Central Banking Challenges Posed by Uncertain Climate Change

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Confronting policy uncertainty

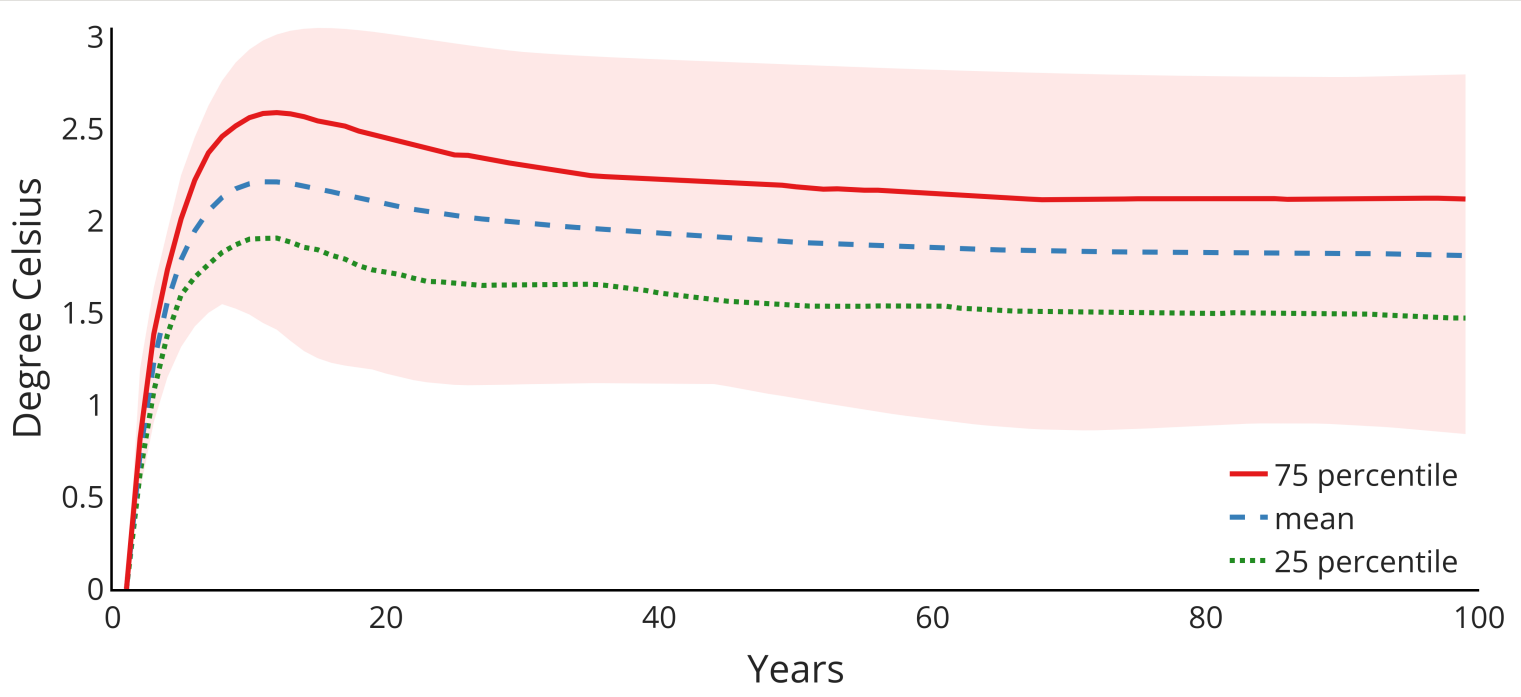
Tension:

- limited understanding of the mechanism by which policy influences economic outcomes
- demand for precise answers by the public

