N. GREGORY MANKIW NINTH EDITION

PRINCIPLES OF

ECONOMICS

CHAPTER

10

Externalities

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IN THIS CHAPTER

- What is an externality?
- Why do externalities make market outcomes inefficient?
- What public policies aim to solve the problem of externalities?
- How can people sometimes solve the problem of externalities on their own? Why do such private solutions not always work?

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Externalities

- Externality: one type of market failure
  - Arises when a person engages in an activity that influences the well-being of a bystander
    - But neither pays nor receives compensation for that effect
- Negative externality
  - Impact on the bystander is adverse
- Positive externality
  - Impact on the bystander is beneficial

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Market Inefficiency

- Self-interested buyers and sellers
  - Do not take into account the external effects of their actions: market outcome is not efficient
- "Government action can sometimes improve upon market outcomes"
  - Why markets sometimes fail to allocate resources efficiently
  - How government policies can potentially improve the market's allocation
  - What kinds of policies are likely to work best

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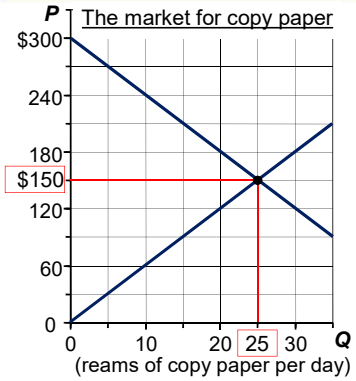
Recap of Welfare Economics, No Externalities



Supply curve shows **private cost**, the costs directly incurred by sellers.

Demand curve shows **private value**, the value to buyers (the prices they are willing to pay).

The market equilibrium maximizes consumer + producer surplus.

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EXAMPLE 1: Negative Externalities

A. Air or water pollution from a factory
B. The neighbor's barking dog or late-night party
C. Noise pollution from construction projects
D. Second-hand smoke
E. Texting while driving or walking

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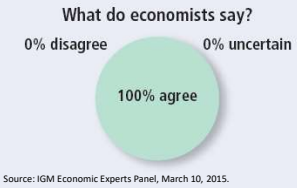
ASK THE EXPERTS
Vaccines

"Declining to be vaccinated against contagious diseases such as measles imposes costs on other people, which is a negative externality."



Source: IGM Economic Experts Panel, March 10, 2015.

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The Social Cost

- With negative externalities, the social cost includes:
  - Private cost (the direct cost to sellers) – the supply curve
  - External cost (the value of the negative impact on bystanders)

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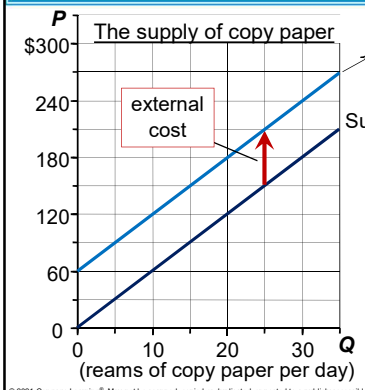
EXAMPLE 2: Analysis of a Negative Externality – 1



Social cost
= private + external cost

Supply (private cost)

External cost
= value of the negative impact on bystanders
= $60 per ream (value of harm from air and water pollution)

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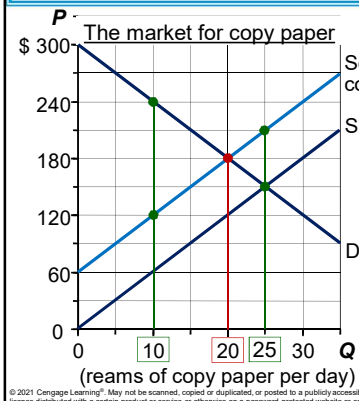
EXAMPLE 2: Analysis of a Negative Externality – 2



The socially optimal quantity is 20 reams of paper.

At any Q < 20, value of additional copy paper (***WTP***) exceeds the social cost.

At any Q > 20, social cost of the last ream of copy paper exceeds its value to society.

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Internalizing the Externality

- Internalizing the externality:
  - Altering incentives so that people take into account the external effects of their actions
  - In our example, an NT$60/ream tax on sellers will make sellers' costs = social costs.
- If market participants pay social costs
  - Market equilibrium = social optimum

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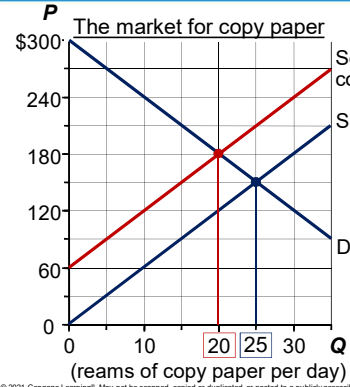
EXAMPLE 2: Analysis of a Negative Externality – 3



Market equilibrium (***Q*** = 25) is greater than the social optimum (***Q*** = 20).

