Externalities

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Vassar College

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Should We Tax People for Being Annoying?

JAN. 8, 2013

It's the Economy

By ADAM DAVIDSON

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Driving home during the holidays, I found myself trapped in the permanent traffic jam on I-95 near Bridgeport, Conn. In the back seat, my son was screaming. All around, drivers had the menaced, lifeless expressions that people get when they see cars lined up to the horizon. It was enough to make me wish for congestion pricing — a tax paid by drivers to enter crowded areas at peak times. After all, it costs drivers about $16 to enter central London during working hours. A few years ago, it nearly caught on in New York. And on that drive home, I would have happily paid whatever it cost to persuade some other drivers that it wasn't worth it for them to be on the road.

Instead, we all suffered. Each car added an uncharged burden to every other person. In fact, everyone on the road was doing all sorts of harm to society without paying the cost. I drove about 150 miles that day and emitted, according to E.P.A. data, about 140 pounds of carbon dioxide. My very presence also increased (albeit infinitesimally) the likelihood of a traffic accident, further dependence on foreign oil and the proliferation of urban sprawl. According to an influential study by the I.M.F. economist Ian Parry, my hours on the road cost society around $10. Add up all the cars in all the traffic jams across the country, and it's clear that drivers are costing hundreds of billions of dollars a year that we don't pay for.

Illustration by Jasper Rietman

Adam Davidson, "Should we tax people for being annoying", New York Times Magazine, 1/8/2013.
http://www.nytimes.com/2013/01/13/magazine/should-we-tax-people-for-being-annoying.html

Learning goals

- Understand the concept of an externality as a mismatch between social and private marginal costs and benefits
- Understand how a lack of property rights (the Coase theorem) can generate externalities
- Evaluate different policy solutions to externalities
- Learn to estimate economic and social costs/benefits of externalities

Externalities

- 1WT assumes agents[1] **only** and **indirectly** affect others through prices
  - If someone demands more of a good, the price goes up
  - If someone supplies more of a good, the price goes down
- Realistically, people and firms affect each other in other ways
- **Externality**: When an agent's actions **directly** affects welfare
- Externalities affect economic efficiency of the equilibrium allocation:
  - An MRS[2] shows private marginal utilities; ignores how choices affect others

$$\underbrace{\frac{MU_x}{MU_y} = \frac{p_x}{p_y}}_{\text{Private MRS}}, \text{ while } \underbrace{\frac{MU_x - MD_x}{MU_y} < \frac{p_x}{p_y}}_{\text{Social MRS includes marginal damage}} \Rightarrow \text{Overprovision of } x!$$

[1] Fancy word for people or firms

[2] And/or producers' MRTS

Can you name some negative externalities?

- pollution
- traffic congestion
- fishing (common resource problem)
- passive smoking
- smoking — its effect on future health
- Behaviors changing the risk of infectious diseases

Context for externalities

- Externalities may be positive or negative
- They may be generated by activity of consumers or firms
- Effects operating through the price mechanism are not externalities
  - Is hoarding toilet paper a negative externality? No, price accounts for it.
  - **Caveat:** The price may incompletely reflect an externality
- Externalities are due to a lack of trading (non-existence or non-enforcement of property rights)

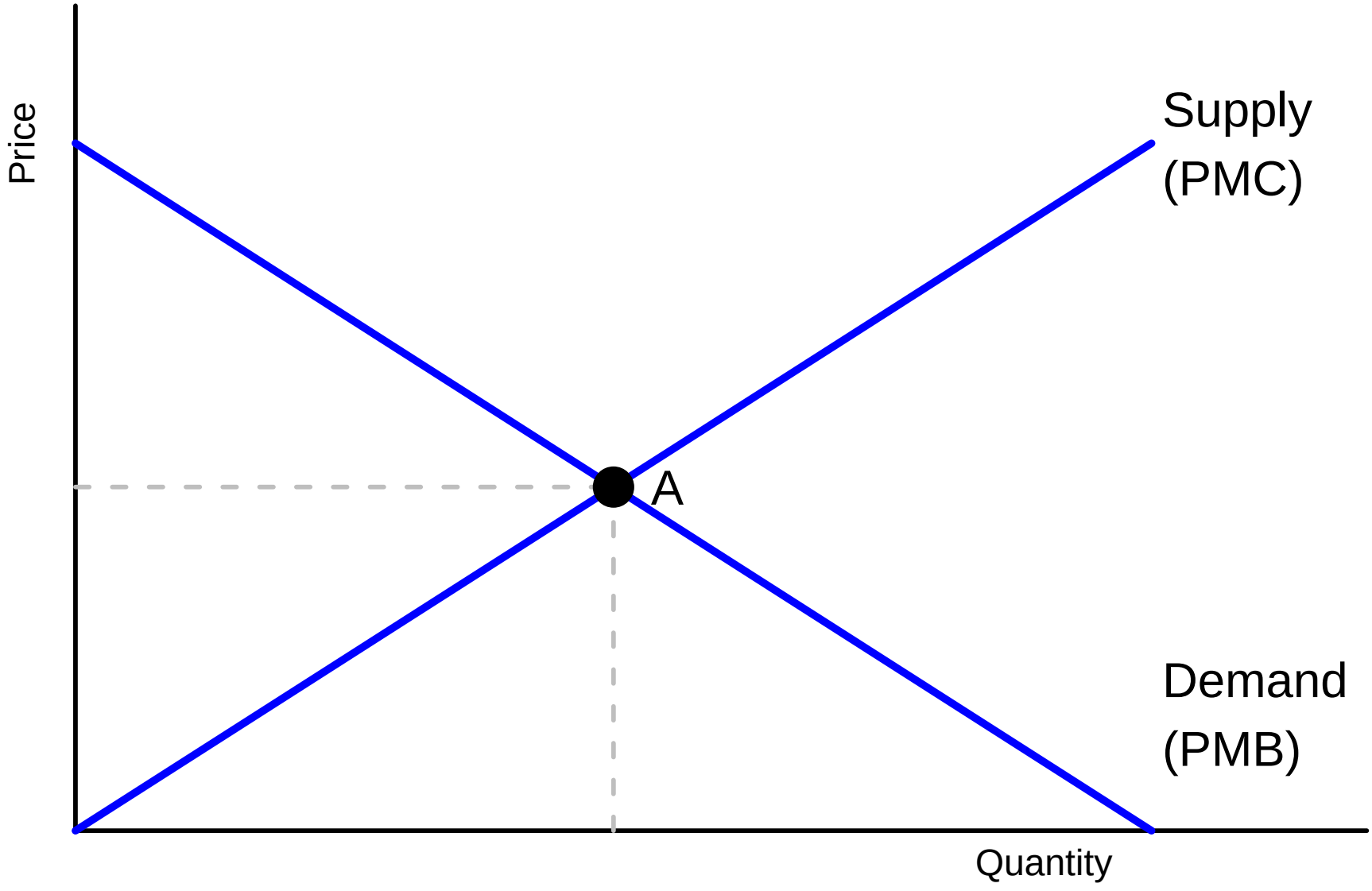
Definitions: Private and Social Marginal Benefits and Costs

- **Private marginal benefit (PMB)**: the direct benefit to the consumer of consuming an additional unit of a good
- **Private marginal cost (PMC)**: the direct cost to the producer of producing an additional unit of a good
- What are they in a model of market equilibrium?
  - **PMB** = **Demand** – marginal willingness to pay for a good
  - **PMC** = **Supply** – marginal cost of producing a good
  - Both often represented by price in the demand/supply framework
- **Social marginal benefit (SMB)**: the PMB to consumers plus any (uncompensated) benefits or minus any (unpaid) costs to others
- **Social marginal cost (SMC)**: the PMC to producers plus any (unpaid) costs or minus any (uncompensated) benefits to others

