

Climate policy under fat-tailed risk: an application of FUND

David Anthoff

University of California, Berkeley

Richard S.J. Tol

Economic and Social Research Institute, Dublin

Vrije Universiteit, Amsterdam

Trinity College, Dublin

- 1) Are there fat tails?
- 2) If yes, what policy?

Outline

- **Literature**
- Fat tails and IAMs
- Policy
 - MiniMax Regret
 - ((Minimum tail risk))
 - (Minimize fatness of tail)
- Conclusions

Literature

- Weitzman (2009) “On modeling and interpreting the economics of catastrophic climate change”
- Previous literature: Arrow (1974), Geweke (2001), Tol (2003)
- Follow up: Ackerman et al. (2010), Dietz (2010), Horowitz and Lane (2009), Karp (2009), Newbold and Daigenault (2010), Nordhaus (2009), Pindyck (2010), Roe and Bauman (2010), Weitzman (2009a), Weitzman (2010)
- Millner (2010) “On welfare frameworks and catastrophic climate risks”

Outline

- Literature
- **Fat tails and IAMs**
- Policy
 - MiniMax Regret
 - ((Minimum tail risk))
 - (Minimize fatness of tail)
- Conclusions

$$E[m] = E \left[\beta \frac{u'(C)}{u'(1)} \right] \quad Y \equiv \ln C$$

$$E[m] = \beta E[e^{-\eta Y}]$$

$$Y \sim N(g, \sigma^2)$$

$$Y \sim Stt(g, \sigma^2, v)$$

Analytical

$$E[m] = \exp \left(\ln \beta - \eta g + \frac{1}{2} \eta^2 \sigma^2 \right)$$

$$E[m] = +\infty$$

\approx pretty good

\neq pretty bad

Monte Carlo

0.006

0.006

“Monte Carlo stationary”



“Monte Carlo stationary”

- Test hypothesis of stationarity
- Augmented Dickey-Fuller test
- p-value=0.104 → can't rejection the null hypothesis

Outline

- Literature
- Fat tails and IAMs
- **Policy**
 - MiniMax Regret
 - ((Minimum tail risk))
 - (Minimize fatness of tail)
- Conclusions

Policy

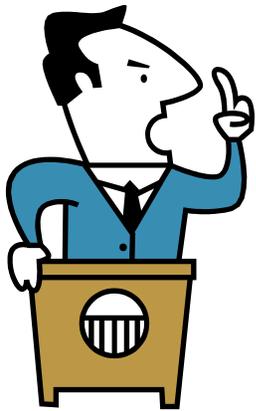
- So should we set the carbon tax to ∞ ?
 - Fossil fuels essential input
- change decision rule

Outline

- Literature
- Fat tails and IAMs
- Policy
 - **MiniMax Regret**
 - ((Minimum tail risk))
 - (Minimize fatness of tail)
- Conclusions

