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Eni
Enrico Mattei

The Economic Costs of Uncertain Targets and Delayed Participation in Climate Policy

Conference on the “Economics of Climate change and Sustainable Development”, Chia, Italy, 26-27 September 2007

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Motivation

Motivation

» Climate change uncertainties

1. timing and magnitude of climate change, cost of transition to a low-carbon world
2. fundamental political uncertainty that underlies international climate agreements

Analysis

» Optimal emission path under uncertainty on

1. Mitigation target
2. Participation timing in climate agreements

Focus on economic costs of neglecting uncertainty

Tool

WITCH: www.feem-web.it/WITCH

- a hybrid energy-economy-climate model.
  - World, 12 regions
  - Economy: Ramsey-type neo-classical optimal growth (dynamic, perfect foresight)
  - Energy Sector
    - Electric and non electric energy use
    - 6 Fuels types (Oil, Gas, Coal, Uranium, Trad. Biofuels, Adv. Biofuels)
    - 7 Technologies for electricity generation
  - Climate: damage feedback
  - The three modules are hard-linked
  - ETC (LbD, LbR)
  - Cooperative vs non-cooperative (strategic interaction) solution

Stochastic programming version:

Implicit formulation: non-anticipativity is implicitly defined through characterization of predecessor/successor relationships among nodes.

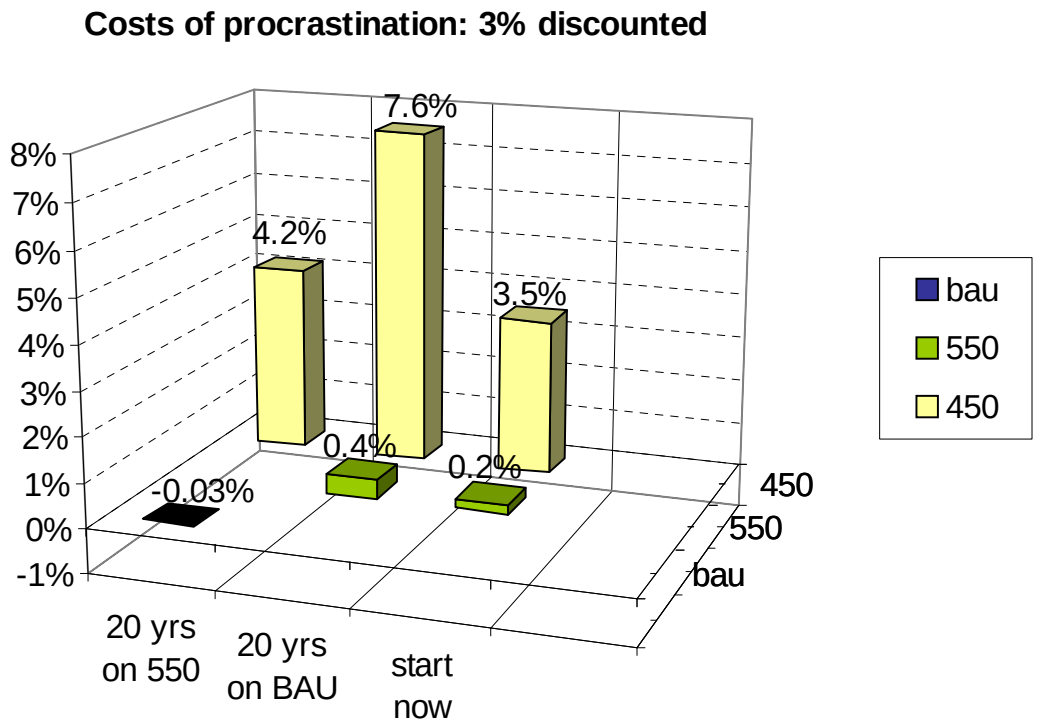
1. MITIGATION TARGET

Deterministic Set up

CO_2 CONCENTRATION TARGET:
Deterministic analysis

» Check the sensitivity of 450/550 ppm policy costs to 20yrs delay of action, and conversely the cost of initiating a policy but subsequently dropping it

Costs and procrastination



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Stochastic Set up

CO_2 CONCENTRATION TARGET:
Stochastic analysis

» Cooperative solution
(first best, total “when” & “where” flexibility)
» CO_2 concentration target revealed in 2035
» 3 States of the World (1/3 probability each):

