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Green Innovation and Economic Growth in a North-South Model

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Research Question

- Low-cost green technologies necessary for decoupling economic growth from carbon emissions growth
- Motivates green research subsidies in regions with ambitious environmental policies reduction targets ('North')
- Research Question: under what conditions switch to green technologies in North can induce similar switch in South.
- Policy Relevance: power of unilateral actions

Literature

Previous studies:

- South imitates green technologies from North (Acemoglu et al. 2014)
- by green R&D North could remove the comparative adventage of South in polluting good (Hemous, 2016)
- North can avoid environmental disaster by shifting comparative advantage of South from energy to manufacturing (Ravetti, 2016)

This article:

- Trade of technological goods
- South and North technologies compete with each other

Quality Ladder

- Setup based on Grossman and Helpman (1992) and Aghion and Howitt (1992)
- Successful innovation:
  - allows innovator to capture ('steal') a market
  - increases the value of the market
- Then, many competing innovators implies:
  - shorter time interval of expected profit flow
  - value of the market grows fast => high expected profit per unit of time

Production

Final good is produced from clean and dirty intermediate goods

$$Y_t = \left(Y_{ct}^{\frac{\varepsilon-1}{\varepsilon}} + Y_{dt}^{\frac{\varepsilon-1}{\varepsilon}} \right)^{\frac{\varepsilon}{\varepsilon-1}}$$

Intermediate good $j \in (c, d)$ is produced using

- labour purchased at price w
- resources R_j (at price c_j)
- and a composite of specialized machines $\ln X_{jt} = \int \ln (A_{jit} Z_{jit})\, di$ (Z_{jit} at price p_{ijt})

$$Y_{jt} = R_{jt}^{\alpha_2} L_{jt}^{1-\alpha_1-\alpha_2} X_{jt}^{\alpha_1}$$

Machines

- Machines produced by firms with best available technology
- An innovation improves quality (A_{jit}) by factor $(1+\gamma)$, thus allows to replace the incumbant
- $n_c^{North} + n_c^{South}$ innovators in the clean sector
- Poisson arrival of innovations $=>$
- time between two successive innovations is random (distribution: $exponential\left(\lambda\left(n^N, n^S\right)\right)$)

Machines

- Value of an innovation: $v_t = \int \pi e^{-\lambda(t-\tau)} d\tau = \frac{\pi}{\lambda}$
- $\pi_c \sim share_{clean} \sim A_{cit} \sim e^{\gamma\left(n_c^N + n_c^S\right)t}$
- $\lambda \sim n_c^N + n_c^S$

Proposition 1

If

- all North researchers switched to clean technologes
- number of researchers in South is smaller than the number of researchers in North

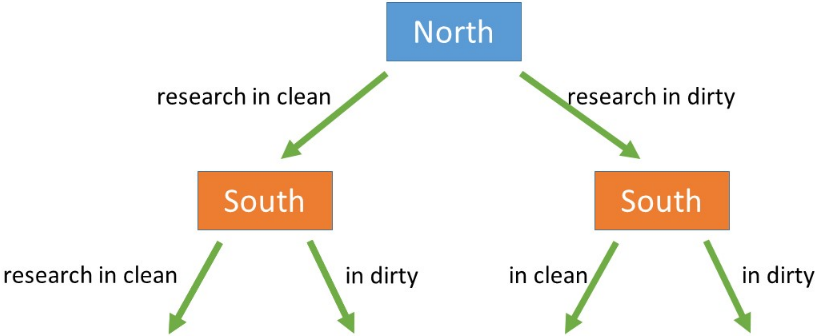
then, in the long run all Southern researchers switch to green technologies

Lock-in

- Assume $n^N < n^S$
  (i) Consider Balanced Growth Path (BGP) with $n_c^N = n^N$ and $n_d^S = n^S$
    - $\pi_{clean} \sim share_{clean} \sim A_{cit} \sim e^{n^N t}$
    - $\pi_{dirty} \sim share_{dirty} \sim A_{dit} \sim e^{n^S t}$
    - South stays forever in dirty
    - Long run economic growth = growth of dirty sector $\sim n^S$

  (ii) If South researchers coordinate and $n_c^S = n^S$, then
    - Long run economic growth = growth of clean sector $\sim n^S + n^N$

Stackelber game



Long-run econ. growth in South:	$g^S \sim n^N + n^S$	$g^S \sim n^S$	$g^S \sim n^S$	$g^S \sim n^N + n^S$
Long-run econ. growth in North:	$g^N \sim n^N + n^S$	$g^N \sim n^N$	$g^N \sim n^N$	$g^N \sim n^N + n^S$
Emissions growth:	$g_{Co2} = 0$	$g_{Co2} \sim n^N$	$g_{Co2} \sim n^N$	$g_{Co2} \sim n^N + n^S$

