Externalities and Pigouvian Taxes

EC313 - Public Economics: Taxation

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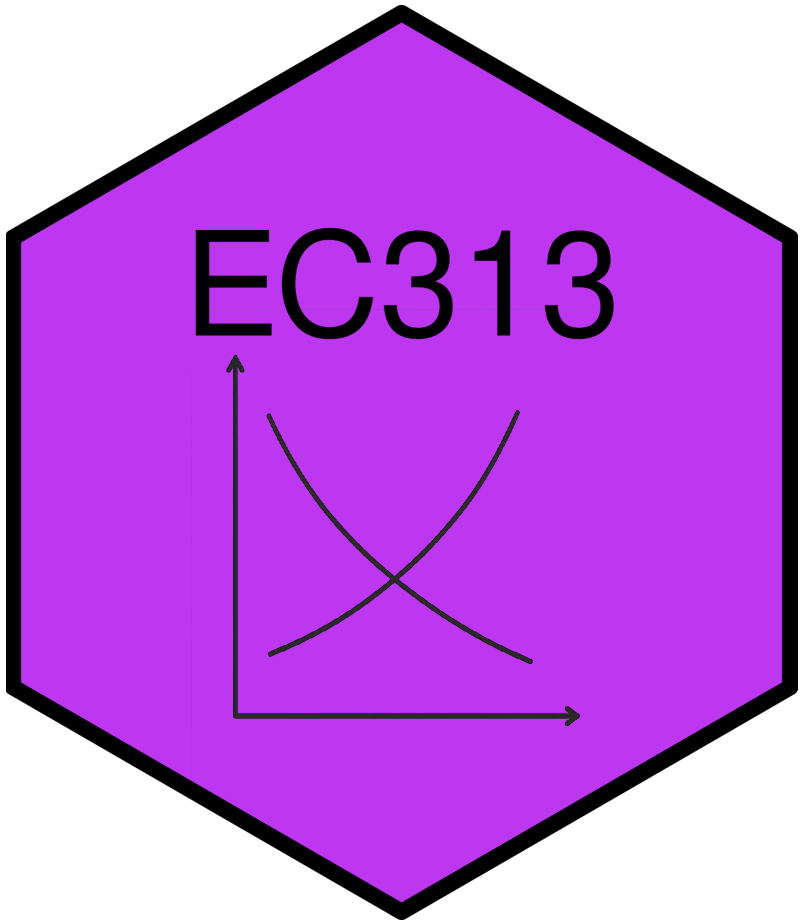

Goals of This Section

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- Define and discuss externalities
- Differentiate between negative and positive externalities
- Discuss private responses to externalities
- Discuss public responses to externalities, including Pigouvian taxes and subsidies

Externalities

Defining Externalities

- Absent any market failures, economic theory says private markets lead to efficient outcomes
- Resources are allocated to their best possible uses
- This is the first fundamental theorem of welfare economics
- However, in some cases, private markets fail to achieve efficiency
- One important source of market failure is externalities
  - An **externality** is a cost or benefit imposed on a third party not involved in a market transaction

Defining Externalities

- Some examples of negative externalities
  - Carbon emissions: pollution from burning fossil fuels harms the environment and public health
  - Crypto mining: high energy consumption leads to increased greenhouse gas emissions
  - Noise pollution: loud nightclubs disturb nearby residents
  - Fertilizer runoff: agricultural chemicals contaminate water supplies
- Some examples of positive externalities
  - Vaccinations: immunized individuals reduce disease spread, benefiting others
  - Education: educated individuals contribute to a more informed and productive society
  - Public parks: green spaces enhance community well-being and property values
  - Research and development: innovations can lead to widespread technological advancements

David Suzuki on Externalities

OPINION

David Suzuki needs an economics refresher course

MIKE MOFFATT >
SPECIAL TO THE GLOBE AND MAIL
PUBLISHED OCTOBER 10, 2012

"But if you ask the economists, in that equation where do you put the ozone layer? Where do you put the deep underground aquifers of fossil water? Where do you put topsoil or biodiversity? Their answer is 'oh, those are externalities'. Well then you might as well be on Mars, that economy is not based in anything like the real world," Dr. Suzuki goes on to say.

Dr. Suzuki's remarks on externalities were clarified in an interview given to the magazine Common Ground: "I won't go into a long critique, but currently nature and nature's services – cleansing, filtering water, creating the atmosphere, taking carbon out of the air, putting oxygen back in, preventing erosion, pollinating flowering plants – perform dozens of services to keep the planet happening. But economists call this an 'externality.' What that means is "We don't give a shit." It's not economic. Because they're so impressed with humans, human productivity and human creativity is at the heart of this economic system. Well, you can't have an economy if you don't have nature and nature's services, but economics ignores that. And that's an unbelievably egregious error."

Defining Externalities

- Economic problem with externalities
  - When externalities are present, private markets may not allocate resources efficiently
  - Negative externalities can lead to overproduction of harmful goods
  - Positive externalities can lead to underproduction of beneficial goods
- In these instances, there are possible solutions to the inefficiency
  - Private solutions: negotiation between affected parties (Coase theorem)
  - Public solutions: government intervention through taxes, subsidies, or regulations

Characteristics of Externalities

- Can be produced by individuals, firms, or governments
  - Usually think of firms polluting
  - Individuals can also create externalities (e.g., loud parties, smoking in public)
- They are reciprocal
  - One party's actions can create externalities for another party, and vice versa
  - Example: a factory polluting a river affects downstream residents, but protesting and restricting them affects the factory's operations
- Can be positive or negative
  - Negative externalities impose costs on others (e.g., pollution)
  - Positive externalities provide benefits to others (e.g., education)

Characteristics of Externalities

- Sometimes hard to distintuish from public goods
  - Public goods are goods that are non-excludable and non-rivalrous
  - Externalities can sometimes have similar characteristics (e.g., clean air)
  - Key difference is intention
    - Externalities are unintended side effects of economic activities
    - Public goods are intentionally provided for the benefit of all
  - Example: public fireworks may are both a public good and create externalities
    - Created intentially for everyone to enjoy
    - But people living nearby may experience noise pollution (negative externality)

Inefficiency of Externalities

Negative Externalities

- Inefficiency of externalities comes from the divergence between private and social costs/benefits
  - Individuals involved in a market transaction only consider their private costs and benefits
  - Typically ignore the social costs
- With negative externalities this leads to overproduction
- In this section we outline how that happens

