09. PUBLIC GOODS AND EXTERNALITY

ECON1005 Principles of Economics I (Microeconomics)

1. MARKET FAILURE

- A **market failure** occurs when the market on its own does not allocate resources efficiently.
  - It leads to a *deadweight loss*, i.e. total surplus is not maximized.

- Major sources of market failure:
  - Monopoly Power
  - **Public Goods**
  - **Externalities**
  - Asymmetric Information

2. PUBLIC GOODS

- A **public good** is a good that is **both nonrival** and **nonexcludable**.

- **Nonrival**
  - A good is nonrival if one person's consumption does not preclude consumption of others at a time and does not reduce the amount available for others.
  - Examples: TV signal, radio broadcast, online class

- **Nonexcludable**
  - A good is nonexcludable if it is not possible (or practical) to exclude people from using the good once it exists.
  - Examples: public roads, beach

- A **private good** is the opposite of a public good: **both rival** and **excludable**. (the goods we have studied so far).

APPLICATION: DENGUE FEVER AND MOSQUITO CONTROL

- In October 2014:
  - Guangdong: 21,527 dengue fever cases
  - Hong Kong: Only ONE case

(Source: *SCMP*, 6 Oct, 2014)

- This is probably a result of good **mosquito control**.
- Mosquito control (including fumigation, removing standing water) is a **public good.**
  - Is it nonrival?
  - Is it nonexcludable?





In theory, it is possible to encrypt or restrict the GPS signal, and some military signals are restricted, but the basic civilian service is open to all and nonexcludable.

GPS (Global Positioning System): Nonrival? Nonexcludable?



2. PUBLIC GOODS

What type of good is HKBU website?

- Types of Goods: Rivalry & Excludability

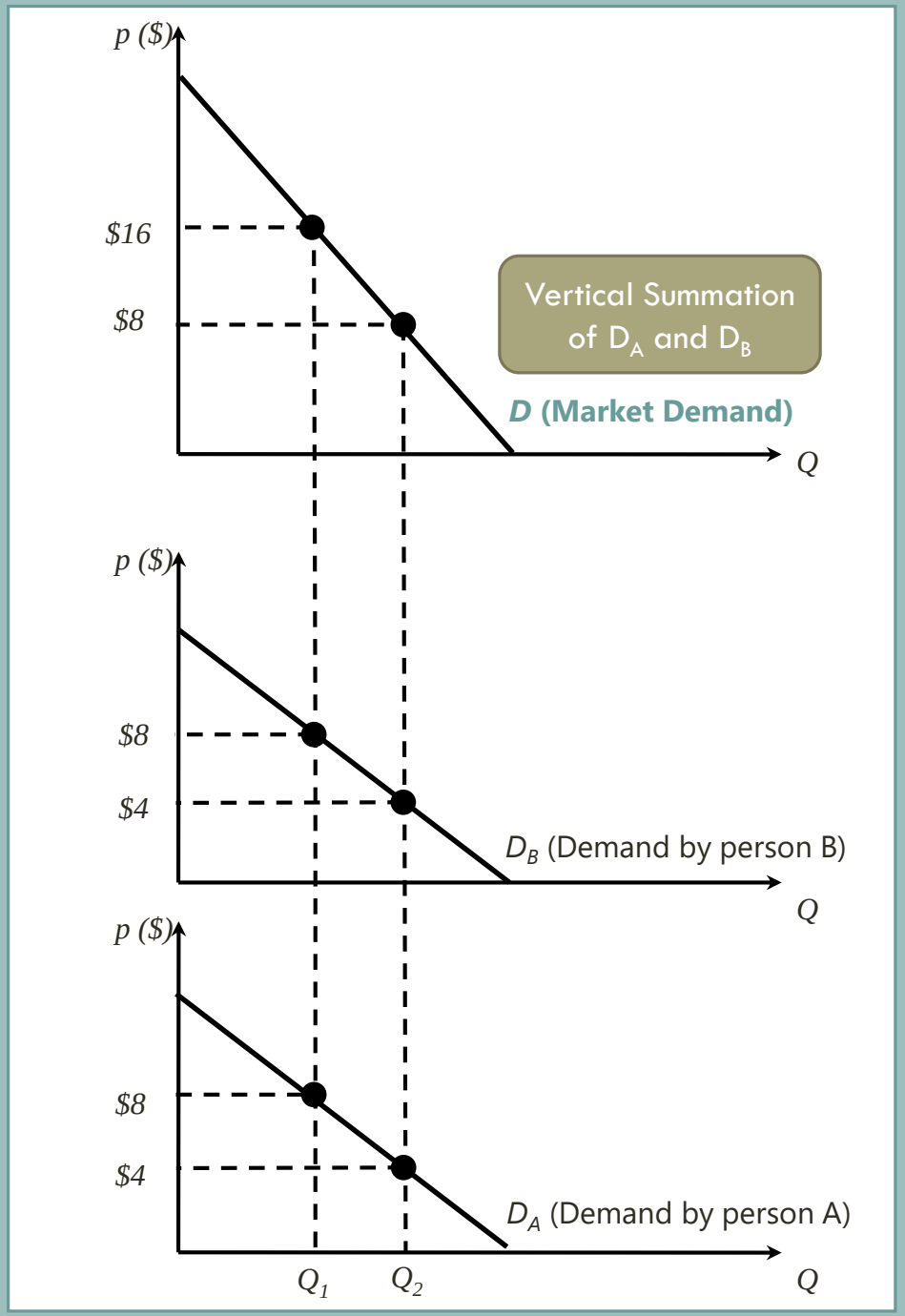
		Rivalry	
		Rival	**Nonrival**
Excludability	**Excludable**	**Private goods** • Food • Clothing • Housing	**Club Goods** • Netflix subscription • Spotify Premium • Online gaming server
	Nonexcludable	**Common-resource goods** • Fish in the ocean • Natural forests and wildlife • Parking spots on street	**Public goods** • National defense • Mosquito control • Tsunami Warning Systems

- The classifications of goods are not always clear-cut, as real-world goods fall along a spectrum!