MiniMax Regret

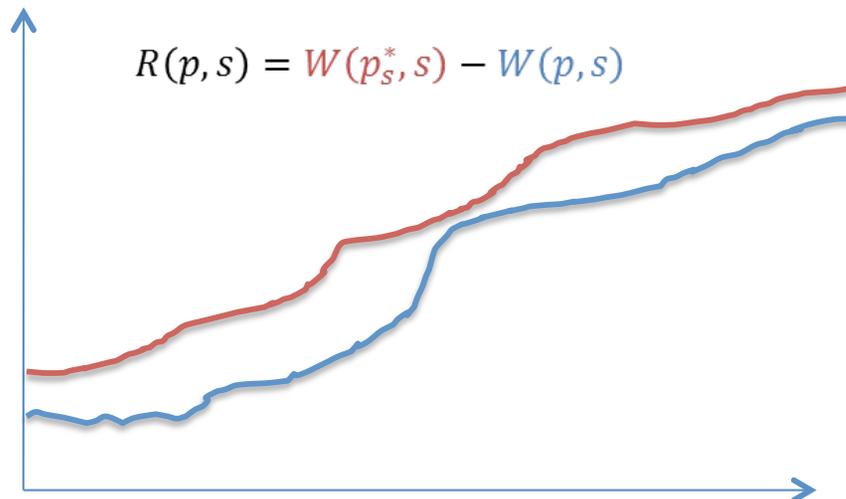
MiniMax Regret



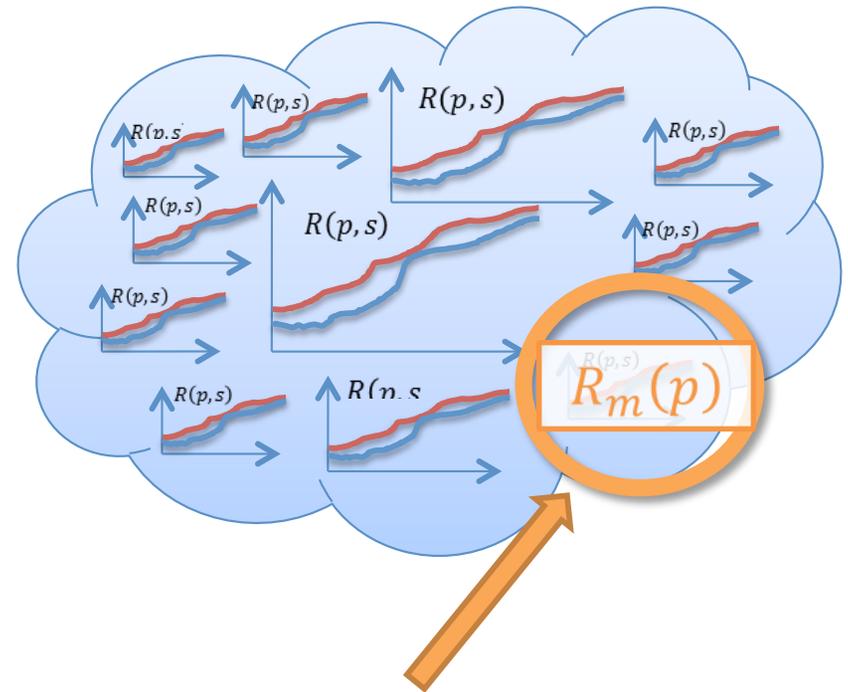
$$p = \frac{\$6}{tC}$$

Pick one state of the world s

Compute regret



Do this for all states of the world

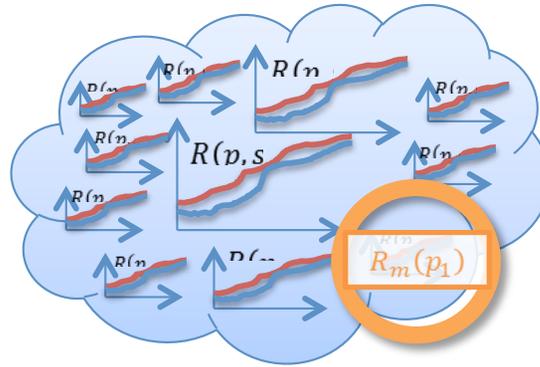


Find the state of the world with the highest regret for the policy

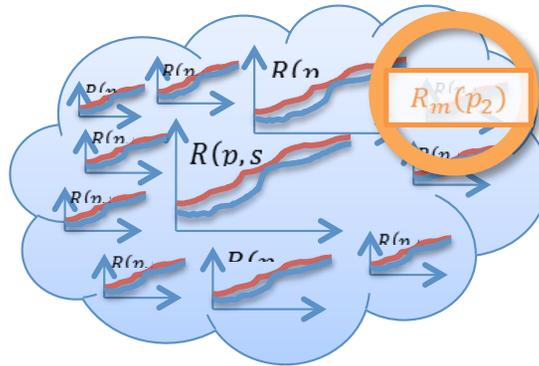
