Discussion of:

To Build or Not to Build? Capital Stocks and Climate Policy

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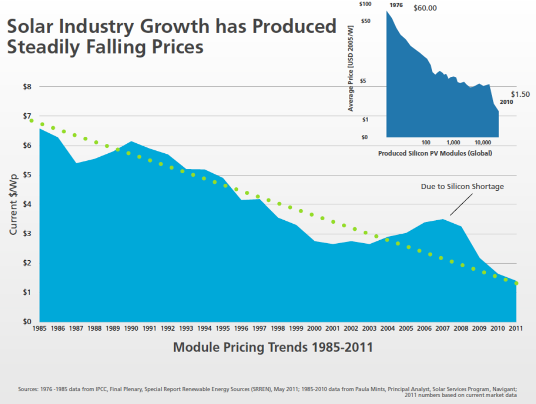
Overview

- Interesting paper on a policy relevant topic!
- Investment irreversibility is a key feature of both dirty and clean capital stocks
- Why relevant?
  - Debate on stranded assets: If we indeed limit emissions to target levels i.e. $\leq 2\%^{\circ}C$ then some of the dirty assets will become obsolete and companies' valuation will be revised downwards.
- **This paper: Irreversibility affects optimal investment schedules for a given government policy and thus the effectiveness of the latter**

Overview

- Clean technologies exhibit learning by doing (LBD). Why relevant?



- **This paper: Positive externalities and non trivial interactions with optimal subsidies**

Summary of main results

- Irreversibility results in under-investment ("early stop") in dirty assets if the damage from emissions is high enough ("stringent policy")
  - Correspondingly, returns must be higher (compared to economy wide return) in the short term to compensate for the low returns in the long term
  - Optimal carbon tax is more effective
- "Acceleration effect"
  - Optimal subsidy is proportional (λ) to the growth rate of the sector, where λ is the learning rate: $\tau_t^H = \lambda(g_t^H + \delta^H)$

Summary of main results

- Welfare comparison in second best scenario (only one instrument available):
  - Less stringent target: Subsidies less costly and sufficient
  - More stringent target: Use carbon pricing, as is more effective
- Sub-optimal Policy mix: When carbon tax is set to half of the optimal level, subsidy is not as small as in the fully optimal tax

Outline

1. Overview

2. Comments and Questions
   - Understanding Irreversibility
   - General Modeling Approach and Empirical Evidence

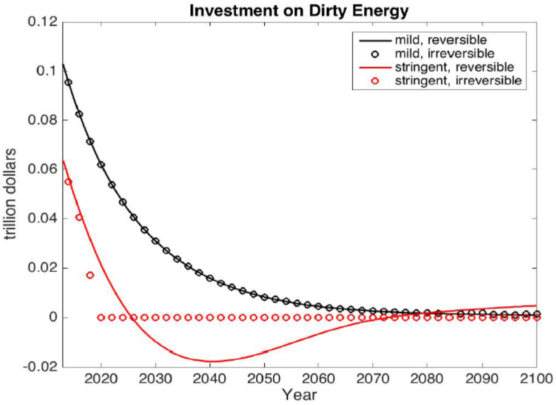
3. Extras

Irreversibility vs Green Paradox

- Irreversibility vs the Green Paradox
  - Hotelling rule: $\uparrow \tau^d_{t+s} \Rightarrow \uparrow \mathit{Stocks}_t$ at given price
  - Irreversibility: $\uparrow \tau^d_{t+s} \Rightarrow \downarrow i^d_t \Rightarrow \mathit{Stocks}_t \downarrow$
- Under which conditions does the irreversibility effect dominate the "Hotelling" effect?
  - Important for understanding the mechanism, even for exogenous taxes/subsidies!

Irreversibility and Optimal Policy

- Irreversibility does not seem to matter for less stringent (DICE) damages.



Irreversibility and Optimal Policy

- Irreversibility does not seem to matter for less stringent (DICE) damages.
  - Is the Green Paradox more dominant?
  - How does the path of optimal taxes interact with the irreversibility distortions?
    - Less stringent target$\Longrightarrow$less damage sensitive path of taxes $\Longrightarrow$ return on investment in dirty capital is higher
    - This is important for the welfare ranking of second best polices
- How does calibration matter in this respect?
  - P_d (Price of dirty investment) set as constant$\Rightarrow$exacerbating the learning effect on the price of green investment, $P_{h,t}$?
  - Damage function parameterization

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Social Cost of Emissions, Policy and Budget

- Social cost of emissions:

$$\chi_t = -\sum_{s=1..\infty} \beta^m M_{t,t+s} \frac{\partial Y_{t+s}}{\partial D_t}$$

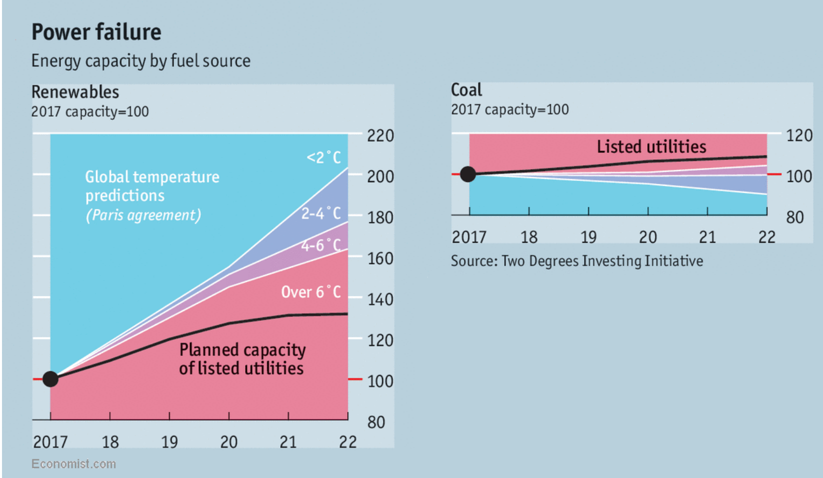
$\frac{\partial Y_{t+s}}{\partial D_t} = f(\text{climate module})$ and $M_{t,t+s}$ the stochastic discount factor