One solution: tax sellers $60/ream, would shift ***S*** curve up by $60.

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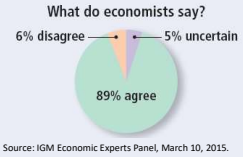
ASK THE EXPERTS
Vaccines

"Considering the costs of restricting free choice, and the share of people in the US who choose not to vaccinate their children for measles, the social benefit of mandating measles vaccines for all Americans (except those with compelling medical reasons) would exceed the social cost."



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EXAMPLE 3: Positive Externalities

A. Being vaccinated against contagious diseases
B. Research into new technologies
C. People going to college raise the population's education level, which reduces crime and improves government
D. Restored historic buildings
E. Owning a fire extinguisher

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The Social Benefit

- With a positive externality, the social value of a good includes
  - Private value (the direct value to buyers) – the demand curve
  - External benefit (the value of the positive impact on bystanders)

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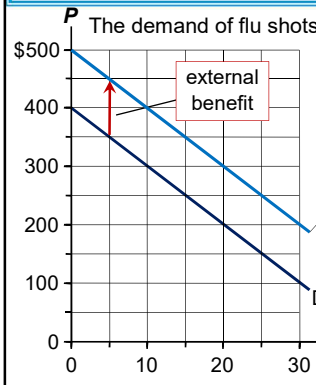
EXAMPLE 4: Analysis of a Positive Externality – 1



External benefit
= value of the positive impact on bystanders

Social value
= private value
+ $100 external benefit

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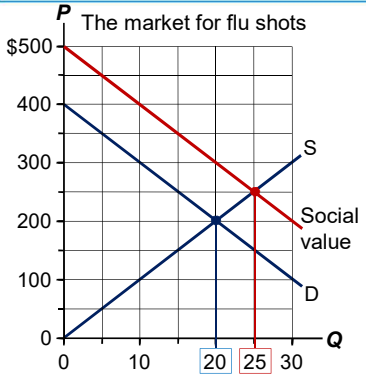
EXAMPLE 4: Analysis of a Positive Externality – 2



Market equilibrium (***Q*** = 20)

is lower than the social optimum (***Q*** = 25).

One solution: subsidize buyers $100 (external benefit), would shift ***D*** curve up by $100

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Effects of Externalities: Summary

- If negative externality
  - Market quantity > than socially desirable
- If positive externality
  - Market quantity < than socially desirable
- To remedy the problem, "internalize the externality"
  - Tax goods with negative externalities
  - Subsidize goods with positive externalities

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Public Policies Toward Externalities – 1

1. Command-and-control policies
   - Regulate behavior directly by requiring or forbidding certain behaviors
   - Impossible to prohibit all polluting activity
   - Examples:
     - Decide a maximum level of pollution
     - Require that firms adopt a particular technology to reduce emissions

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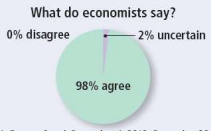
ASK THE EXPERTS

Carbon Taxes

"The Brookings Institution recently described a U.S. carbon tax of $20 per ton, increasing at 4 percent per year, which would raise an estimated $150 billion per year in federal revenues over the next decade. Given the negative externalities created by carbon dioxide emissions, a federal carbon tax at this rate would involve fewer harmful net distortions to the U.S. economy than a tax increase that generated the same revenue by raising marginal tax rates on labor income across the board."



Source: IGM Economic Experts Panel, December 4, 2012, December 20, 2011, and November 13, 2018.