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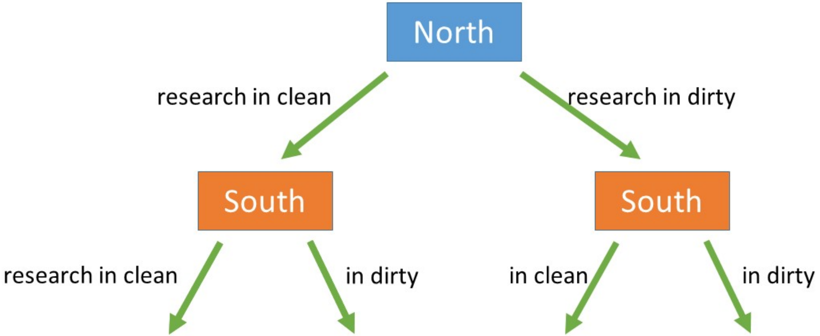

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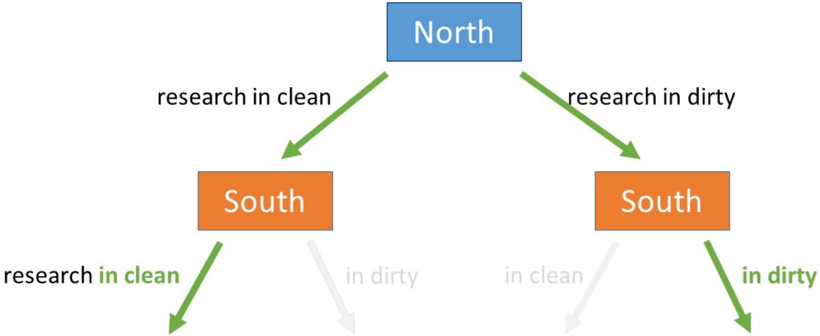

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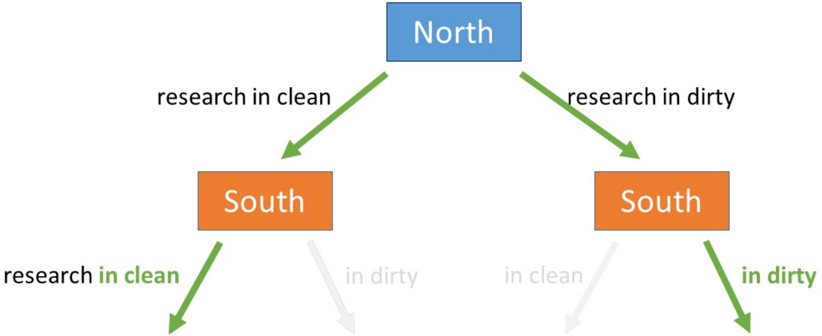

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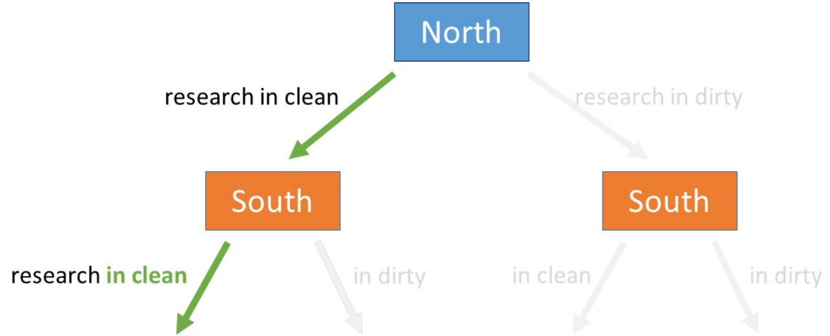

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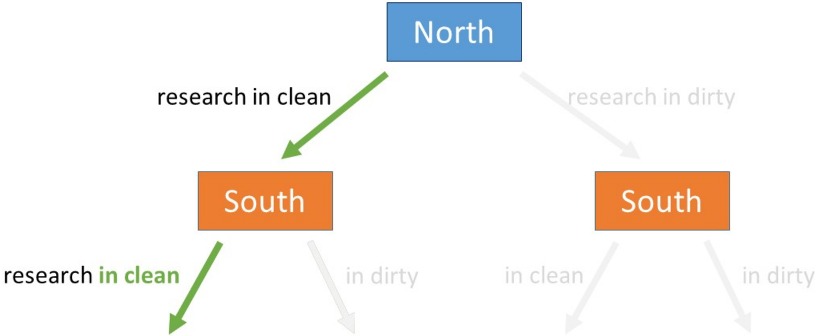

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Long-run econ. growth in North:	$g^N \sim n^N + n^S$	$g^N \sim n^N$	$g^N \sim n^N$	$g^N \sim n^N + n^S$
Emissions growth:	$g_{Co2} = 0$	$g_{Co2} \sim n^N$	$g_{Co2} \sim n^N$	$g_{Co2} \sim n^N + n^S$

Conclusions

- If North R&D sector is large enough, its switch from dirty to clean technologies will induce a similar switch of the South R&D sector in the long-run
- If North R&D sector is not large enough, South might not follow
- In such case the two groups of inventors work on two substitutable technologies
- To ensure fast long-run growth, South government would incentivise Southern researchers to work on the same technologies as the North.
- Given this strategy of South, North should committ to going green.

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THANK YOU

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