3. MARKET DEMAND CURVE FOR A PUBLIC GOOD

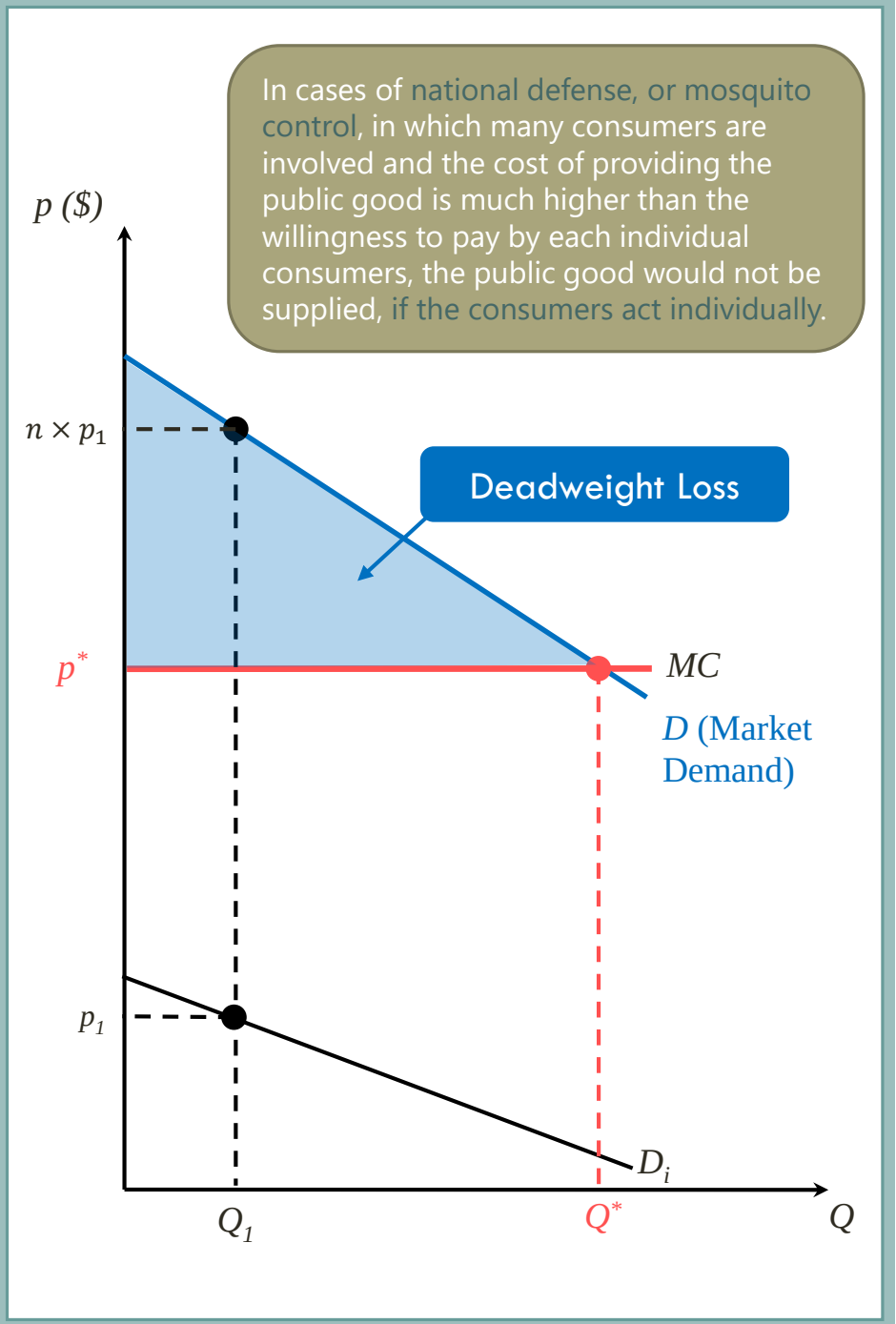
- For private goods: market demand is derived by horizontal summation of individual demand curves.

- For public goods: market demand is derived by **vertical summation** of individual demand curves.
  - Each unit of a public good is enjoyed by all, because the good is nonrival and nonexclusive.
  - So, for each unit, add up all individuals' willingness to pay to obtain the value for that unit to the whole market.



4. PRIVATE PROVISION OF A PUBLIC GOOD?

- Suppose there are *n* identical consumers.
- Suppose the marginal cost is constant at p^*. *What is the efficient output level?*
- *Will any individual buy at this price?*
  - No. The *MC* (p^*) is higher than any individual's willingness to pay at any quantity.
  - One consumer alone won't buy the public good.
- Result: **Underproduction** - nothing will be produced (in this case)
  - The **deadweight loss** is indicated by the shaded area.



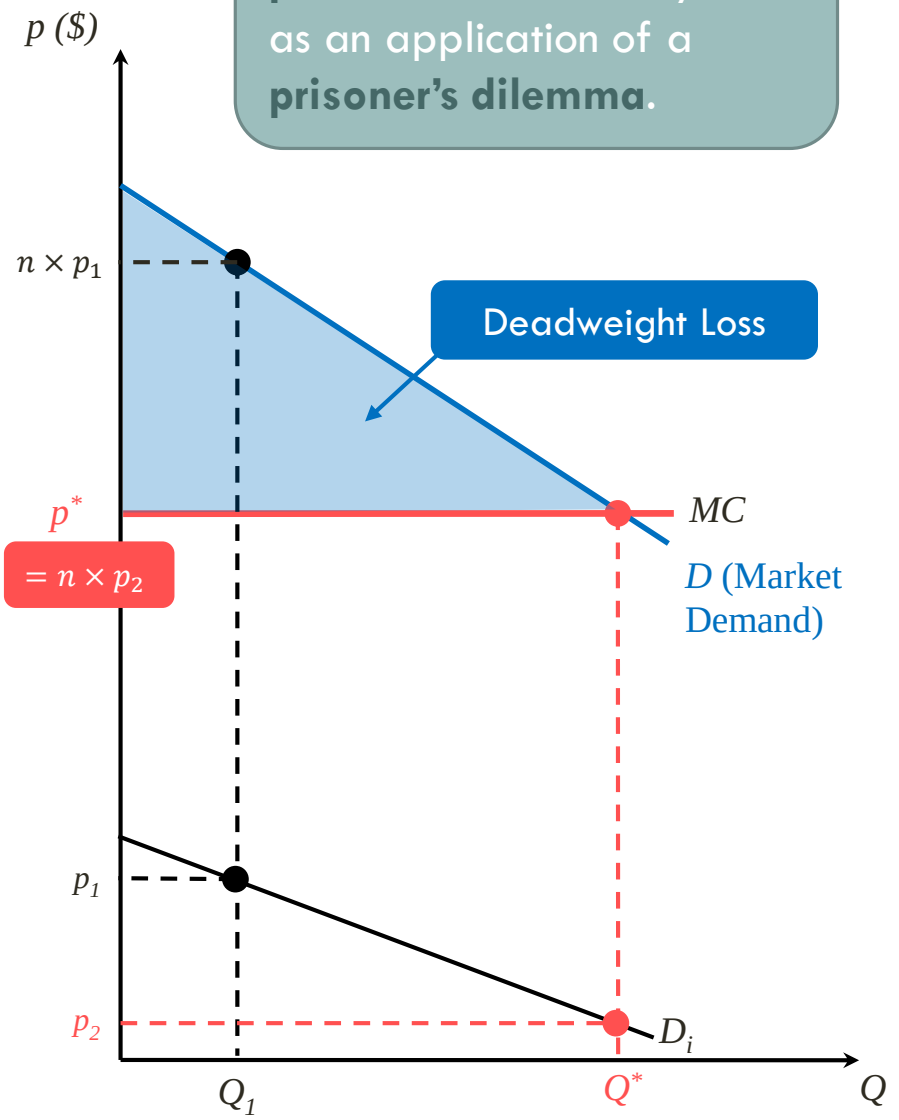
4. PRIVATE PROVISION OF A PUBLIC GOOD?