MiniMax Regret



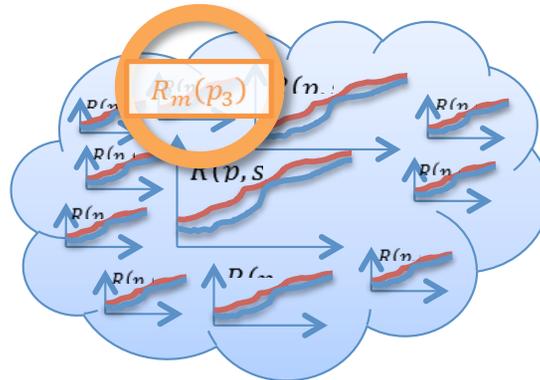
$$p_1 = \frac{\$6}{tC}$$



$$p_2 = \frac{\$7}{tC}$$



$$p_3 = \frac{\$8}{tC}$$

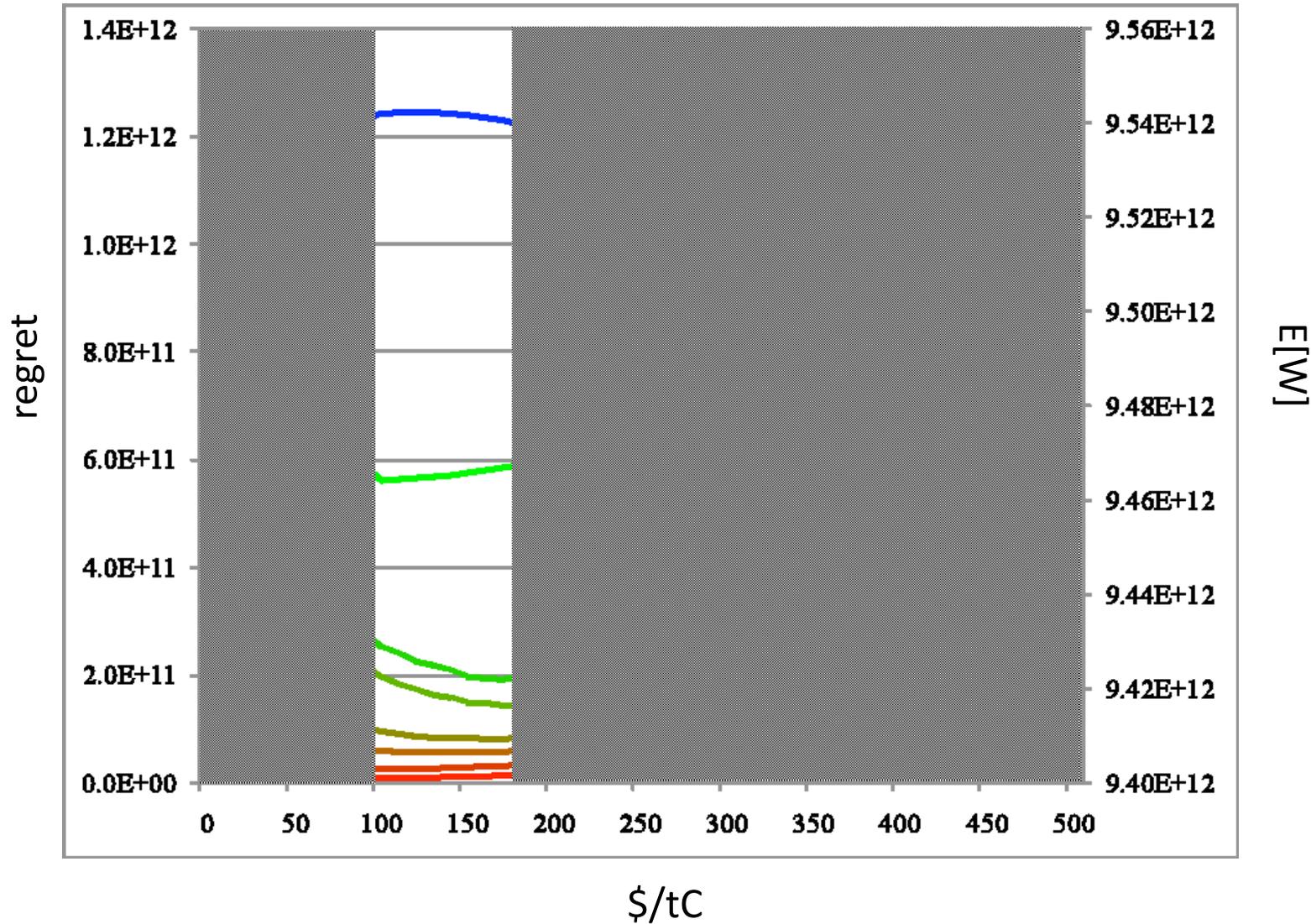


Pick policy with lowest R_m

MiniMax Regret

- No probabilities (in theory)
- Only states with room for policy matter
 - (Really, really bad states might be ignored)
- In practice, Mini**Percentile** Regret

