Greening Oil:

Optimal Extraction During the Transition from Coal to Renewables

Bård Harstad, Katinka Holtsmark

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What role can suppliers of oil and gas potentially play in global climate change mitigation?

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Specific motivation for the model:

- It is not clear what a coalition of oil/gas suppliers should or would do.
  - Restrict supply to encourage green investments?
  - Flow the market to crowd out coal?

Preview of key findings

- Formation of a climate-motivated supply-side coalition of oil suppliers may play a role in mitigating climate change.
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  - The coalition may face a time-inconsistency problem that leads them to slow down renewables development and production instead of speeding it up.

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  - The key role: speed up development of renewable energy technologies and production capacities.
- Formation of a climate-motivated coalition of oil suppliers may, however, also increase emissions and decrease welfare.
  - The coalition may face a time-inconsistency problem that leads them to slow down renewables development and production instead of speeding it up.
- Reducing investment in search and exploration may (partly) alleviate the time-inconsistency problem.

The basic model

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- Representative renewables producer/investor:
  - Capacity R_0 available in period 0
  - Invests in capacity period 0: $c^r(r_0)$.
  - Capacity $R_1 = \delta R_0 + r_0$ in period 1.

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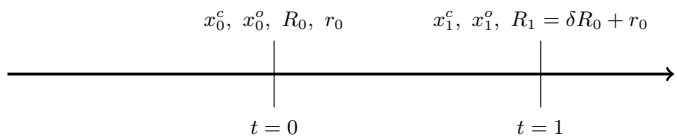

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- Welfare: $W_t = u(e_t) - c^o(x_t^o) - c^c(x_t^c) - c^r(r_t) - D_t$

Potential role of oil in the green transition

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Laissez-faire equilibrium:

- Energy consumption is too high: $e_t^{LF} > e_t^{FB}$.
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Potential roles of a climate coalition of oil producers:

- Take supply down to induce higher investments in renewables.
- Take supply up to crowd out coal.

Supply-side agreement

- A share $m \in [0, 1]$ of the oil producing countries form a coalition.
  - The coalition strategically sets a common tax on its own oil supply, τ_t.
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- Questions:
  - What will the coalition do?
  - How will formation of the coalition affect welfare?

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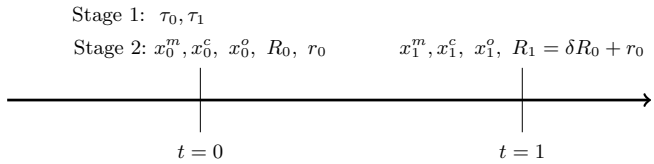

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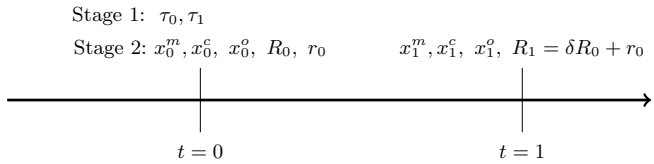

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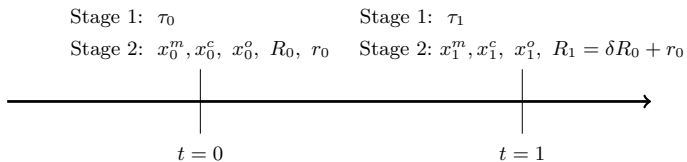

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Given:

- r' is sufficiently large (in the long run)
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- Formation of a climate-motivated coalition will increase emissions: $D_1^{equ} > D_1^{LF}$.
  - The increase in emissions will be larger the more climate-motivated the coalition is.
  - The increase in emissions will be larger the more countries join the coalition.

Extension of the model: Search and exploration activity

Extension of the model:

- The coalition can strategically tax or subsidize search and exploration.
- Changes in search and exploration can constitute a commitment mechanism.

Extension of the basic model

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- Cost of oil production: $k(x_t^o, S_t^o)$
  - $\partial k / \partial S_t^o < 0$
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- Coalition sets:
  - Production tax (for each period) as before: τ_0, τ_1.
  - Tax on search and exploration (in period 0): ψ.

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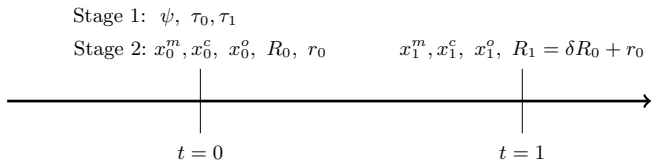

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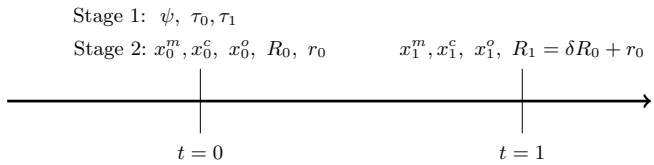

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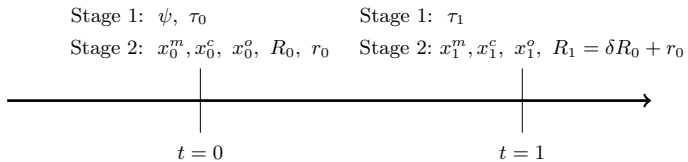

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- The coalition will increase its production subsidy in the second period: $d\tau_1/d\psi < 0$.

Summary

- With commitment, the coalition can decrease emissions by taxing extraction.
- Without commitment, the coalition may subsidize extraction and by that end up increasing emissions.
- Without commitment, the coalition may want to tax search and exploration activity to signal lower future extraction.
- Extension: If the oil resource is exhaustible, the coalition may want to extract even more in the first period, to signal lower future extraction.
- Extension: The coalition may want to invest in renewables to signal lower future extraction.