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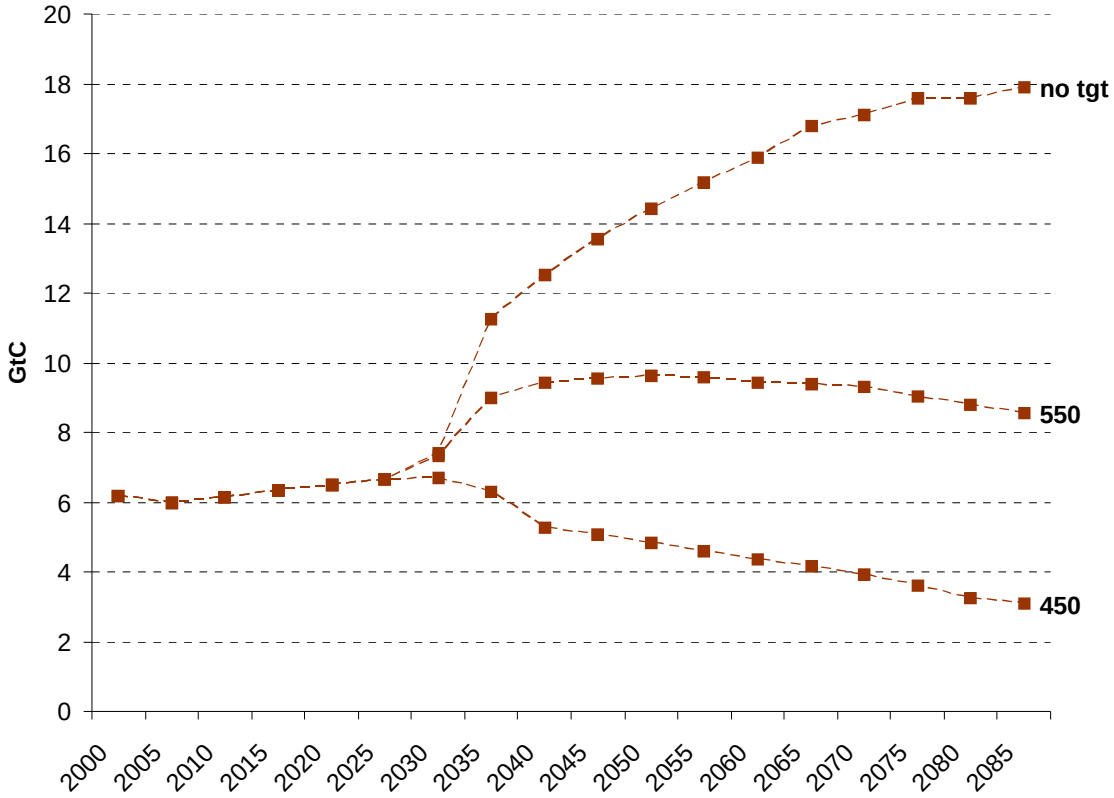
CO_2 emissions

