The social cost of carbon,
or: was climate economics a mistake?

Thomas Stoerk
t.a.stoerk@lse.ac.uk

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These slides only represent my personal views and not necessarily those of any institution.

Nobel for climate economics in 2018...

THE
NOBEL
PRIZE

Nomination | Alfred Nobel | News & insights | Events | Education network

Prize in Economic Sciences 2018 | William D. Nordhaus - Facts

of

William D. Nordhaus
Facts

William D. Nordhaus
The Sveriges Riksbank Prize in Economic Sciences in Memory of Alfred Nobel 2018

Born: 31 May 1941, Albuquerque, NM, USA

Affiliation at the time of the award: Yale University, New Haven, CT, USA

Prize motivation: "for integrating climate change into long-run macroeconomic analysis."

Prize share: 1/2

...and yet

Why has climate economics failed us?

Economists could have helped in the fight against climate change. So far, they haven't.

Noah Smith
Apr 13 ♡66 💬94

"Wildfire in the Pacific Northwest" by BLM Oregon & Washington, CC BY 2.0

Ezra Klein has an excellent post at the *New York Times* on the politics of Bidenomics. This part really caught my eye:

> **Biden has less trust in economists, and so does everyone else...**

Part 1: The beginning, or: what is the social cost of carbon

Externality: the key concept in environmental economics

Arthur Cecil Pigou (1920, *The Economics of Welfare*)

- Key insight: the private costs of an activity differ often differs from its social costs.
- In these cases, there will too much or too little of an activity compared to the social optimum.

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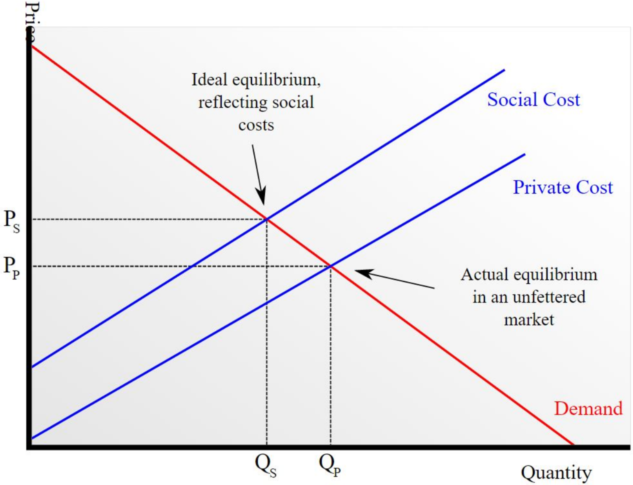
It is true of resources devoted to the prevention of smoke from factory chimneys:[3] for this smoke in large towns inflicts a heavy uncharged loss on the community, in injury to buildings and vegetables, expenses for washing clothes and cleaning rooms, expenses for the provision of extra artificial light, and in many other ways.[4]

Externality: the key concept in environmental economics



Source: Wikipedia

Externality: the key concept in environmental economics

What does Pigou teach us?

- In a market economy, there will inefficiently many GHG emissions unless companies have to pay to emit GHGs.
- The price they should pay equals the additional marginal cost for society: the social cost of carbon

Externality: the key concept in environmental economics

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Collateral: if we knew the social cost of carbon, we could derive the optimal amount of emissions (T&Cs apply)

- "Optimal pollution" can be hard to digest for environmental policy-makers

Part 2: IAMs, or: how to estimate the social cost of carbon

Why is estimation of the social cost of carbon difficult?

Economists use integrated assessment models (IAMs) to estimate the social cost of carbon

First climate economic IAM in 1975 by William Nordhaus (a working paper at IIASA)

- Later evolved into DICE, which is one of the three leading IAMs (PAGE and FUND are the other two)
- Key input for decision makers

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1. GHGs are long-lived $\rightarrow$need to consider very long timescales (typically at least 1-2 centuries)

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3. Damage channels are hard to estimate empirically $\rightarrow$need to extrapolate based on limited past experience

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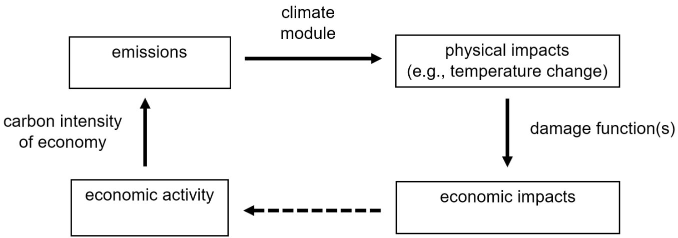
Typical IAM building blocks



Source: Own elaboration.