- ***How can the efficient output be produced?***

- The efficient output level (Q^*) can be produced if every consumers contributes their maximum willingness to pay at Q^*.
  - The sum of everyone's contributions must cover the cost.

- Is **voluntary contribution** feasible?
  - Because of **nonexcludability**, consumers can benefit without paying.
  - Each person has an incentive to "free ride", hoping others will pay.
  - This problem is called the **free-riding problem**.

In fact, the **free-rider problem** can be analyzed as an application of a **prisoner's dilemma.**



5. FREE-RIDING PROBLEM AND GOVERNMENT INTERVENTION

- Suppose two persons can each choose to contribute $100, or not to contribute, to a public good. Since the public good is nonexclusive, no matter which the contributor is, the benefit is evenly shared between the two persons.
- If both contribute, the public good is fully funded and the total benefit is $300. Each consumer receives half the benefit ($150) and pays $100. **Payoff to each person is $50**.
- If only one contributes, less of the public good is provided and the total benefit is only $150. Benefit is shared equally ($75 each); the contributor pays $100, the free-rider pays $0.
  - Contributor's payoff: -$25; Free-rider's payoff: $75
- If neither contributes, no public good is provided, payoff for everyone is $0.

What is the predicted outcome of this game?

		Consumer B	
		Contribute	**Free-ride**
Consumer A	**Contribute**	$50, $50	-$25, $75
	Free-ride	$75, -$25	$0, $0

Each player has a dominant strategy, and the dominant strategy equilibrium (also the Nash equilibrium) is **both players choose to free-ride**.



5. FREE-RIDING PROBLEM AND GOVERNMENT INTERVENTION

- Therefore, government intervention is often necessary to ensure the provision of public goods.
- The government may produce the public good itself or subsidize firms that produce it.
- Potential problems
  - Government failure?
    - Inefficiency, waste, or poor targeting; the government may not know the true value to society or may mismanage resources
  - Equity?
    - Who pays and who benefits? Public goods may be funded by taxes, raising questions about fairness and the distribution of costs and benefits.





Source: The ungoverned seas, *The Economist*, Nov 29th, 2014.

APPLICATION: PIRACY OFF SOMALIA

- **The Gulf of Guinea** was the global piracy hotspot. **Piracy** peaked in late 2010s, with the region accounting for the most kidnappings for ransom at sea globally.
  - Smaller countries in the region have asked for help from the world's navies. But Western countries are **reluctant to help**. **Why?**

- **Anti-piracy naval defence is a public good**!
  - Once provided, all ships in the region benefit, regardless of who pays for patrols.
  - **Free rider problem:** Each country hopes others will pay for expensive patrols, so most under-contribute.

- For example, off Somalia:
  - 15 countries conduct anti-piracy naval patrols in Indian Ocean. That might sound a lot, but 30 warships are operating in an area almost as big as the United States!

6. EXTERNALITIES: NEGATIVE EXTERNALITIES

- An **externality** is the costs or benefits of a market activity that affect a third party.
  - *Negative* externality imposes external costs on third parties.
  - *Positive* externality provides external benefits to third parties.

- **Negative Externality**:
  - Suppose a factory produces chemicals and emits sulfur dioxide (SO_2), an air pollutant, as a by-product.
  - The resulting air pollution impacts the health and environment of people not involved in the production or consumption of the chemicals.

  - The **marginal external cost (*MC^E*)** is the additional external cost to the third parties when output increases by one unit.