optimal emission path accounting for uncertainty



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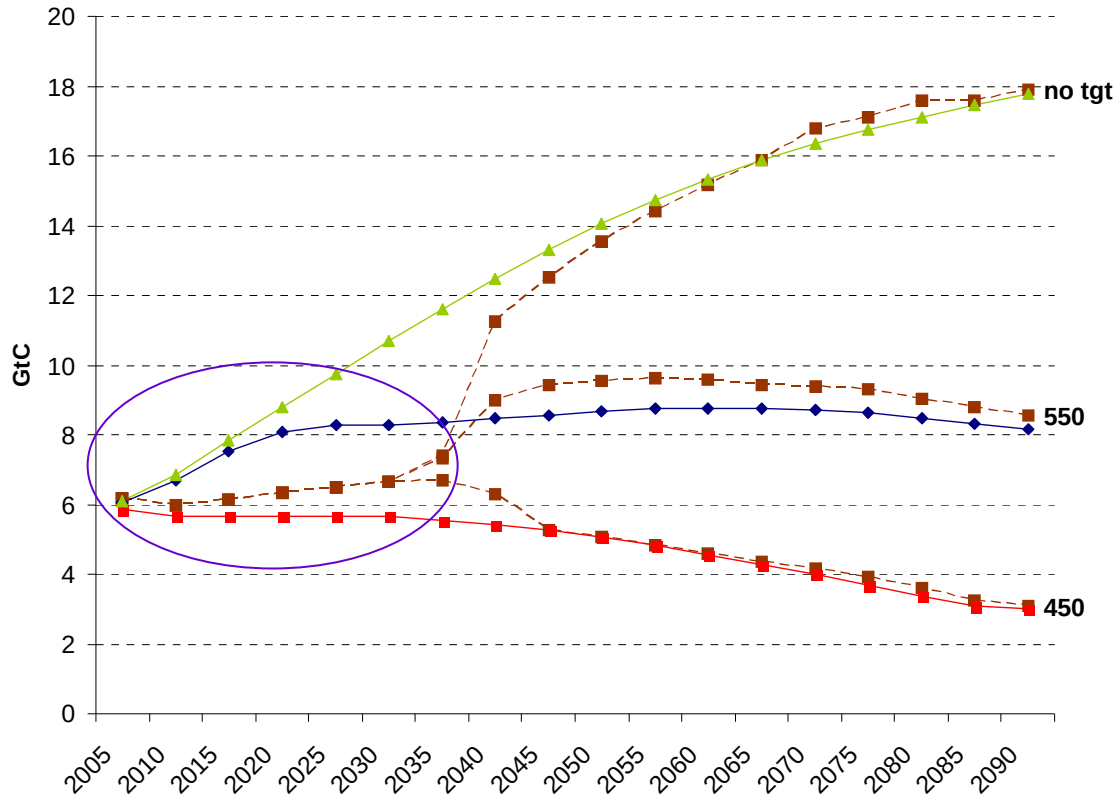
CO_2 emissions

optimal emission path accounting for uncertainty



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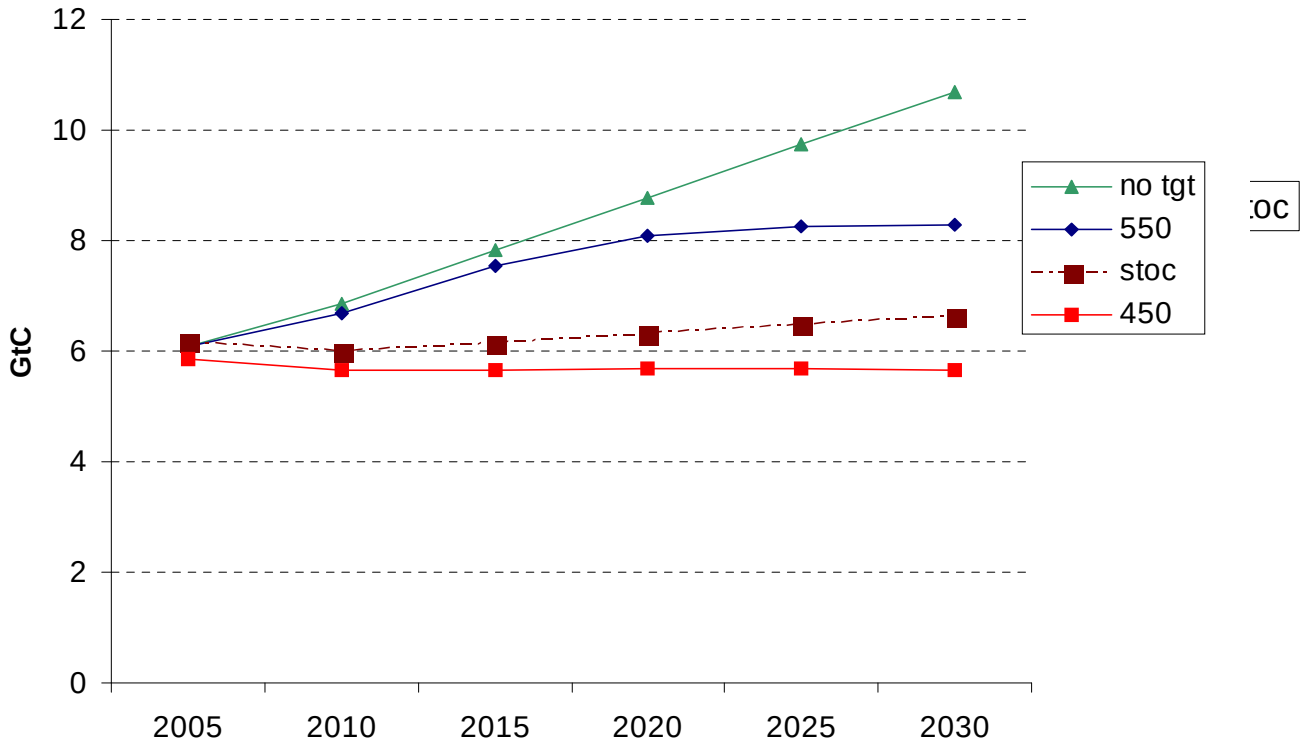
Optimal abatement