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Public Policies Toward Externalities – 2

2. Market-based policies
   - To align private incentives with social efficiency
   - Private decision makers will choose to solve the problem on their own
   1. Corrective taxes and subsidies
   2. Tradable pollution permits

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Corrective Taxes and Subsidies

- Internalize the externality
  - Taxing activities that have negative externalities
    - Ideal corrective tax = external cost
  - Subsidizing activities that have positive externalities
    - Ideal corrective subsidy = external benefit

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Corrective Taxes

- Corrective taxes (*Pigovian taxes*)
  - Align private incentives with society's interests
  - Induce private decision makers to take into account the social costs of a negative externality
  - Should equal the external cost
  - Places a price on the right to pollute
  - Reduce pollution at a lower cost to society (than regulation)
  - Raise revenue for the government
  - Enhance economic efficiency

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Corrective Taxes vs. Regulations

- A pollution tax is efficient:
  - Firms with low abatement costs will reduce pollution to reduce their tax burden
  - Firms with high abatement costs have greater willingness to pay tax.
- Regulation requiring all firms to reduce pollution by a specific amount is not efficient
  - Firms have no incentive to reduce emission further once they have reached the required target

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CASE STUDY

Why is Gasoline Taxed So Heavily?

The gas tax can be vied as a corrective tax targeting three negative externalities:

- Congestion: The more you drive, the more you contribute to congestion.
- Accidents: Larger vehicles cause more damage in an accident.
- Pollution: Cars cause smog. Burning fossil fuels is widely believed to be the primary cause of global climate change.

- Actual gas tax: $0.50 per gallon
- Optimal corrective tax: $2.95/gallon (2018 dollars)

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ASK THE EXPERTS

Carbon Taxes

"A tax on the carbon content of fuels would be a less expensive way to reduce carbon-dioxide emissions than would a collection of policies such as 'corporate average fuel economy' requirements for automobiles."

What do economists say?

Source: IGM Economic Experts Panel, December 4, 2012, December 20, 2011, and November 13, 2018.

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Tradeable Pollution Permits

- Tradable pollution permits system
  - Reduces pollution at lower cost than regulation
    - Firms with low cost of reducing pollution do so and sell their unused permits
    - Firms with high cost of reducing pollution buy permits
  - Result: Pollution reduction is concentrated among those firms with lowest costs
  - The initial allocation of the permits among firms does not matter from the standpoint of economic efficiency

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Active Learning 1: Reducing Pollution

Tiana's Paper Mill and Jordan's Tire Factory are both polluting the Blue River with 100 tons of green glowing glop per month (each).

Goal: Reduce total green glowing glop pollution to 140 tons/month.

- Cost of reducing pollution:
  - NT$1,000/ton for Tiana's Paper Mill
  - NT$2,000/ton for Jordan's Tire Factory
- Which is more efficient: regulation or tradable pollution permits?

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Active Learning 1: A. Regulation

Policy option 1: Regulation

Each firm must cut its pollution by 30 tons.

Compute the cost to each firm and total cost of achieving goal using this policy.

- Cost to Tiana's Paper Mill:

30 tons x (NT$1,000/ton) = NT$30,000/month

- Cost to Jordan's Tire Factory:

30 tons x (NT$2,000/ton) = NT$60,000/month

- Total cost of reducing pollution = NT$90,000

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Active Learning 1: B. Tradable Pollution Permits

Policy option 2: Tradable pollution permits

- The government issues 140 permits, each allows one ton of green glowing glop pollution.
- Gives 70 permits to each firm.
- Establish a market for trading permits.
- Each firm may use all its permits to emit 70 tons, may emit < 70 tons and sell leftover permits, or may purchase extra permits to emit > 70 tons.

Compute the cost of achieving goal if Tiana's Paper Mill uses 40 permits and sells 30 to Jordan's Tire Factory for NT$1,500 each.

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Active Learning 1: B. Answers

Tiana's Paper Mill

- Uses 40 permits: can pollute only 40 tons
- Sells Jordan 30 permits for NT$1,500 each, bringing in a revenue of 30 x 1,500 = NT$45,000
- Must clean 100 – 40 = 60 tons of pollution at a cost of 60 x 1,000 = NT$60,000

Tiana's Total cost = 60,000 – 45,000 = NT$15,000

Jordan's Tire Factory

- Buys 30 permits from Tiana at a cost of 30 x 1,500 = NT$45,000
- Now they have 70 + 30 = 100 permits, exactly how much they pollute

Total cost for Jordan is = NT$45,000

Overall pollution reduction cost = 15,000 + 45,000 = NT$60,000

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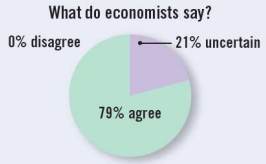
ASK THE EXPERTS

Carbon Taxes

""Carbon taxes are a better way to implement climate policy than cap-and-trade."."