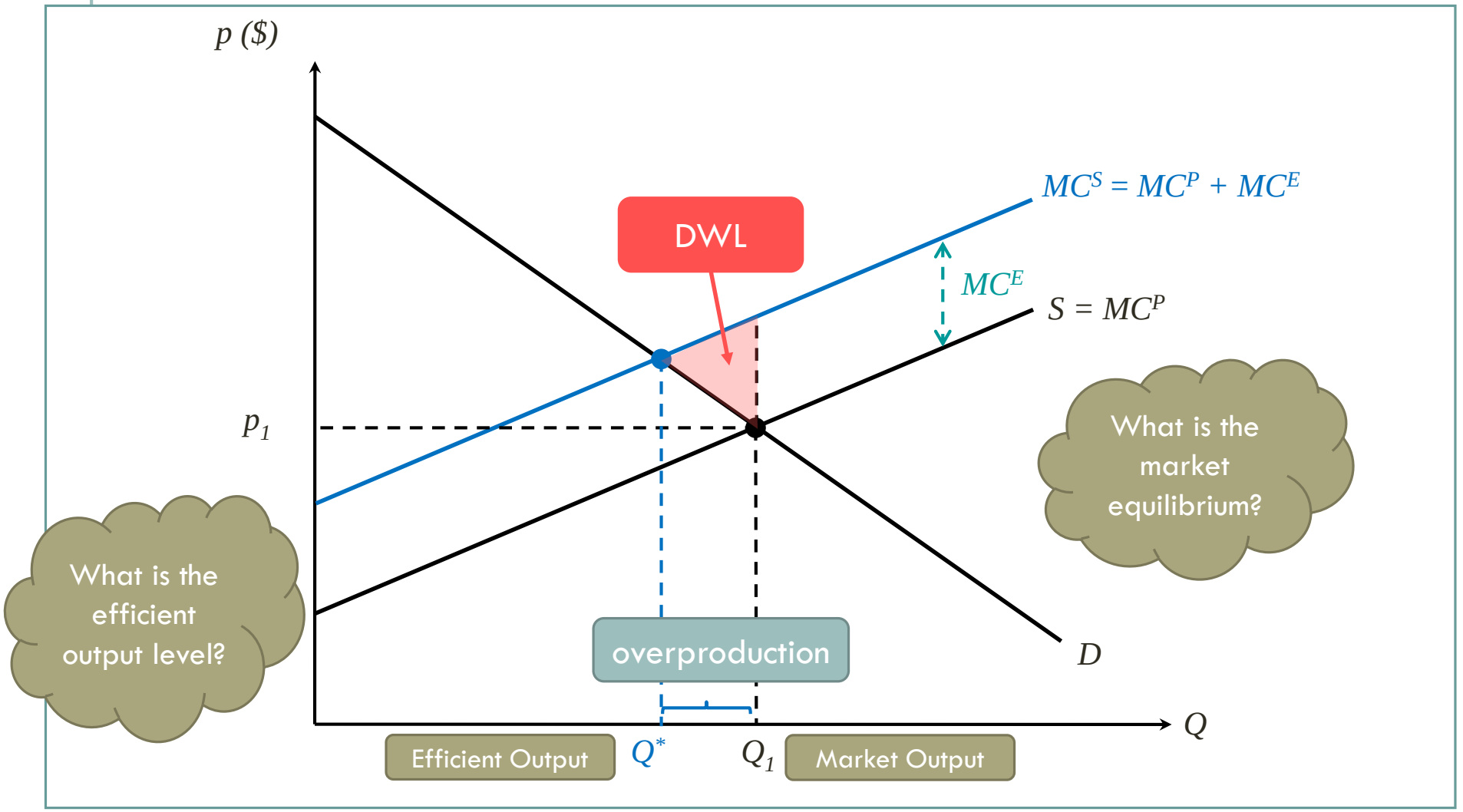
  - The **marginal social cost (*MC^S*)** is the total cost to society of producing an additional unit of good:
    - The cost to the producers (**marginal *private cost***) + The external cost to the third-parties (**marginal *external cost***)

=MC (marginal private cost)

Marginal external cost

$$MC^S = MC^P + MC^E$$

6. EXTERNALITIES: NEGATIVE EXTERNALITIES



Source: *The Economist*, Aug 7th 2021

Phantom firearms

Taking aim at ghost guns

Can American politicians hit a spectral target?



Across America, police departments are seeing ghosts—the gun kind. "Ghost guns" are privately
firearms that do not have serial numbers and are therefore impossible to trace if they are used to co
a crime.

They are on the rise. Last year 8,712 such guns were recovered at potential crime scenes and rep
to the Bureau of Alcohol, Tobacco, Firearms and Explosives (atf), more than triple the number in
In 2020 police in Baltimore recovered 126 ghost guns, 15 of which were directly linked to shoo
Nearly a quarter of ghost guns seized by Baltimore's Police Department were from people too y
to buy a firearm legally.

Technology is partly to blame. The internet has enabled people to buy kits or component part
assemble them into guns without serial numbers. The well-resourced can also produce them
3d printers. Websites that sell "80%" receivers, which are almost-finished firearms that require
and tools to put together, have thrived. Typically all you need is metal files, sandpaper, wd-
hammer, screwdriver, bench vice and power drill to assemble the firearm's parts: kits arrive
instructions and links to video tutorials. "This makes starting your own personal gun factory a bre
boasts one firm, 80 Percent Arms, in its online listing for an ar-15 home-assembly kit.

Such sellers are exploiting loopholes to their advantage. Because they are peddling unfinished kit
not completed guns, these companies have technically not been required to mark a serial number o
"frame" or "receiver", which contains all the gun's operating parts. Nor have they been oblig
conduct a background check on buyers, as licensed gun-dealers must do. This means that people
might be barred from buying a gun, such as convicted felons, the mentally ill or the under-age, are
to do so with relative ease.

Police departments and politicians are worried. In 2019 the House Committee on Homeland Sec
argued in a report that "terrorists and other bad actors may seek to exploit the availability of
weapons for dangerous ends", and called ghost guns a "homeland-security threat". They have al



APPLICATION: GHOST GUNS

- **"Ghost guns"** are privately made firearms without serial numbers, making them virtually untraceable if used in crimes. Their prevalence is rising.
- Technology is partly to be blamed
  - The internet has enabled people to buy kits or component parts and assemble them into guns at home.
  - More websites offer "80% finished guns" – kits with instructions and links to video tutorials.
  - Those with 3D printers can produce their own guns.
  - Terrorists and criminals can exploit the availability of ghost guns, making them "a homeland-security threat".
    - In 2020, 8,712 ghost guns were recovered at potential crime scenes in the U.S.
- (Source: Ghost guns, *The Economist*, 7th August, 2021.)

7. EXTERNALITIES: POSITIVE EXTERNALITIES

- **Positive Externality**:
  - Consider the consumption of surgical mask during the period of COVID-19 pandemic. When someone wears a surgical mask, they protect themselves (private benefit) and help protect others by reducing virus spread (external benefit)
  - The **marginal external benefit (*MB^E*)** is the additional external benefit to the third parties when one more unit is used.
  - The **marginal social benefit (*MB^S*)** is the total benefit to society of an additional unit of good:
    - The benefit to the buyers (**marginal *private benefit***) + The external benefit to the third-parties (**marginal *external benefit***)

