Experimental Economics, Environment and Energy '24

Lecture 5: Markets: Double Auctions, externalities, taxes, trade

Paolo Crosetto

Aggregating value: markets

Why markets?

- markets are ubiquitous and follow a set of simple yet powerful rules...
- ...plus lots of not-so-simple and less known ones.
- changing the rules you change the outcomes
- (price, quantity, distribution of profit...)
- experiments allow us to explore *counterfactual* consequences of market rules

Markets are the place where **values** and **cost** meet to form a **price**

Setting up an experimental market

Exeperimental market

- you will be asked to play the role of *buyers* and *sellers* in an experimental market
- we will use this market to demonstrate:
  1. private good no-externality markets
  2. private good *with* externality
  3. solution 1: pollution tax
  4. solution 2: cap & trade
- let's go (on veconlab)

An experimental market

Exeperimental market

- each of you will sell or buy **one** item
- you are either a seller or a **buyer**
- If you are a seller:
  - you get **one** unit to sell
  - for this unit, you see a value that represents its *cost*.
- if you are a **buyer**:
  - you can buy up to **one** unit
  - you have a *value* for the good
- each seller has one unit to sell, each buyer one unit to buy.

An experimental market: sellers

Sellers

- you have one unit to sell
- your aim is to **make a profit**
- your profit *on each transaction* is calculated as

$$\Pi = price - cost$$

- where price is the price you will sell at; cost is the given by the software
- you should aim to sell at the highest possible price

An experimental market: buyers

Buyers

- you can buy up to **one unit**
- your aim is to **make a profit**
- your profit *on each transaction* is calculated as

$$\Pi = value - price$$

- where price is the price you will buy at; value is the **given by the software**
- you should aim to buy at the lowest possible price

An experimental market: market rules

Pit market rules

- trade takes prace by placing bids
- if you are a seller you set a *selling price*; if you bid 5, it means you are willing to sell for 5
- if you are a **buyer** you set a *buying price*; if you bid 7, it means you are willing to buy for 7
- you are free to bargain with anyone – i.e. no secret bilateral deals, but an open market
- a *deal* is reached when a seller and a **buyer** agree on a price
- sellers are not allowed to sell below cost; **buyers** are not allowed to buy above their value (i.e.: no losses)
- once you have traded your unit you exit the market

An experimental market: market rules

Periods and profits

- trade continues for 5 minutes
- or ends before that if no more trades can be dealt upon
- when a period ends we compute the prices and the number of sales
- then a new period starts, with the same or different rules

We do it on Veconlab

To access the market, go to http://veconlab.econ.virginia.edu/

- login as a participant
- name of the session is **pcro7**
- then the program asks you to provide an ID and invent a password
- password is optional and is used only should you crash the system
- We will go through instructions together [they are quite tricky]

Market 1: private goods

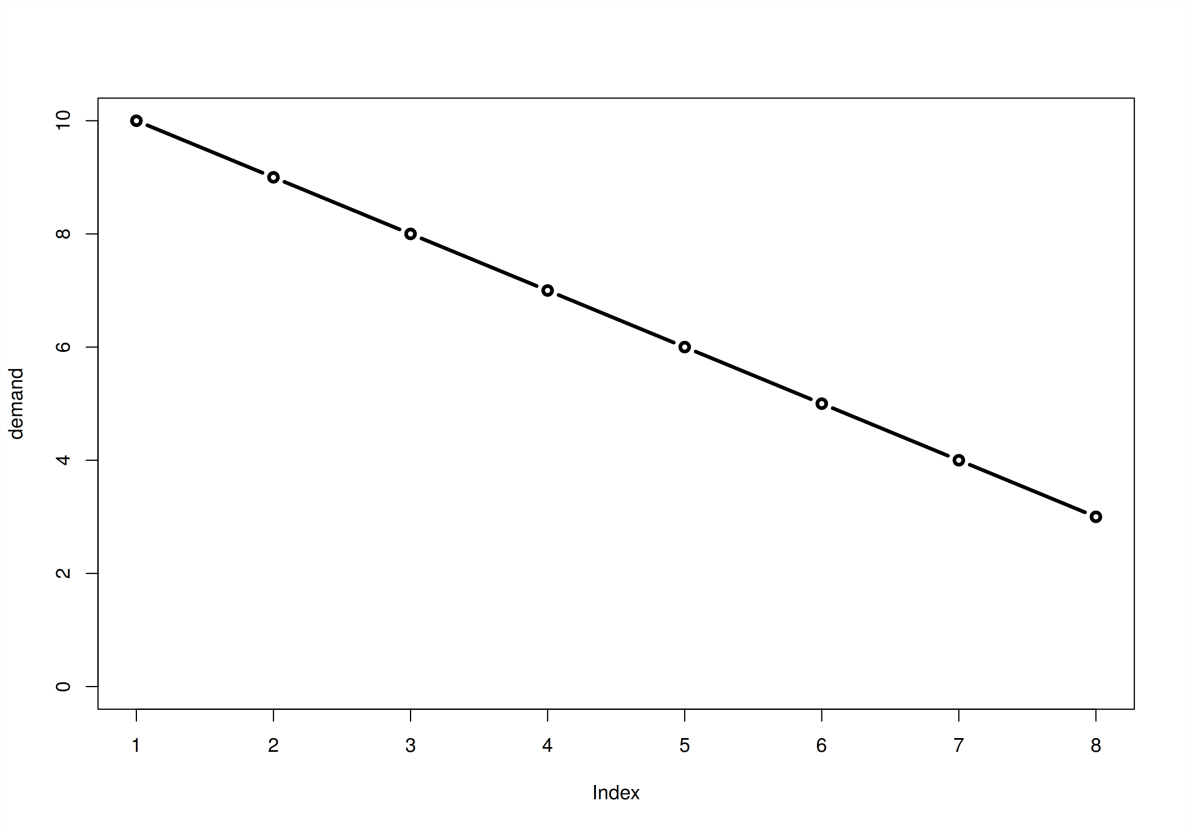
You now trade a private good with no externality