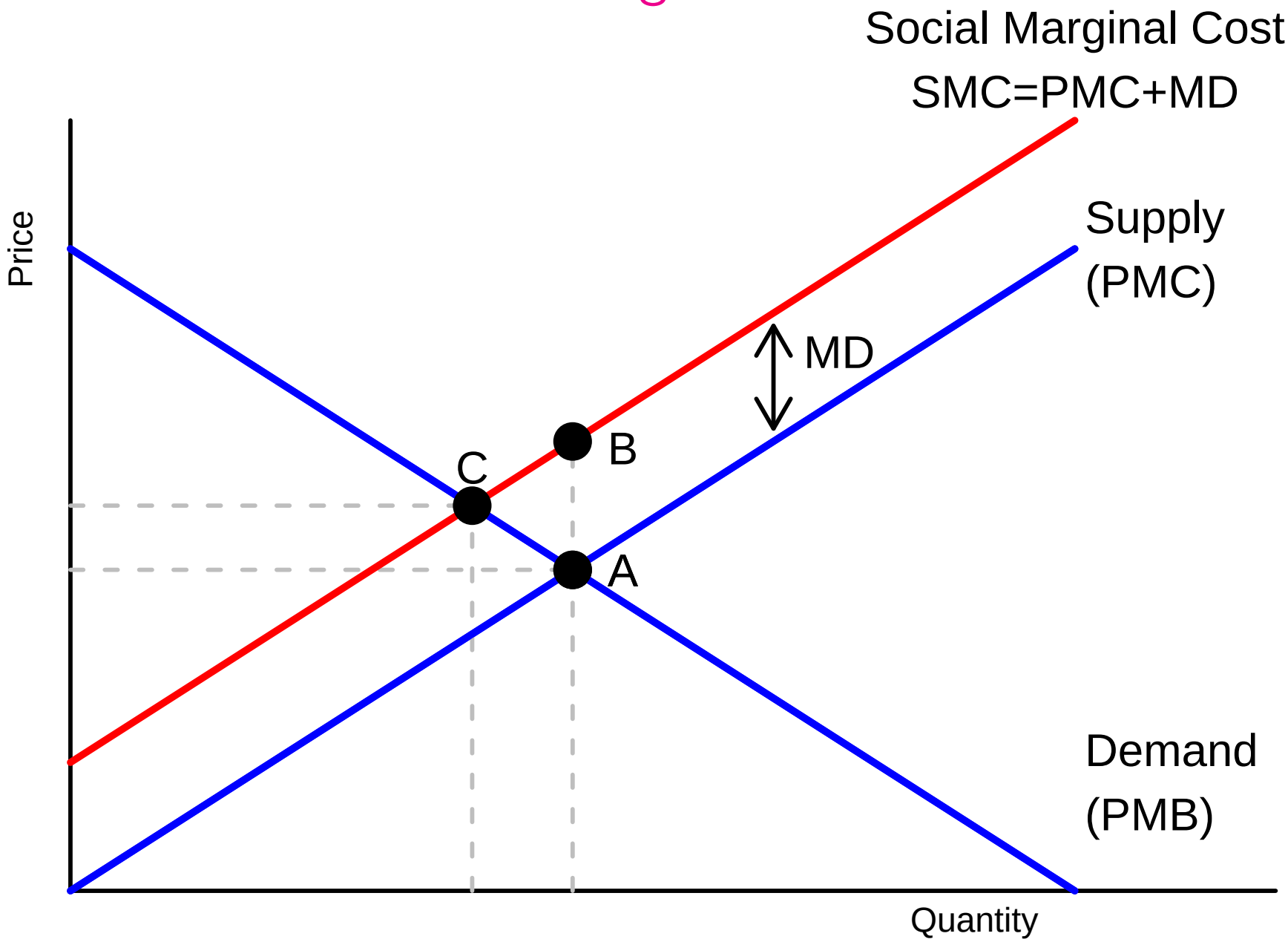
Optimum

- In the classic model, the PMB=SMB and PMC=SMC
- In competitive equilibria, PMB=PMC $\Rightarrow$ SMB=SMC
- With neg. externalities, SMC or SMB include marginal damage (MD)
- So the market equilibrium is inefficient
- $PMB = PMC \not\Rightarrow SMB = SMC$
- This creates deadweight loss (DWL)

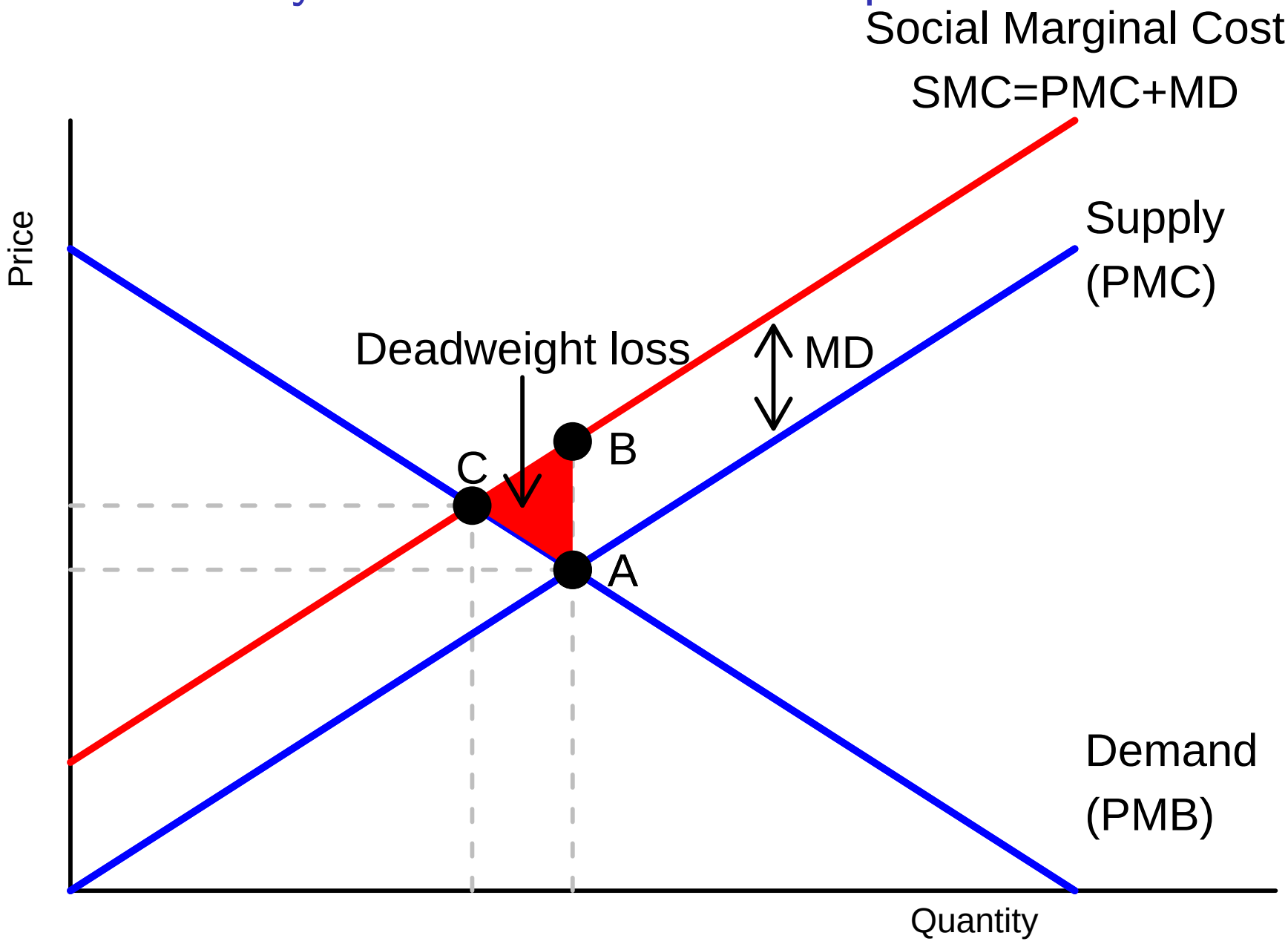
Analytics of externalities — production



Analytics of externalities — productionWhere is deadweight loss?



Analytics of externalities — production



Numerical example — consumption externality

- Demand is given by $D = 60 - P$, supply is given by $S = 3P$, consuming each unit of the good generates a marginal damage of 10.
- Rearranging demand as $P = 60 - Q$ and supply as $P = Q/3$, we can solve:

$$\underbrace{60 - Q}_{PMB} = \underbrace{Q/3}_{PMC} \Rightarrow P = 15 \quad Q = 45$$

- Social marginal benefit: $SMB = PMB - MD = 60 - 10 - Q$, giving:

$$\underbrace{50 - Q}_{SMB} = \underbrace{Q/3}_{SMC} \Rightarrow P = 12.5 \quad Q = 37.5$$

- **Deadweight loss**: quantity fell by 7.5 and MD was 10.

$$DWL = \frac{1}{2} \cdot \underbrace{10}_{MD} \cdot \underbrace{7.5}_{\Delta Q} = 37.5$$

Who should pay for climate change costs?

Who Should Pay Climate Change Costs?