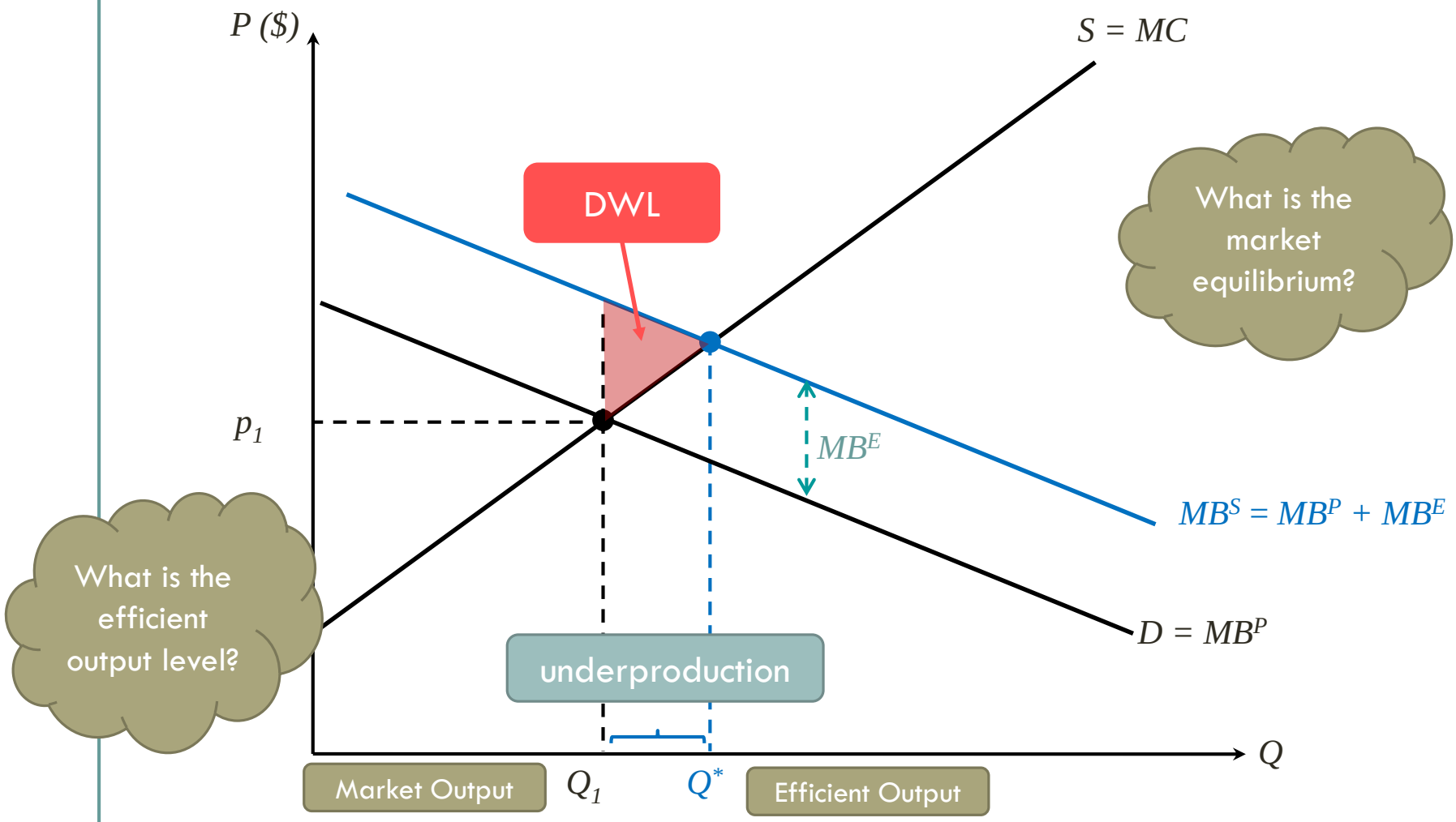
= *D* (marginal private benefit)

Marginal external benefit

$$MB^S = MB^P + MB^E$$



7. POSITIVE EXTERNALITIES AND EFFICIENCY



APPLICATION: FACE MASK

Cloth of gold

Why the economic value of a face mask is $56.14

A new frontier in facial finance

Aug 22nd 2020



Editor's note: Some of our covid-19 coverage is free for readers of The Economist Today, *our daily newsletter. For more stories and our pandemic tracker, see our hub*

After a brutal first six months of the year, governments across the world are hoping for an economic bounce-back. Rich-world gdp fell by about 10% in the first half of 2020. Yet much has changed since—including that more people are now wearing masks. Economists, obsessed with translating everything into gdp, wonder if more widespread face-covering could help the recovery.

The thinking goes that masks can, in part, substitute for lockdowns. People wearing them need not be discouraged as much from using public transport. More shops and offices might be able to reopen, albeit while practising social distancing.

Calculations from Goldman Sachs, a bank, suggest that a 15 percentage-point rise in the share of the population that wears masks would reduce the daily growth of cases by about one percentage point. That obviates the need for lockdown measures that would otherwise subtract nearly 5% from gdp. *The Economist* took those calculations a step further. According to our reckoning, an American wearing a mask for a day is helping prevent a fall in gdp of $56.14. Not bad for something that you can buy for about 50 cents apiece.

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- According to *The Economist*, an American wearing a mask a day is helping prevent a fall in GDP of $56.14.
- (Source: Cloth of gold, *The Economist*, 22nd August, 2020)

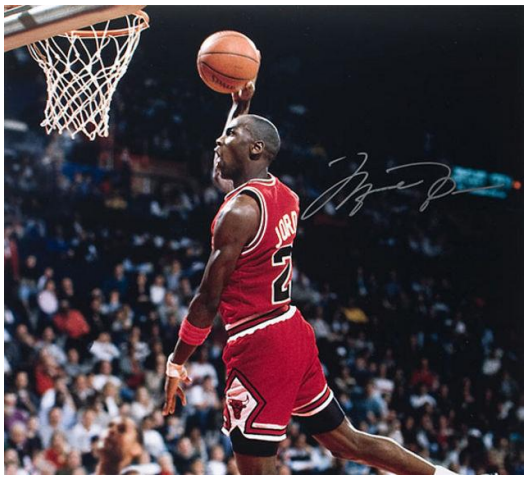
APPLICATION: THE SUPERSTAR EFFECT



(Source: Lawson, Robert A., Kathleen Sheehan, and E. Frank Stephenson, "Vend it like Beckham: David Beckham's Effect on MLS Ticket Sales," *International Journal of Sport Finance,* 3(1), November, 2008, p. 189 – 195.)

- Sports superstars create **positive externalities**.
- Controlling for team records, two economists Hausman & Leonard (1997) estimated that **Michael Jordan's** presence, when he played for Chicago Bulls during 1991-1992 season, the total value of Jordan's **positive externalities** at $40.3 million.
  - It included ticket revenues at away games and increased local TV advertising revenues for these games.
  - It increased national TV revenues and NBA Properties earnings (both shared by all teams).
- Lawson et al. (2008) calculated that when **David Beckham** joined the U.S. Major League Soccer team, LA Galaxy, in 2007, the value of extra ticket sales at away games was between $6 and $20 million a year.

Source: Hausman, Jerry A., and Leonard, Gregory K., "Superstars in the NBA: Economic Value and Policy," *Journal of Labor Economics,* 14(4), October, 1997, p. 586 – 624.



