Global climate change negotiations: A research agenda

Introduction

- The current scientific consensus is that there is overwhelming evidence of both global warming and the contribution of human activities to climate change (IPCC, 2007).

- A new round of global discussions on climate change agreements is starting, and there is an opportunity for economic theory and analysis to provide a solid underpinning for this.

- Mitigating climate change involves costly switching to low carbon economic activities in the short-run to yield uncertain benefits from reduced global warming in the medium to long term future.

- Adapting to climate change requires setting up global insurance mechanisms via restructuring of aid flows and financial innovation.

- The research agenda proposed here aims to use economic theory to work out some conceptual issues involved in developing a global climate change policy.

- Three issues:

(i) constructing a global welfare benchmark to evaluate the costs and benefits of switching to low carbon economic activities (hereafter L),

(ii) identifying the implications of an self-enforcing global climate change agreement,

(iii) designing effective policy interventions to establish a global carbon price that lowers the relative cost of L.

Constructing a global welfare benchmark

- Any global climate change agreement has to start by working out why it is desirable to mitigate climate change by switching to L.

- Such an exercise involves constructing a global welfare benchmark to evaluate the costs and benefits of mitigating climate change.

Timing of *aggregate* cuts in GGE:

- A major conclusion of the Stern Review is that it is worthwhile cutting GG emissions now at a cost of 1% of global GDP today or in the near future to benefit from preventing a larger damage of 5% to GDP in the future.

- Underlying economics: costly emission cuts in the short-run limited by consumption smoothing over time.

- Uncertainty:

Costly emission cuts in the short-run also help in smoothing consumption across different states of the world in the future.

Heterogenous beliefs: slow learning with possibility of persistent disagreement over the future.

Knightian Uncertainty and Incomplete preferences: The precautionary principle vs the status quo bias.

Conditional emission cuts: Information and technology

Distribution of emission cuts: Fairness subject to participation constraints.

Sustainibility: "the needs of present generations are met without compromising the ability of future generations to meet their own needs" (UN 1987).

Can Knightian uncertainty and unawareness (possibly combined with changing preferences) justify a concern for sustainability?

A global climate change agreement with cumulative participation

Some theoretical problems:

- Can a global climate change agreement be stable? If a coalition deviates and is able to capture benefits from high carbon economic activities but is able to pass on some of the environmental costs to others, no global agreement will be stable.

- Shapley and Shubik (1969): the core may be empty with negative externalities ⇒ there exist no bargaining scheme that can achieve a global climate change agreement.

- Starret (1973) vs Foley (1970): Lindahl equilibria may not be in the core.

- Limited relevance of folk theorem type results from repeated games: most reciprocal punishment scenarios aren't renegotiation proof.

Role of domestic politics in enforcing global climate change agreements: median voter preferences and domestic lobbies.

A dynamic model of emission cuts:

Starting point: There a small group of countries that are willing to act unilaterally in the face of global climate change.

The question, then, becomes how does a global climate change agreement have to be structured around these countries to maximize the spread of low emission activities?

Key point: design a global agreement so that cost of switching falls fastest over time subject to the lack of commiment constraints.

How?

A limited but credible commitment to cut emissions creates a market for innovation that lowers the cost of switching to L.

Such technologies will primarily relate to energy generation and consumption and hence, are general purpose technologies and generate positive externalities.

Design issues:

Sequencing participation and spread,

Terms of access to new technologies.

Conditional access to a global carbon fund (to fund development and adoption of low carbon technologies and perhaps existing climate change) might restore the possibility of a comprehensive global climate change agreement.

A simple example illustrating the dynamics

$t = 1, 2.$

$i = 1, 2.$

$e_t^i \in \{0, \bar{e}\}, \bar{e} \geq 1.$

An action pair at t is $\left\{e_t^1, e_t^2\right\}$ with $E_t = e_t^1 + e_t^2$ the aggregate cut in emissions.

Payoffs:

payoffs at $t = 1$: $\alpha^i E_1 - c^i e_1^i$;

payoffs at $t = 2$: $\alpha^i E_2 + \beta^i e_2^i E_1 - c^i e_2^i$.

Future payoffs are discounted by δ.

The focus is on SPE.

There are several cases to consider.

Case 1: $\beta^i = 0$. In this case, the pattern of emission cuts is identical across periods.