)EVELOPMENT & SOCIETY : Climate Change, Economics, Displacement, Vulnerabilities

2013•01•21 David Morris Institute for Local Self-Reliance

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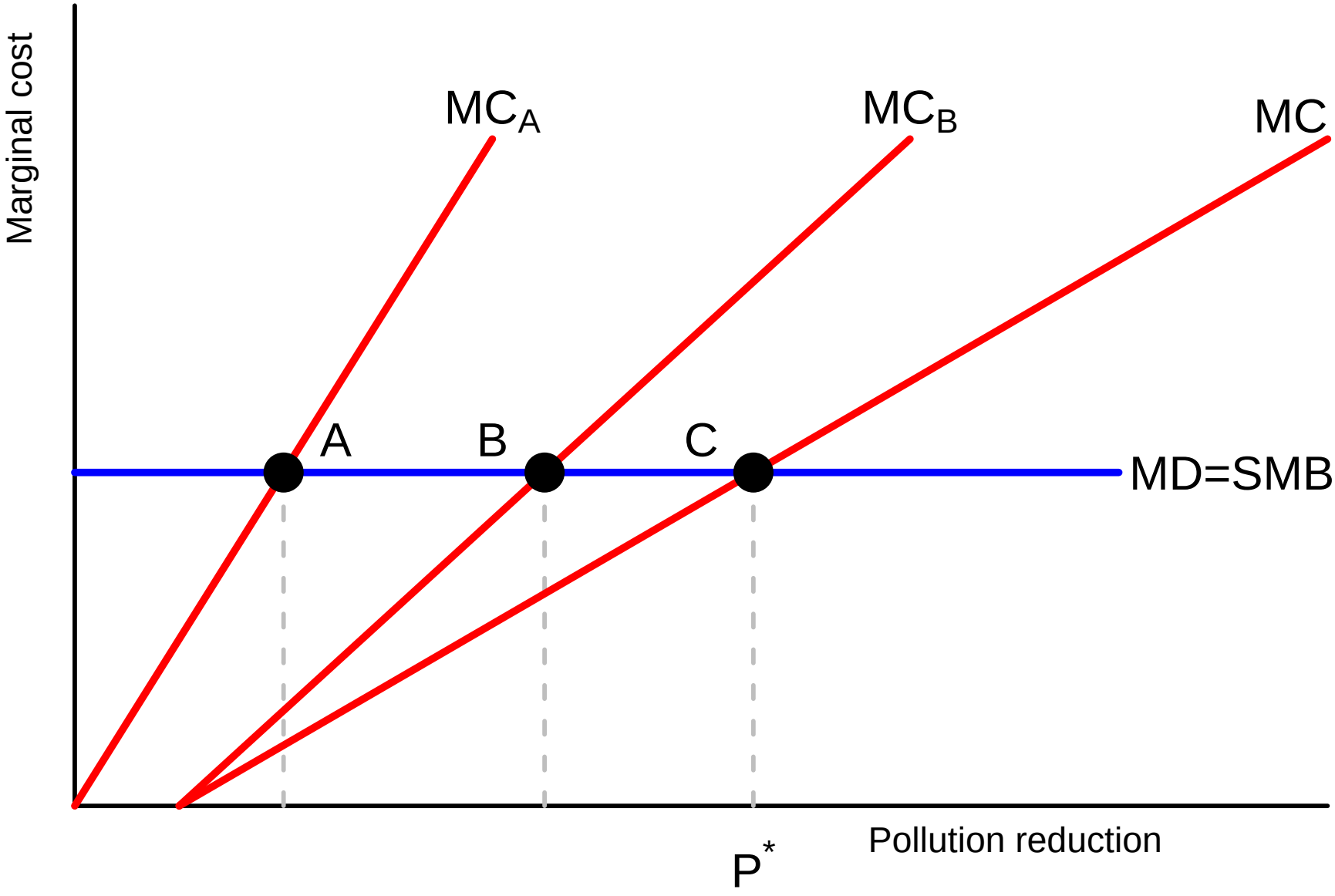
Taken from *Our World* https://ourworld.unu.edu/en/who-should-pay-climate-change-costs

Who should reduce pollution?

- Countries or firms face different marginal costs of reducing pollution: $MC_A = aP$ and $MC_B = bP$, where P is the reduction in pollution.
- Total cost is minimized when $MC_A = MC_B = MC$. Why?
- Otherwise, the higher-cost polluter should reduce less, and the lower-cost one more.
- Solving: $P = \frac{MC}{a} + \frac{MC}{b}$ or $MC = \frac{ab}{a+b}P$
- *In practice:* Which countries or firms have higher or lower marginal costs?

Cost of reducing pollution



Private solutions to externalities

- Externalities persist because actions have unpriced effects on others.
- If we can **assign property rights**, parties can negotiate toward efficiency.

Coase Theorem

When property rights are clearly defined and transaction costs are zero, private bargaining yields the socially efficient outcome—regardless of who holds the rights.

Example: Secondhand smoke

- Non-smokers could pay smokers not to smoke — or smokers could pay for the right to smoke.
- Either way, the efficient level of smoking can, in theory, be achieved through bargaining.

Limits of Coasian bargaining

- **Transaction costs:** Negotiating and enforcing contracts is rarely costless.
- **Assignment:** Who owns the right? Multiple parties complicate bargaining.
- **Information:** True costs and benefits are often unknown.
- **Holdout and free-rider problems:** With many affected parties, coordination breaks down.

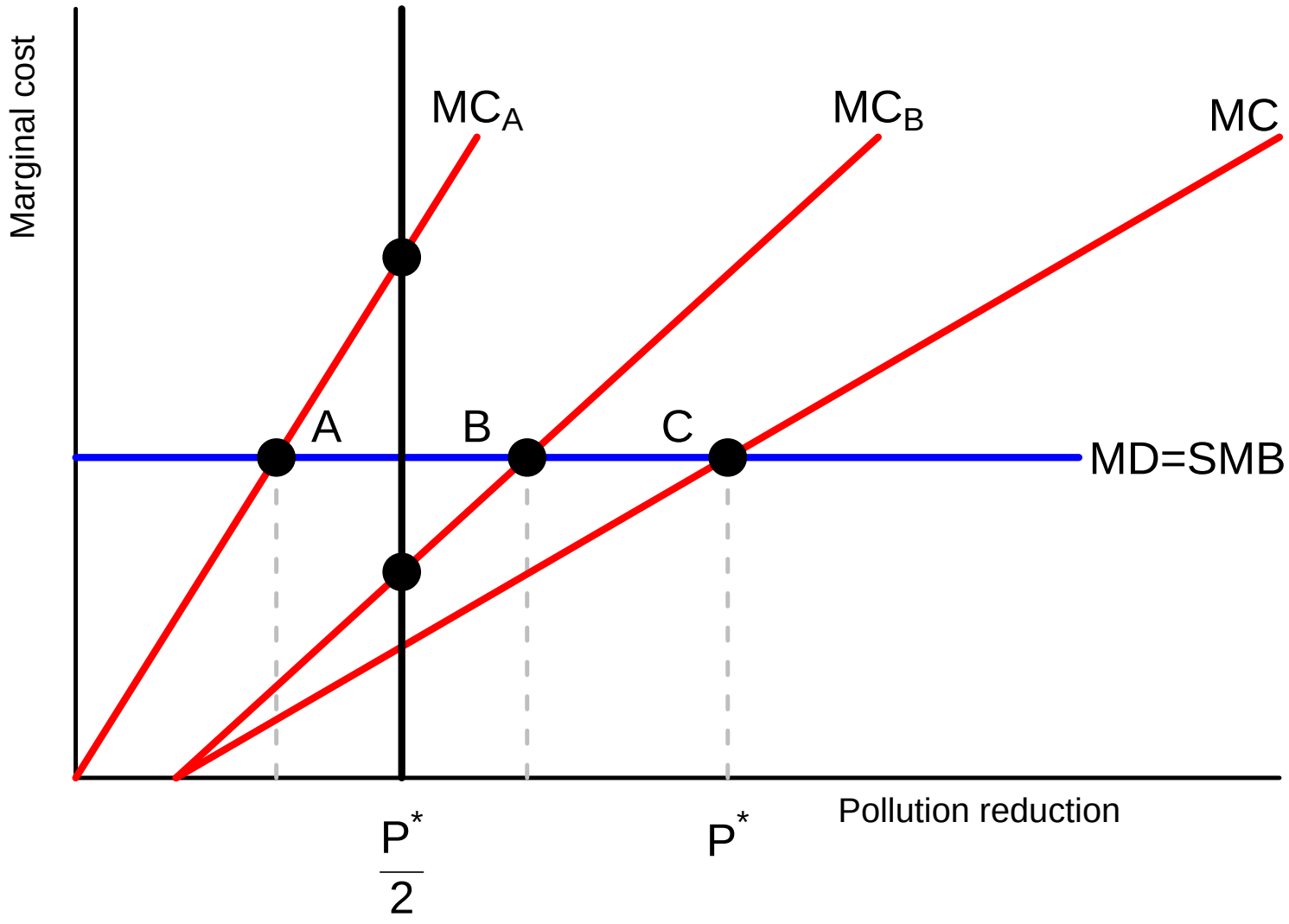
Bottom line: Coasian solutions work best for small, well-defined externalities (e.g., a noisy neighbor), but not large-scale problems like air pollution.

What policy instrument can correct an externality?