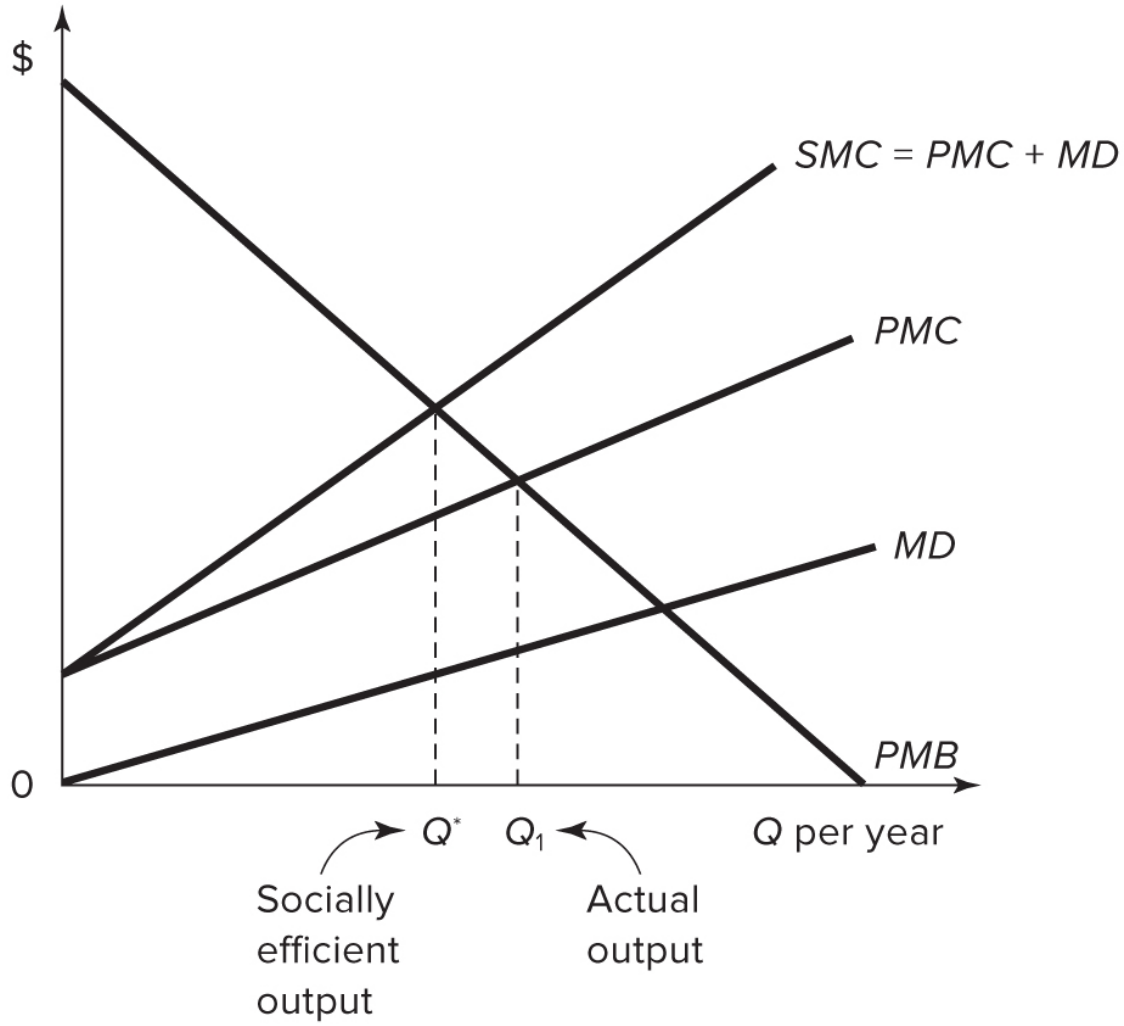
Negative Externalities

- Consider two individuals
  - Azul: operates factory that dumps waste into a river
  - Jules: fisherman downstream from Azul's factory
- Water pollution affects Jules' ability to fish
- Nobody owns the river that is polluted
  - This is key to the externality
  - If someone owned the river, a price mechanism could be established to account for pollution
  - But without ownership, it is used at a zero price
- The water is a scarce resource that can be used up
  - Polluting it reduces the amount of clean water available for others