GHGs are long-lived →need to consider very long timescales

Economic modelling is difficult

- Many uncertain economic parameters: population, innovation, cost of mitigation, ...
- Economic IAM components can perform poorly even in hindsight (Millner and McDermott, 2016)
- Partly avoid this problem by using scenarios (SSP-RCP)

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Ethical judgements about future generations matter as much as the economic analysis itself

- IAMs try to find the climate policy target that leads to the largest human welfare (jargon: utility, happiness, ...)
- Do so by summing current and future welfare. Different weights on future vs. present: the discount factor

$$Welfare = \sum_{t=0}^{T} \frac{1}{(1+\rho)^t} u_t \quad (1)$$

Complex impacts $\rightarrow$ need to model full climate system

IAMs need reduced-form models for all components of the climate system

- Carbon cycle, warming models, changes in geophysical outcomes
- Incorrect geophysical representations can lead to incorrect policy conclusions from climate economists (Dietz, van der Ploeg, Rezai and Venmans, 2021)
- Missing climate system components such as tipping points can lead to underestimates in the social cost of carbon (Dietz, Rising, Stoerk, and Wagner, 2021)

Damage channels are hard to estimate empirically

Key problem: lack of past experience with rapid climate change

- Lack of both data and tools meant early IAMs had to pull damage functions out of a hat
- Empirical advances in the last 10 years now help improve damage functions for temperature damages (Hsiang, 2016)...
  - ...but it is unclear whether past relationships can be extrapolated into the future
- Modelling of sea-level rise damages only partially based on empirical foundations
- Damages channels for key impacts such as precipitation changes or ocean acidification still absent from IAMs

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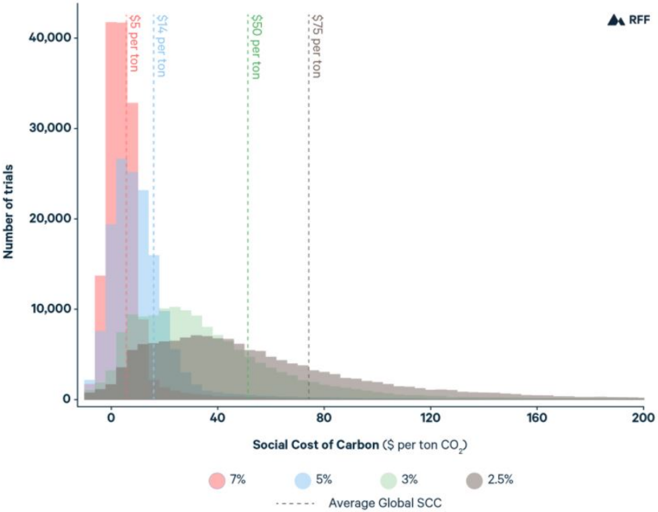
Role of adaptation

- Adaptation can lower climate damages. Treatment of adaptation is therefore a first-order concern.
- However: treatment of adaptation in its infancy (for temperature damages) and somewhat simplistic (for sea-level rise damages)

Part 3: Let's look at the numbers

Social cost of carbon estimates span orders of magnitude

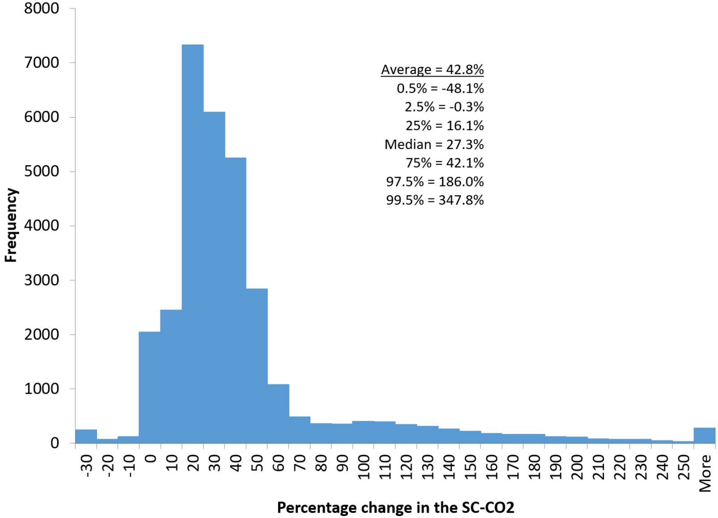
Baseline social cost of carbon estimates (DICE, PAGE, and FUND)



Source: Resources for the Future.