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Pollution Permits vs. Corrective Taxes

- Reducing pollution using pollution permits or corrective taxes: firms pay for their pollution
  - Corrective taxes: pay a tax to the government
    - Firms can pollute as much as they want by paying the tax
  - Pollution permits: pay to buy permits
  - Internalize the externality of pollution

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Objections – 1

- "We cannot give anyone the option of polluting for a fee."
  —late US Senator Edmund Muskie
- People face trade-offs
  - Eliminating all pollution is impossible
  - Clean water and clean air – opportunity cost: lower standard of living

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Objections – 2

- Clean environment is a normal good
  - Positive income elasticity
    - Rich countries can afford a cleaner environment, have a more rigorous environmental protection
  - Clean air and clean water: law of demand
    - The lower the price of environmental protection, the more the public will want it
    - Using pollution permits and corrective taxes reduces the cost of environmental protection

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Private Solutions to Externalities

- The types of private solutions
  - Moral codes and social sanctions
    - No littering
  - Charities
    - Sierra Club, donations to universities
  - Self-interest of the relevant parties
    - Apple orchard and beekeeper
  - Interested parties can enter into a contract

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The Coase Theorem

- The Coase theorem
  - If private parties can bargain without cost over the allocation of resources
  - They can solve the problem of externalities on their own
- Whatever the initial distribution of rights
  - Interested parties can reach a bargain
  - Everyone is better off
  - Outcome is efficient

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EXAMPLE 5A: Private Solutions to Externalities

A. Taio has the legal right to play the piano.
- Taio gets a NT$5,000 benefit playing the piano
- Zehra bears an NT$8,000 cost from this "music"

- Efficient outcome:
  - Zehra can offer Taio NT$6,000 to stop playing piano in the apartment
  - Taio will gladly accept (he's better off with NT$6,000 cash than with NT$5,000 worth of piano playing)
  - Both are better off

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EXAMPLE 5B: Private Solutions to externalities

B. Taio has the legal right to play the piano
- Taio gets a NT$10,000 benefit playing the piano
- Zehra bears an NT$8,000 cost from this "music"

- Efficient outcome:
  - Taio turns down any offer below NT$10,000
  - Zehra will not offer any amount above NT$8,000
  - Taio keeps playing the piano (and Zehra moves her tutoring business to the library)

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EXAMPLE 5C: Private Solutions to Externalities

C. Zehra can legally compel Taio to stop playing
- Taio gets a NT$8,000 benefit playing the piano
- Zehra bears an NT$5,000 cost from this "music"

- Efficient outcome:
  - Taio pays Zahra NT$6,000 to put up with the loud music (or move her tutoring business to the library)
  - Taio keeps playing the piano

The private market achieves the efficient outcome regardless of the initial distribution of rights

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Active Learning 2: Applying the Coase theorem

Collectively, the 1000 residents of the Chou Tribe (鄒族) value fishing in a clean Sun Moon Lake at NT$1,000,000.

The annual Sun Moon Lake International Cross-lake Swimming Carnival (泳渡日月潭) pollutes the lake water, and would require NT$500,000 for clean-up.

A. Describe a Coase-like private solution.

B. Can you think of any reasons why this solution might not work in the real world?

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Why Private Solutions Do Not Always Work

- High transaction costs:
  - Costs that parties incur in the process of agreeing to and following through on a bargain
- Stubbornness: (最牛釘子戶)
  - Bargaining simply breaks down
- Coordination problems:
  - Large number of interested parties
  - Coordinating everyone is costly

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THINK-PAIR-SHARE

Your father is reading your parents' property tax bill. On the property tax bill, there is a deduction if the property owner has done anything to beautify his property: If your parents spent NT$20,000 on landscaping, they can reduce their tax bill by 50% × NT$20,000 = NT$10,000 so the true cost of the landscaping was only NT$10,000.

Your father announces, "This is an outrage. If someone wants to improve his house, it is no one's business but his own. I remember some of my college economics and I know that taxes and subsidies are always inefficient."

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THINK-PAIR-SHARE

A. What is the city government trying to subsidize with this tax break?

B. What is the externality that this subsidy is trying to internalize?

C. Although taxes and subsidies usually create inefficiencies, are taxes and subsidies always inefficient? Why or why not?

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CHAPTER IN A NUTSHELL

- Externality: when a transaction between a buyer and seller directly affects a third party
  - For negative externalities, such as pollution, the socially optimal quantity in a market is less than the equilibrium quantity.
  - For positive externalities, such as technology spillovers, the socially optimal quantity is greater than the equilibrium quantity

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CHAPTER IN A NUTSHELL

- Governments pursue various policies to remedy the inefficiencies caused by externalities.
  - Regulating behavior
  - Corrective taxes
  - Issuing permits. The government could protect the environment by issuing a limited number of pollution permits. The result of this policy is similar to imposing corrective taxes on polluters.