Negative Externalities

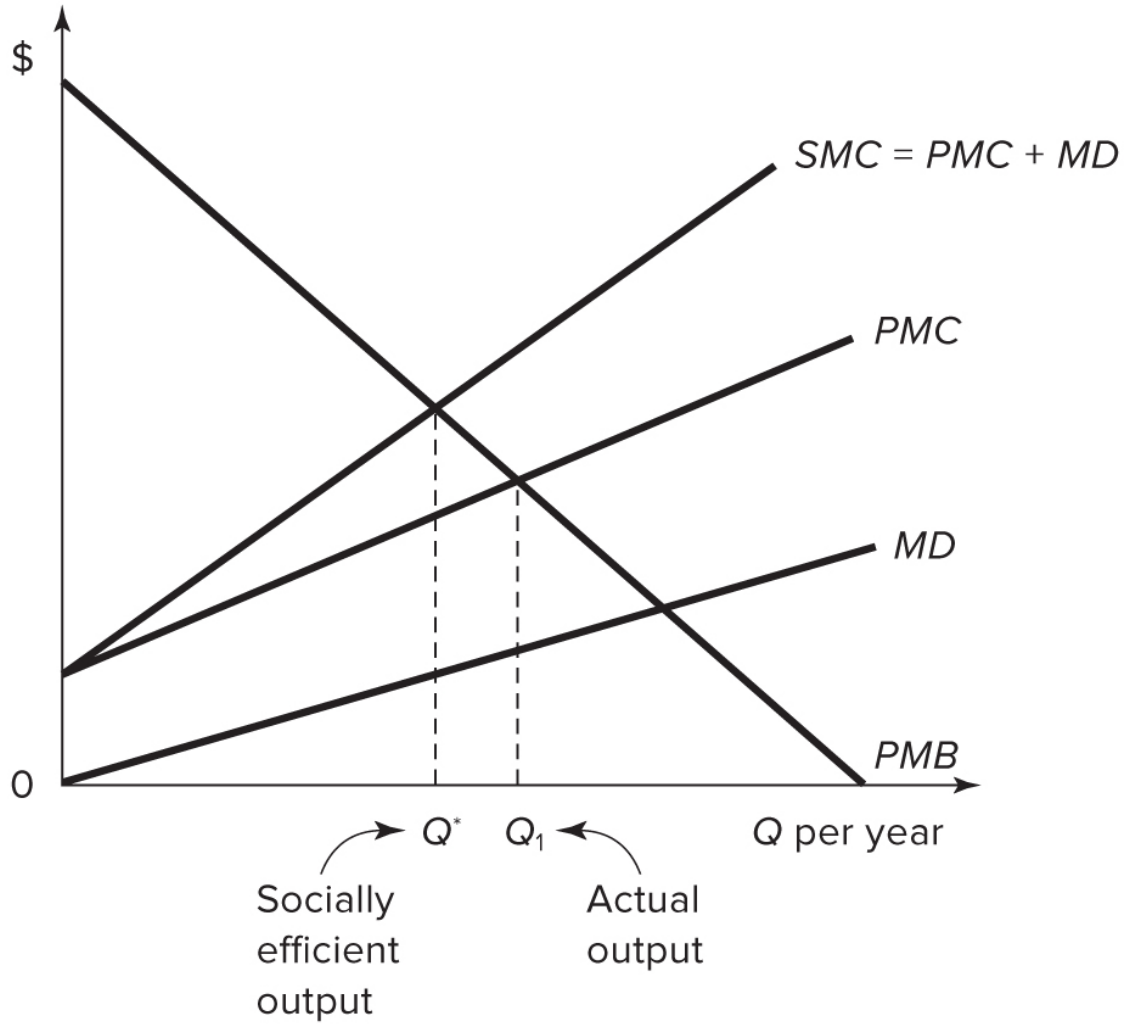
- Consider how much output Azul chooses to produce
- He faces private marginal cost (PMC) and private marginal benefit (PMB)
  - The costs and benefits that apply only to him
  - Ignores the costs imposed on others
- Azul produces where PMB = PMC

Negative Externalities



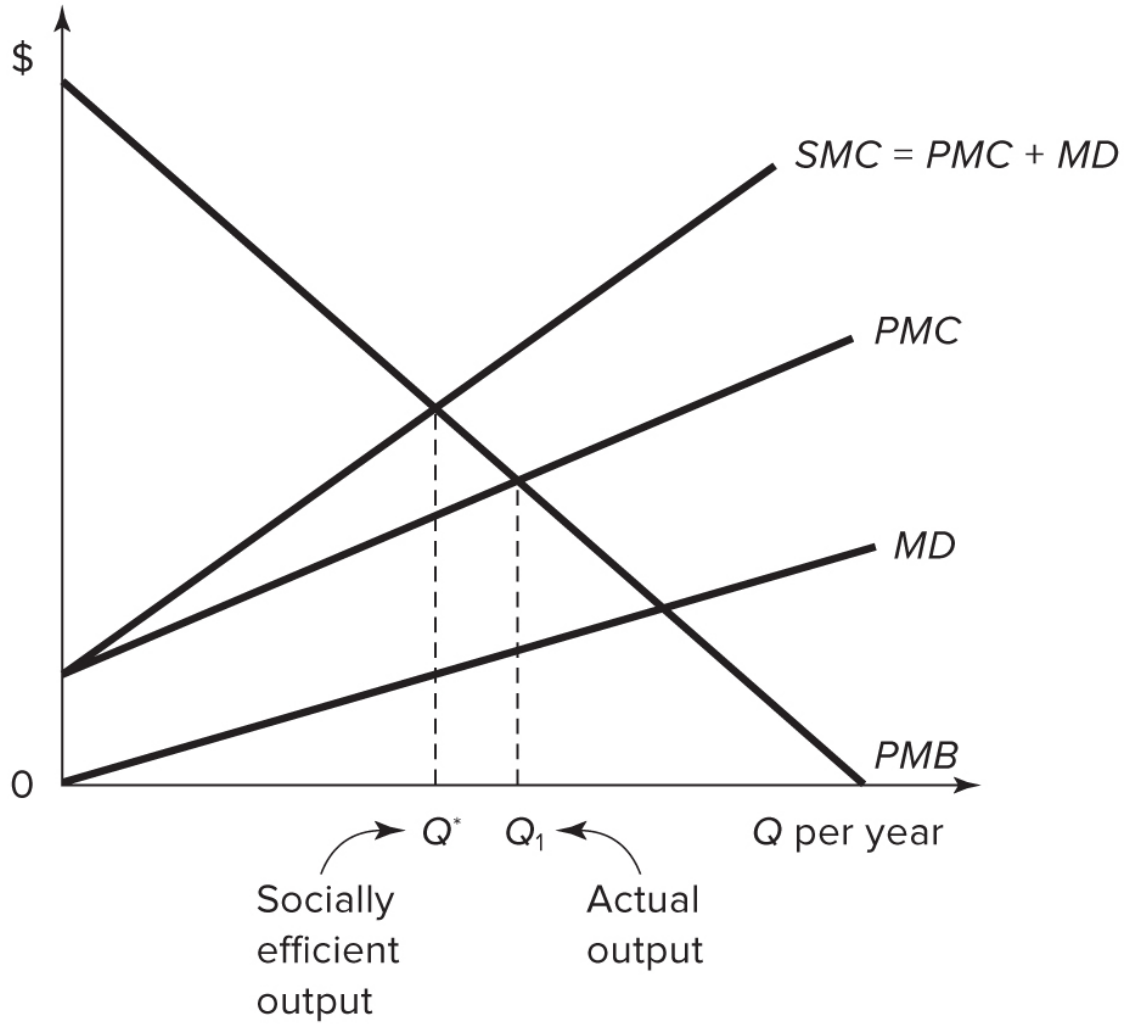
- Azul's private benefit (PMB) and cost (PMC) depicted to the left
- The PMC is upward sloping
  - Costs increase as output increases
- PMB is downward sloping
  - Benefits decrease as output increases
- Produce where PMB = PMC
- Output Q_1

Negative Externalities



- Azul's production also creates damage to the river
  - This damage imposes costs on Jules
- Assume that the marginal damage (MD) increases with output
  - Each additional unit of output causes more damage than the last
- Depicted on graph as the upward sloping MD curve

