Committed to a decarbonizing world

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- “Too little too late” published as “Moving targets—cost-effective climate policy under scientific uncertainty”, Gerlagh & Michielsen 2015, *Climatic Change*

Main results

- Climate target is an endogenous variable dependent on preferences for climate stabilization, interacting with preferences for consumption streams
- Climate targets tend to erode over time both in naive and sophisticated policies

Remaining questions:

- Need to think about commitment mechanisms.
- Pledges don’t commit / Clean energy technologies can work as commitment device
- Is cheap clean technology a good commitment device / do we need to support clean technology beyond carbon price?

Conceptual background

- There is no ‘safe climate change’.
  - We don’t know precisely how emissions map into long-term concentrations, how concentrations map into long-term temperatures, all feed backs, and how temperatures map into economic + intangible damages.
- Each decision maker (DM) trades off welfare versus risk of dangerous climate change (CC).
- Each DM likes to reduce CC risks, but let the next DM pay the costs
- Procrastination: the Naïve DMs finds themselves in a sequence of deteriorating targets. They start aiming for 450 ppmv, end up with >550 ppmv.

Research Question

- What is the sophisticated response to CC and policy procrastination?
- Iverson (2012) & Gerlagh and Liski (2012): the sophisticated DM acts the same as the Naïve DM. The DM can foresee but can't help prevent the outcome.
- Depends on the specific functional forms (logarithmic utility, full capital deprecation, no effect of current emissions on future demand for emission permits, specific CC modelling, …)

- This paper: can the DM commit to stringent climate policy through specific abatement choices (e.g. clean energy)?
- Method: employ a standard Economy-CC model, carefully design abatement technologies as 'immediate'='static' or 'persistent'='dynamic'
- Simulate naïve and sophisticated policies, and analyze

Other literature

- Kriegler et al. (2009): we don't know tipping points. Climate change is uncertain risk.
- Barret and Dannenberg (2014): climate uncertainty makes it hard to coordinate on stabilization
- Ha-Duong, Grubb, Hourcade (1997): dynamic aspect of abatement overlooked in models. We must do more upfront efforts.
- Dengler, Gerlagh, Trautman, van der Kuilen (2016): commitment devices help groups to commit intertemporal coordination

General model

Welfare depends on consumption stream and long-term climate (cf Chichilnisky 1999)

- $W_\tau = \sum_{t=\tau}^{\infty}(1+\rho)^{-N(t-\tau)} N L_t \ln\ (C_t/L_t) - \frac{1}{2}\Phi max(Atm_t - 275)^2$
- W_t = welfare, C_t = consumption, L_t = population, N = 10 years/period, ρ = pure time discount rate

Output & immediate / ‘static’ abatement efforts (e.g. DICE)

- $Y_t = \Omega(Temp_t)(1 - \zeta \frac{1}{2}\theta_t {\mu_t}^2)X_t$
- $Z_t = (1 - \mu_t)\sigma_t X_t$

- Y_t = output (GDP), X_t = potential output, Z_t = emissions, Ω= climate damages,μ_t= emission reduction

Model 1,2,3

View of worlds

Model 1: Immediate / '*static*' abatement efforts (e.g. DICE, driving less)

- $Y_t = \Omega(Temp_t)(1 - \zeta \frac{1}{2}\theta_t {\mu_t}^2)X_t$

Model 2: Permanent / '*dynamic*' abatement efforts (e.g. renewable infrastructure)

- $Y_t = \Omega(Temp_t)(1 - \frac{1}{2}\phi_t(\mu_t - \mu_{t-1})^2)X_t$

Portfolio policy choice: Model 3: both *static* and *dynamic* abatement measures

- $Y_t = \Omega(Temp_t)(1 - \zeta \frac{1}{2}\theta_t {\mu_{1t}}^2 - \frac{1}{2}\phi_t(\mu_{2t} - \mu_{2t-1})^2)X_t$
- $Z_t = (1 - \mu_{1t})(1 - \mu_{2t})\sigma_t X_t$

Model calibration

Model 1,2,3 give same optimal committed policy in 2000

Assumption 1

Static abatement efforts: full reduction at 5% of GDP costs

Preferences for stable climate such that by 2000: optimum = 450 ppmv stabilization

Assumption 2

Dynamic abatement efforts: costs such that same preferences result in same 450 ppmv stabilization

Assumption 3

When portfolio available, costs such that same preferences result in same 450 ppmv stabilization

Scenarios

Proposal 2000: optimal committed policy = 450 ppmv stabilization

Proposal 2020: after BAU for 20 years, how does optimal policy change?

Naïve: From 2020 onwards, policy starts. Each next period, policy is re-evaluated and revised.