- essentially, all profit you make is yours
- there are no negative impacts on society, no common pools, no pollution

Market 1: discussion

The demand schedule

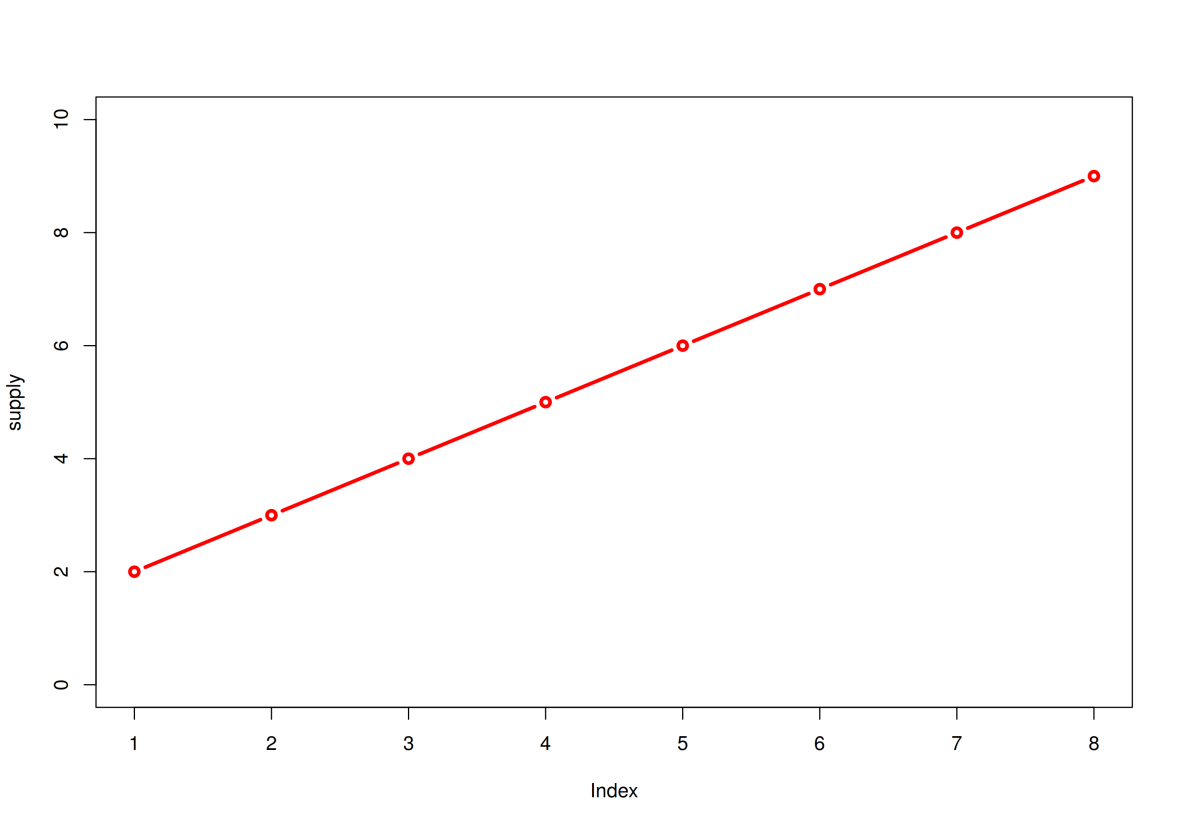
- you take all values (2,3,4,5,6,7,8,9,10)
- you order them from higher to lower