Negative Externalities

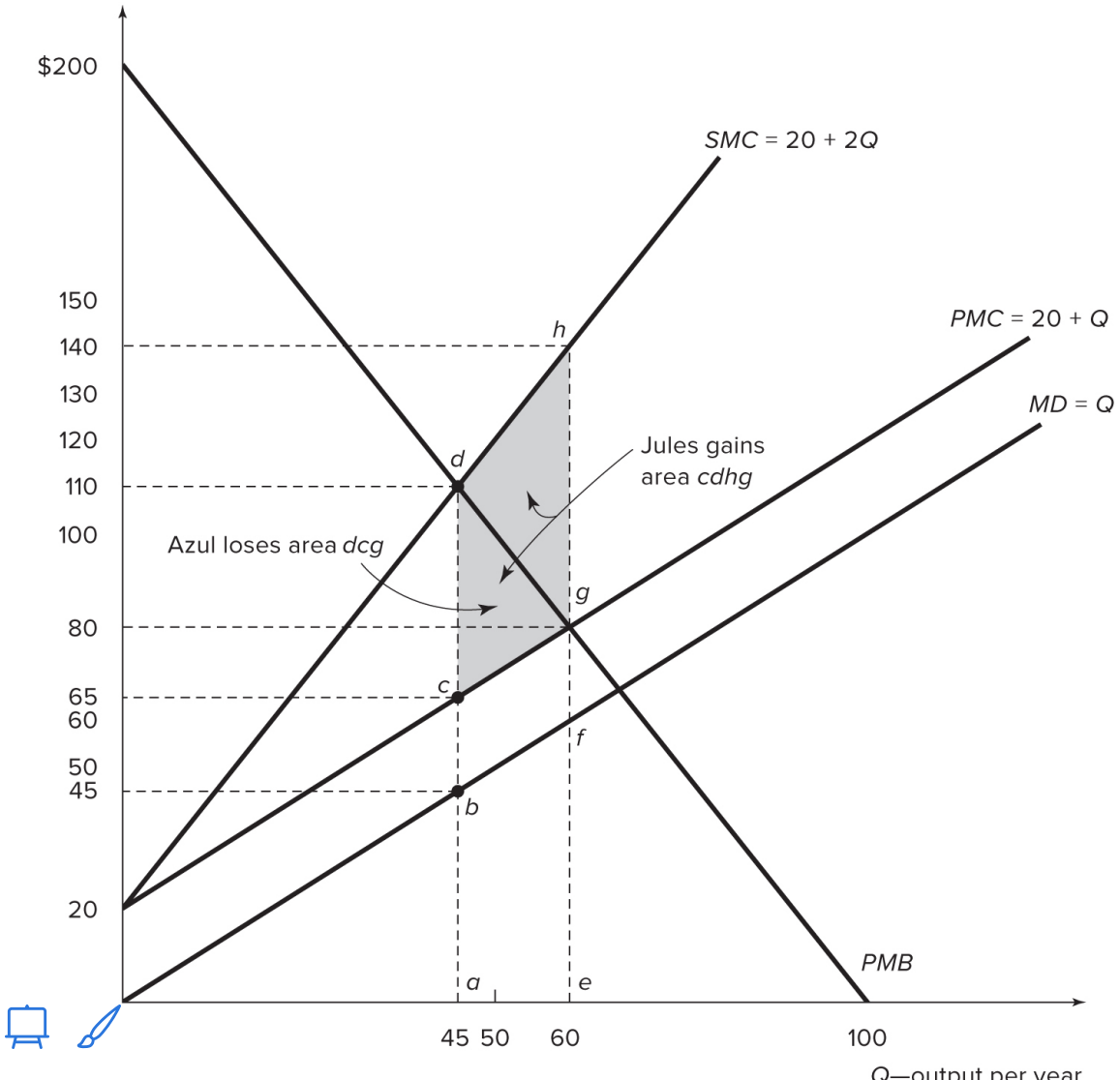


- The social cost of production includes both the private cost and the damage to others
  - Social marginal cost (SMC) = PMC + MD
- SMC curve lies above the PMC curve by the amount of MD
- SMC is what costs Azul would face if they had to pay for the damage they cause
- Assume that the private and social benefits are the same (PMB = SMB)
- From a social point of view, optimum is where PMB = SMC