Important Considerations

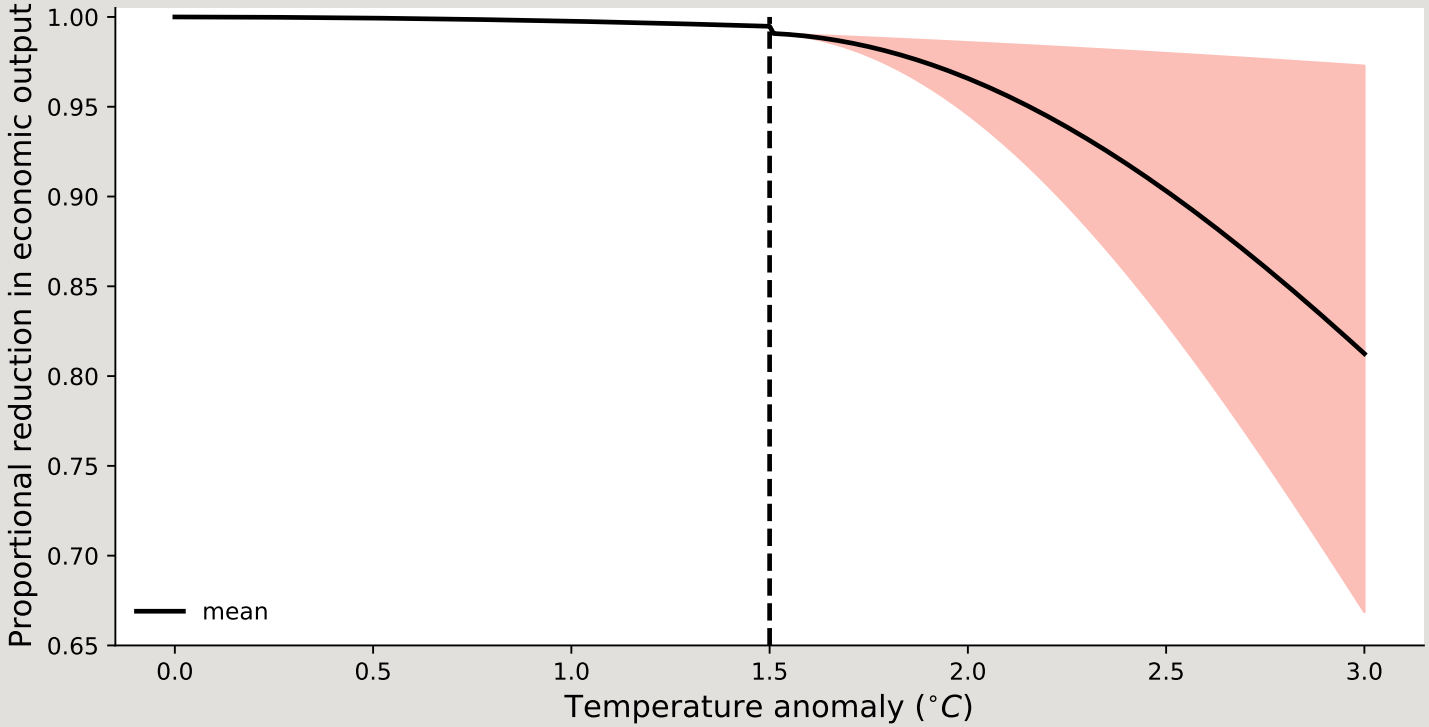
- historical measurement alone has limited value - push advanced economies in realms that we have yet to experience.
- hastily devised policies unsupported by credible quantitative modeling could backfire, harming reputations of central banks
- stated climate change ambitions may generate unwarranted confidence in the abilities of central banks to address this important problem

Divergent climate model predictions



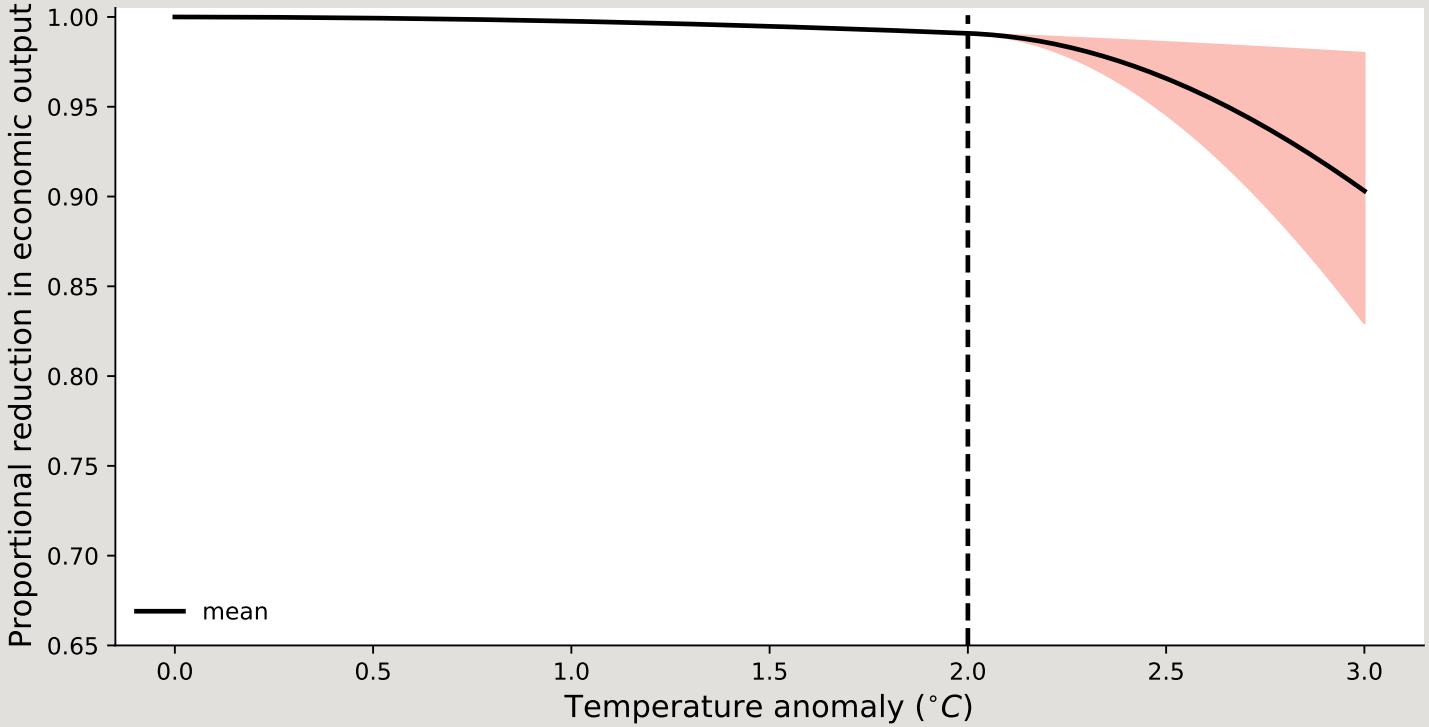
Percentiles for temperature responses to emission impulses. The emission pulse was 100 gigatons of carbon (GtC) spread over the first year. The temperature units for the vertical axis have been multiplied by ten. The boundaries of the shaded regions are the upper and lower envelopes based on 144 models.

