Economics of Climate Change
Some Recent Progress and Future Directions

Solomon Hsiang
UC Berkeley
Once you start thinking about climate change you can’t think about anything else.
CLIMATIC CHANGE AND AGRICULTURAL EXHAUSTION AS ELEMENTS IN THE FALL OF ROME

SUMMARY


I

In history as in science the normal order is from obvious facts to hidden causes. The fact of the disastrous fall of Rome is so obvious that every intelligent person is aware of its causes. Its causes are so obscure that the world is still uncertain what they are. Among the many theories advanced in explanation of this great historical event, the one now gaining most prominence is the climatic theory. All the important historians of ancient Rome have given the matter serious attention and have generally concluded that the catastrophic fall of the Roman Empire is to be attributed to climatic causes.

Huntington (QJE, 1917)

Nordhaus (Science, 1992)
This talk

- Recent Progress + Future Directions
- New Directions
- What might happen by 2030?
Recent progress
+ future directions
How does the climate affect economic activity and outcomes?
# How does the climate affect economic activity and outcomes?

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How does the climate affect economic activity and outcomes?

Recent Progress

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What we actually know
How does the climate affect economic activity and outcomes?

Future Directions

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What we aren’t thinking much about
Climate change and economic growth
Climate change and economic growth

Recent Progress

Burke et al. (Nature, 2015)
Climate change and economic growth
Recent Progress

Figure 3.11. Effect of Temperature Increase on Real per Capita Output Estimated at the Temperature of the Median Low-Income Developing Country over Time
(Percent; years on x-axis)

The contemporaneous effect of temperature shocks on per capita output has remained relatively constant over time.

Source: IMF staff calculations.
Note: The figure depicts the effect of a 1°C increase in temperature at horizon 0 estimated at the median low-income developing country temperature (25°C), over a 20-year rolling window. Each point estimate is for a period (t, t + 20).
Climate change and economic growth

Future Directions

• What is going on?!

• Can all results be reconciled?
  • Panel vs Cross Section
  • Micro vs Macro

• How persistent are GDP effects? (80 yrs > 5 yrs)

• Can policy do anything to alter this linkage?
Social stability
# Social stability

## Recent Progress

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<td>Buckley et al (2010)</td>
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<td>Kuper &amp; Kröpelin (2006)</td>
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<td>Carleton (2017)</td>
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<td>Burke et al (2018)</td>
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Baysan et al. (JEBO, 2019)
Social stability
Recent Progress

Fig. 1. Response of asylum applications to the EU with respect to the annual average temperature over the maize growing season.

Missirian & Schlenker (Science, 2017)

Panel A: Total Number of Events

Fetzer (JEEA, 2020)
Social stability

Future Directions

• What are the mechanisms?
  ● Economic vs. Gov’t capacity vs. Logistics vs. Psychology

• What is actually going to happen with migration?

• How have / will political systems respond?

• What stabilizer policies can be deployed sustainably?
  ● Likely an important role for machine-learning
Adaptation
Adaptation

Recent Progress

Carleton & Hsiang (Science, 2016)
Adaptation

Recent Progress

Carleton & Hsiang (Science, 2016)
Adaptation
Recent Progress

Change in adaptation costs due to climate change

Optimal adaptation under new climate

Optimal adaptation under old climate

Adaptation costs (via revealed preference)

Carleton et al. (QJE, forthcoming)
Adaptation
Recent Progress

Rode et al. (Nature, 2021)
Adaptation

Future Directions

• How much does the information known by agents matter?
  • Currently, the “perfect information” assumption is doing a lot of work

• Must go beyond “mechanisms” (e.g. ‘income’) to understand actual actions (technologies + policies) that are effective.

• Can deployment of tech + policies be replicated and cost effective?
  • Think: field experiments
Risk
Risk

Recent Progress

Hsiang et al. (Science, 2017)
Risk

Recent Progress

Panel A. Climate feedback tipping point

V. The Dismal Theorem

Let $E[M|\lambda]$ represent the expected value of a stochastic discount factor $M(C)$ given by formula (3) when $C \geq D(\lambda)$ (or, equivalently, $Y \geq \ln D(\lambda)$) and given by $M(C) = (D(\lambda))^{-n}$ when $C < D(\lambda)$ (or, equivalently, $Y < \ln D(\lambda)$), where $D(\lambda)$ is defined by equation (16). The following “dismal theorem” (hereafter sometimes abbreviated “DT”) shows under quite general circumstances what happens to the price of future consumption $E[M|\lambda]$ when $\lambda$ might be very big.