- We need a policy that gets each polluter to reduce until $MC_i = MC^*$.
- Regulation rarely achieves this—it's often one-size-fits-all.
- But a **tax**[3] (or subsidy) lets each polluter respond efficiently.
- **Tradable permits (cap-and-trade)**—a market-based regulation.
- Design questions:
  - How many permits (total emissions cap)?
  - Who gets them (auction or free allocation)?
  - What happens to revenue?

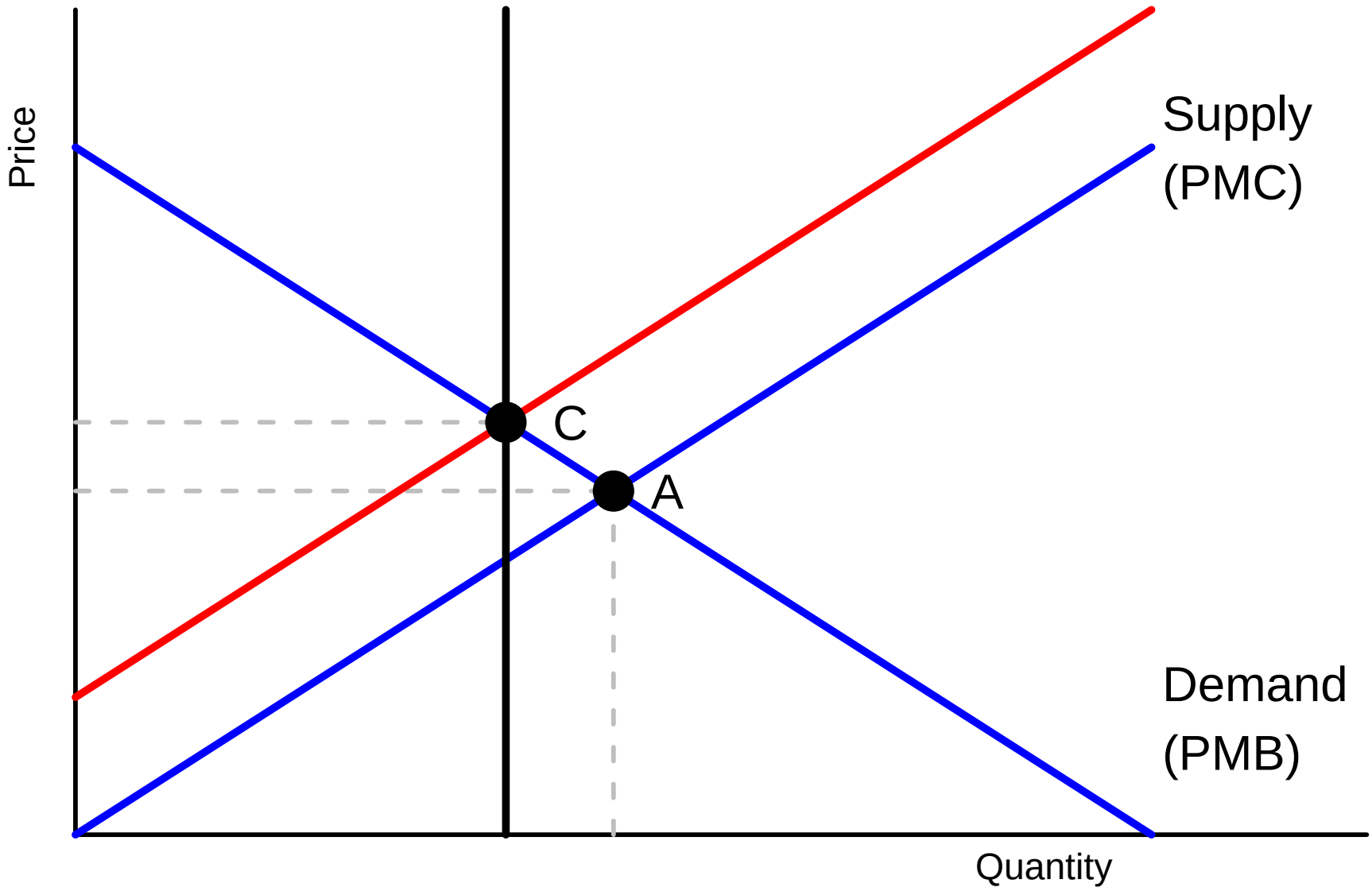
[3] A Pigouvian tax – named for Arthur Pigou

Cost of reducing pollution



Regulation rarely efficient

Regulation



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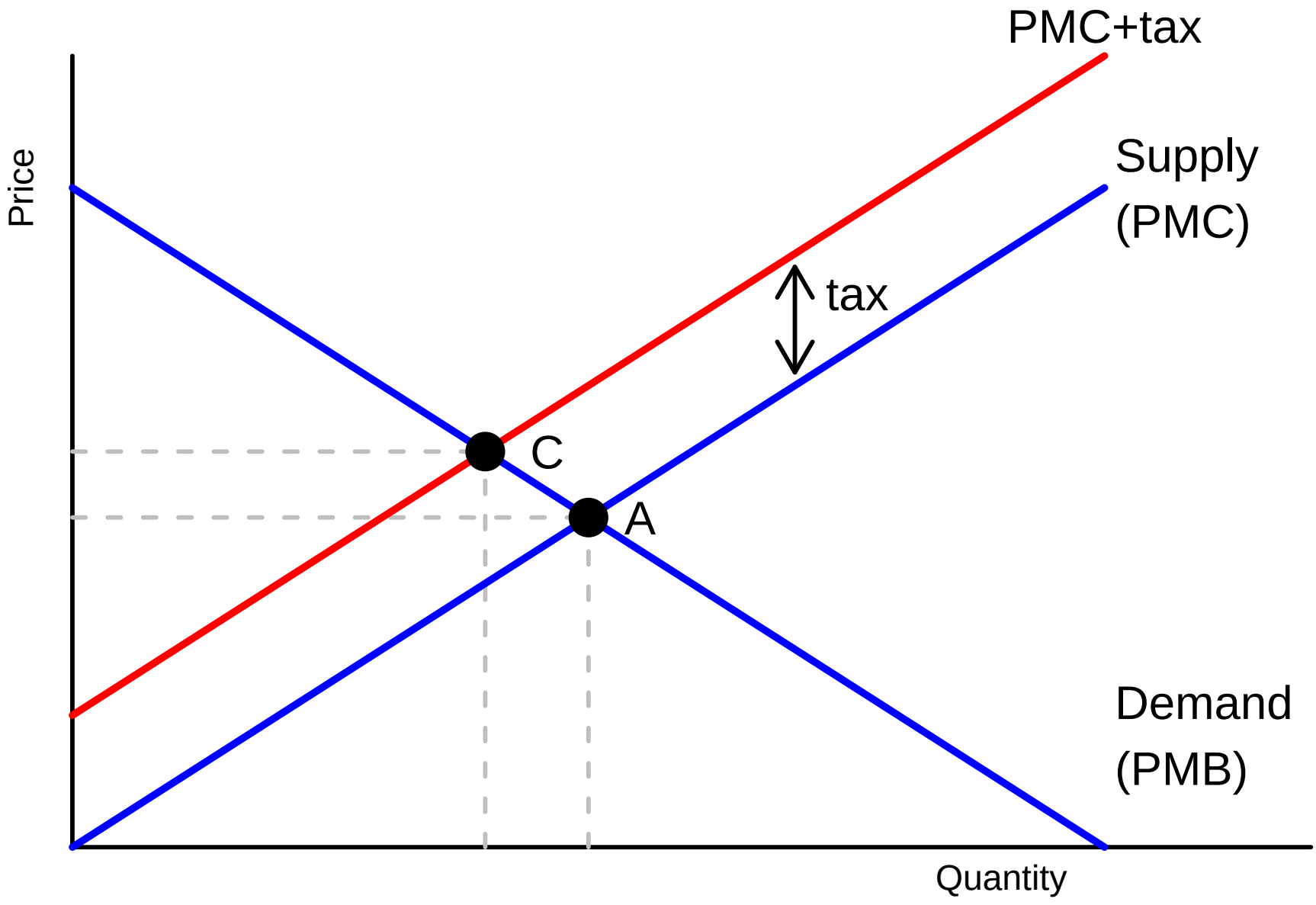
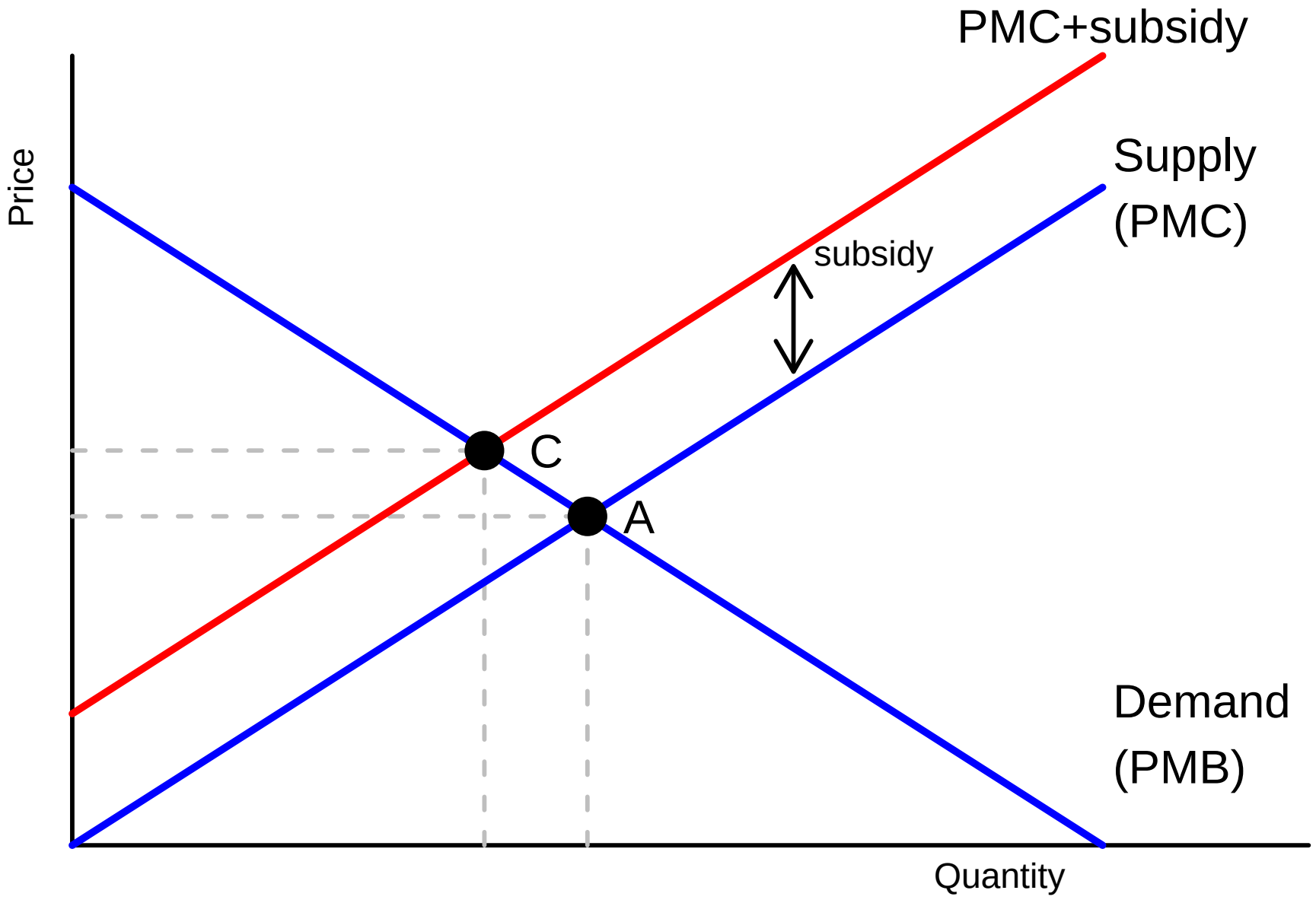
Taxation of Negative Externalities