A stochastic model of damages



Percentiles of possible proportional reductions of the productive capacity of the economy. Temperature anomaly threshold is 1.5 degrees celsius.

A stochastic model of damages



Percentiles of possible proportional reductions of the productive capacity of the economy. Temperature anomaly threshold is 2.0 degrees celsius.

Decision theory under uncertainty

- allows for a broad perspective on uncertainty
  - risk - unknown outcomes with known probabilities
  - ambiguity - unknown weights to assign to alternative probability models
  - misspecification - unknown ways in which a model might give flawed probabilistic predictions
- includes formulations that are dynamic and recursive

Uncertainty tradeoffs

- How much weight do we assign to:
  - best guesses
  - potentially bad outcomes

  when designing policy?
- Do we act now, or do we wait until we learn more?

Uncertain climate economics

- physical risk
  - climate sensitivity - the temperature responses to changes in emissions
  - environmental tipping points - consequences triggered after crossing a temperature anomaly threshold
- transition risk
  - damages and adaptation - economic and social consequences of climate change
  - green technology - development of new “clean” technologies
  - policy - private sector exposure to uncertain government actions

Given difficulties in quantification, replace risk with uncertainty.

Financial stability challenges

- What is systemic risk? - modeling successes have been largely qualitative
- How do we integrate climate change into our current understanding?
- Over what time scale should we seek to quantify climate change uncertainty?

Regulation and supervision of the banking sector

Distinguish:

- ▷ systematic risk
- ▷ systemic uncertainty

A systemic concern is that the private sector collectively understates-estimates magnitudes of their exposure to climate change.

Productive initial steps

- Work collectively (regulators and regulated) on methods and models for quantifying climate change exposure over alternative horizons
- Embrace a broad notion of uncertainty using decision theory as a guide
- Come up with agreed upon and prudent ways to measure climate change exposure

Caution I: push beyond what is currently envisioned by NGFS

Caution II: whose models do we use for assessing the exposure of financial institutions to climate change: regulators' or the ones of those who are regulated? - see Behn, Haselmann, and Vig, "The Limits of Model-Based Regulation"

Scenario-based stress tests

Possible aims:

- explore events through a collection of well-defined scenarios that can extend over three decades
- investigate more extreme possible outcomes that climate change outcomes that could stress the financial system

Only a very limited role for probabilities and the dynamic implications of future information

