“Green Paradoxes”

Paris 2015 and Beyond
Cooling the Climate Debate

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Partly based on:

Pricing carbon

- Curbs fossil fuel demand
- Switches demand from CO2 intensive to less CO2 intensive fossil fuel
- Substitutes renewables for fossil fuel
- Leads to more fossil fuel left in the crust of the earth
- Increases attractiveness of CCS
- Moves directed technical progress to green growth
Green Paradoxes

Well-intended policies may lead to adverse outcomes.

What if

- a carbon tax is not implemented, or does not reflect the social cost of carbon?
- backstops (renewables) are subsidized?
Green Paradox: counter-productivity of green policies


Focus on demand for carbon ignores supply of carbon.
Green Paradoxes

- **Weak**: initial extraction goes up.
- **Strong**: green welfare goes down.
- **Super strong**: social welfare goes down.
Hotelling
Hotelling with backstop

- $\bar{p}$
- $\bar{p}'$

Diagram showing a graph with price on the y-axis and time on the x-axis, with two curves indicating the price at different times $T'$ and $T$. The graph illustrates the concept of Hotelling with backstop.
Stock-dependent extraction cost

\[ b - G(S_0) \]

Cost differential \( b - G(S(T)) \)

Social cost of carbon \( D'(E_0 + S_0 - S(T)) / \rho \)

not too high backstop cost

\( S_T \) \hspace{1cm} \( S_0 \) \hspace{1cm} remaining stock \( S(T) \)
Comparative statics

- Lower backstop price lowers $MB$:
  Higher remaining stock
- If global warming is acute:
  Higher remaining stock
- More patience:
  Higher remaining stock
Additional issues

- Upward sloping supply of renewables
- Dirty backstops
- Imperfect substitutability
- Capital accumulation and economic development
- Multiple countries/regions
- Imperfect competition. Strategic behavior
- Innovation
Upward sloping supply of renewables

Two effects.

- Higher subsidy on renewables increases supply of renewables.
- With constant marginal extraction cost all fossil fuel is exhausted. Hence lower fossil fuel price.

→ No green paradox.
Dirty backstops

- Coal, tar sands
- Typically oil $\rightarrow$ oil + coal $\rightarrow$ coal in optimum
- Typically oil $\rightarrow$ coal in market economy
- Subsidy is bad in market economy
- With clean renewables, subsidy on renewables needs to be high.
Substitutability

- Coal, oil and carbon-free renewables.

- Future tax on coal depresses oil price today and thereby demand for coal.

- No green paradox.
Capital accumulation

- Green growth model with capital accumulation.
- In a ‘poor’ economy marginal utility of consumption is high, marginal damages are low. Green paradox occurs but doesn’t harm welfare much.
Multiple countries

- Oil-importing and oil exporting regions.
- Making the interest rate endogenous: may lead to attenuation but also to amplification of the green paradox.
- Countries with different policies: green paradox might be mitigated
Different carbon taxes

Inelastic demand 10

\[10T_1 + 10T_2 = S_0\]

\[p_0 e^{rT_1} + t_1 = b\]

\[p_0 e^{rT_2} + t_2 = b, \quad t_2 < t_1\]

\[t_2 \uparrow \Rightarrow p_0 \downarrow, T_1 \uparrow, T_2 \downarrow\]

Higher climate cost

Lower social welfare
Imperfect competition

- Reversal of the green paradox
- Limit pricing
Innovation

- Uncertainty on breakthrough technologies
- Directed technical change
- Kick-starting green innovation
Conclusions

- Stranded assets
- Optimal carbon taxes
- Empirics