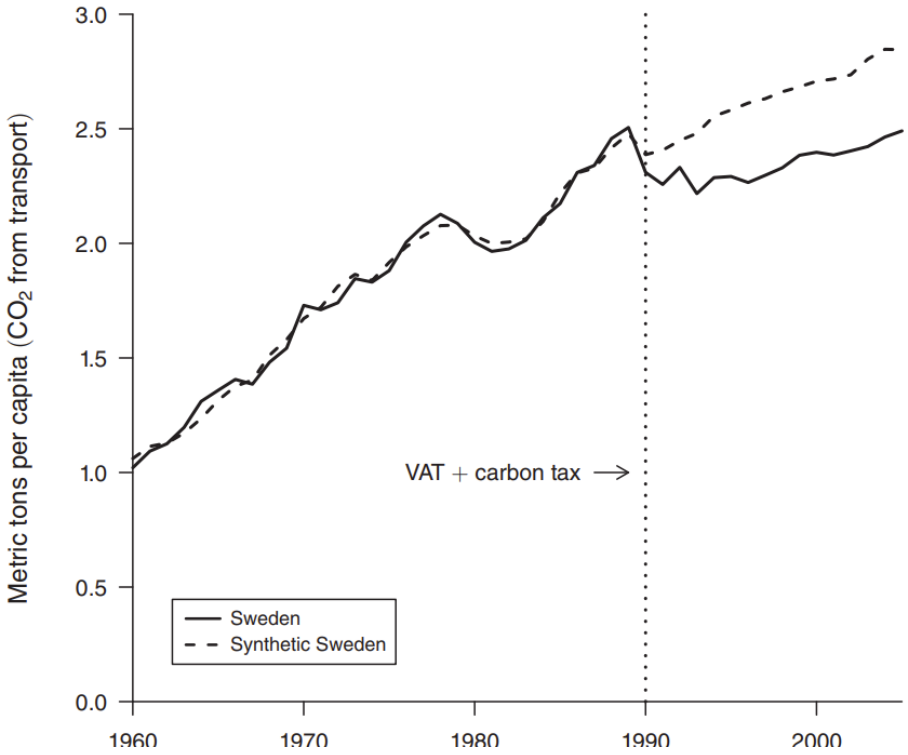
Subsidy


PMC+subsidy
Supply
(PMC)
subsidy
Price
C
A
Demand
(PMB)
Quantity

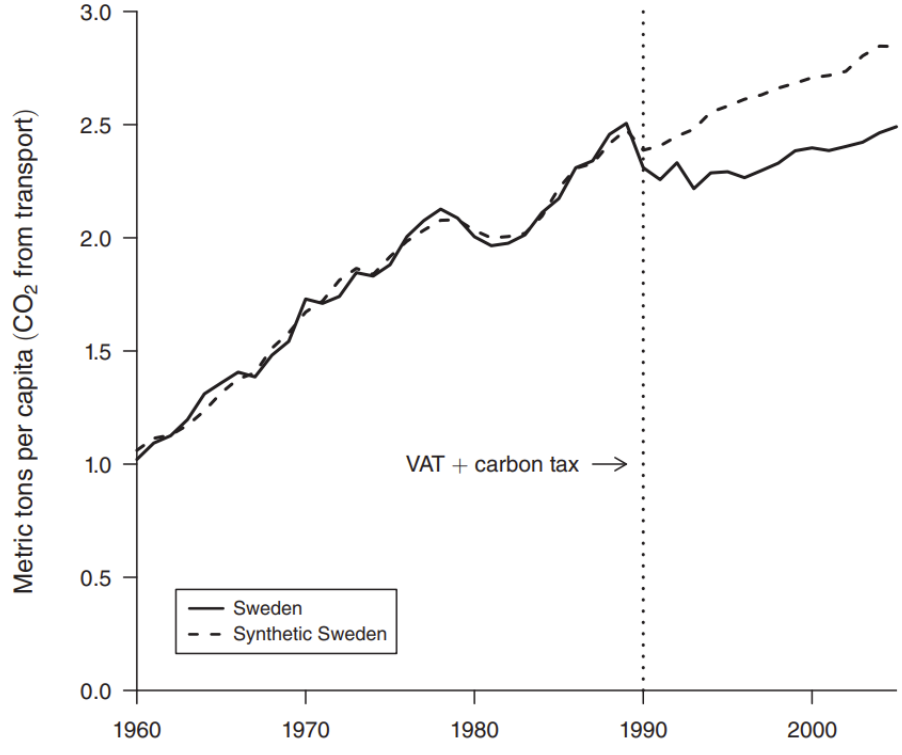
Carbon tax in Sweden

- What about directly taxing the source of the externality?
- Sweden did just that with a carbon tax in 1991
- Andersson (2019) uses an event study framework and synthetic control method to estimate the effect of the carbon tax on emissions
- Finds 11% reduction seemingly due to carbon tax and tax incidence 3x higher than price elasticity of gasoline $\Rightarrow$ we may underestimate the benefits of carbon tax
- Low opportunity cost: No meaningful deviation of GDP

Sweden Carbon tax event study



OECD emissions before and after the carbon tax



Synthetic control estimate of the effect of the carbon tax on emissions

Andersson (2019)

Targeting

- The source of externality should be targeted directly (if possible)
- Imposing a tax/regulation directly allows polluters to respond most efficiently, while taxing/regulating substitutes leads to other responses
- A tax on gasoline would reduce the overall usage of gasoline
- A tax on vehicles could mean people drive older, gas-guzzlers[4]
- Giving hybrids access to the HOV lane creates congestion