- Interpretation of “stringent” versus “non-stringent” target
  - Stringent target **implies** higher taxes through $\frac{\partial Y_{t+s}}{\partial D_t}$
- Interesting to compute paths under **budget neutral** policy
  - Isolating Substitution effects
  - Important for political economy issues as well

Social Cost of Emissions and *Ramsey* Policy

- Two **strong assumptions**:
    1. Private sector understands the implications of the Paris Aggreement and the steps required to achieve the "$\leq 2\%^{\circ} C$ " target
        - No uncertainty about $\frac{\partial Y_{t+s}}{\partial D_t}$. In fact, no uncertainty at all
    2. Policy makers are themselves credible
        - Government is able to commit to its tax and subsidy plan
- How likely are these assumptions to hold?

Some evidence on private sector response



Implications of Model Uncertainty?

- How do results change when you allow for uncertainty inside and outside the model?
- $\chi_t = -\sum_{s=1..\infty} \beta^m \mathcal{E}_t M_{t,t+s} \frac{\partial Y_{t+s}}{\partial D_t}$ where $\mathcal{E}_t$ are the subjective expectations of the private sector
- Different ways to treat $\mathcal{E}_t$

Different ways to treat $\mathcal{E}_t$

- $\mathcal{E}_t = \mathbb{E}_t : \mathbb{E}_t(.)$ will reflect the objective uncertainty that climate scientists/economists have on the damage (Cai et al. (2015))
- Family of models: Uncertainty about long run effects (Brock and Hansen (2017))
  - Ambiguity aversion (and other similar approaches): $\tilde{M}_{t,t+s} : \mathbb{E}_t \tilde{M}_{t,t+s} X_{t+s} = \mathcal{E}_t M_{t,t+s} X_{t+s}$ will place more weight on bad outcomes and thus higher taxes
- Entertain optimistic and pessimistic agent beliefs
  - Can underestimation of the possible impact by the private sector rationalize the current state of affairs?
- Treat deviations from RE as unobserved and estimate the distortion to $M_{t,t+s}$ (Tryphonides (2017))
  - Use survey data as additional information (i.e. WVS)

link

Implications of Limited Commitment?

- Governments (or the world) may not be able to commit for various reasons
  - Political Economy issues i.e. change in government and reneging from aggreements (we have very recent examples..)
  - Tension between developing and deveoped countries on sharing the burden of emissions abatement
- Speculation: This can be good and bad:
  - Less of Green Paradox, less of under-investment in the short run
  - Sign of total effect is thus ambiguous
- Quasi-Commitment as in Schaumburg and Tambalotti (2017)?

"Taking the model to the Data"

- Forward simulation
  - Interesting to run the model from an earlier starting date
  - Paths of taxes and subsidies can be calibrated to observed policy
    - "Realized" paths for welfare (consumption) and the optimal paths can then be compared.
- Another reason why you should have uncertainty (shocks) is to be able to make formal comparisons to the data
  - i.e. Comparing impulse responses of the model to impulse responses identified in the data

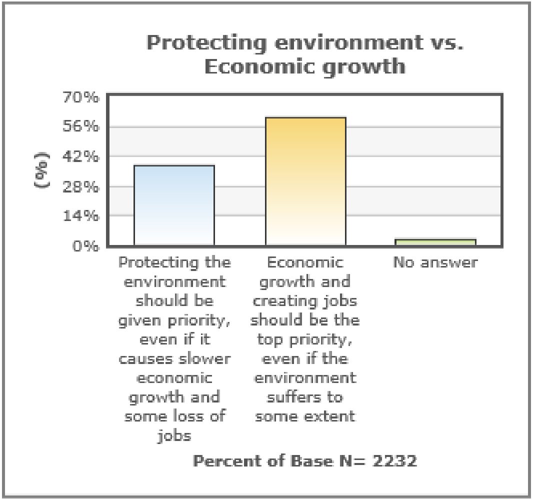
Conclusion

- Fascinating topic, important policy implications
- I learned a lot!
- Many open questions
- Curious to see follow up work by Elizabeth, Yongyang and Karlygash!

Irreversibility and Learning by doing

- How do the results change when we do allow for partial irreversibility i.e.: $K^d_{t+1} \geq \rho_d(1-\delta)K^d_t$?
  - My guess is that the effects will be small/convex combination of the extreme cases of $\rho_d = 0$ and $\rho_d = 1$
- Irreversibility in the green sector is also a feature of the model
  - How does optimal policy look like in the presence of asymmetric irreversibiities?
  - How does it interact with the learning rate?
    - If $\lambda \rightarrow 0$, then $\tau^H_t \rightarrow 0$ but $i^H_t \geq 0$ can be binding. Still optimal to invest in the green sector or under-invest in both sectors?

World Values Survey



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