Market 1: discussion

The supply schedule

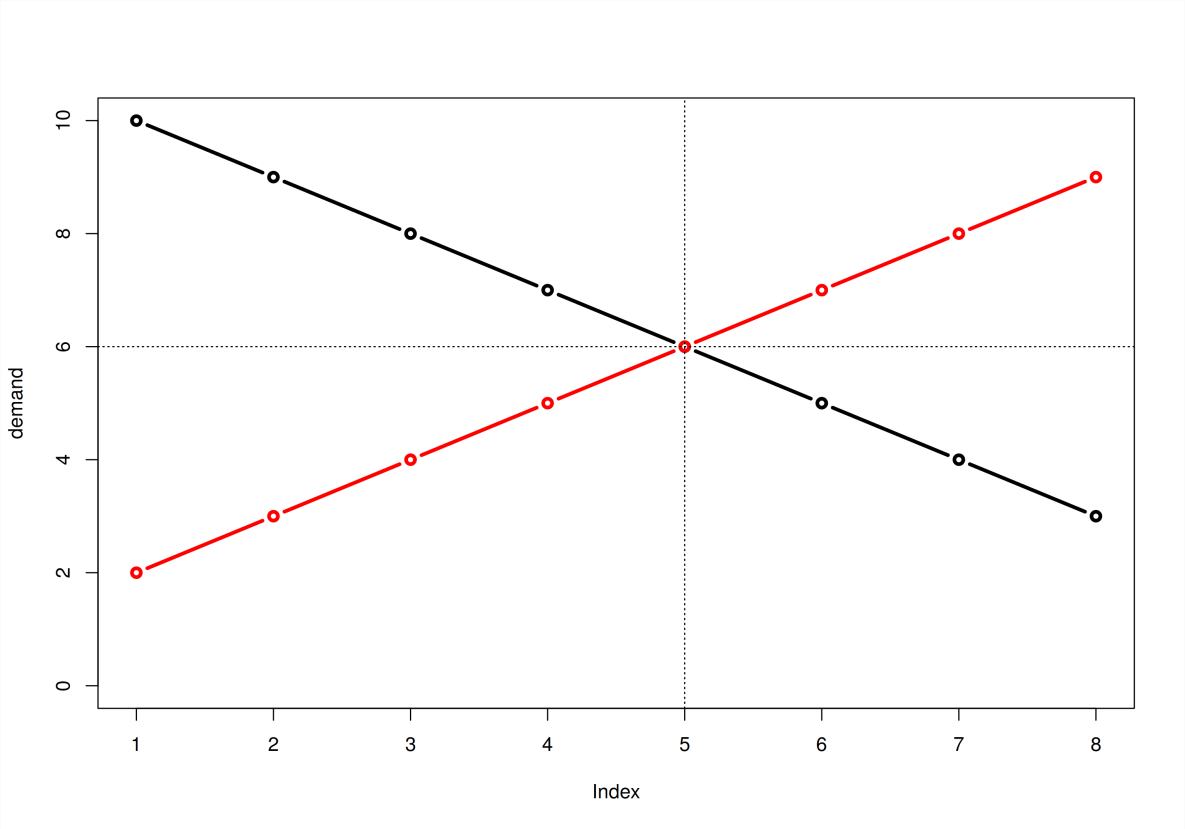
- you take all cards (2,3,4,5,6,7,8,9,10)
- you order them from lower to higher



Market 1: discussion

The market equilibrium

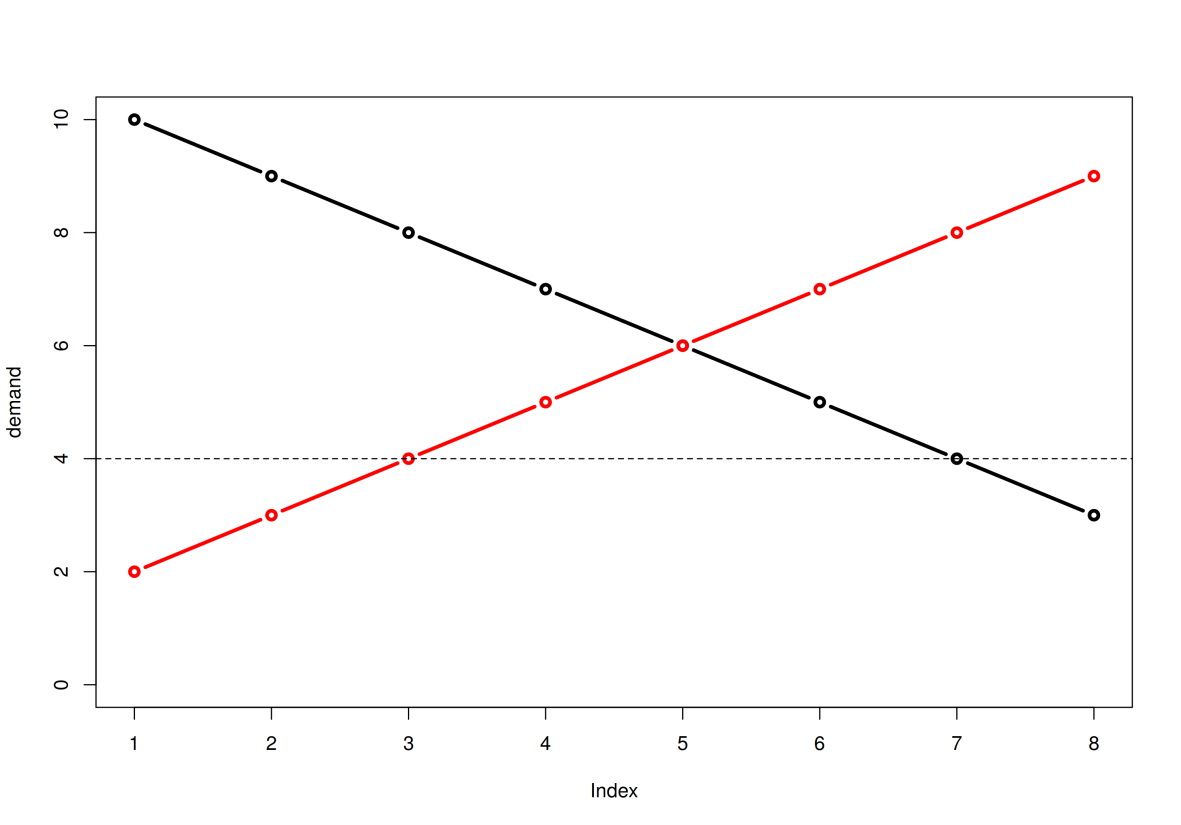
- you match supply and demand
- and get a price and quantity of equilibrium