Negative Externalities

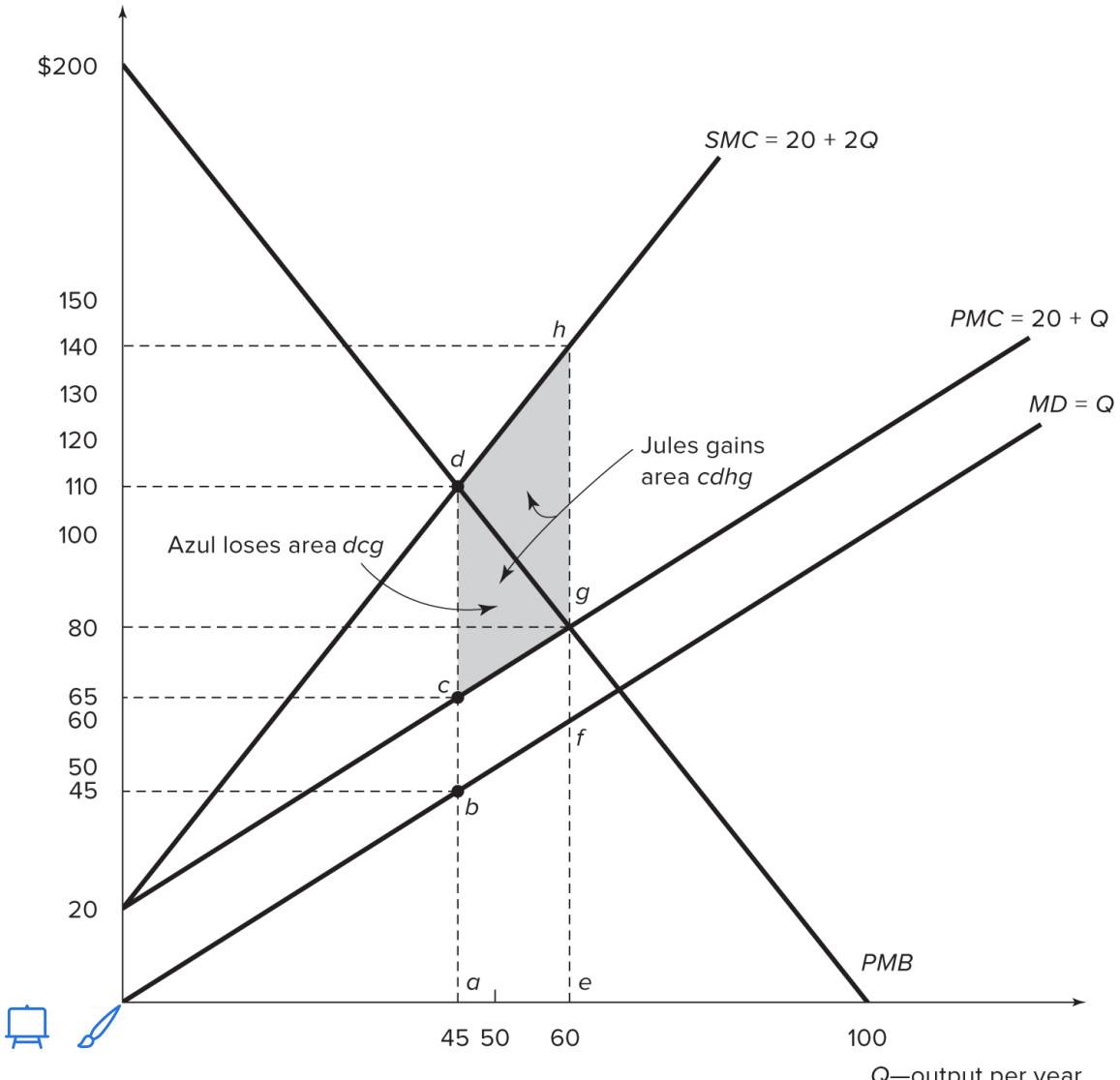
- Ignoring the negative externality leads to overproduction
  - Too much cost to society relative to the benefits
- This creates and inefficiency
- We can quantify the inefficiency using the graph
- Figure on next slide shows the inefficiency with some hypothetical numbers

Negative Externalities



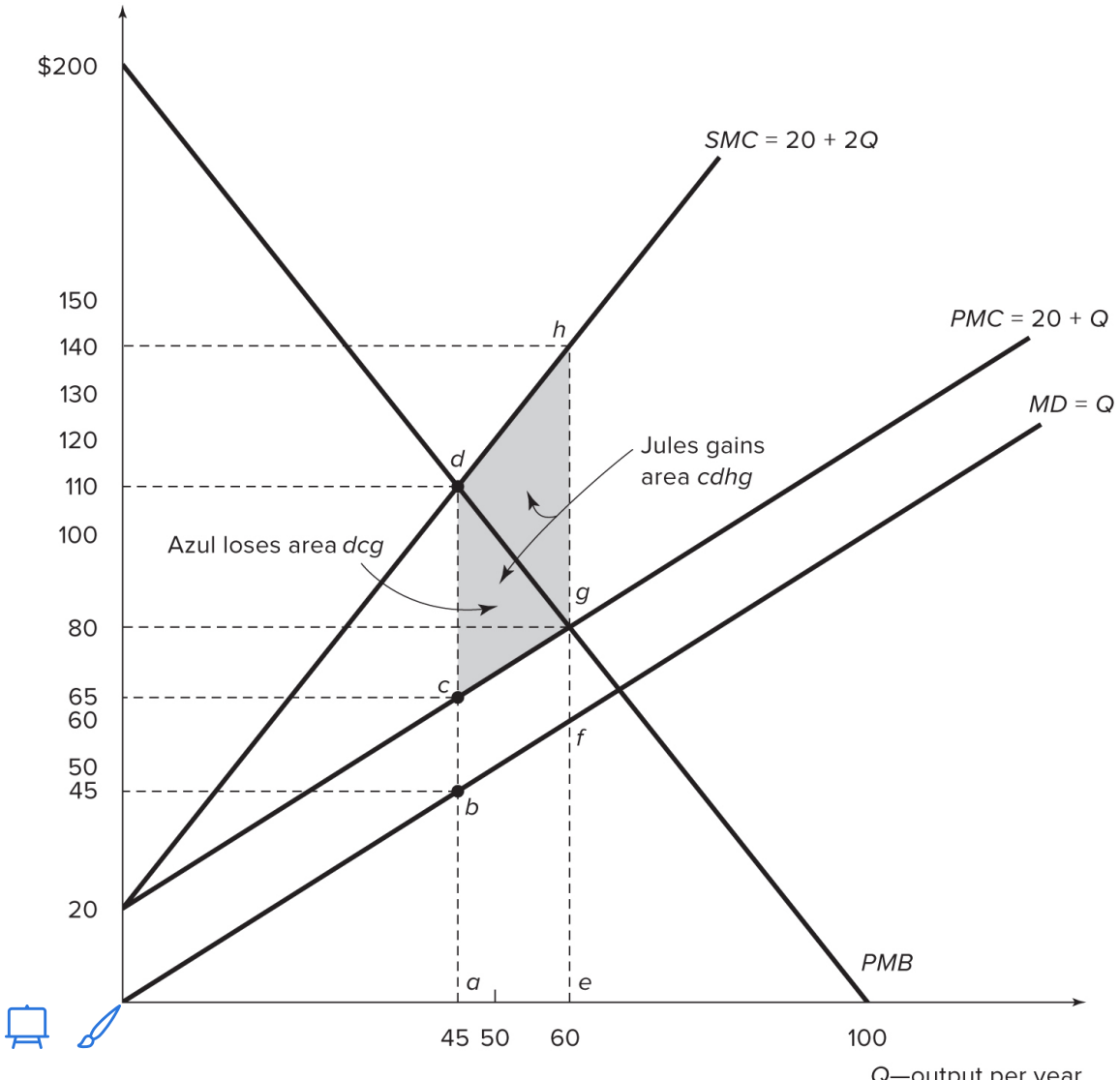
- Suppose we produce where PMB = PMC
- Total benefit to Azul from production is area under PMB curve
  - Like adding up marginal benefits for each unit produced
- Total cost to Azul is area under PMC curve
- **Net** to Azul gain is area between total benefit and total cost