[4] Caveat: could also lead to carpooling

HOV sticker

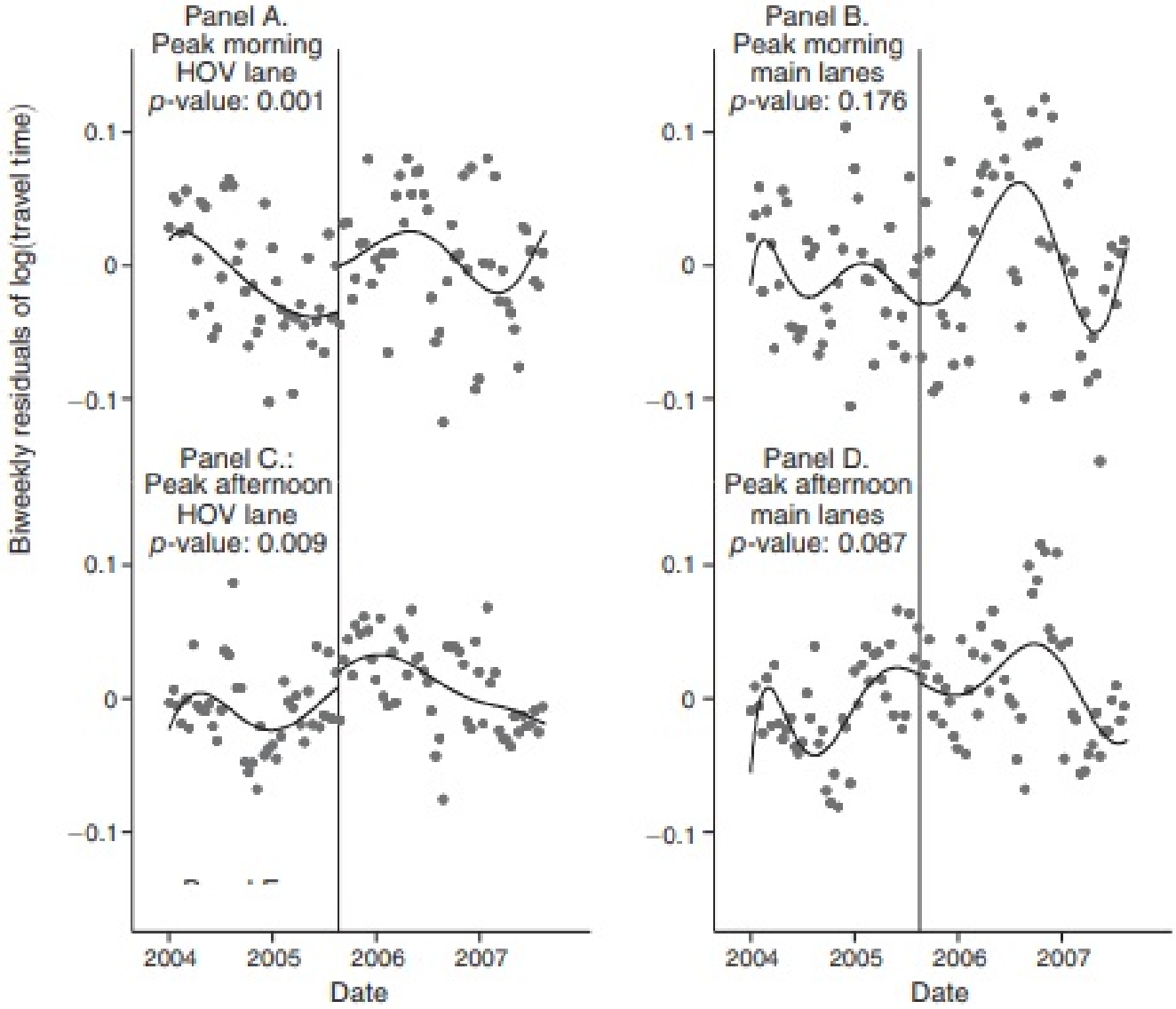


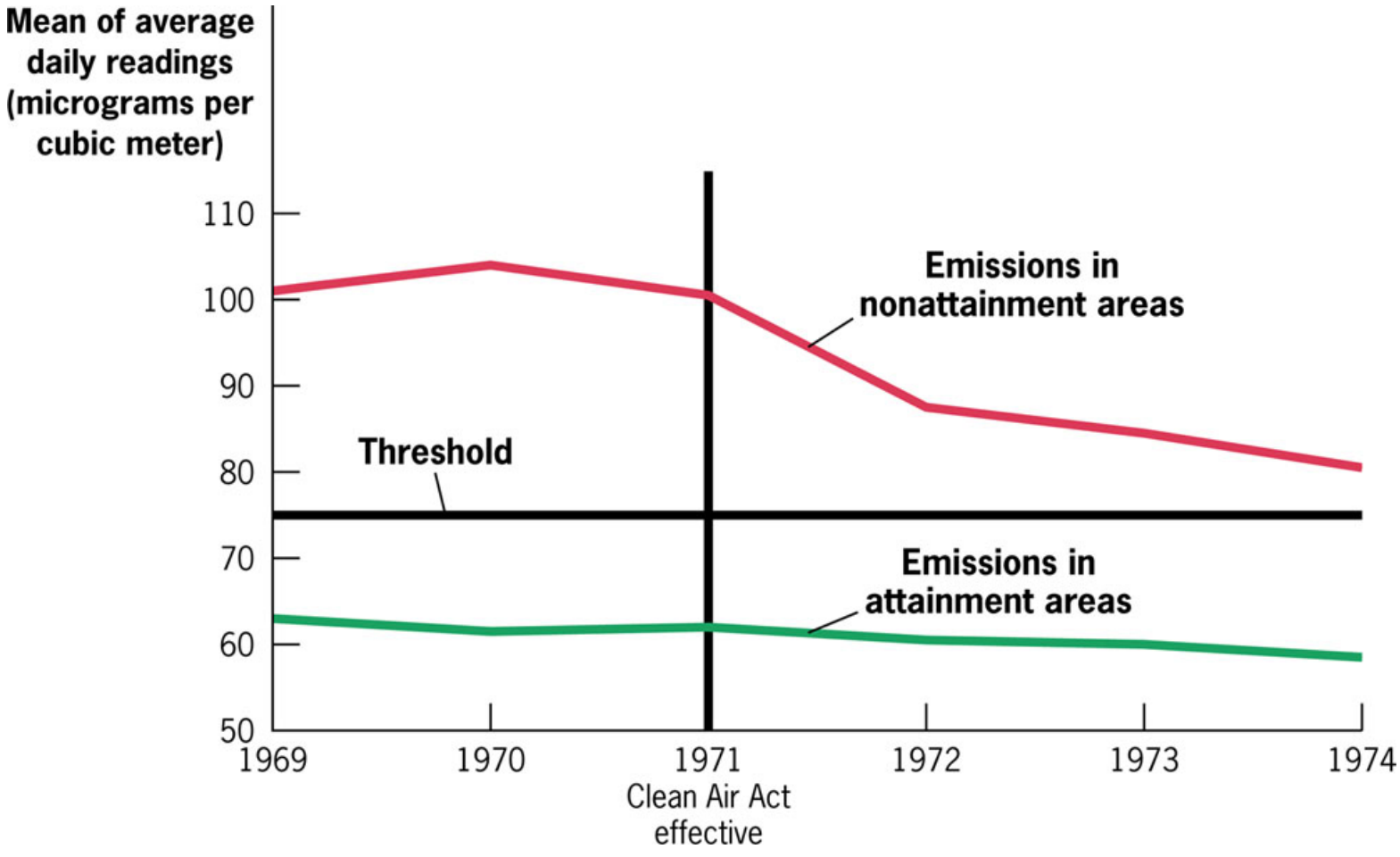
FIGURE 2. INTERSTATE 10 WEST TRAVEL TIME

Figure from Bento et al. (2014)

Regulation: Reducing emissions

- Acid rain comes from SO_2 emissions—mainly from power plants.
- Too many polluters and victims make private negotiation infeasible.
- Clean Air Act (1970): set air-quality standards for new plants.
- Chay & Greenstone (2005): compared counties above vs. below federal air-quality thresholds and found meaningful benefits.
- Early rule: limited emissions from new plants $\rightarrow$ old plants ran more.
- State-level implementation led to uneven enforcement/compliance costs.
- 1990 amendment to Acid Rain Program: tradable **emission allowances** ("cap-and-trade").
- Trading cut compliance costs by roughly 30-70%. (Fried 2012)