Market 1: discussion

The market equilibrium

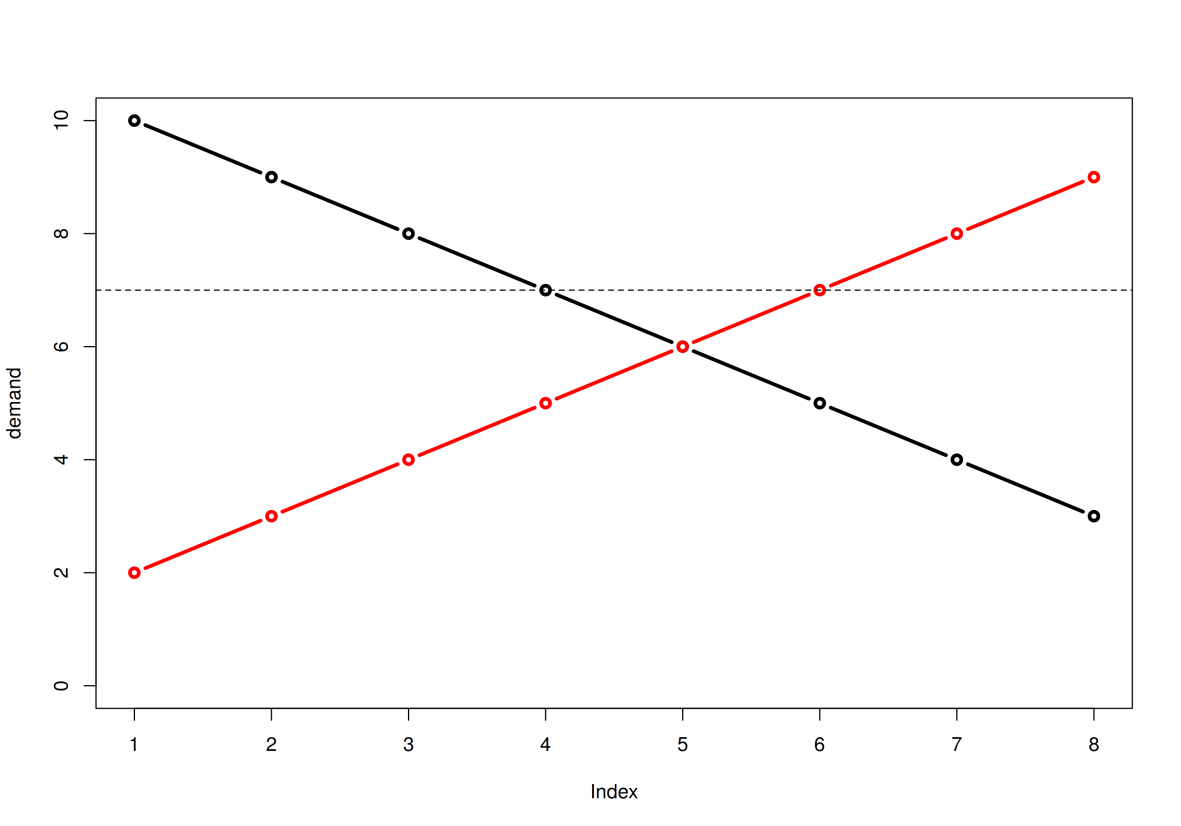
- what would happen if price lower?



Market 1: discussion

The market equilibrium

- what would happen if price higher?



The problem of collective action

Individual and collective good might not coincide

- There might exist private gains $\neq$ public gains
- Everyone would be better off if all *cooperate*
- But individually, each person has an incentive to *defect*
- knowing this, no-one will cooperate and everyone will be worse off.
- examples abound.

Negative externalities

The tragedy is the result of (not-managed) negative externalities

- An externality is the (economic) effect an economic action has on persons other than the agent
  1. smoking increases utility for the smoker but reduces utility for the passive smokers around him
  2. polluting increases utility for the producer (more production = more pollution, but also not investing in pollution reduction is a source of profits) but decreases utility for the people exposed to the pollution
  3. using a private car occupies public space and public road and produces pollution for the private benefit of the driver and against the interest of the pedestrians
- adding one more cow has a (small) negative externality on the amount of present (and future) grass available
- this cost is imposed on others and not taken into account by the herdsman
- so there will be overgrazing (overfishing, overcollecting token...)