8. IMPROVING EFFICIENCY BY PRIVATE NEGOTIATION? THE COASE THEOREM

- **Property rights** are the key to a private solution of externalities.
  - If residents own the property right to the river, the polluting firm must compensate the residents for the pollution it causes.
    - *This makes the firm internalize the external cost, leading it to reduce pollution and output to the socially optimal level.*
- *What would happen if the property right to the river belongs to the firm? Would it worsen the problem of externality?*
  - If the firm own the property right to the river, residents must pay the firm to reduce its pollution.
    - *The negotiation can still make the firm internalize the external cost and may result in the firm reducing pollution if the residents value a clean river enough to pay.*
- **The Coase Theorem** (named after Ronald Coase, who won the 1991 Nobel Prize in Economics):
  - If property rights are well-defined and transaction costs are low, **negotiations ("side payments")** will lead to **an efficient outcome** regardless of who owns the property right.

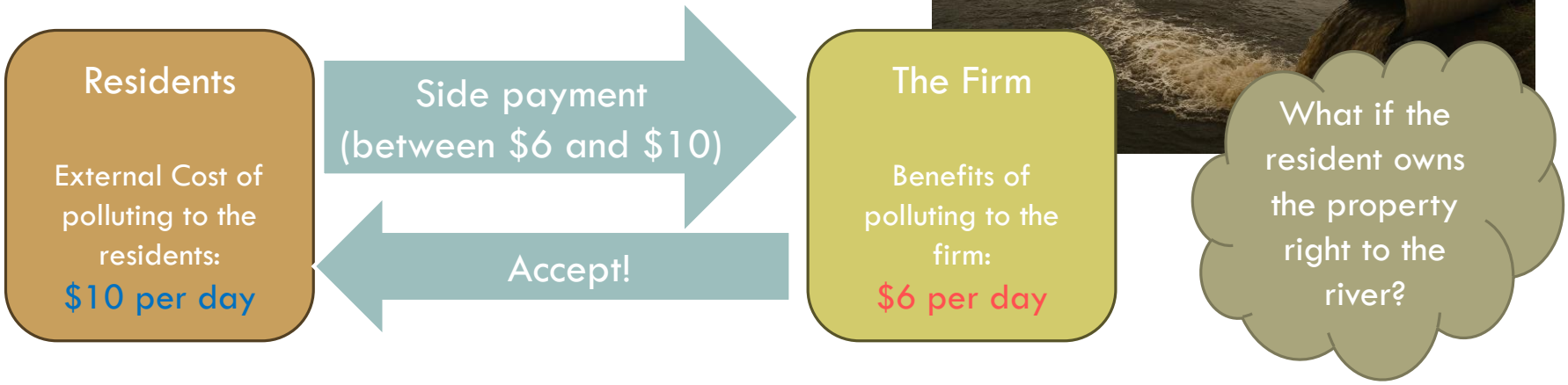
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8. IMPROVING EFFICIENCY BY PRIVATE NEGOTIATION? THE COASE THEOREM

- Suppose:
  - External cost of pollution to the residents: $10 per day
  - The firm saves by polluting: $6 per day
- If **the firm owns the property right to the river**



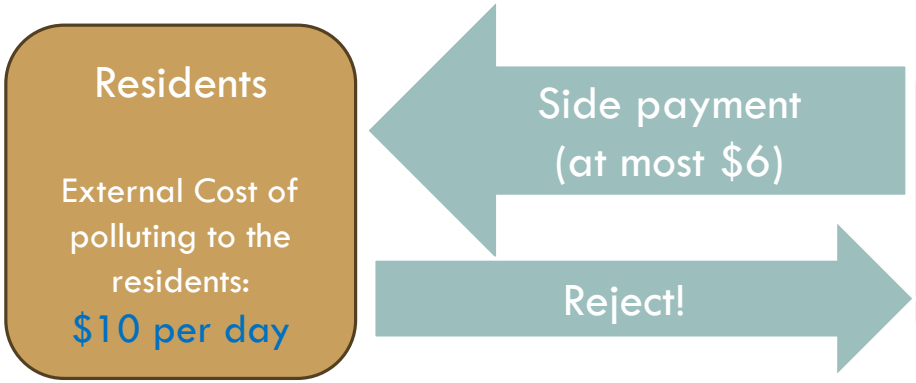


- As external cost to the residents ($10) > the gain to the firm ($6), a mutually beneficial agreement of side payment is possible.
- **Outcome**: No pollution (Efficient Outcome)

8. IMPROVING EFFICIENCY BY PRIVATE NEGOTIATION? THE COASE THEOREM

- If **the residents own the property right to the river**:





- **Outcome**: No pollution (Efficient Outcome)

- **What would happen if the external cost to the residents ($6) < the gain to the firm ($10)?**
  - **Polluting the river is the efficient outcome**

8. IMPROVING EFFICIENCY BY PRIVATE NEGOTIATION? THE COASE THEOREM

- If **the firm owns the property right to the river**:



Residents

External Cost of polluting to the residents:
$6 per day

Side payment (at most $6)

Reject!

The Firm

Benefits of polluting to the firm:
$10 per day

- If **the residents own the property right to the river**:

Residents

External Cost of polluting to the residents:
$6 per day

Side payment (between $6 and $10)

Accept!

The Firm

Benefits of polluting to the firm:
$10 per day

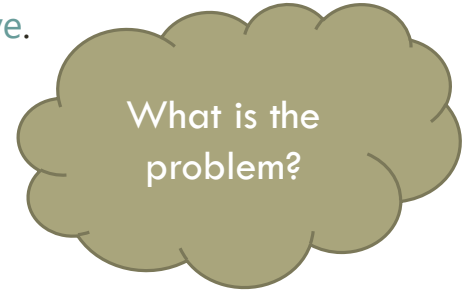
Outcome: Pollution (Efficient Outcome)

8. IMPROVING EFFICIENCY BY PRIVATE NEGOTIATION? THE COASE THEOREM

- **Efficient outcome** (whether pollution happens or not) is achieved regardless of who has the property right as long as side negotiations are possible.