Sophisticated: Markov equilibrium. From 2020 onwards, Decision Makers understand future response to present policies, and maximize present welfare given future response

Cost-effective: same emissions path as sophisticated, but with efficient abatement portfolio (only Model 3)

Comparisons:

Naïve – Proposal 2020: what do we loose because of time-inconsistency?

Sophisticated – Naïve: How do we commit / what do we gain by commitment devices?

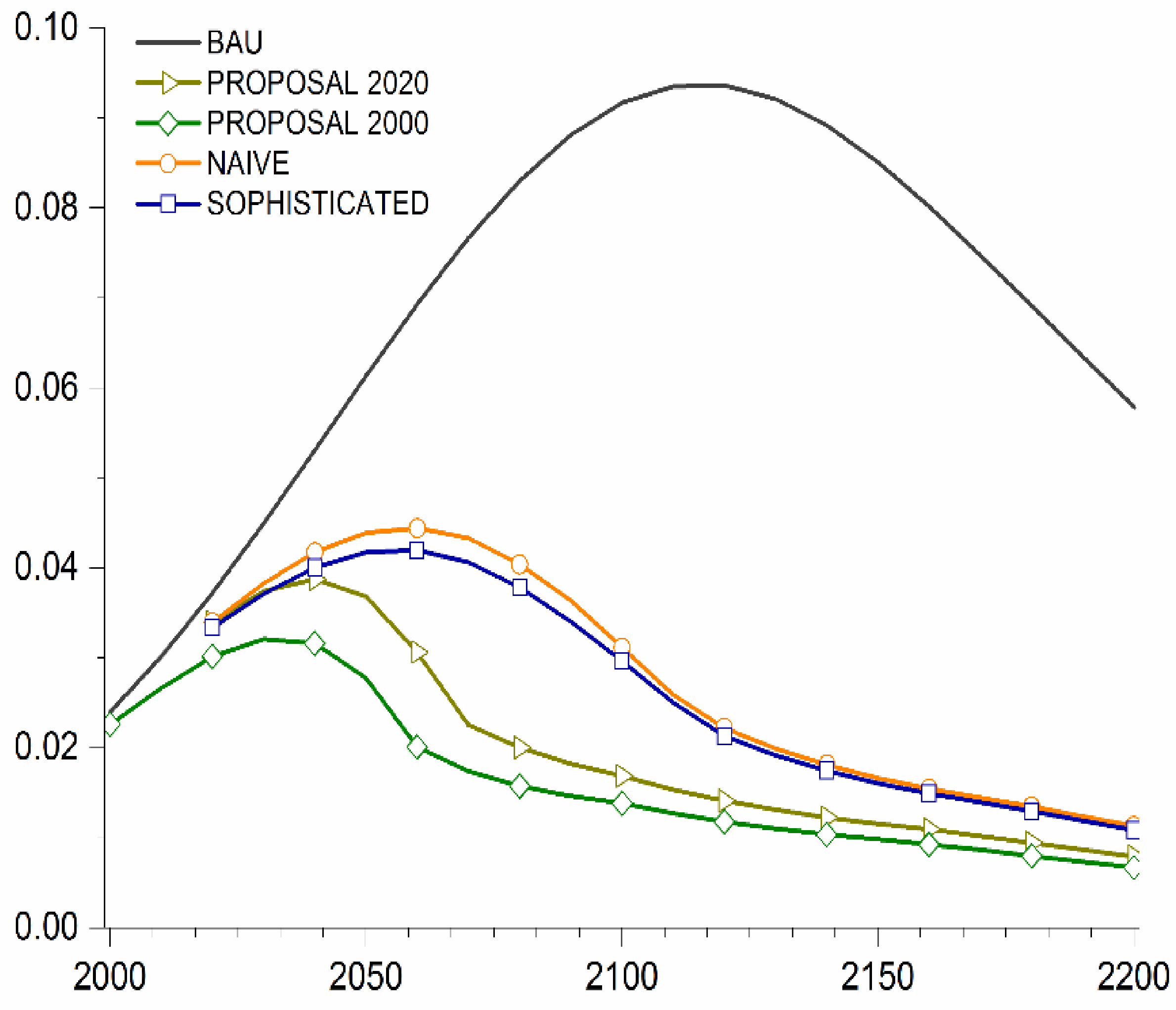
Cost-effective – Sophisticated: what are the costs of commitment devices?