Collecitve action: possible solutions to the tragedy

- Repeated interactions
- (costly) Punishment
- (Elinor Ostrom): culture, norms and institutions
- **markets and permits**

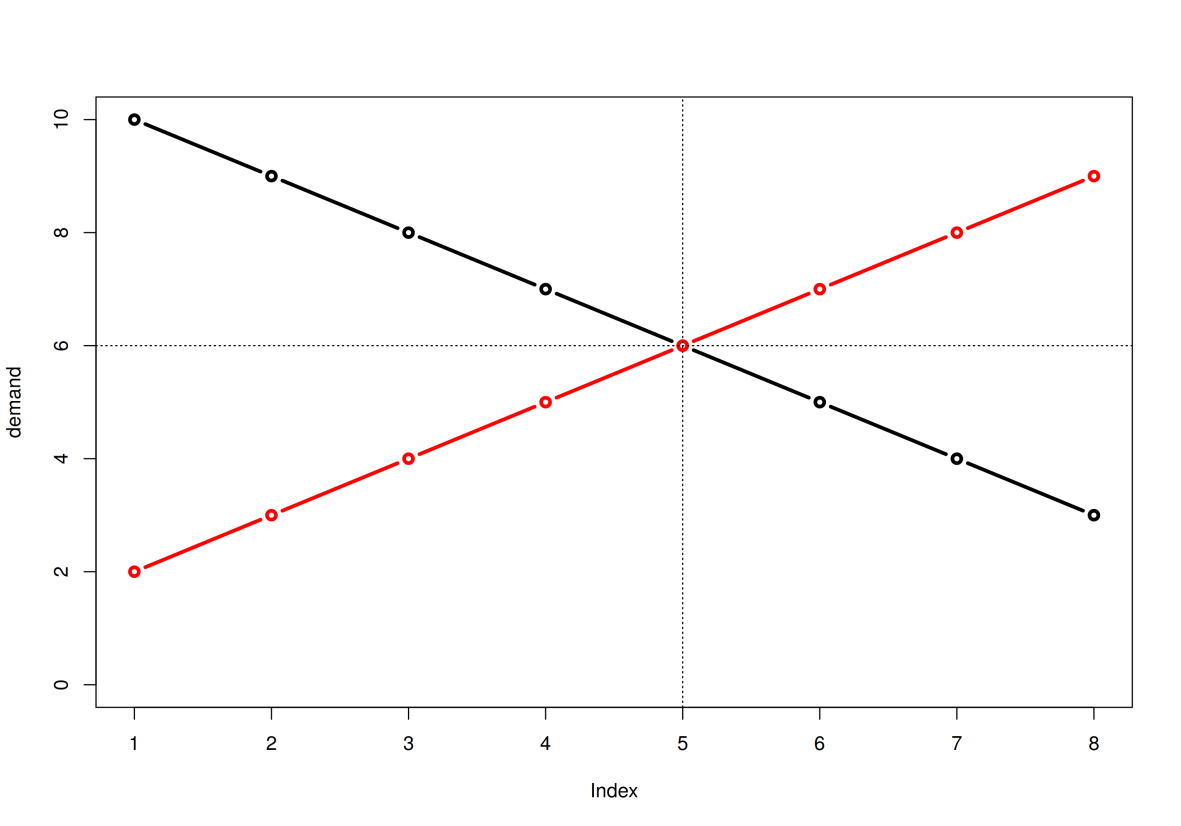
Market 2: private goods with negative externality

You now trade a private good with externality

- same as before, but at the good is a pollutant.
- this means that at the end of the market, for *any unit sold*, there will be pollution.
- Cleaning it up costs 2 per unit. These costs will be public, so the sum of all pollution costs will be divided among you all
- and subtracted from everyone's payoff
- all other rules are as before

Market 2: discussion

The market equilibrium



- since the cost is public and not private
- the market equilibrium is exactly the same (or nearly so...)
- on the other hand, each one pays 1/12 of the total social cost – including those who did not trade or made little profit.

Markets

Basic principle: provide incentives to solve the problem of negative externalities

- tragedy of the commons stems from misaligned use and exclusion rights: firms can use a common resource but do not have exclusive use (since it is common).
- fishermen use the fish stock at sea but cannot exclude other fihsermen; firms emit Greenhouse Gases; etc...
- **aligning** use and exclusion rights restores the alignment between public and private interest, at the cost of making the interest private.
- this can be achieved through privatization

Markets

Privatization

- farmers overuse common land: split it into several parcels of private land, and the overuse issue is solved
- on the other hand, this generates problems of its own
  1. too much fragmentation can be bad
  2. privatization might be socially undesirable
  3. some resources (like the sea or the air quality) cannot be privatized even if we wanted – which we usually do not
- is there another way?

