RIETI BBL Seminar Handout

“Technology Policy and Climate Change”

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http://www.rieti.go.jp/jp/index.html
Technology Policy and Climate Change

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Overview

• Carbon policy is necessary but not sufficient
• Technology market failures
• Current state of public support for energy R&D
• Lessons from other technologies
• Speculative conclusions
• Research needs
Motivation

• Regardless of outcome of current debates about the timing, GHG emissions need to be stabilized and then reduced
• Assuming that we want world GDP to continue to grow, this means significant reductions in the world GHG/GDP ratio at some point this century
• Certainly at least 50%, probably more, by 2050

How hard will this be?
Do prices spur innovation?

- Old literature on induced innovation (Hicks, 1932)
- Theory suggests that high/rising carbon price should direct resources towards carbon-saving innovation
- Some evidence on changing menus (Newell, Jaffe and Stavins, 1999)
- No natural experiment confirming innovation impacts of the magnitude sought here
Cigarette Taxes and Patents over Time

- **Successful Patent Applications**
- **Average Cigarette Tax**

Key Events:
- Introduction of Nicotine Gum
- Nicotine Patch
- Tobacco Master Settlement

From Werfel and Jaffe, 2013
What does this mean for climate policy?

- Even significant increase in the effective price of carbon is unlikely, on its own, to yield needed emissions reductions.

- A *qualitative* socio-economic transformation will be required—comparable to IT/communications revolution

- Getting environmental policy “right” is surely *necessary*, it is unlikely to be *sufficient*

- Carbon base will be larger for a long time, so private incentives will continue to favor carbon innovation (Acemoglu, et al 2009)
Technology Market Failures

• Imperfect appropriability of knowledge
  – Research spillovers (Jaffe, 1998)
  – Learning curve spillovers (Thompson, 2010)
  – User-driven technology improvement (von Hippel, 2010)

• Asymmetric information affecting capital market (Hall and Lerner, 2010)

• Path-dependence and potential importance of technology trajectories (Dosi and Nelson, 2010)

Important caveat: SR inelastic supply of specialized human capital
Figure Four

IEA Countries Energy R&D

- HYDROGEN AND FUEL CELLS
- RENEWABLE
- EFFICIENCY
- ALL OTHER
- FOSSIL
- NUCLEAR
Manhattan and Apollo projects (Willbanks, 2011)

- Manhattan project: $28B over 2-3 years
- Apollo $140B over 10 years
- Well-defined technical objectives with cost no object
- Maybe relevant to subgoals, e.g. carbon capture and storage
War on Cancer/NIH budget doubling (Cockburn, et al, 2011)

- Human capital is crucial
- Market demand (3rd party payment, one way or another)
- NIH doubling
  - Adjustment costs
  - Importance of training in parallel with research expansion
Semiconductors, computers and communications (Mowery, 2011)

- Design competitions for defense and space uses, with little or no regard to cost
- Transition to commercial markets later after cost fell
- Induced R&D through competition for technically specified products (Lichtenberg, 1988)
Synfuels
(Cohen and Noll, 1991)

- Government-built demonstration plants
- (contrast to previous case)
- Not cost-effective
- Crowded out private investment
Speculative Conclusions

• Long-term perspective
• The social rate of return to government technology investments is high.
• Increase in public support should be gradual.
• Building specific human capital is critical.
• Public purchases and/or purchase mandates will be needed.
• Government investment should be designed to be complementary to private investment.
• “Success” will almost surely require technologies not foreseen today.
• Nothing should be “off the table.”
Research Needs

• Systematic program evaluation.
• Which means:
  – Modeling of “but for” world so that incremental impact of policy can be estimated
  – Which means:
    • Evaluation has to be built into program design and funding up front, so that data on initial evaluations, rejected proposals and baseline attributes of funded entities are collected and maintained.
References


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