Efficient level and underprovision

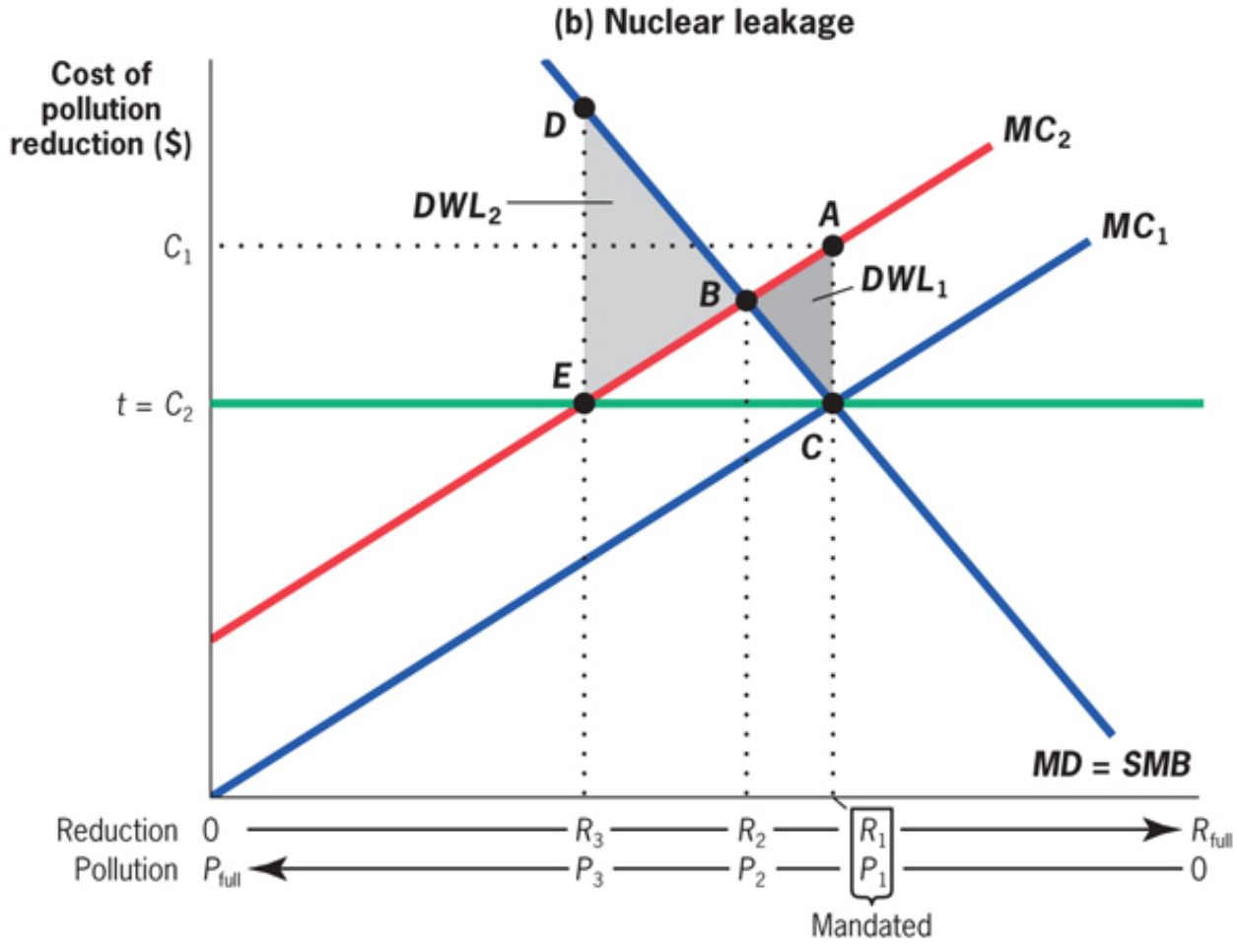


Chay & Greenstone (2005): 10% drop in particulates $\rightarrow$ 5% lower infant mortality ($\approx$ 1300 fewer deaths in 1972) and 2–3.5% higher housing values ($\approx$ 45 billion total)

Policy design under uncertainty

- With externalities, we rarely know true marginal costs or damages.
- **Taxes:** uncertain MD $\rightarrow$ risk of mispricing pollution.
- **Regulation or cap-and-trade:** uncertain MC $\rightarrow$ risk of over/under-abatement.
- Which to prefer depends on which curve—MC or MD—is steeper.
- (Weitzman 1974): If damages rise steeply with pollution, prefer quantity control; if flat, prefer price control.

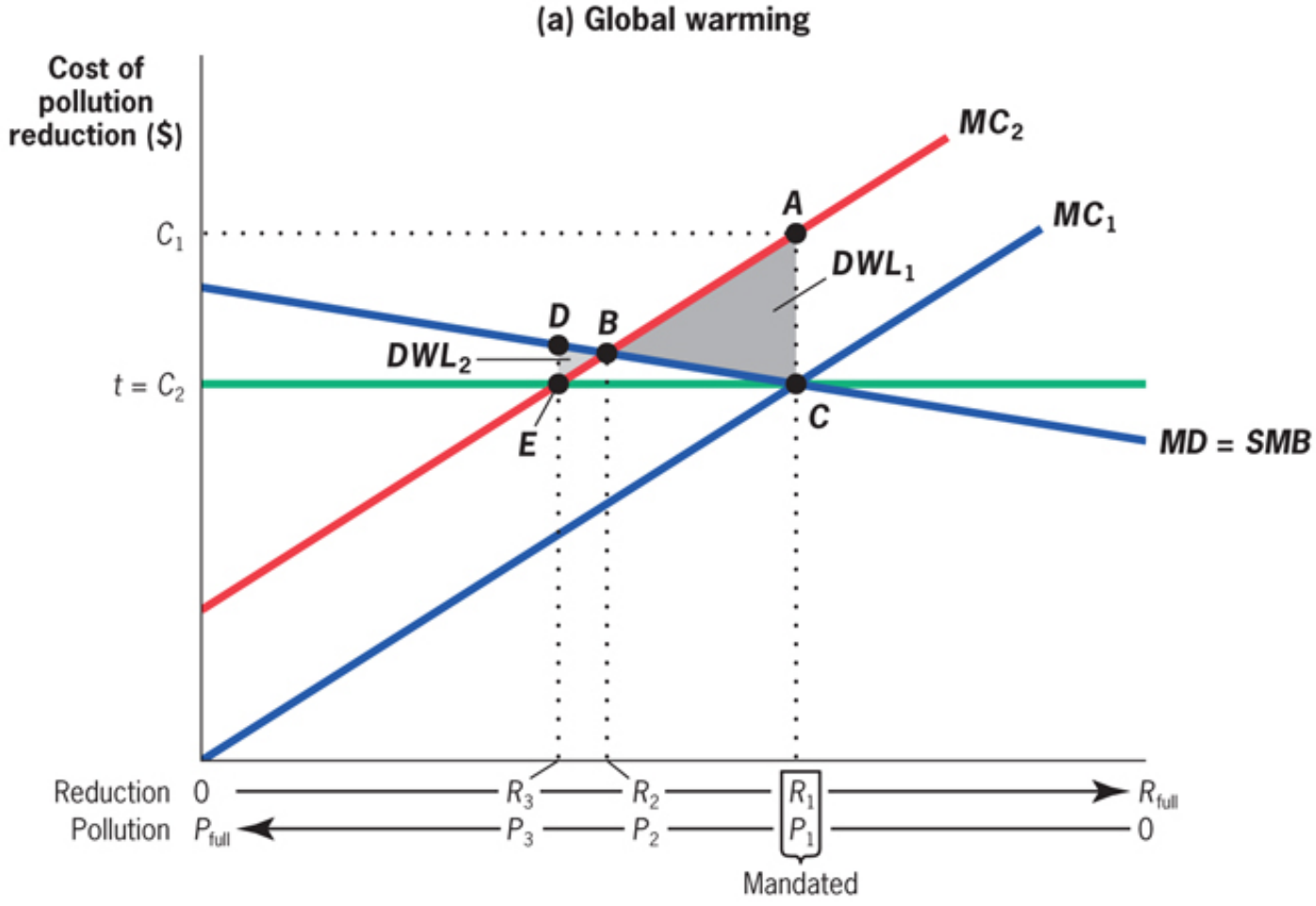
Uncertainty about MC — regulation preferred



Source: Gruber, Public Finance and Public Policy, 5th edition

- *MD* is relatively steep, so optimal quantity is not very sensitive to *MC*.
- Getting quantity wrong is very costly, so we make firms act a certain way