Market 3: pollutant correction: tax

To correct the pollution problem a tax is introduced

- the tax covers the full cost of pollution
- so it amounts to 2 per unit sold
- the tax must be paid by sellers
- so that sellers unit profits now are given by

$$\Pi = price - cost - 2$$

- all other rules are as before (especially common pollution cost)

We do it on Veconlab

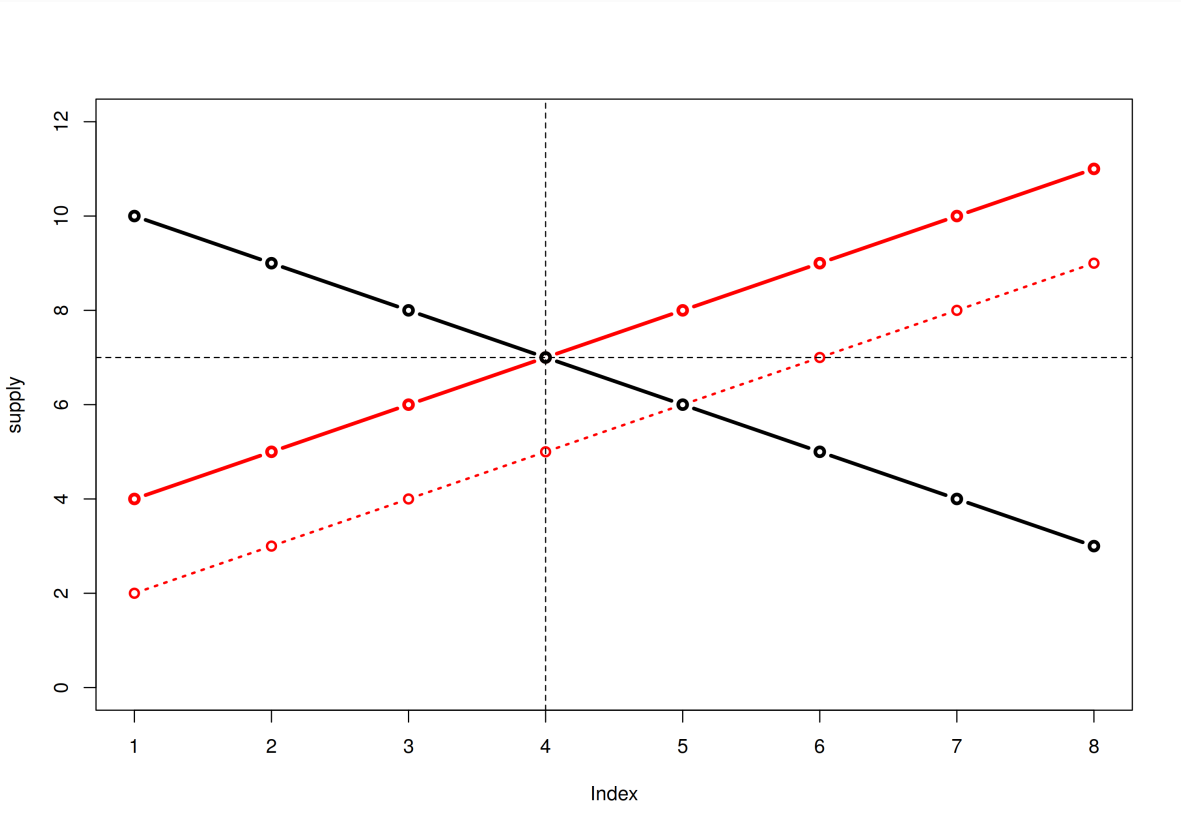
To access the market, go to http://veconlab.econ.virginia.edu/

- login as a participant
- name of the session is **pcro8**
- then the program asks you to provide an ID and invent a password
- password is optional and is used only should you crash the system
- We will go through instructions together [same as before]
- all is as before, only seller's cost are now $+2$

Market 3: discussion

The market equilibrium

- since sellers (nominally) pay the cost, their profit is reduced
- but they can (partly) shift the tax onto the buyers via higher prices
- there is a new market eq with higher price and lower demand
- social cost is lower, but still there



Market 4: pollutant correction: permits

To correct the pollution problem a cap & trade system is introduced

- the total amount of pollution is limited (cap)
- and who is allowed to produce depends on a market for pollution permits (trade)
- there are 3 pollution permits
- these are allocated *via a* 4^{th} *price sealed-bid auction*
- there are now two markets:
  1. a market for pollution permits – you bid in an auction
  2. a market for the good (as usual, but restricted to permit holders)

Market 4: discussion

Why permits

- emission permit allows to directly extract producer surplus
- permits *should* go to the firms with lower cost – they are the ones who benfit more from trade
- production capped at 3 units ($<$ than equilibrium in previous markets)
- here everyone has the same pollution potential: in reality there is heterogeneity
- in reality the firms that have higher pollution buy permits, face higher cost; the firms that pollute less sell permits, face higher revenues. We generate incentives to pollute less!