» uncertainty motivates a precautionary approach, emissions are closer to the highest reduction target case (450ppm) before uncertainty is disclosed

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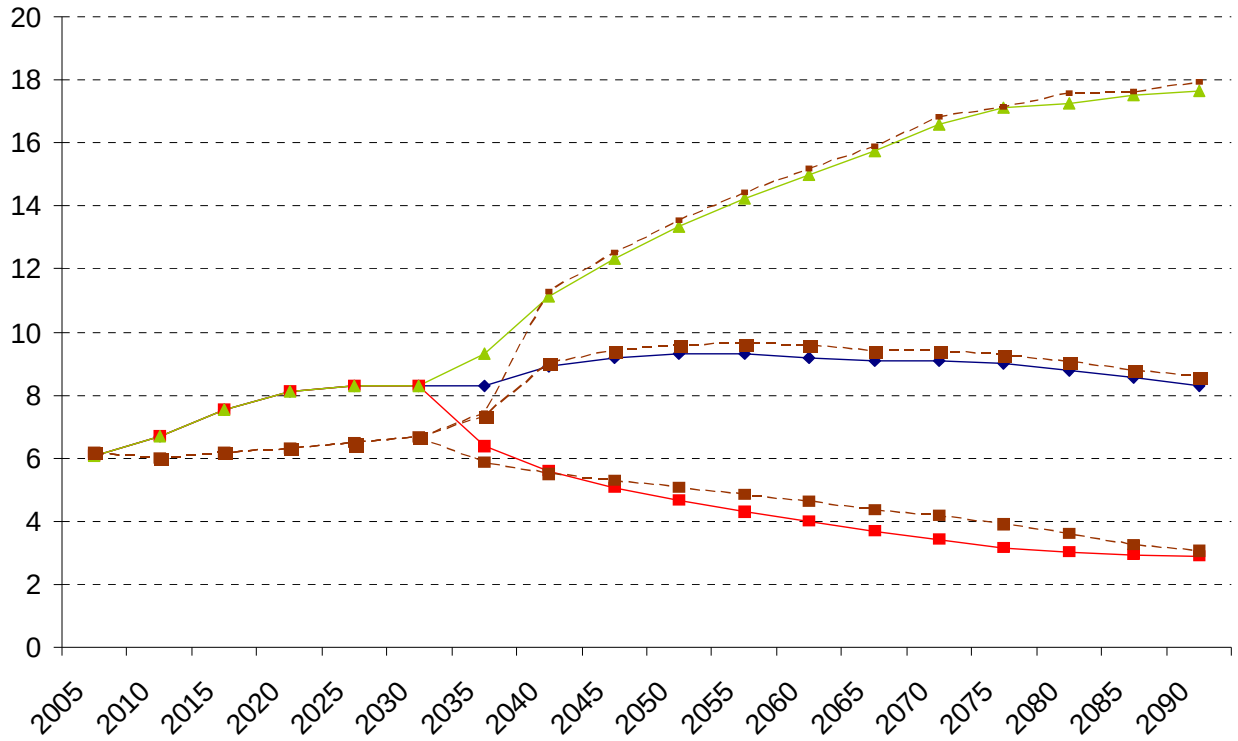
Economic costs of neglecting uncertainty

Run stoch. optimization, but fix choice variables before 2030 at the optimal values for deterministic 450, 550 and no tgt.