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CHAPTER IN A NUTSHELL

- Those affected by externalities can sometimes solve the problem privately.
  - When one business imposes an externality on another business, the two businesses can internalize the externality by merging.
  - Coase theorem: if people can bargain without cost, then they can always reach an agreement in which resources are allocated efficiently.
  - In many cases, reaching a bargain among the many interested parties is difficult.

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Chapter 10: Externalities

- Market Failure? Or, Lack of Market Failure!
  - Caused by lack of property rights!
  - Social Cost/Benefit ≠ Private Cost/Benefit
- Market-based Public Policy:
  - Corrective Taxes
  - Tradable Pollution Permits
- Private Solutions: Coase Theorem
- Homework:
  - Mankiw, Ch.10, Problem 1, 4, 5, 8, 9

Chapter 10: Challenge Questions/ex-Midterm

- 2007 - Q6b
- 2008 - C5-9 (Multi-Choice Q12, Q13)
- 2009 - C1-4 (Multi-Choice Q13)
- 2010 - A (True/False Q10)
- 2014 - B
- 2015 - A4-5, B3
- 2016 - D
- 2017 - C
- 2018 - C, D
- 2019 - D1-D5

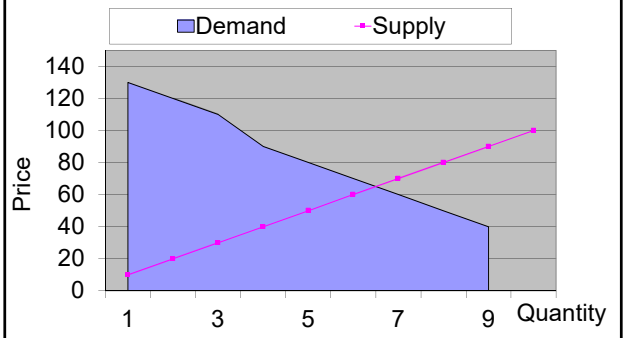
Experiment 6: Tradable Permit Market

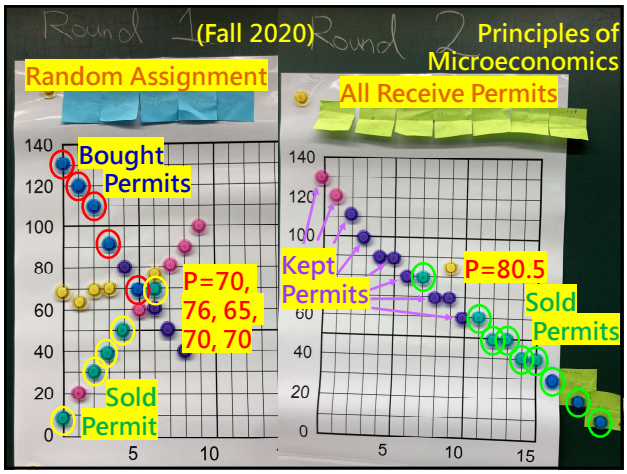
- 3-4 per group; 1 market = 20 factory
  - 3-4人一組參與交易實驗，每組同學代表一家工廠，分屬兩個不同市場副本，每個市場有二十家工廠。
- Each group gets a card (J=11, Q=12, K=13, A=1, "Small" Joker = 14, "Big" Joker = 15)
  - 每組同學會拿到一張有數字的撲克牌(J=11，Q=12，K=13，但A=1，而大鬼=15，小鬼=14)，
- # of your card multiplied by 10 = Cost to reduce 1 ton of carbon emission
  - 牌面數字乘以十代表您減少一噸碳排放所需的減碳成本(元)。請收好這張牌不讓人看到其花色數字。

Gov't issues permits (政府發放執照)

1. Random Assignment (隨機發放):
   - After distribution, firms can trade permits under Free Form Bargaining (自由談判)
2. All firms receive permits (通通有獎):
   - Then, the government buys back half of the permits in a Sealed Bid Auction (密封式投標),
3. Auction off permits to half: (政府拍賣)
   - After distribution, the government sells permits to half of the factories through a Dutch Auction (荷蘭式拍賣, Descending Price Auction)

2020 Exp. 6: Tradable Permit Market





2020 Exp. 6: Tradable Permit Market

Round 3 Results