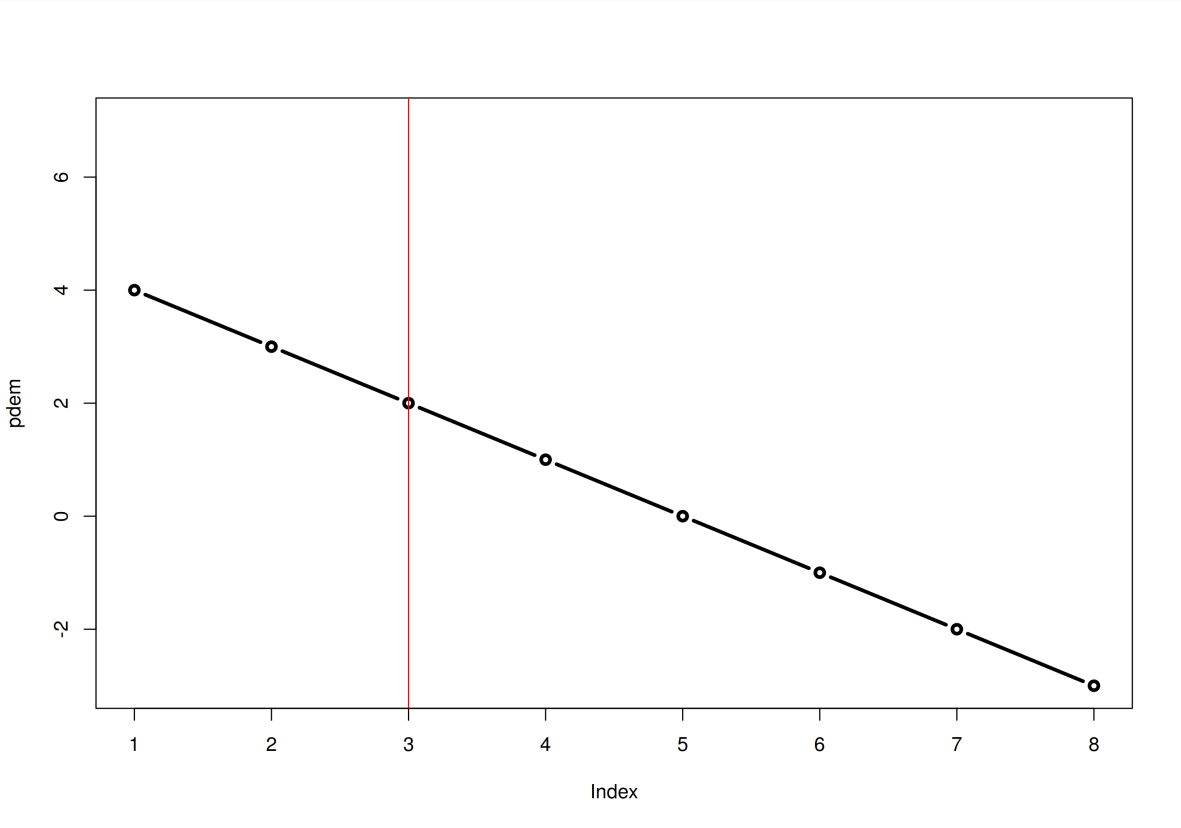
Market 4: discussion

The market for permits: demand

- there are 3 permits
- the firms with the lowest cost have the highest incentive to buy a permit
- the firms with the highest cost have the highest incentive to sell a permit
- If firms assume that they can sell at 5-6 (eq price)
- then the two firms that have cost $= 2$ have a wtp of 3.5
- the two firms with cost $= 3$ have wtp of 2.5
- the two firms with cost $= 4$ have wtp of 1.5 ...and so on