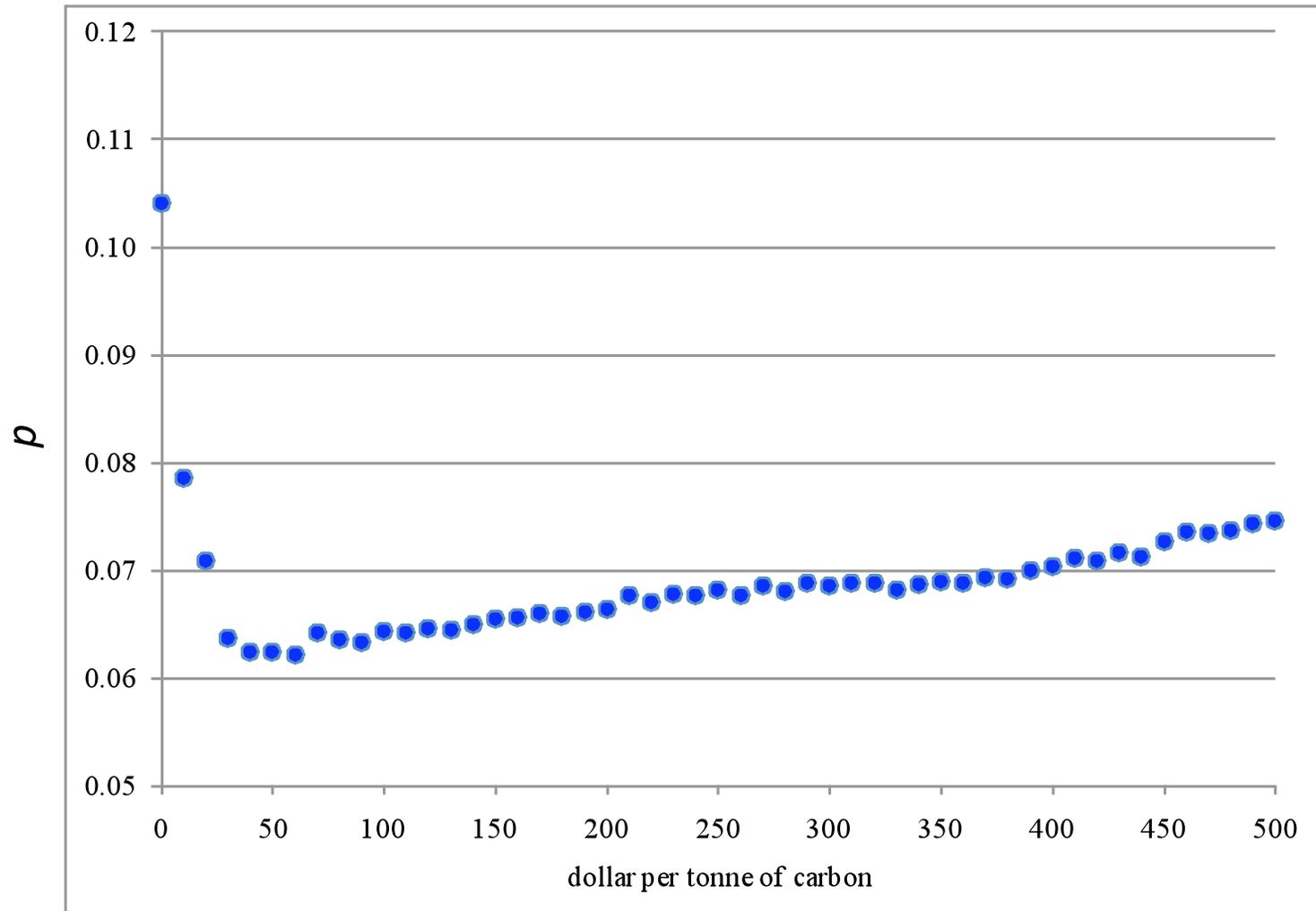
MiniPercentile Regret



Outline

- Literature
- Fat tails and IAMs
- Policy
 - MiniMax Regret
 - ((Minimum tail risk))
 - **(Minimize fatness of tail)**
- Conclusions

Minimize Fatness of Tail



Outline

- Literature
- Fat tails and IAMs
- Policy
 - MiniMax Regret
 - ((Minimum tail risk))
 - (Minimize fatness of tail)
- **Conclusions**

Conclusions – 1

- There is dangerous climate change
- There is dangerous climate policy too
- Numerical models can give insight
- Using three alternative decision rules → carbton tax between \$50/tC and \$170/tC
- Large range, but not arbitrary

Conclusions – 2

- Open Questions:
 - Are there really fat tails?
 - CBA/expected welfare with other utility functions

Thank you!

david@anthoff.de

<http://www.david-anthoff.de>