_2}\right)^{1-a}}_{\text{utility for the old, high price}}$$

$$= \underbrace{\left(a\frac{m - CV\left(p_1^h \to p_1^n\right)}{p_1^n}\right)^a \left((1-a)\frac{m - CV\left(p_1^h \to p_1^n\right)}{p_2}\right)^{1-a}}_{\substack{\text{utility for the new, low price}\\ \text{and compensating variation}}}.$$

$$\Rightarrow CV\left(p_1^h \to p_1^n\right) = m\left(1 - \left(\frac{p_1^n}{p_1^h}\right)^a\right)$$

Equivalent variation

Example: price increase of good 1



- initial situation point O
- Price increase good 1
- Parallel shift of the old budget line to the new indifference curve
- *EV* real versus
- *EV* nominal

Equivalent variation for a price decrease of good 1

Cobb-Douglas utility function:

$$U(x_1, x_2) = x_1^a x_2^{1-a} \qquad (0 < a < 1)$$

$EV\left(p_1^h \to p_1^n\right)$ is defined implicitly by

$$\underbrace{\left(a\frac{m}{p_1^n}\right)^a \left((1-a)\frac{m}{p_2}\right)^{1-a}}_{\text{utility for new, low price}}$$

$$= \underbrace{\left(a\frac{m + EV\left(p_1^h \to p_1^n\right)}{p_1^h}\right)^a \left((1-a)\frac{m + EV\left(p_1^h \to p_1^n\right)}{p_2}\right)^{1-a}}_{\substack{\text{utility for old, high price}\\ \text{and equivalent variation}}}$$

$$\Rightarrow EV\left(p_1^h \to p_1^n\right) = m\left(\left(\frac{p_1^h}{p_1^n}\right)^a - 1\right)$$

Problem

Compensating and equivalent variation for $U(x_1, x_2) = \ln x_1 + x_2, x_1 > 0$ in case of $\frac{m}{p_2} > 1$?

- For Cobb-Douglas preferences:

$$\text{compensation claim} \;>\; \text{willingness to pay}$$

- It can be shown:
  For normal goods the willingness to pay for a price decrease is never larger than the compensation claim.
- However, there are special cases where both are equal.

Consumer and producer surplus

Compensating or equivalent variation

- On markets: “quid pro quo” or “nothing is for free”
  $\Longrightarrow$ compensating variation
  - for consumers: willingness to pay
  - for firms: compensation claim
- Equivalent variation
  - for consumers: Which amount should a consumer receive who waives a good?
  - for firms: Which amount makes the firm as worse off as the delivery of a good?

Consumer surplus

Demand curve $\Rightarrow$ marginal willingness to pay

Assumptions:

- x_2 : "all other goods" (money)
- $p_2 = 1$.

$\Rightarrow$

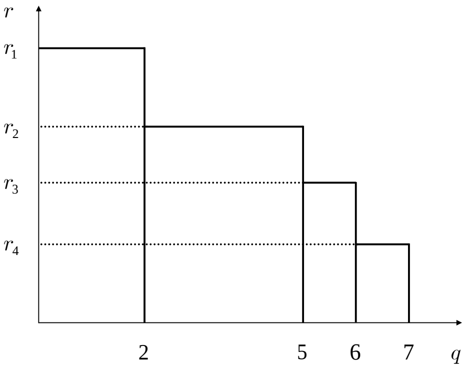
- MWP for one additional unit of good 1:

$$MRS = \frac{p_1}{p_2} = p_1$$

- Hence, the inverse demand function measures the marginal willingness to pay for 1 additional unit of the good.

Consumer surplus

Demand curve ⇒ marginal willingness to pay



Arrange willingness to pay according to size ⇒ demand curve

$p(q)$ willingness to pay for the qth unit

Consumer surplus from the perspective of inverse demand

	individual	aggregated
willingness to pay	r	$GCS(q)$
consumer surplus	$r - p$	$NCS(q) = CS(q)$

Consumer surplus from the perspective of inverse demand

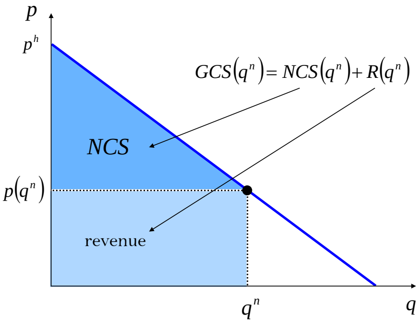
- Gross consumer surplus for continuous demand function $p(q)$

$$GCS(q^n) = \int_0^{q^n} p(q)\,dq$$

- Net consumer surplus

$$\begin{aligned} CS(q^n) &= \int_0^{q^n} (p(q) - p^n)\,dq \\ &= \int_0^{q^n} p(q)\,dq - p^n q^n \\ &= GCS(q^n) - R(q^n) \end{aligned}$$