Predictions

- Climate damages are slightly convex
- Static climate abatement policies are strategic substitutes
- Dynamic abatements are strategic complements (create lock ins)
- Sophisticated policies create lock ins in clean production
- Increase of (dynamic) abatement: lower emissions at higher costs (cost-ineffective portfolio).
- Ambiguous whether welfare improves

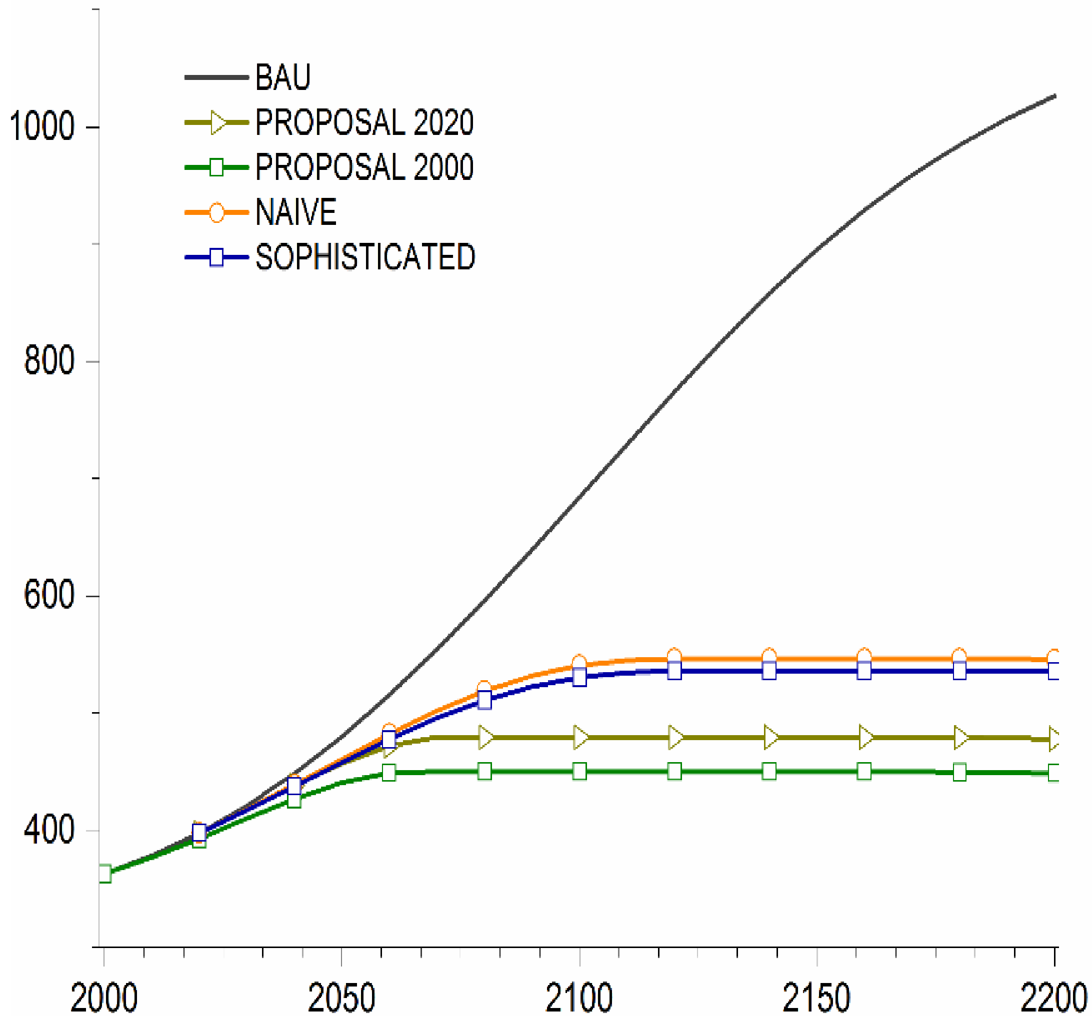
Emissions

- 20 years delay increases emissions substantially (future does not want to carry out our proposals!)
- Further naivity increases future emissions
- Sophistication improves climate effectivity tiny bit