Case 2: $\beta^i > 0$. This case corresponds to a scenario where emisssion cuts at $t = 1$ lowers the marginal costs of emission cuts at $t = 2$ or equivalently, increases the marginal benefits from emission cuts tomorrow. In this case, the pattern of emission cuts isn't necessarily identical across periods.

(i) Suppose $\alpha^1 + \beta^1 - c^1 \geq 0$, $\alpha^i - c^i < 0$, $i = 1, 2$ but $\alpha^2 + \beta^2 \bar{e} - c^2 \geq 0$ and $\alpha^2 + \beta^2 - c^2 < 0$.

If $\delta \geq \frac{c^1 - \alpha^1}{\alpha^1 + \beta^1 \bar{e}}$, then, $e_1^1 = \bar{e}$, $e_1^2 = 0$ and $e_2^i = \bar{e}$, $i = 1, 2$.

If $\delta < \frac{c^1 - \alpha^1}{\alpha^1 + \beta^1 \bar{e}}$, then, $e_1^1 = 0$, $e_t^2 = 0$ and $e_2^1 = \bar{e}$, $i = 1, 2$.

(ii) Suppose $\alpha^i + \beta^i \bar{e} - c^i \geq 0$, $\alpha^i - c^i < 0$, $\alpha^i + \beta^i - c^i < 0$, $i = 1, 2$.

If $\delta \geq \frac{c^1 - \alpha^1}{2\alpha^1 + \beta^1 \bar{e} - c^1}$ and $\delta < \frac{c^2 - \alpha^2}{2\alpha^2 + \beta^2 \bar{e} - c^2}$, then, $e_1^1 = \bar{e}$, $e_1^2 = 0$ and $e_2^i = \bar{e}$, $i = 1, 2$.

If $\delta < \frac{c^1 - \alpha^1}{2\alpha^1 + \beta^1 \bar{e} - c^1}$ and $\delta \geq \frac{c^2 - \alpha^2}{2\alpha^2 + \beta^2 \bar{e} - c^2}$, then, $e_1^2 = \bar{e}$, $e_1^1 = 0$ and $e_2^i = \bar{e}$, $i = 1, 2$.

Results:

1. *Static patterns of emission cuts*: When $\beta^i = 0$, the pattern of emission cuts is identical across periods. When $\beta^i > 0$, the pattern of emission cuts isn't necessarily identical across periods.

2. *Evolving patterns of emission cuts*: Note that Case 2 there are scenarios where starting from a situation with limited coverage, emisssion cuts are gradually globally adopted.

3. *Global efficiency and equilibrium outcomes:* In general, there is the pattern of emission cuts is assymetric across countries. In equilibrium, emission cuts are below the globally optimal level. Equilibrium outcomes coincide with global efficiency only in limited scenarios.

Establishing a global carbon price and the transition to a low carbon economy

- Under the Kyoto protocol, emissions trading via the clean development mechanism and cap and trade schemes is the main market instrument by which a global carbon price is sought to be established.

Some problems:

1. The process by which target emission limit for different countries are set itself has to be self-enforcing (under the ETS countries may choose to revise their own emission limit unilaterally in a given year);
2. If carbon prices fluctuate over time or are too low or if too many economic activities are excluded from emissions trading, there may be little or no impact on behaviour of firms and households.
3. There are significant regional, national and activity-specific differences in carbon prices.
4. Moral hazard and the CDS.

- The industrial organisation of carbon markets (see Joskow et. al. (1998) for a similar study of the market for sulphur dioxide emissions):

How do the specific trading institutions affect the strategic behaviour of agents in carbon markets? What impact does such strategic behaviour have on carbon prices over time?

A related issue is the interplay of strategic trading in carbon markets with a self-enforcing process by which different countries set target emission limits.

- Interaction with incentives to invest in the develoment of technological change that lowers the relative cost of L.

- General equilibrium issues:

- Second best market scenarios and limited mechanism design.

- Carbon taxes with emission caps

- A global carbon funded from the proceeds of carbon taxes can be used to supply a bundle of global public goods relating to climate change

(i) funding investment in low carbon technologies,

(ii) subsidizing the global transfer and adoption of such technologies,

(iii) mitigating the costs of emissions cuts,

(iv) adapting to existing climate change.