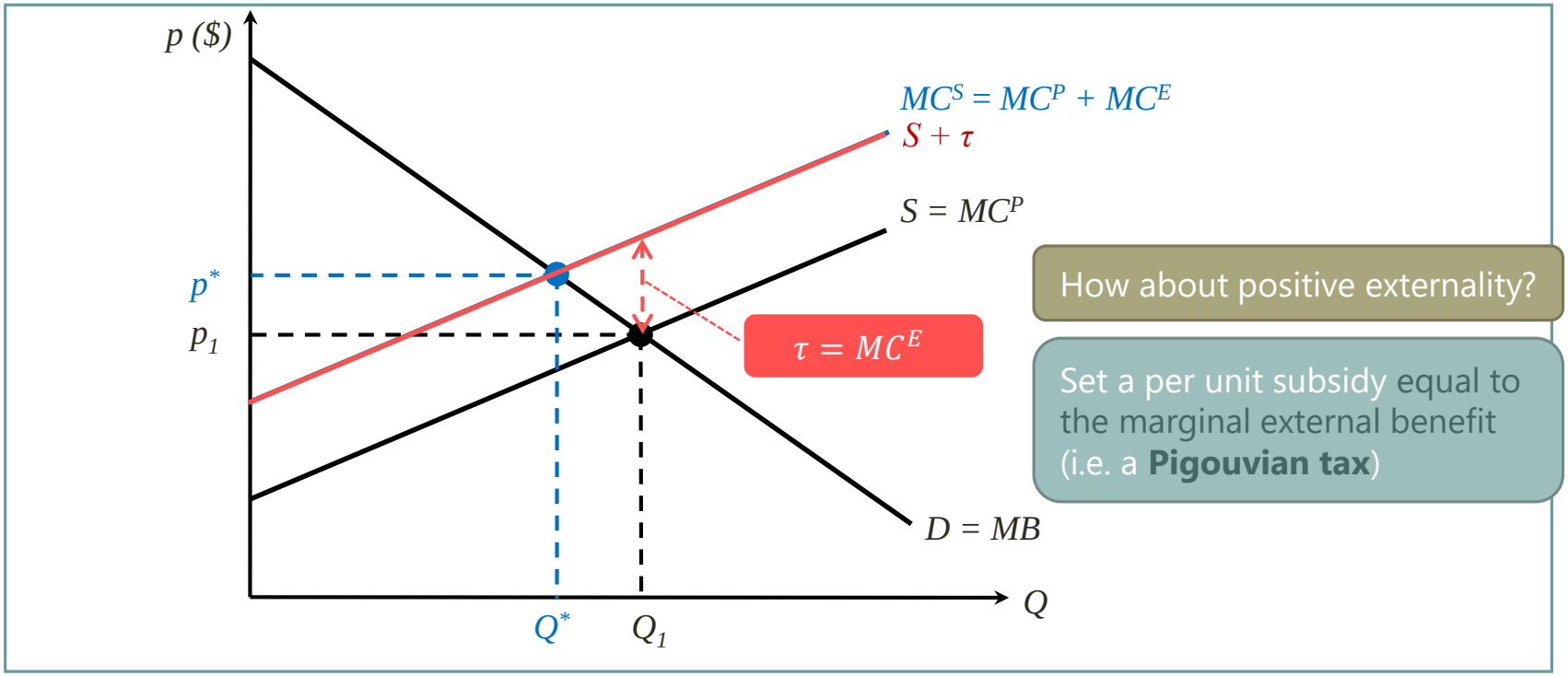
- However, who pays whom (and thus the distribution of income/wealth) depends on who owns the property rights.

- The Coase theorem requires that the bargaining can be conducted *without significant* transaction cost.
  - The number of people involved therefore is a major concern.
  - For instance, if the firm owns the property right, residents must group together to negotiate with the firm. However, bargaining may be even more difficult to conduct because, once the agreement is reached; the impact is nonrival and nonexclusive.



9. EXTERNALITY AND GOVERNMENT INTERVENTION

- Taxes or subsidies can help internalize externalities.
  - Set a per unit tax equal to the marginal external cost (i.e. a **Pigouvian tax**)
    - It leads to efficient output, as well as allocation.
  - Taxes can target the good (e.g. gasoline taxes) or on the externality itself (e.g. **carbon tax**)
    - Taxing the externality encourages cleaner technological change or adoption.



APPLICATION: PRICIER POP

- In 2011, Hungary introduced a wide tax on unhealthy foods (sugar, salt, fat, alcohol, energy drinks).
  - Almost 2/3 of Hungarians are overweight and nearly 1/3 are obese.
  - Tax rates vary by type of food.

- Effects:
  - **40% of manufacturers changed their recipes** to use fewer unhealthy ingredients.
  - Consumers shifted to cheaper and often healthier foods.
  - By 2015, the tax generated 61.3 billion forints to help cover the cost of public health care.

Ravenously Hungary

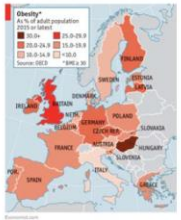
Taxes to trim waistlines are spreading across Europe

Hungary, the fattest EU member, is leading the charge

Print edition | Europe — Jun 10th 2017

VISIT any culinary establishment in Budapest and some of the reasons why Hungary is the most obese country in Europe will soon become clear. In the coffee houses, you'll see *dobostorta*, a five-layer chocolate buttercream concoction topped with glazed caramel; *somloi galuska*, a chocolate and rum sponge cake; and *gesztenyepure*, a chestnut purée served with whipped cream. In markets you can buy slabs of fried dough covered in cheese, bread served with goose fat and lumps of lard and, of course, lashings of goulash.

According to new data released by the OECD, a club of mostly rich countries, almost two-thirds of Hungarians are overweight and nearly a third are obese. Hungarians eat fewer vegetables than most people in the rich world and more salt than any other EU state. Educated Hungarian men are at least as likely to be overweight as their unschooled male compatriots. Uneducated Hungarian women are 60% likelier to be obese than educated women; in slim Italy uneducated women are three times



Source: Ravenously Hungary, *The Economist*, June 10th, 2017

Source: Pricier pop, *The Economist*, March 19th, 2016

The Economist

A tax on sugar

Pricier pop

A levy on drinks may change recipes, but not waistlines

Mar 19th 2016 | From the print edition



BRITAIN'S government wants its citizens to strive, not slurp. The budget on March 16th unveiled a new levy on sugary drinks, to be implemented by April 2018. Jamie Oliver, a television chef and sugar-tax evangelist, danced for joy outside Parliament. Shares in fizzy-drinks companies fell (though those of Tate & Lyle, a food company, recovered once traders remembered that the firm sold off its sugar business in 2010).

Stand back, it's time for a shake-up

The policy's advocates hope that it will reduce sugar consumption, slimming the nation's children and taking a weight off the National Health Service. The government believes that obesity and its related diseases cost the NHS £27 billion ($39 billion) a year. A levy on drinks makes particular sense because, unlike some sugary foods, they tend to contain few other nutrients. Some studies also suggest that sugar is less filling when gulped than when gobbled, making people particularly prone to overindulging. The tax will reduce the Treasury's need to tighten its own belt, raising £520m in its first year. The proceeds are earmarked for extra sport in schools.

euronews.

