

One Way to Pick a Climate Econ Research Question

Adapted from the first lecture of ECO481: Climate Economics

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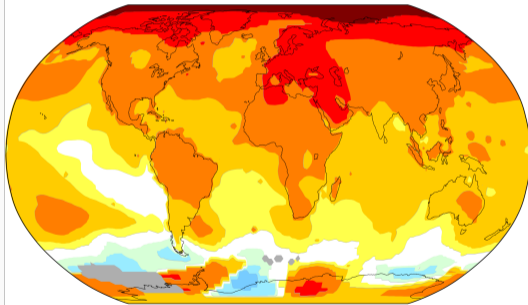
ECO 481 Course Overview

- What is the unique contribution of economists to climate research?
- This course's focus: Application of certain “structural modeling” methods to economic climate questions
- Focus on economic **substitution** and **equilibrium**, to study everything from flooding impacts to effectiveness of solar subsidies
- Focus on concrete “micro” questions
- This whole course: a gentle model of real graduate-level research
 - Very restricted in methods and tools
 - Enough to write a serious research paper

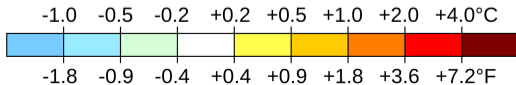
Climate Economics

Climate Change

Temperature change over the past 50 years

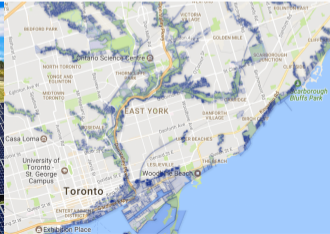
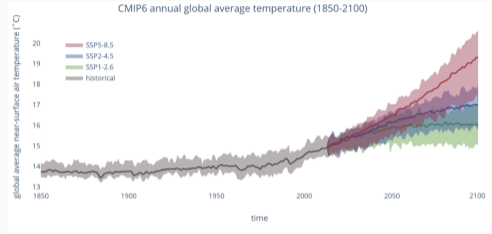


Trend from 1973 to 2023



- Climate change is a *huge* phenomenon
 - Driven by the interaction of emissions with complex natural systems
 - Impacting almost every aspect of human life, now and in the future
 - Where to even start?
1. Narrow down the topic
 2. Narrow down the question
 3. Narrow down the method

The Overwhelming Complexity of Climate Change



Climate Research

Humans \rightarrow Climate

Humans \leftarrow Climate

Climate Research



Climate Science (Is Not Climate Economics)



Climate Economics



Climate Economics



How do **economic forces** shape:

- Emissions
- The impact of climate change on humans
- The impact of *policy* on emissions and impacts

The Equilibrium Perspective

- How will people adopt solar panels in the future?
- How much would a carbon tax reduce emissions?
- Who would benefit/lose from a flood insurance subsidy?

Remember:

- Economic outcomes always arise in **equilibrium**
- Policy/shocks do not *directly* determine outcomes, only shift the equilibrium.

“Structural Micro” Climate Economics Within Economics

- All academic research comes out of “research communities,” made up of people
- Each community has its own subject matter, but also its own methods, norms, and epistemologies (ideas about what constitutes knowledge)
- What is the context of the approach I take in my class?

“Structural Micro” Climate Economics Within Economics

- Climate *macro* tends to incorporate how climate drivers *interact* with climate impacts, e.g. through growth
- We focus on the *micro* level, where we can use data and theory to provide concrete answers to concrete questions
- “Reduced-form” climate/environmental/resource economics tends to focus on measuring specific responses: e.g. how much does a solar subsidy increase adoption?
- We take a more “structural” perspective, using some simple theory and modelling to interpret, understand, and predict responses
- Draw from macro, trade, industrial organization, urban, etc. An attempt to bring many tools together, rather than an established community

Research Question

Our Type of Question

- Our only question: How will X shift the equilibrium?
- If something changes, something is causing that change.
- If it is government action, we call it “policy”.
- Anything else (e.g. tech, climate change, public opinion) we call a ”shock.”
- Policy targeting emissions we call “mitigation policy.”
- Policy targeting impacts we call “adaptation policy.”

Examples:

- How would allowing Chinese EVs affect emissions?
- How do EV charging station subsidies affect emissions?
- Which products would be made more expensive by a carbon tax?