Uncertainty about MC — tax preferred



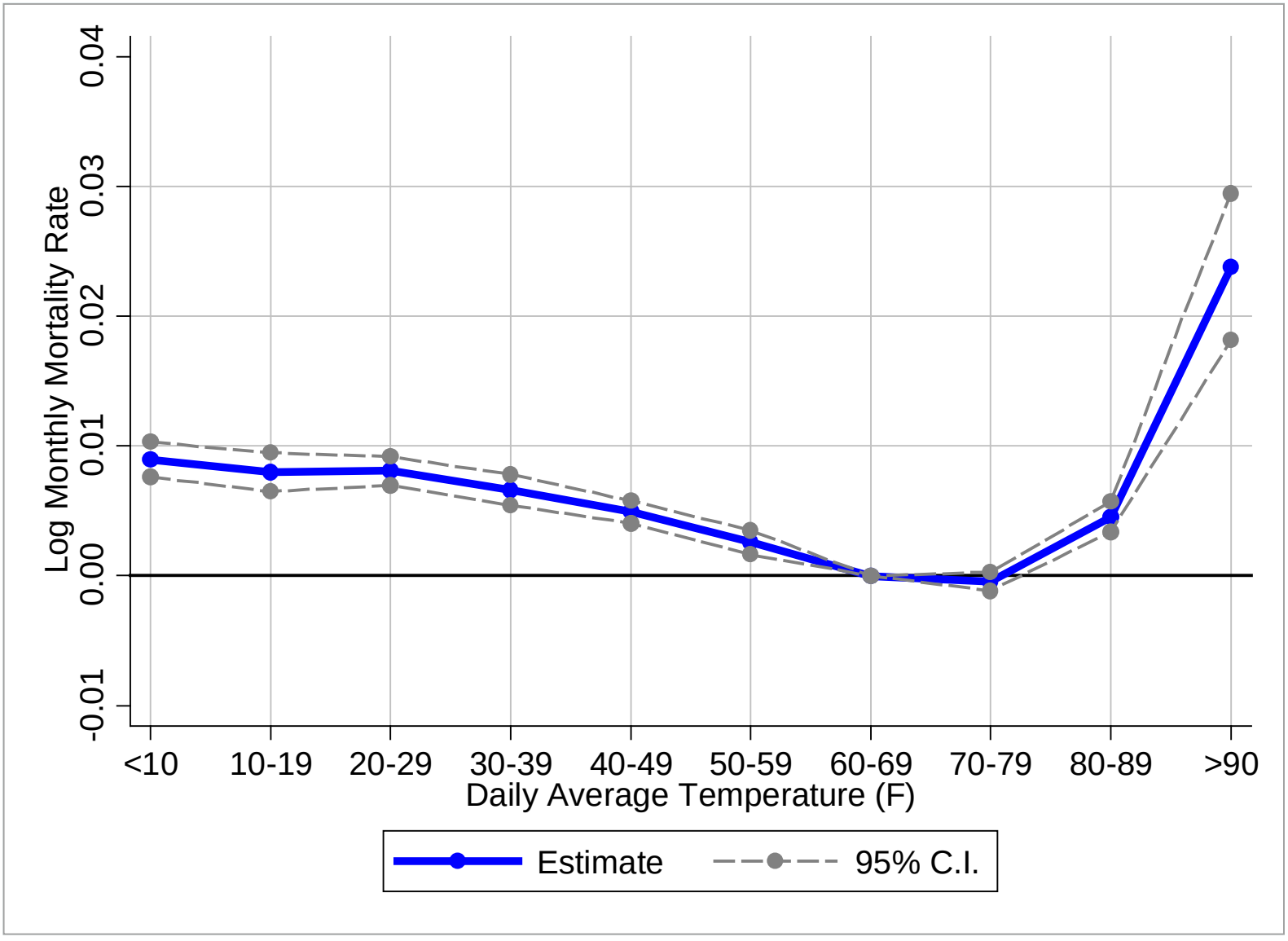
Source: Gruber, Public Finance and Public Policy, 5th edition

- *MD* is relatively flat, so optimal tax is not very sensitive to *MC*.
- Missing quantity not costly, so allow firms respond to an imprecise tax

Uncertainty about the damage

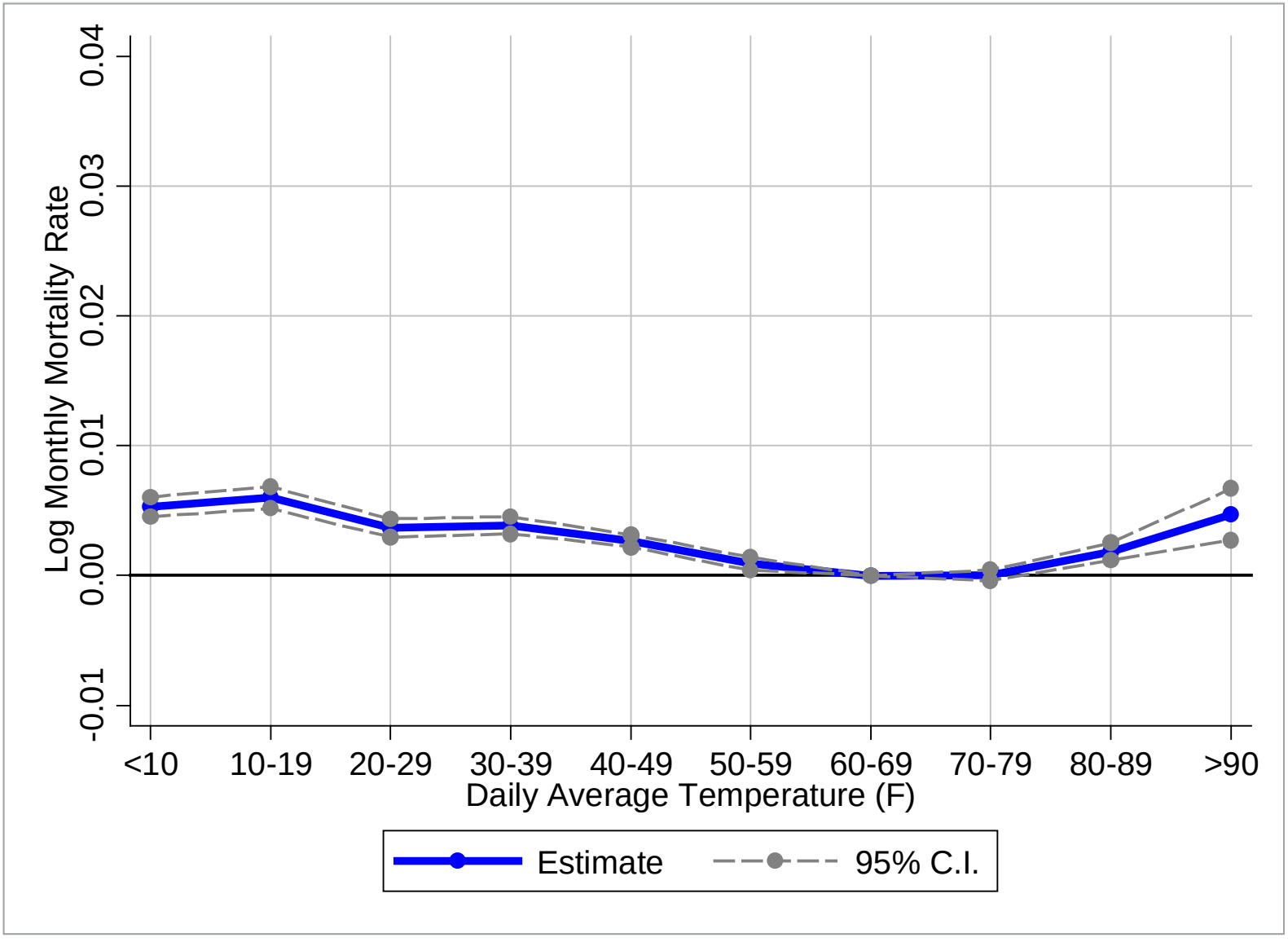
- Measuring marginal damage from externalities is also difficult.
- Take climate change
- Scientific consensus that the average temperature is rising. A lot of uncertainty about exactly how it will affect the climate.
- Also, a lot of uncertainty about economic and social costs. In particular, uncertainty about the potential for adaptation to changes.
- Barreca et al. (Journal of Political Economy, 2016). Air-conditioning mitigates the adverse health consequences of heat waves.
- Of course, while using AC reduces the health effects it also contributes to the problem.

(c) 1929-1959



Source: Barreca et al. "Adapting to Climate Change: The Remarkable Decline in the U.S. Temperature-Mortality Relationship over the 20th Century, Journal of Political Economy 124, no. 1 (February 2016): 105-159

(d) 1960-2004



Source: Barreca et al. "Adapting to Climate Change: The Remarkable Decline in the U.S. Temperature-Mortality Relationship over the 20th Century,Journal of Political Economy 124, no. 1 (February 2016): 105-159

Conclusion

- Externalities are a common market failure
- They lead to inefficiency in the market equilibrium
- There are many ways to address externalities
- The choice of policy depends on the nature of the externality and the information available