Consumer surplus from the perspective of inverse demand



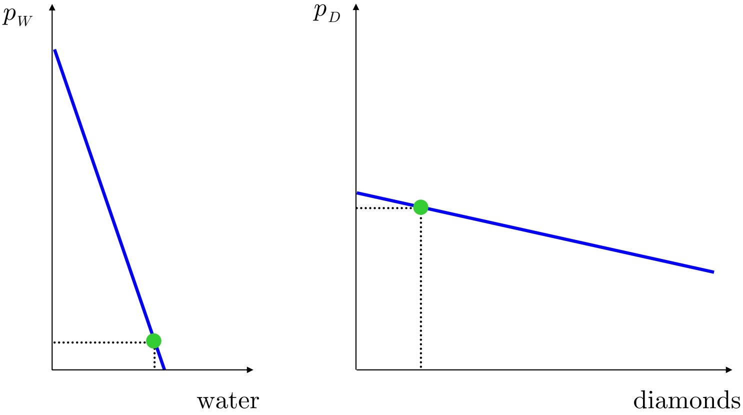
Problem

$p(q) = 20 - 4q$, $p = 4$

Gross consumer surplus? Net consumer surplus?

The diamond-water paradox

Why are diamonds more expensive than water,
while water is "more valuable"?



Producer surplus

- Willingness to pay for consumption
  $\Rightarrow$ consumer surplus
- Compensation claim for production
  $\Rightarrow$ producer surplus
  Marginal cost: minimal compensation claim for production of one additional unit of a good

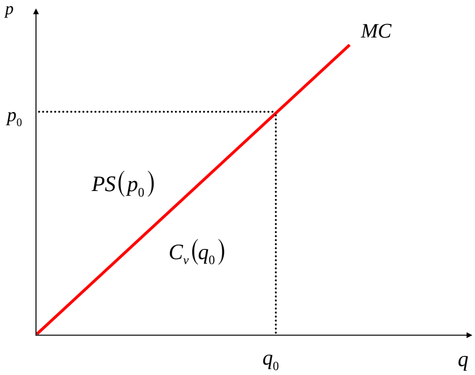
Producer surplus

	for one unit	for all considered units
compensation claim	MC	C_v
producer surplus	$p - MC$	$NPS = PS$

Producer surplus

- $PS(p)$: measure for producer's willingness to pay for selling at the market at price p
- For one unit
$$p - MC$$
- For a price of p_0 the producer surplus for all considered units is the sum or integral of these differences up to the quantity $q_0 = q(p_0)$.

Producer surplus



$PS(p)$ = willingness to pay for selling at the market at price p

$C_s(q) = q^2 + 2q + 2$,
$p = 10$

- profit?
- producer surplus?

Producer surplus

- In the short run fixed cost may occur
- Producer surplus

$$\begin{aligned} PS(p_0) &= \underbrace{p_0 q_0}_{\text{revenue}} - \underbrace{C_v(q_0)}_{\text{variable cost}} \\ &= \underbrace{\left(p_0 q_0 - C_v(q_0) - F\right)}_{\text{profit}} + \underbrace{F}_{\text{fixed cost}} \end{aligned}$$

Welfare theory based on consumer and producer surplus

Assessment of economic policy measures

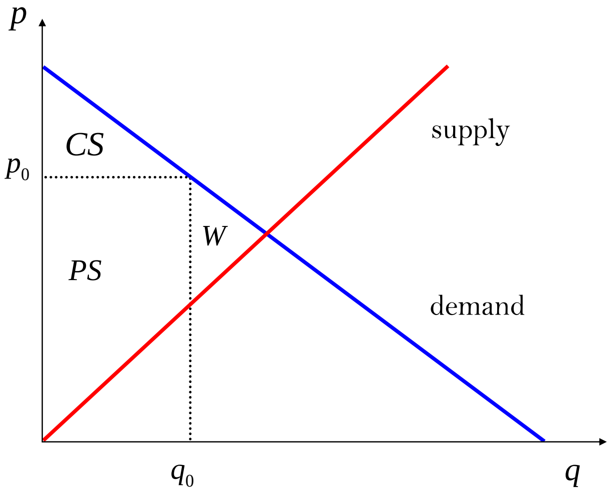
- Maximize the sum of

  consumer surplus
  producer surplus and
  tax revenue

  if taxes are taken into account, otherwise the sum of CS and PS.
- Distributional aspects are not considered.