Negative Externalities



- From a societal point of view, we need to account for damage to Jules
- Total damage to Jules is area beneath MD curve between private and social optimum
  - Area abfe
- It is equivalent to the area between PMC and SMC curves
  - Area cdhg
- There is a societal loss of area dhg
  - Overproduction means costs to society exceed benefits

Negative Externalities



- What happens if we reduce output to the social optimum?
- There is a gain for Jules, but a loss for Azul
- Jules gains area cdhg
  - Reduction in production means less harm to him
- Azul loses area dcg
  - Produces less and benefits less privately
- Society gains area dhg

Negative Externalities

- What activities tend to pollute and cause negative externalities?
  - Manufacturing and industrial processes
  - Transportation (cars, trucks, airplanes)
  - Energy production (coal, oil, natural gas)
  - Agriculture (fertilizers, pesticides, livestock)
  - Waste disposal (landfills, incineration)
  - Many of these produce smog, which pollutes the air and travels long distances
- Which pollutants do harm?
  - Particulate matter (PM2.5 and PM10): tiny particles that can penetrate lungs and cause respiratory issues
  - Nitrogen oxides (NOx) and sulfur dioxide (SO2): contribute to acid rain and respiratory problems

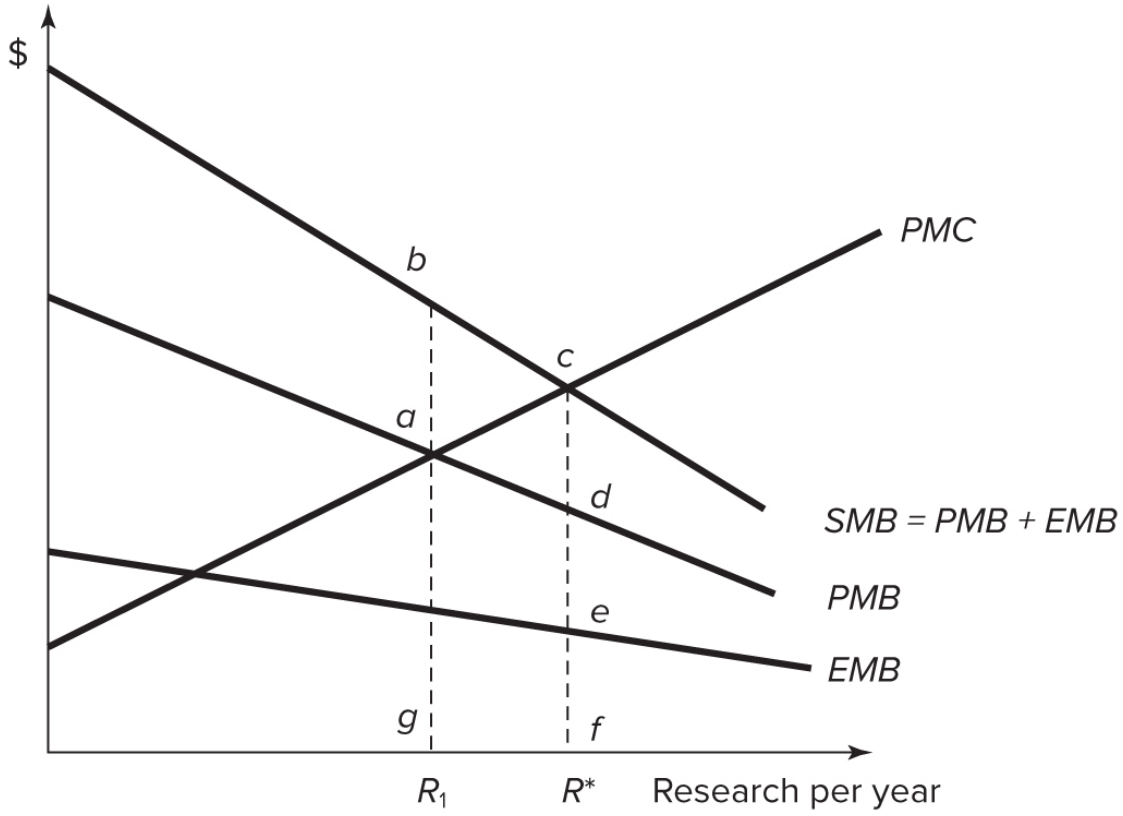
Negative Externalities

- What is the value of the damage?
  - Difficult to measure precisely
  - Economists have used differences in house prices in areas with different levels of pollution
  - Illustrates how much people are willing to pay to avoid pollution
  - But can be complicated by other factors affecting house prices