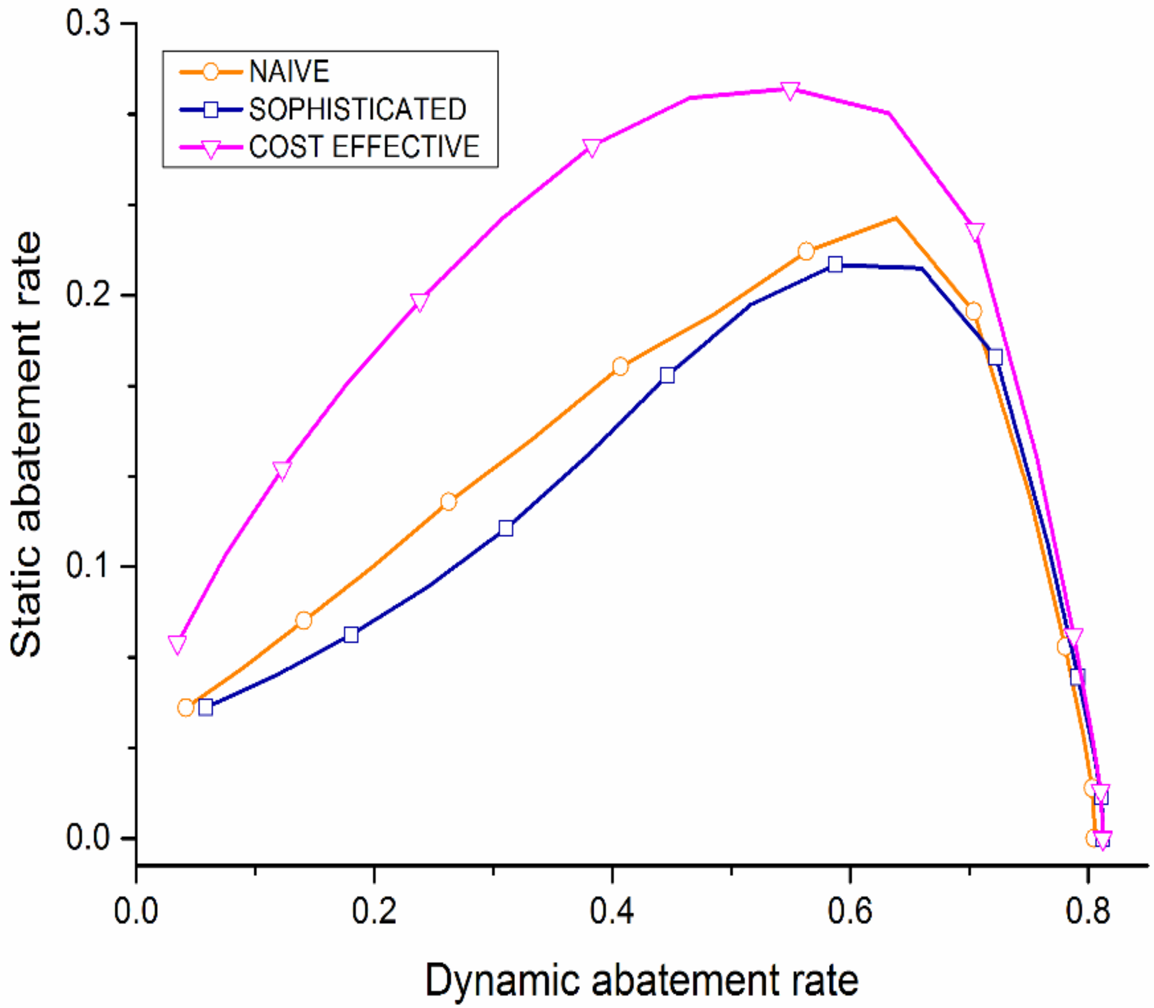
Concentrations

- 20 years delay increases stabilization from 450 to 490 ppmv.
- Further naivity increases climate change to 550 ppmv
- Sophistication improves climate effectivity tiny bit



Abatement policies

- Sophistication increases dynamic abatement above cost-effective level.
- ‘Commit to lock-in’



Welfare

[%]	BAU	Naïve	Soph.	CE
$\frac{W_{2020} - W_{PROP2020}}{\sum_{t=0}^{\infty}(1+\rho)^{-t} NL_t}$	0.64	0.33	0.26	0.29
$\frac{\Gamma_{PROP2020} - \Gamma_{2020}}{\sum_{t=0}^{\infty}(1+\rho)^{-t} NL_t}$	-6.59	-0.74	-0.61	-0.61
Total Welfare Cost	**-5.95**	**-0.41**	**-0.36**	**-0.32**

- Proposal by 2020 costs 0.64% of perpetual consumption equivalent
- Naïve Policy continually renegotiates, increasing consumption by 0.33% perpetual equivalent. But climate risk is evaluated as 0.74% perpetual equivalent
- Sophisticated policy does a slightly better job, but forcing commitment costs (0.29-0.26) 0.03% perpetual consumption loss

Welfare

	Model 1		Model 2	
[%]	Naïve	Soph.	Naïve	Soph.
$\frac{W_{2020} - W_{PROP2020}}{\sum_{t=0}^{\infty}(1+\rho)^{-t} NL_t}$	1.004	1.038	0.557	0.517
$\frac{\Gamma_{PROP2020} - \Gamma_{2020}}{\sum_{t=0}^{\infty}(1+\rho)^{-t} NL_t}$	-1.356	-1.501	-0.823	-0.786
Total Welfare Cost	**-0.352**	**-0.462**	**-0.266**	**-0.269**

- Sophisticated policy does not always do a better job. Result is not robust.

Model calibration

1. Gerlagh and Michielsen (2015): Climate Policy Procrastination is ‘reasonable’
2. Focus on first-best is self-defeating strategy.
3. ‘Dynamic abatement’ is needed for effective climate policy to reduce procrastination
4. Investment in clean energy & infrastructure above levels rationalized through prices is reasonable
5. Yet, scope for effective policy seems limited, even when anticipating?