Social cost of carbon estimates span orders of magnitude

Percentage increase due to tipping points



Source: Dietz, Rising, Stoerk, and Wagner (2021).

Part 4: How the social cost of carbon enters policy

How do social cost of carbon numbers get used in practice?

Three main uses

1. Optimal policy, a.k.a. economists wanting to determine ambition
2. Learn about economic impacts of climate change
3. Cost-benefit and cost-effectiveness analysis of investments and policies

Optimal policy

Findings based on DICE (Nordhaus, 2018)

- Social cost of carbon estimate at 33.6\$/tCO2
- "A second result is that the international target for climate change with a limit of 2°C appears to be infeasible"

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Optimal policy

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- Social cost of carbon estimate at 33.6$/tCO2
- "A second result is that the international target for climate change with a limit of 2°C appears to be infeasible"

Since then: climate economists have shown that Paris Agreement can be seen as optimal

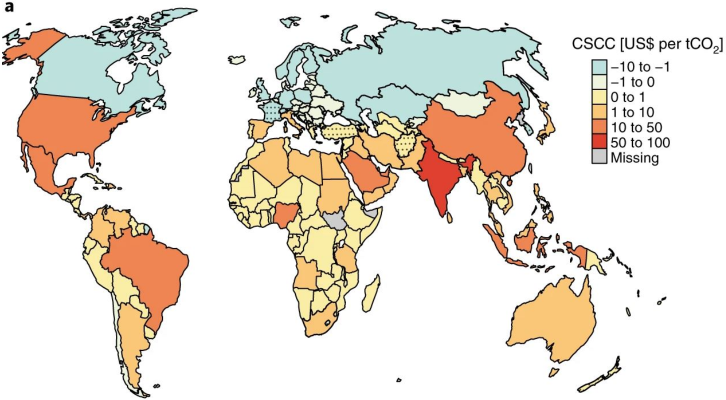
- Hänsel et el. (2020): "the benefits of limiting global warming to (well) below 2°C outweigh the costs of doing so"

Concerns

- Conclusions sensitive to ethical and arbitrary assumptions
- Runs counter to the European model of democratically elected politicians choosing ambition based on the science

Learn about economic impacts of climate change

E.g., to study the distribution of climate impacts around the globe



Source: Ricke, Drouet, Caldeira, and Tavoni (2018).

Cost-benefit and cost-effectiveness analysis

US: No federal GHG emissions target

- Cost-benefit analysis required for any significant policy proposal (since 1936 Flood Control Act)
- Impacts must be quantified based on best available science. Not using the SCC would value climate benefits at 0$/tCO2

EU: Net-zero GHG by 2050

- European Climate Law sets climate neutrality (=net-zero GHG emissions) as 2050 quantity target
- Mitigation cost of carbon numbers consistent with this emissions reduction target conceptually different from social cost of carbon

Conclusions

Key take-aways

In the past, climate economists used the social cost of carbon to argue against serious climate policy ambition based on questionable premises.

Current use of the social cost of carbon in climate economics is mainly to measure climate impacts. Adaptation can lower impacts substantially, but how to calculate its effects is still an ongoing methodological debate.

Policy-making only requires social cost of carbon numbers in the absence of a quantity target on GHG emissions (e.g., US). With a binding emissions target, mitigation cost of carbon numbers become relevant.

Bonus slide: redeeming climate economists

"Sorry, Harold, but I'm reducing our carbon footprint."

Bonus slide: redeeming climate economists

Design of policy instruments

- Carbon pricing
- Cost-effective distribution of effort
- Cost-effective adaptation
- Support for innovation
- Prevention of leakage

Ex-post evaluation of the effects of climate policy

- Huge literature on the effects of the EU ETS on innovation, emissions, carbon leakage, firm competitiveness, etc.

Thank you!

t.a.stoerk@lse.ac.uk

Further reading

Carbonbrief explainer

- https://www.rff.org/publications/explainers/social-cost-carbon-101/
- In particular, the section entitled "How else can we price CO2 emissions?"

Resources for the Future explainer (US focus)

- https://www.rff.org/publications/explainers/social-cost-carbon-101/

Wider background on Pigouvian taxation

- https://en.wikipedia.org/wiki/Pigovian_tax

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