Scenario based stress tests

Figure 3.1 Illustrative variable pathways in each scenario

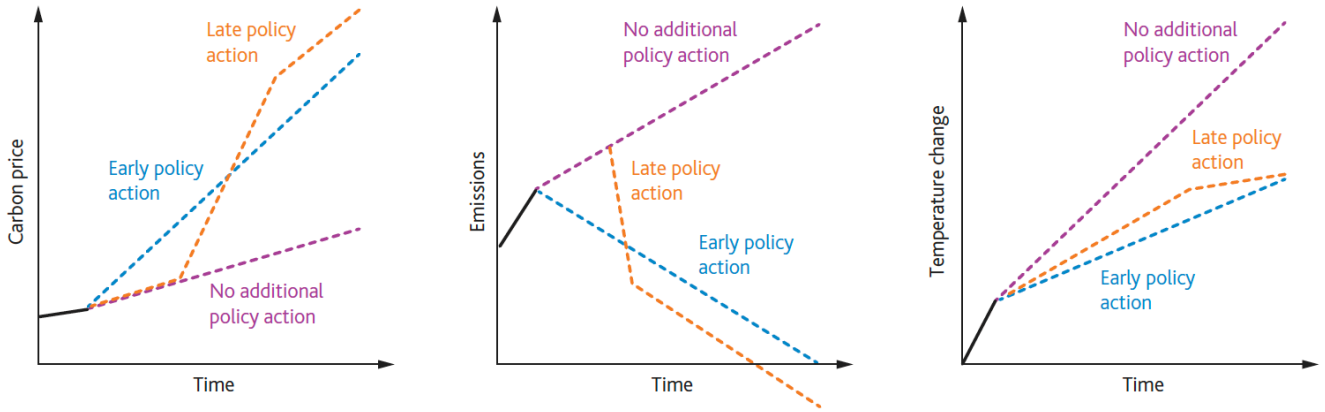


Figure taken from the Bank of England report: The 2021 Biennial Exploratory Scenario on the Financial Risks from Climate Change

See also the NGFS Scenarios Portal

Uncertainty tradeoffs: revisited

- How much weight do we assign to:
  - best guesses
  - potentially bad outcomes

  when making decisions?
- Do we act now, or do we wait until we learn more?

Banks being regulated also will need to confront these tradeoffs! In contrast, the scenario-based stress tests are inherently static with limited use of probabilities.

Limits to stress tests

- ▷ miss important lessons from dynamic decision theory under uncertainty
- ▷ opens the door to stress test answers that condition on the entire path

Shunting dynamic evolution of probabilities (including their uncertianties) and information revelation undermines their value.

Tilting portfolios green I

What is the potentially valuable role of central banks for embracing and enforcing green mandates as policy objectives?

Recent investigations:

- ▷ Hong, Wang, and Yang (2021) “Welfare Consequences of Sustainable Finance”
- ▷ Papoutsi, Piazzesi and Schneider (2022) “How Unconventional is Green Monetary Policy?”

They investigate the potentially important role for policies that tilt towards green production. But ...

Tilting portfolios green II

Current ESG (environmental, social and governance) portfolio standards are problematic: open the door to gamesmanship undermining their socially productive consequences

- The "risk-adjusted" expected return loss to ESG investing has been notoriously hard to estimate with substantially different findings across alternative studies
- The real impact of ESG investing has been challenging to uncover. See Elmalt, Igan and Kirta "Limits to Private Climate Change Mitigation" (2021)
- Substantial green patenting done by firms with low ESG scores. See Cohen, Gurun and Nguyen "The ESG-Innovation Disconnect" (2021)

What should the role of central banks be in correcting and enforcing such standards?

Lessons from Social Cost of Carbon Measurements

- proposed measurement framework: four modules i) emissions, ii) climate, iii) damages, iv) discounting; (See: National Academies of Sciences, Engineering and Medicine "Valuing Climate Damages: Updating Estimation of the Social Cost of Carbon Dioxide, 2017")
- limitation: important interactions across the proposed modules that get amplified in the presence of uncertainty

More meaningful approaches embrace these interactions and capture the multiplicative interaction among uncertainty components

See discussion in "Climate Change Uncertainty Spillover in the Macroeconomy," Barnett, Brock and Hansen (2021)

Conclusion/Summary

- The time horizon over which climate change uncertainty plays out is different than in other forms of turbulence on the radar screen of central banks creating unique challenges for policy making.
- Quantifying uncertainty in climate change creates special challenges that are missed by commonly-used "risk-based" methods.
- Understanding the sources of subjective uncertainty and the limitations of models used by both the regulated and regulators will make oversight more effective.

Sometimes more can be accomplished by trying to do less

Some references

- Hansen-Miao (PNAS, 2018): propose and investigate a recursive implementation of the smooth ambiguity model in continuous time. See Klibanoff-Marinacci-Mukerji (Econometrica, 2005) for the initial work on smooth ambiguity models with many subsequent contributions.
- Hansen-Sargent (JET, 2022): propose and investigate a recursive implementation to account differentially for model ambiguity and model misspecification in dynamic settings. See Gilboa-Schmeidler (J Math Econ, 1989), Maccheroni, Marinacci and Rustichini (Econometrica, 2006) and initial work on supporting decision theory with many subsequent contributions. Our research also builds on a substantial robust control literature.
- Barnett, Brock and Hansen (RFS, 2020) and Barnett, Brock and Hansen (Macro Annual, 2021): develop the methodology in practice and apply it to some illustrative models of the economics of climate change.

These papers contain references to many other related contributions that support decision theory and uncertainty quantification.