Theorem 1. For any given $n$ and $k$,

$$\lim_{\lambda \to \infty} E[M|\lambda] = +\infty.$$ (17)
Risk
Future Directions

• Should different “flavors of uncertainty” be managed / valued using the same tools?
  • Parameter uncertainty
  • Scientific uncertainty
  • Uncertain state of the world

• How do we manage globally aggregate risk?

Carleton et al. (QJE, forthcoming)
Inequality
Inequality
Recent Progress

Burke et al. (Nature, 2015)
Carleton et al. (QJE, forthcoming)
Inequality

Future Directions

- Systematically identify causes of unequal effects
- Gradual extinction of representative agents
- Elimination of “Negeshi weights” from models (explicit down weighting of poor populations)
- Explicit discussion of how inequality is valued (recall discounting debate)
Integrated Assessment + Social Cost of Carbon
Integrated Assessment + Social Cost of Carbon

Recent Progress

DICE (1992)  
1 region

FUND (1996)  
16 region

Diaz & Moore (Nature Climate Change, 2017)
Integrated Assessment + Social Cost of Carbon
Recent Progress

Carleton et al. (QJE, forthcoming)
Integrated Assessment + Social Cost of Carbon
Recent Progress

Integrated Assessment + Social Cost of Carbon
Future Directions

• Simultaneously valuing inequality and uncertainty

• Systematic updating

• Practical international harmonization

• Integration with concepts of “Loss & Damage”
New Directions for Research
Long-term Economic Projections (New Directions)

• “Shared Socioeconomic Pathways” are standardized inputs to climate models.

• They were not designed to be realistic or for use in economic analyses.

• We need projections that are.
Financialization of Carbon
(New Directions)

- Global CO2 emissions = 40 billion tons
- Suppose SCC = $60 / ton (Obama, 2.5% discount rate)
- Annual emissions valued at $2.4 trillion (Global GDP = $94T)
- Explicit or implicit carbon pricing will create a new major asset class “out of thin air”.
- What are the implications for non-carbon markets (e.g. inflation)?
- How should control of the price be structured?
Innovation forecasting (New Directions)

- Technological innovation is the weakest link in many analyses.
- How can we project it better?
- What do current markets indicate about the future?
- What policies accelerate changes in relative prices via innovation?
Geoengineering
(New Directions)

• Incentives to geoengineer are enormous
• What is the scale/scope of externalities?
• Local, national, and global regulatory regimes almost non-existant
• Geoengineering changes the SCC. How to design a consistent management system?
• What is a reasonable and tractable liability regime?

Proctor et al. (Nature, 2018)
Practical energy strategies for developing economies (New Directions)

• Energy access must scale.
• Emissions probably shouldn’t.
• What is a practical plan?
• Integrated global welfare analysis of proposals?
• How is intragenerational and intergenerational equity achieved?

Image: Carbon Emissions Per-Capita by Country

Visual Capitalist
Treaty design in the presence of “adversaries”
(New Directions)

• The global treaty system is experimental
• Kyoto and Paris did not “work”
• Treaty design literature focuses on incentive-compatible & self-enforcing systems among sovereigns that are regulators.
• Actual treaties are pulled apart by strategic agents that are not sovereigns and not bound by the same game.
• We need treaties that are robust to adversarial strategies, not just self-interest of participants.

Fig. 1 | Waxman–Markey lobbying spending and change in firm value.

Meng & Rode (Nature Climate Change, 2019)
Institutions for adaptation (New Directions)

- There are / will be massive efforts to minimize economic damages from climate change.

- There are no institutions to ensure policies / technologies are “safe and effective”

- We must design institutions for third-party verification (think: RCTs) to protect consumers (e.g. cities).

- What is the structure / design of these institutions?

We do not have comparable institutions for climate-related policies or technologies.
One view of the research outlook
What might happen by 2030?

• Policy will be driven by testable models with verifiable data
  • Financial stakes are real and too big to trust researcher intuition

• Adaptation strategies will become data-driven
  • Metrics and standards for cost effectiveness will exist

• A major focus on practical challenges of integrating new carbon-based assets with the rest of the economy

• Geoengineering will be a major research area

• We will design a global treaty that works