

# Issues for Financing Transformation Investments

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# What is Climate Finance?

- **Assumes a decision to make investments and bear costs.**
  - Whether with caps, carbon taxes, subsidies, regulatory interventions, whatever... in short, some shadow prices.
- **How to design the channels that enable the investment flows to go where they are needed at lowest cost?**
  - In many cases, if you set a price that makes the activity profitable, they will come.
  - But not always!

# Example: Sequestration

- **Sequestration can potentially help reduce atmospheric concentrations.**
  - Biosequestration, geologic sequestration, ocean sequestration.
- **A Question of Permanence.**
  - Is the sequestration long-lived? If not permanent, is it long enough lived to be useful?
    - How long is enough?
    - Depends on the projected time path of the social cost of carbon: Herzog, Caldeira and Reilly (2003)
    - This is a big issue.
  - How do we structure financing to properly incentivize investment and management of sequestration projects?
    - This is another big issue.

# Environmental Bonding

- **A classic financial structure.**
  - Mill (1972) and Solow (1971).
- **Used in the U.S for various mining and drilling activities, and for nuclear decommissioning:**
  - GAO (1986, 1988, 2005 and 2008), Pennsylvania Department of Environmental Protection (2000) GAO (2003), Gerard (2000) and Boyd (2002).
- **Discussed for carbon sequestration.**
  - Edenhofer, Held and Bauer (2004), Held, Edenhofer and Bauer (2006) and Gerard and Wilson (2007)

# Operation

- **Credit for avoided emissions at the time of injection, equal to the quantity sequestered times the social cost of carbon.**
- **At the same time, establish an escrow account to fund any potential liability from future release of carbon.**
  - Any releases require debits equal to the quantity released times the then current social cost of carbon.
- **Through time...**
  - Account earns income. Potentially available for payout.
  - Must maintain the escrow account through time at a sufficient level. With a rising social cost of carbon, the potential liability for already sequestered carbon rises, requiring an increasing balance in the account.
- **Net cash flow depends on the income earned versus the addition required.**

# Toy Model & Heroic Assumptions

- **Project:**
  - @  $t=0$ , discrete injection of  $Q$  tons, at cost  $\$K/t$  CO<sub>2</sub>e.
  - Costless management.
  - @  $t=H$ , discrete release of all  $Q$  tons.
- **Risk-free rate of interest**
  - Constant at  $R\%$ .
  - Rate earned on the escrow account.
- **Social Cost of Carbon (SCC)**
  - @  $t=0$ , social cost of carbon (SCC) =  $\$C/t$  CO<sub>2</sub>e.
  - Through  $t=B$ , SCC grows at a constant  $R\%$  per year.
  - @  $t=B$ , SCC is constant.

# Implications for Bonding

- **No cash payouts until  $t=B$ .**
  - There is no realized value from sequestration unless the carbon remains sequestered past  $t=B$ .
    - This is NOT what many proposals for REDD+ type projects imagine.
- **Sequestration is a long duration investment.**
  - A problem?
  - We have many other long duration investments, especially in real estate and infrastructure. Investors are typically insurance companies or similar.
  - Cash flows BETWEEN entities on the value chain are OK, but not net external cash flows.

# Institutional Challenges

- **Bonding has had mixed results.**
  - U.S. mining liabilities have often been underfunded.
  - U.S. nuclear decommissioning have generally worked, so far.
- **Similar long-horizon funding problems have had mixed results.**
  - Pension funding, medical insurance liabilities.
  - Complicated questions about the different rates: growth rate for the social cost of carbon vs. rate earned on escrow.
- **Risk is a big issue.**
  - Social cost of carbon is stochastic: Daniels, Litterman and Wagner (2015).
  - A challenge for bonding, since CONTRIBUTIONS to the escrow account may be required.



# My Inventory of Climate Finance Issues

- **1. Financing R&D.**
  - Classic public goods problem. Unique issues for climate finance?
- **2. Financing adaptation.**
  - Classic public goods problem. Unique issues for climate finance?
- **3. Inefficient institutions.**
  - Old frictions under new stress: energy efficiency investments.
  - New challenge: sequestration
- **4. Immature capital markets in many developing countries.**
  - Role of government funding channels and how to optimize.

# Gripes

- **The Health of the Overall Financial System.**
  - The vast majority of climate investments will be readily funded through the standard financial system. Not an problem.
  - Don't do stupid shit. Even in the name of green. Really. Don't.
- **A Low Price for Carbon is the Main Problem.**
  - But it is not a finance problem per se.
- **IPCC AR5**
  - Agenda shaped by politics, not science.
  - Omits many of the main climate finance issues.
  - Traffics in fallacies.
    - Tying sources and uses - High Level Advisory Group on Climate Change Financing (AWG)
    - Social value of transferring private risk to governments.
    - Substitution of headline numbers for hard facts.

# The End