Mitigation



- How much will emissions be reduced by solar adoption?
 - How much would a solar subsidy help?
 - What would happen to electricity prices and quantities?
 - How much would a breakthrough storage technology help?
- Carbon capture? Methane leakage standards? International cooperation?

Adaptation



- How will global warming affect crop yields?
 - What if farmers can choose which crops to grow?
 - How will this affect crop prices and food security?
- How will flooding affect welfare?
 - Will flood insurance subsidies hurt or help?
 - How unequal will these impacts be?

A Menu of Questions: Mitigation (Emissions-Targeting Policies)

“How would policy/shock X affect emissions from Y, in equilibrium, when people have choices Z?”

“How would it affect welfare, inequality, and other outcomes?”

- Sources: Manufacturing, energy, transportation, land use...
- Possible Shocks: Technology, policy, consumption decisions...
- Mitigation Policy: Taxes, subsidies, regulations...

A Menu of Questions: Adaptation (Climate Impacts-Targeting Policies)

“How would climate-driven environmental change X affect outcomes Y, in equilibrium, when people have choices Z?”

“How would this be different under policy/shock W?”

“How would this affect welfare, inequality, and other outcomes?”

- Physical Changes: Heat, flooding, fire, sea levels, weather...
- “Direct” Impacts: Agriculture, health, mortality, industry, trade, housing...
- Adaptation: AC, acclimatization, irrigation, migration, capital reallocation, construction, infrastructure...
- Equilibrium Responses: Populations, prices, land use, crop choice, violence, quality-of-life, everything in “direct impacts”...
- Considerations: Welfare, inequality, impacts of policy...

Method

Example: A Hot Dog

Suppose the carbon footprint of a hot dog is 5 kg of CO₂. My friend is about to buy a hot dog, but I tell her this and she decides not to. How much did I reduce emissions by?¹

(Ignore considerations like, “One hot dog is too small to make a difference.” Think about the average effect of a million people making the same decision.)

¹Inspired by 2024 conference presentation at IPWSD by Celia Escribe (coauthored with Philippe Quirion).

Example: A Hamburger

Suppose the carbon footprint of a hot dog is 5 kg of CO₂. My friend is about to buy a hot dog, but I tell her this and she decides not to. How much did I reduce emissions by?

- If she buys a hamburger instead (10kg CO₂), negative! (Substitution)
- In equilibrium, if many people buy less beef, the price of beef will fall. Others may eat more beef, but farmers may produce less beef.
- How much will the overall quantity of beef change by? (Equilibrium.)

How can we account for substitution and equilibrium in our analysis?

- We will cover and use some simple tools. This will tell us something, but still not the whole story!

The Structural Approach

- Measure/estimate what we can (e.g. elasticity of substitution between beef and other things, relative carbon footprints, supply elasticity of beef)
- Hypothesize about how those measurements/estimates translate to predictions (under what conditions, at what time scales, etc.)
- This requires a **model**.
- We decide which features to *incorporate* and which features to *omit*.

Narrow Methodology, Broad Questions

- We focus on the role of **substitution** and **equilibrium** in shaping the drivers and impacts of climate change
- Introduce simple, general tools for dealing with these considerations
- Extra credit: Do *one* extension *after* completing the main assignment

Other Considerations

We will focus on substitution and equilibrium. Other interesting considerations include:

- Expectations
- Uncertainty
- Heterogeneity
- Partial Information and Learning
- Strategic Interaction
- Intertemporal Substitution and Dynamics
- Irrationality and “Behavioral Economics”
- Market Structure
- Financial Frictions
- Political Economy

Results

Anatomy of a Paper

By the end of the semester, you will

1. Motivate
2. Design
3. Code
4. Estimate using data
5. Solve
6. Interpret

a simple model of a question of your choice.

Anatomy of a Paper

1. Motivate: What is your research question?
2. Design: What considerations will you take into account? Which will you omit?
3. Code: Given a set of “fundamentals/parameters”, what is the resulting equilibrium?
4. Estimate using data: Use variation in observed equilibria (e.g. prices and quantities) to infer the values of those parameters
 - What assumptions are you making in doing so?
5. Solve: How would the equilibrium differ under a policy/shock
6. Interpret: What does this exercise teach us? Under what conditions will your prediction be good or bad?