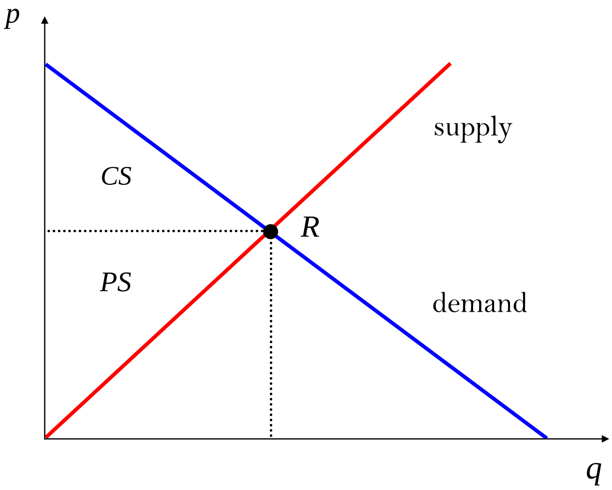
Assessment of economic policy measures

Non-optimal price-quantity combination



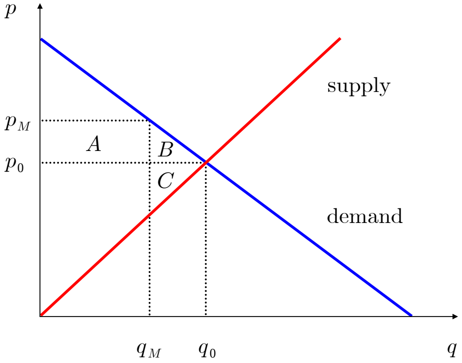
Assessment of economic policy measures

Reference point



Assessment of economic policy measures

Minimum prices



Problem

Change in consumer surplus? Producer surplus? Sum?

Welfare theory based on consumer and producer surplus

Quantity tax

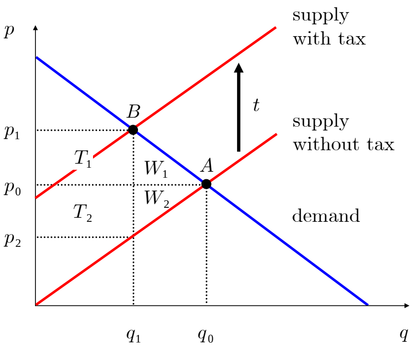
- A quantity tax of t increases marginal cost from MC to $MC + t$.
- Graphically the supply curve is shifted upwards in a parallel fashion.

Problem

The supply function of a firm is given by $S(p) = \frac{1}{2}p - 2$ and the inverse demand curve by $p(q) = 24 - 3q$. How does a quantity tax of $t = 5$ change the equilibrium price?

Welfare theory based on consumer and producer surplus

Quantity tax



- $0 \leq q \leq q_1$: redistribution
  - Consumers loose $(p_1 - p_0)\, q_1 = T_1$
  - Producers loose $(p_0 - p_2)\, q_1 = T_2$
  - State gains taxes $T_1 + T_2$
- $q_1 < q \leq q_0$: welfare loss
  - Consumers loose $\frac{1}{2}\,(p_1 - p_0)\,(q_0 - q_1) = W_1$
  - Producers loose $\frac{1}{2}\,(p_0 - p_2)\,(q_0 - q_1) = W_2$

Why not “laissez faire”?

Only trade that benefits both is done voluntarily $\Rightarrow$ Pareto improvement

But voluntariness does not exist between

- hotels (shady pool) or
- the thief and myself.

$\Rightarrow$ learn more in the chapter “External effects”

Central tutorial I

Problem N.5.1.

$U(x_1, x_2) = (x_1 x_2)^{\frac{1}{2}}$

$p_1 = 1 \Rightarrow p_1 = 2,\ p_2 = 1$

$m = 100$

Compensating and equivalent variation?

Problem N.5.2.

$U(x, y) = \min(x, y)$

$p_x = 2$ (or $p_x = 3$), $p_y = 1$

$m = 12$

a) Optimal consumption bundle for $p_x = 2$ or $p_x = 3$?

b) Compensating variation for price increase?

c) Equivalent variation for price increase?

Central tutorial II

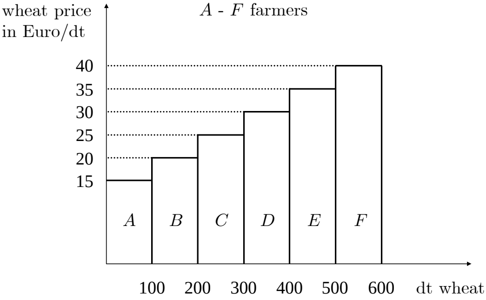
Problem N.5.3.
$C(y) = y^2 + 1$
$p = 20$
Producer surplus?

Problem N.5.4.
$p(q) = 30 - 3q$
Output $q = 5$
Consumer surplus?

Problem N.5.5.
$q(p) = 5 - \frac{1}{2}p$
$p = 6 \Rightarrow p = 4$
Change in consumer surplus?

Central tutorial III

Problem N.5.6.



Producer surplus for a market price of $25\frac{Euro}{dt}$?

Problem N.5.7.

$C(y) = 10 + 5y + y^2$

a) Profit and producer surplus for $p = 15$?

b) Connection between revenue, producer surplus, profit and cost?