Scotland curbed alcohol deaths by raising prices on cheap booze. Will Europe follow suit?

Gabriela Galvin
Wed, October 30, 2024 at 2:00 PM GMT+8



Scotland curbed alcohol deaths by raising prices on cheap booze. Will Europe follow suit?

When Scots walked into their local supermarket in late September, the cheapest bottle of whisky they could find was £14 (€16.80). The next day, it was £18.20 (€21.84).

The change is the result of Scotland's minimum unit pricing (MUP) law, which set a floor price for alcohol bought at supermarkets to try to discourage the kind of risky drinking that lands people in the hospital.

First implemented at £0.50 (€0.60) per unit in 2018, lawmakers agreed in April to raise the floor to £0.65 (€0.78) this autumn to match inflation.

It also marked an important moment in a country that continues to struggle with the **health consequences** of excessive drinking.

"I saw [low-cost alcohol] cut a swathe through my patients," said Dr Peter Rice, a psychiatrist who was working at an alcohol clinic in rural Scotland when he

- Scotland set a minimum unit price (MUP), i.e. price floor, for alcohol to reduce excessive drinking.
  - Introduced at £0.50 per unit in 2018, raised to £0.65 in 2024 to match inflation.
- Results:
  - Alcohol-related deaths dropped by an estimated 13.4%
  - Alcohol-related hospitalizations dropped by 4.1%
  - But no significant effect on deaths from alcohol poisoning.
- "…it was delivering benefits to people who were at a very high risk of death … but alone, it's not enough as a policy to reverse the trajectory that we're on," said Dr Tara Shivaji, a PHS consultant focused on alcohol and drugs.

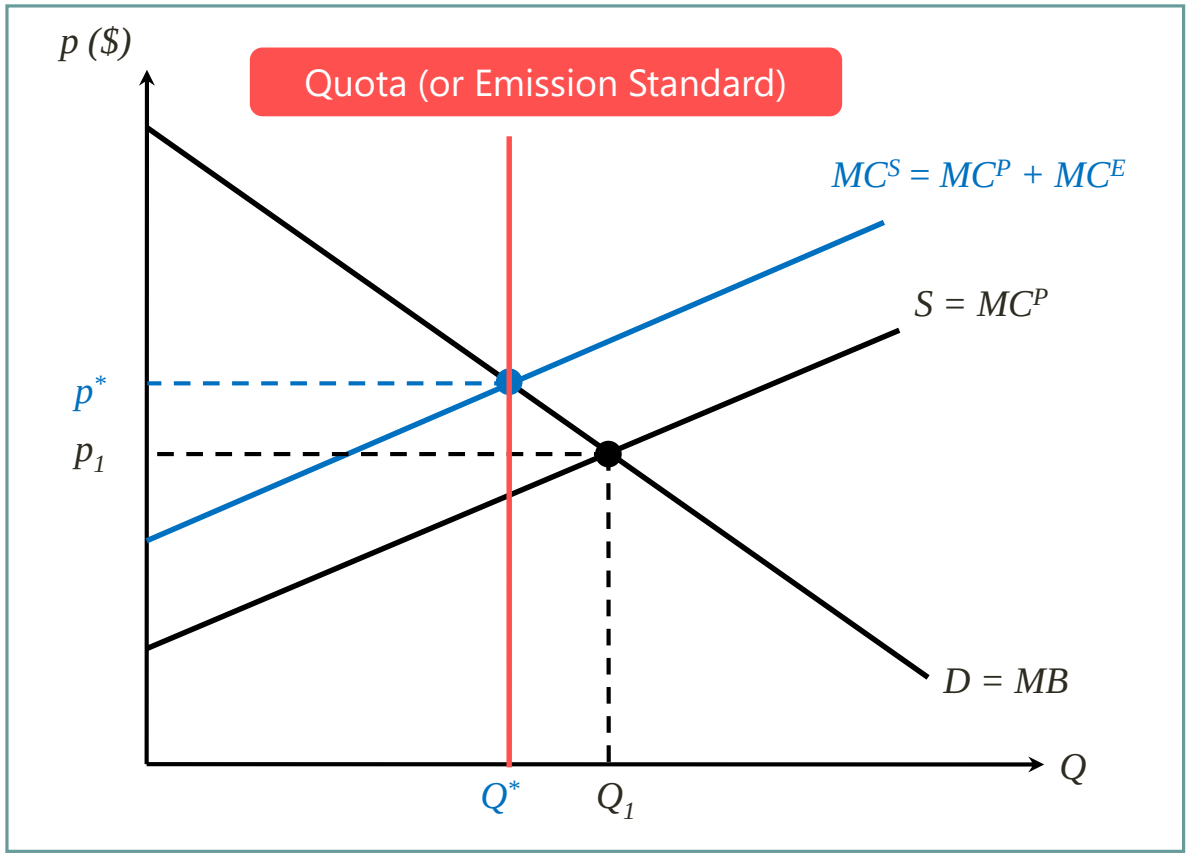


APPLICATION: SCOTLAND'S MUP ON ALCOHOL

(Source: Scotland curbed alcohol deaths by raising prices on cheap booze. Will Europe follow suit?, *euronews*, Oct 30th, 2024.)

9. EXTERNALITY AND GOVERNMENT INTERVENTION

- Governments can set **quotas** (limits), such as **emission standards**, to control externality
  - It guarantees the efficient *total* quantity of output (or externality)
  - However, the allocation of quota among users may not be efficient.



If both high-cost and low-cost firms get equal quotas, reducing pollution is more expensive overall.

Any solutions?

9. EXTERNALITY AND GOVERNMENT INTERVENTION

- **Tradable Permits** (Cap and Trade)
  - Government sets a cap on total emissions and issues permits. Each permit allows a company to emit a certain amount.



  - Permits can be traded:
    - High-cost firms (more costly to reduce pollution) will buy permits.
    - Low-cost firms (cheaper to cut pollution) will sell permits.
  - Total pollution remains unchanged (to the public), but trading ensures reductions happen where it's cheapest (efficient allocation).

10. COMMON POOL RESOURCE GOODS



- Common pool resources are goods that are rival but nonexcludable.
  - Examples: fisheries, grazing land, forests.

- **Tragedy of the commons**:
  - When individuals overuse a common resource, leading to depletion or environmental harm (acting in self-interest, everyone loses).

- Solutions to the tragedy of the commons are similar to those discussed for externalities.
  - Taxes/fees, Tradable permits, etc.