Minimax Regret Discounting

Terrence Iverson

Department of Economics
Colorado State University

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Constant exponential discounting unsettling for long-lived environmental problems

1. Choice of discount rate all important

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1% disc rate		
4% disc rate		
Difference:		

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Declining discount rates (DDRs) do better on all three

Uncertainty-based normative case for DDRs

Weitzman (1998)

If consumption discount rate (CDR) uncertain
and apply Savage axioms (max EU)
then certainty-equivalent CDRs
decline to lowest possible rate

But estimating probabilities a challenge

	Sources of uncertainty	
	Consumption growth	Intertemporal preferences
Weitzman (2001)	X	X
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- Policymakers face a set of welfare specifications, no basis for assigning probabilities

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- Minimax regret:

$$\min_{a \in A} \max_{\gamma \in \Gamma} R(a, \gamma),$$

  where

$$R(a, \gamma) = \left[\max_{a \in A} W(a, \gamma) \right] - W(a, \gamma).$$

Justification for minimax regret

- Axiomatic foundations
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- Equally balances concern about “doing too little”
  with concern about “doing too much”
  (Iverson and Perrings 2011)

Theory

Overall result

Minimax regret discounting mimics a criterion
that maximizes PV of future utility
with a path of certainty-equivalent discount rates
that converges to the lowest possible rate

Theory

Proposition 1: “as if” implicit prior

Consider a set of discounting models $\Gamma = \{\gamma_1, ..., \gamma_m\}$

- $W(a, \gamma)$ concave in a
- Set of feasible policies convex and compact

Then, there exists a prior $\pi = (\pi_1, ..., \pi_m)$
such that MR maximizes

$$E^{\pi} W(a, \gamma) = \sum_{i=1}^{m} \pi_i W(a, \gamma).$$

Theory

Proposition 2

The implicit minimax regret prior puts positive weight on the lowest discount rate model

Application

- Calibrate expert disagreement
  to match Stern–Nordhaus debate
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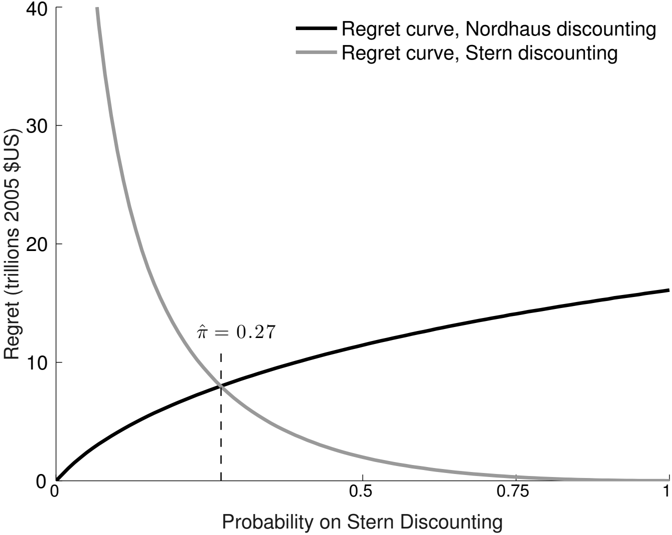
- Solve for minimax regret solution in DICE (Nordhaus 2008)

The implicit MR prior puts positive weight
on extreme models only:

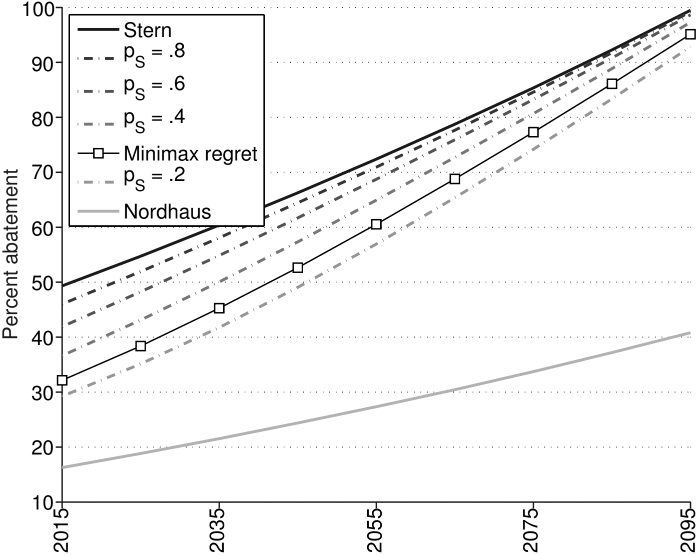
$\hat{\pi}$ on the Stern model,

$1 - \hat{\pi}$ on the Nordhaus model

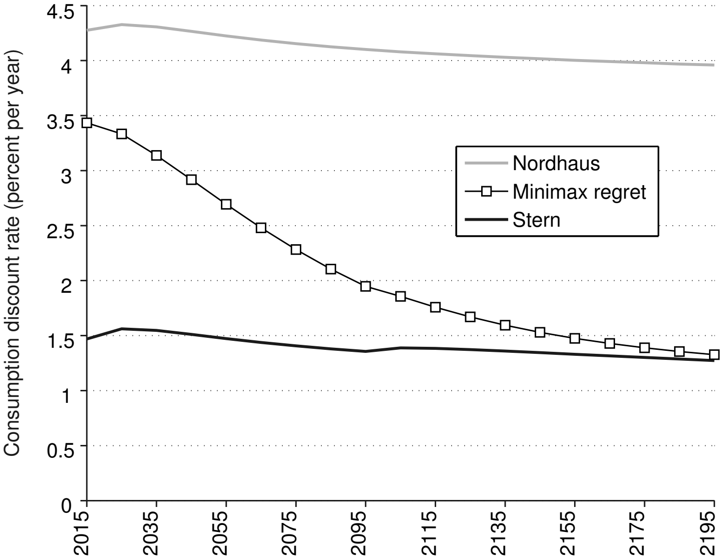
Solving for minimax regret



Solving for minimax regret



The effective CDR



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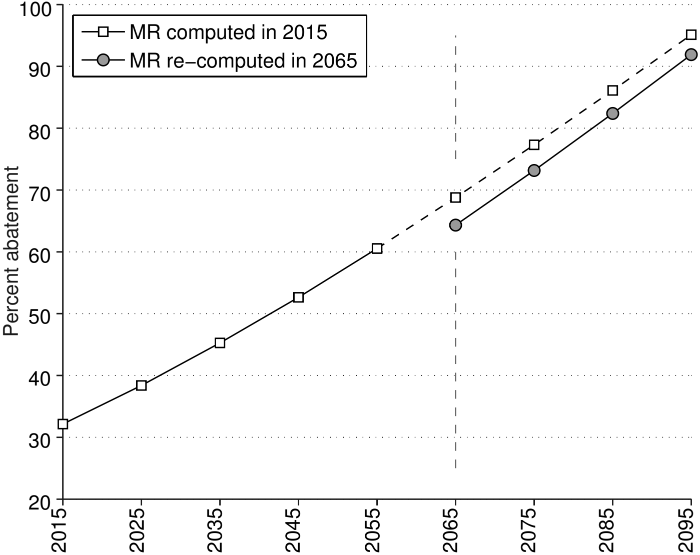
- Provides concrete resolution to discount rate uncertainty when prior unavailable
- Quantitatively interesting: Applied to Stern–Nordhaus, effective CDR converges to Stern CDR within 200 years

BACKUP

Time Inconsistency



Accommodating Time Inconsistency

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- Accounting for time inconsistency increases near term abatement, so original formulation can be viewed as a lower bound