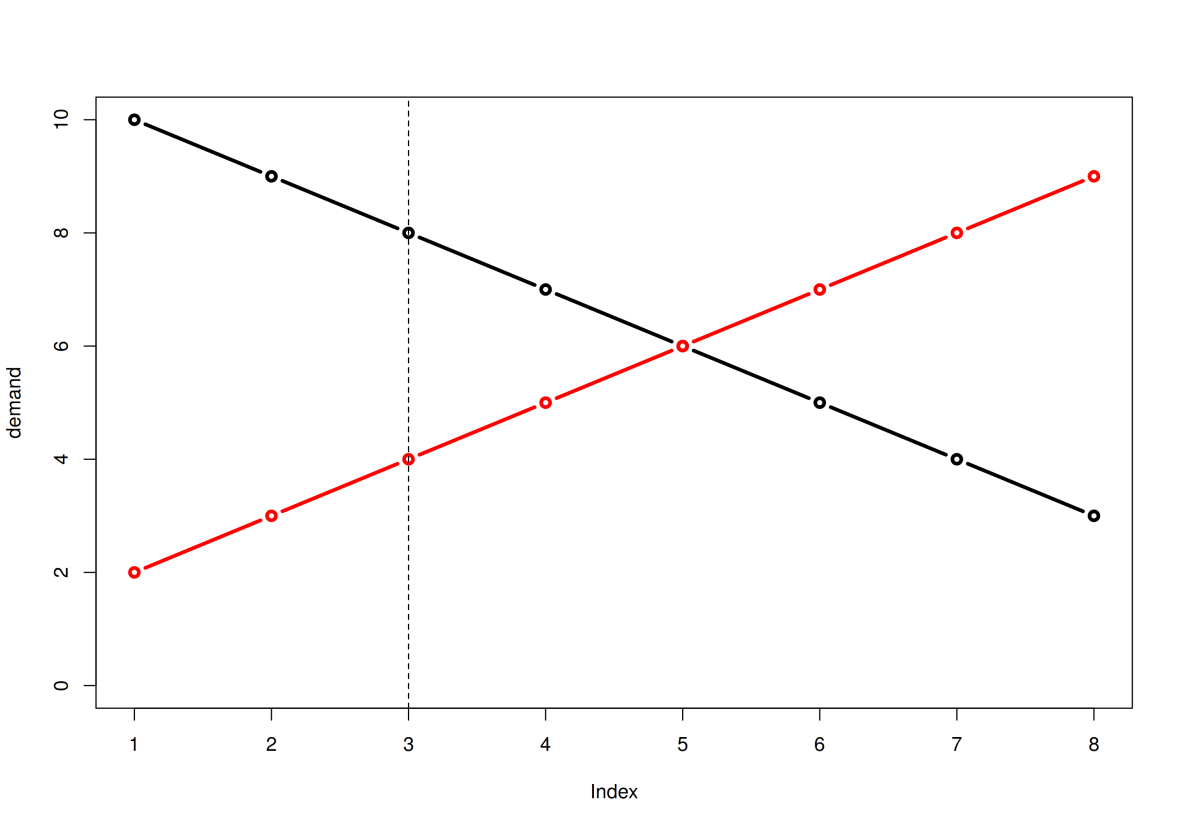
Market 4: discussion

The permit market



Market 4: discussion

The actual market



Discussion

Externalities can be corrected

- cap & trade systems increase efficiency
- reduction in social cost is obtained at lower price
- in reality heterogeneity in technology and pollution make it even better
- the firms that have higher pollution buy permits, face higher cost; the firms that pollute less sell permits, face higher revenues.
- We generate incentives to pollute less!


KEEP
CALM
it's
QUESTION
TIME

Exam details

The exam is a **take home plus a presentation**.

It is done in three easy steps:

1. You choose **one paper** out of a list and **read** it;
2. You **present** the paper to your colleagues and me on March 10th;
3. You **write an article report** and send it to me by March 19th.

Some words about the presentation

5-minutes presentation of a paper

- Exactly three slides (plus eventual title slide);
- **Five** minutes (sharp);
- Aim is to convey meaning of paper to colleagues & to show me your skills and learning;
- Presentation will count for 50% of final mark.

Some words about the article report

Take-home 3-pages report on the same paper you presented

The article report is made up of **three parts**:

1. Summary fo the paper and main results;
2. Criticize the experiment: what are the weak points? Does it lack in external/internal validity?
3. Propose an **alternative design**: if the experiment is *field*, propose a *lab*; if it is *lab*, propose a *field*.

Let us give some more detail on point 3.

Field experiments: Randomized Control Trials (RCT)

If you are a medical doctor, what you do is RCT

- Take a population fo interest (e.g.: lung cancer patients)
- administer a drug to a treatment group, a placebo to a control group
- track effects of the drug
- done.

Control vs. Randomization

- The setting, drug, background health levels, conditions of exposure to the drug, etc... are controlled
- The sample, number of patients, hospitals, control/treatment, are all randomized

But can it be generalized to other patients? other settings? slightly different drug? not really..

Lab experiments

High internal validity, low external validity

- Recreate in a lab the *essential traits* of the setting to be studied
- That is: simplify, simplify, simplify!
- Keep only the minimal things that can prove your theory wrong
- Formally create one (or more) control groups
- done.

Control vs. Randomization

- All is controlled, synthetic, recreated in perfect (from the point of view of the theory) conditions
- Only allocationt o treatment or control is randomized

An example of different methods: Electric appliances

Energy efficiency gap: consumers do not buy the best energy-efficient appliances even if they (and the environment) would benefit Which interventions work?

- Several RCTs failed to give a definite answer on what works and what not.
- See the paper by Pete Lunn on Moodle [very important reading for point 3. of your report]

Country	Appliance	Intervention	Incentives?	Works	doesn't
Germany	Washign machines	info on lifetime operating cost	yes	X	
Ireland	Tumble dryers	info on 5-year energy cost	yes		X
Finland	Tumble dryers	energy label + staff training	yes	X	
Finland	Tumble dryers	energy label only	yes		X
Finland	Tumble dryers	staff training only	yes		X
Finland	Fridge freezers	energy label + staff training	yes		X
Germany	Televisions	info on lifetime operating cost	no	X	
Germany	Televisions	info on yearly operating cost	no		X
UK	Boilers	info on yearly operating cost	no		X

Hard to find a pattern – each RCT is valid but *limited* in scope

- Would lab experiments be better? Yes, if successful in finding the underlying mechanism
- e.g.: problems in processing numbers; ratio of upfront to operating cost... if the underlying mechanism is understood, policy follows