Positive Externalities

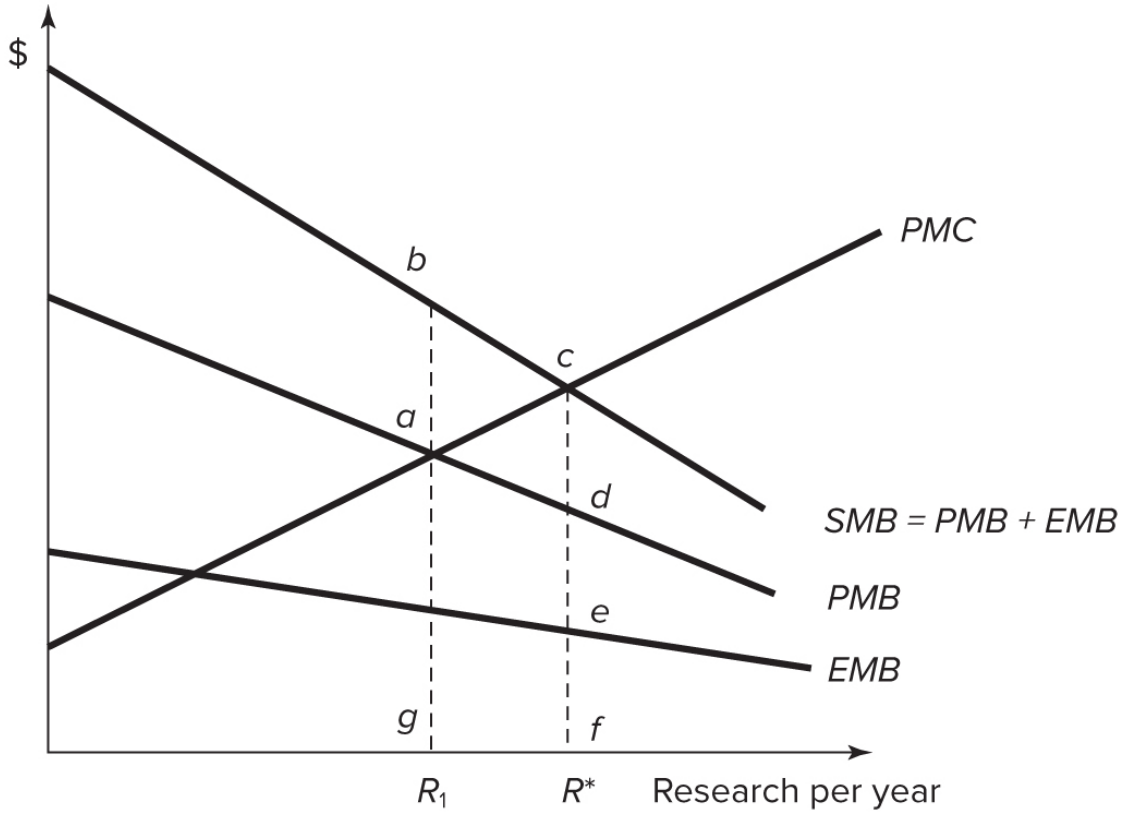
- Less salient, but some production leads to positive externalities
  - Vaccinations: reduce disease spread, benefiting others
  - Education: educated individuals contribute to a more informed and productive society
  - Public parks: green spaces enhance community well-being and property values
  - Research and development: innovations can lead to widespread technological advancements
- Can lead to similar inefficiencies
  - This time due to underproduction

Positive Externalities



- Private and social costs are assumed equal
- Private and social benefits differ by an external marginal benefit
  - SMB = PMB + EMB
- Optimum ignoring externalities is where PMB = PMC
- Social optimum is where SMB = PMC
  - At higher level of output

Positive Externalities



- Can illustrate inefficiency using areas on the graph
- The unrealized benefit to society from underproduction is area under EMB
  - Equivalently, area between PMB and SMB curves bcda
- If we move to the social optimum
  - Society gains area bcda
  - Individual loses acd through extra production
- Total gain is area abc

Private Solutions to Externalities

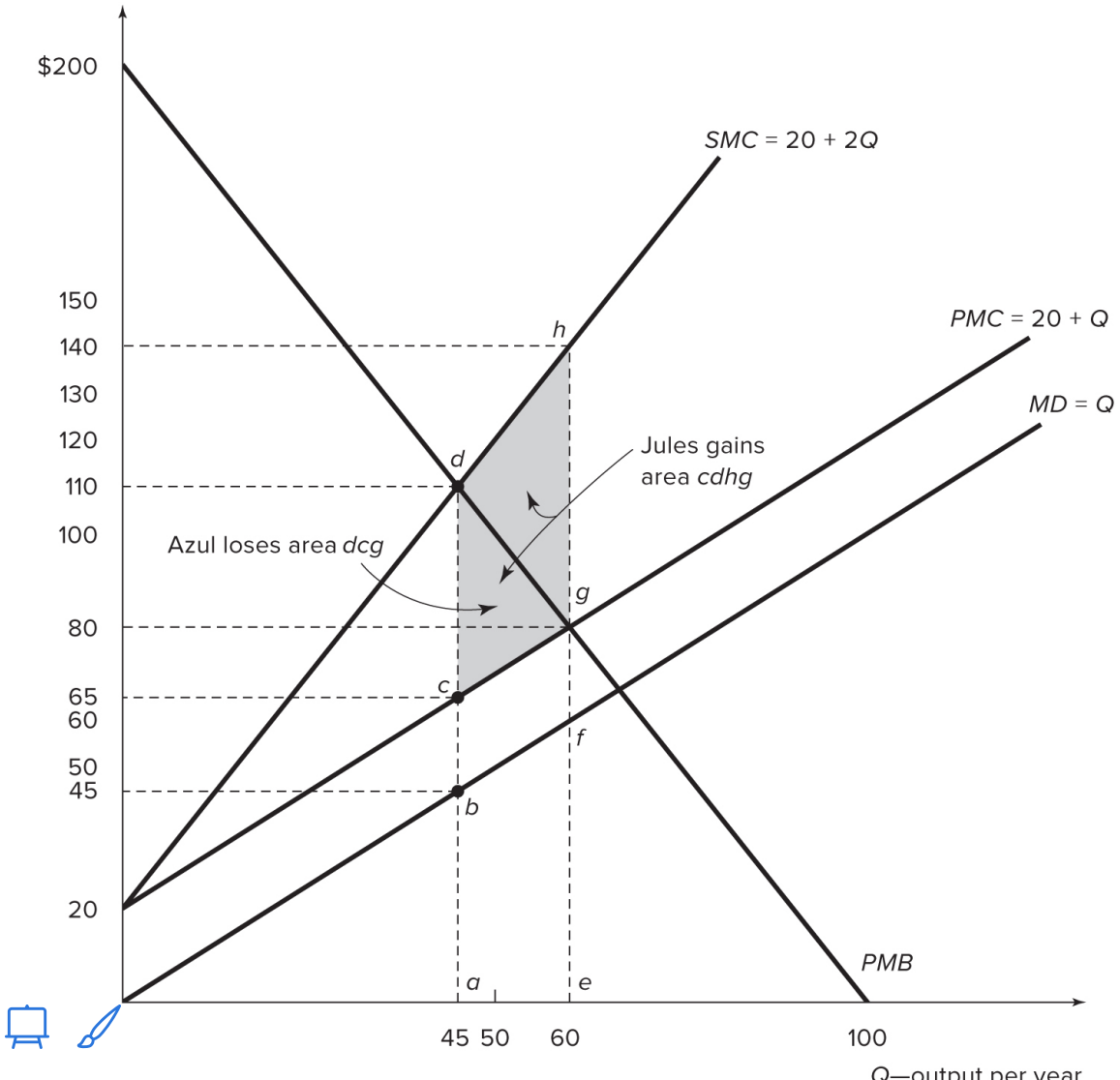
Introduction

- With market failures, government can intervene to get to efficient outcome
- But they do not have to
- In the case of externalities, private solutions are sometimes possible
- Issue with externalities is that property rights are not well defined
  - Example: nobody owns the river that Azul pollutes
- Can be solved by allocating property rights

