Green Policies, Aggregate Investment Dynamics and Vintage Effects

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Modelling the heterogeneity in emission rates

Heterogeneity in emission rate is well documented in the literature. Your modelling framework:

- The leading vintage is more efficient in input use (energy, capital, labor) but it also emits less CO_2 per unit of energy.
- Old and new capital coexist because of a random adjustment cost of capital

Comparison of the effects of a carbon tax

- between this modelling framework and the "usual one" where CO_2 per unit of energy is the same across vintage (or tax energy rather than emissions in you model).

Carbon tax versus energy tax

Comparison carbon tax versus energy tax (which would induce the same decrease in energy use):

- Additional relative benefit from new capital compared to old capital (pay less carbon tax per energy use with new capital).
- More plants are willing to invest in new capital compared to the energy tax case.
- It is more costly so that there is a lower target capital.

Results

- Distribution of plants across vintage is modified $\rightarrow$ newer capital (than with a tax on energy).
- This new capital is also more energy efficient $\rightarrow$ more energy efficiency in aggregate (than with a tax on energy)

A strong assumption

In your CO_2 emission intensity of energy and energy efficiency/productivity are strongly tied by the capital vintage.

- The CO_2 intensity of energy use is mechanically lower for new vintage, even absent any environmental regulation.
- Justification: older power plant in the US also emit more pollution per MWh (2004-2010).
- During this time span, changes in the National Ambient Air Quality Standards (NAAQS) of the Clean Air Act in the US.
- Shapiro and Walker (2018): changes in environmental regulation account for most of the emissions reductions.
- Empirical evidence: energy intensity of output lower for more productive firms but no strong evidence on CO_2 per energy.

A strong assumption

Assuming that firms can choose capital that is clean or less so for a given productivity (or a lower productivity see agricultural output) would be more consistent with the empirical litterature.

- More consistent with the empirical literature on directed technical change (Aghion et al, 2016 in JPE and Acemoglu et al, 2016 in JPE)
- Lyubich (2018) finds that heterogeneity in energy exceeds heterogeneity in most other productivity measures, like labor or total factor productivity.
- But maybe too difficult to solve !

A strong assumption

Assuming that firms can choose capital that is clean or less so for a given productivity (or a even lower productivity eg agricultural output) would change some of your main results.

- More energy efficiency in aggregate (than with a tax on energy) ?
  Not sure if new capital with same energy efficiency but different CO_2 intensity of energy.
- Distribution of firms across vintage (than with a tax on energy) ?
  Not if new capital with higher energy efficiency but same CO_2 intensity per unit of energy.

These results rely on the fact that CO_2 per unit of energy and productivity are strongly tied in your model. Maybe you could discuss what would happen if that was not the case.

- Effect of vintage-differentiated policy? Same conclusion

Other comments

- But what are the implications in terms of welfare loss of targeting the wrong output say energy use instead of pollution?
- Border tax adjustment abroad. What would be the implications of your framework if there was such a tax abroad?
- In Europe, firms that are the more exposed to international competition have a preferential treatment in term of green fiscal policy, would you be able to say something about this kind of "grandfathering" ?