Coase Theorem

- **Coase Theorem**: if property rights are well defined and transaction costs are low, private parties can negotiate to resolve externalities efficiently
  - It does not matter who owns the property rights
- Suppose Azul owns the river
  - Azul has the right to pollute
  - Would be willing to not produce an extra unit if he is paid PMB-PMC or more
  - Jules would pay Azul to not produce if the payment is less than MD
  - Payments could happen if PMB-PMC > MD

Coase Theorem

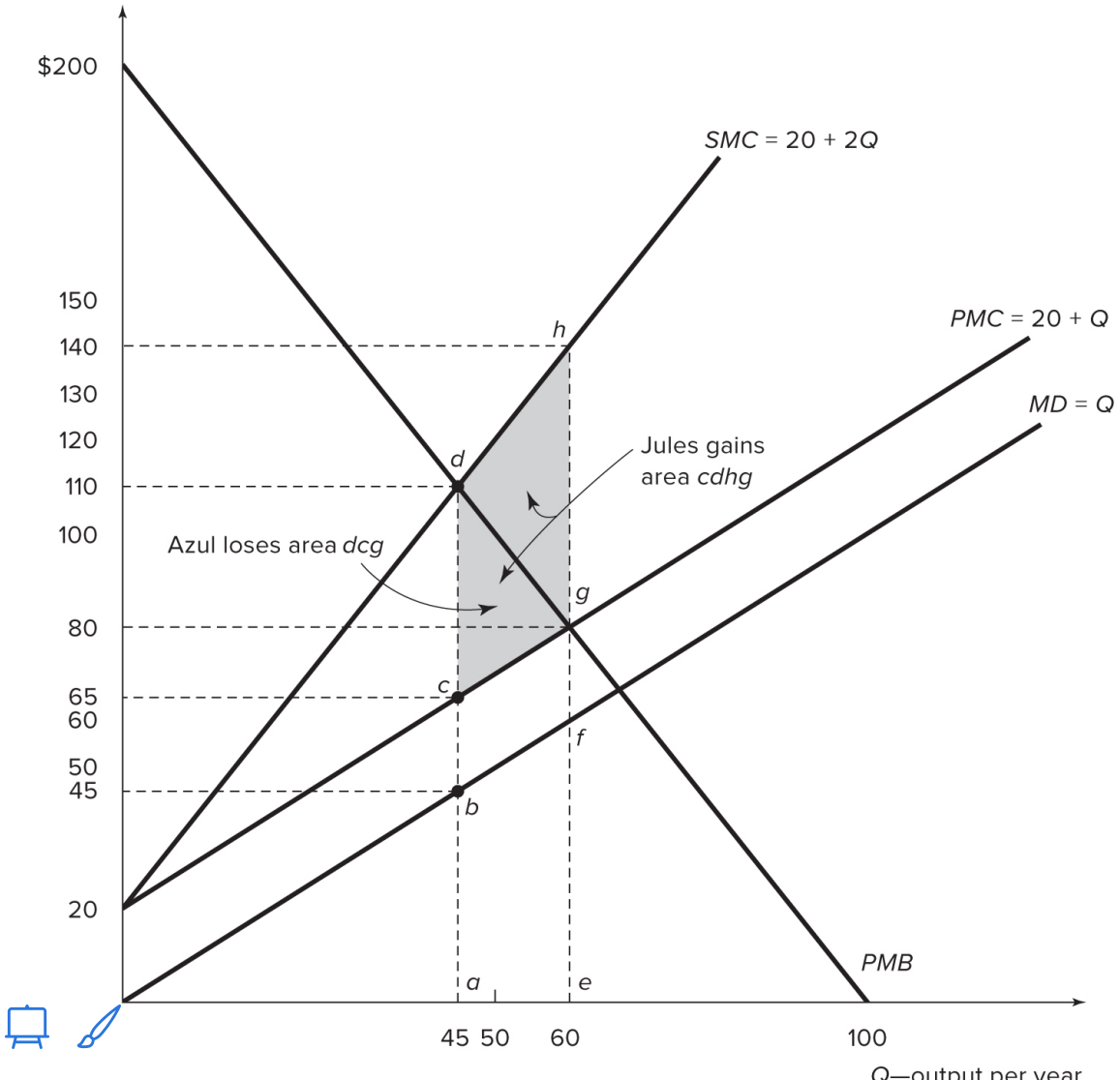


- Suppose Azul owns the river and is currently producing the private optimum
  - Marginal damage at that point is ef
  - PMB-PMC for Azul is zero
  - Jules could pay to not produce that unit
- At every output above the social optimum MD > PMB-PMC
  - Jules could pay Azul to reduce output
- At social optimum MD = PMB-PMC
  - No further mutually beneficial trades possible

Coase Theorem

- Bargaining also works if Jules owns the river
  - Azul would pay Jules to allow pollution
- Azul would pay up to PMB-PMC to pollute
- Jules takes that payment if it is more than MD
- Bargaining stops where PMB-PMC = MD

Coase Theorem



- Consider starting at zero and moving up
- Will Azul produce the next unit?
- At low levels of output, PMB-PMC is large, and MD is small
  - Worth it for Azul to produce and pay for damage
- As more units are produced, PMB-PMC falls and MD rises
- They are equal when production reaches social optimum

Coase Theorem

- Coase won a Nobel prize for this insight into externalities
- However, there are limitations
  - Transaction costs may be high
  - Many parties may be involved
  - Property rights may be hard to define or enforce
- Air pollution is good example of these problems
  - Many polluters and many affected parties
  - Hard to assign property rights to air

Mergers

- The Coase Theorem is an example of internalizing an externality
  - Making it part of the costs or benefits of the decision maker
- Another way to internalize an externality is through mergers
  - If Azul and Jules merge into one firm, the externality disappears
  - The new firm considers both private costs and damages

Social Conventions

- Sometimes social conventions can help solve externalities
  - People may voluntarily reduce negative externalities to avoid social disapproval
  - Example: littering, smoking in public
- However, social conventions may not be sufficient for large-scale externalities
  - Example: climate change requires coordinated action beyond social norms

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