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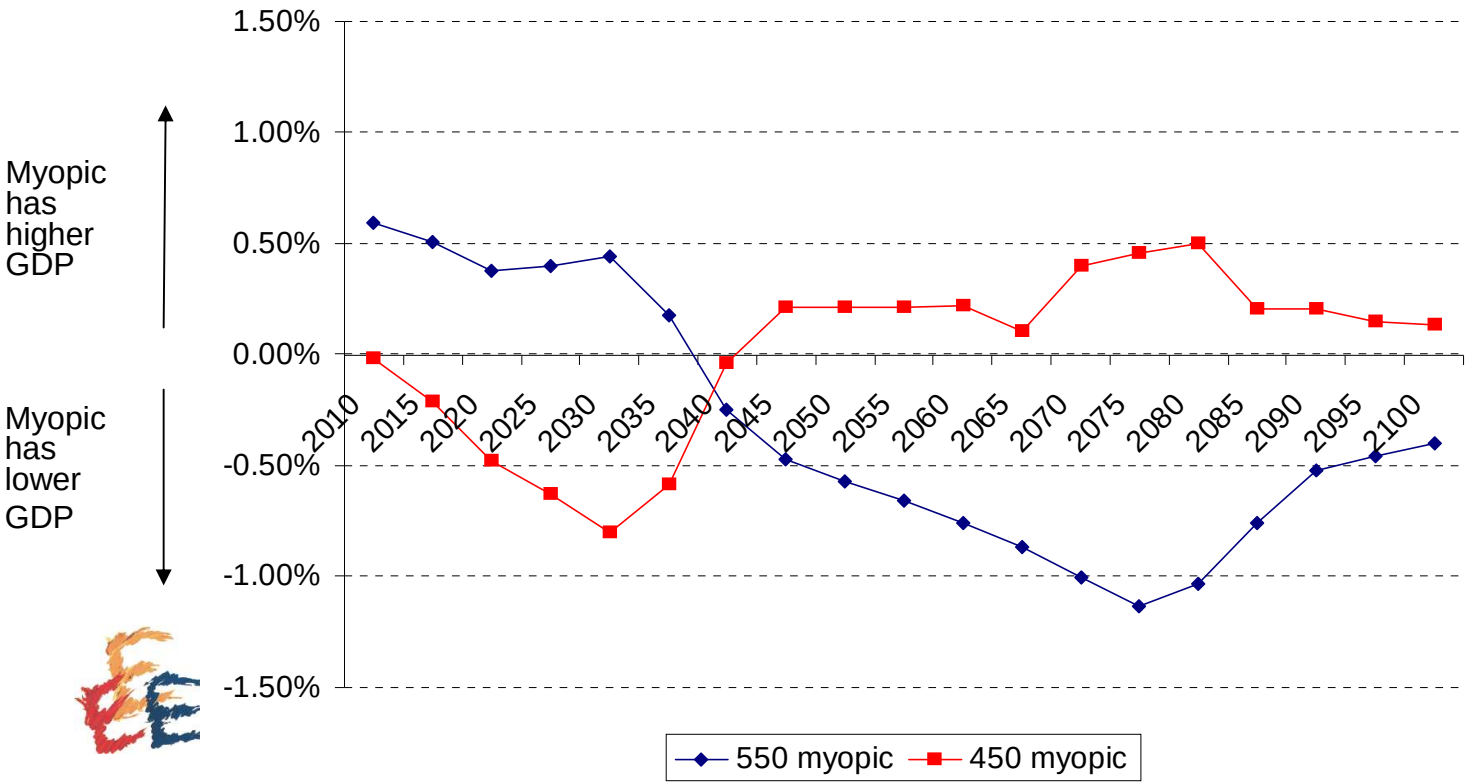
Economic costs of neglecting uncertainty

Compare E(GDP) in myopic cases wrt the one incorporating uncertainty

BAU case doesn't allow a solution (staying for 30 yrs on a BAU precludes the achievement of the 450 tgt)

450 and **550** cases are shown below:



Costs of neglecting uncertainty

Neglecting uncertainty impacts NPV policy costs:

discount	***3% (decreasing)***
Myopic 550	**+ 17.2%**
Myopic 450	**+ 1.7%**

» Myopic behavior at 550 increases policy costs by roughly 20% (from 1.44% to 1.7%)
» Myopic behavior at 450 doesn't affect policy costs (from 1.44% to 1.47%)

PARTICIPATION
IN CLIMATE AGREEMENTS

Set up

» Non-cooperative solution

» Emission path consistent with 450 ppm CO2 (550 ppm all GHG)

» Burden sharing rule based on equal emissions per unit of GDP for participatory countries (non-participatory countries allocated their BaU)

» Allow international permit trading

» Allow banking (partial “when” flexibility, no borrowing, no speculation)

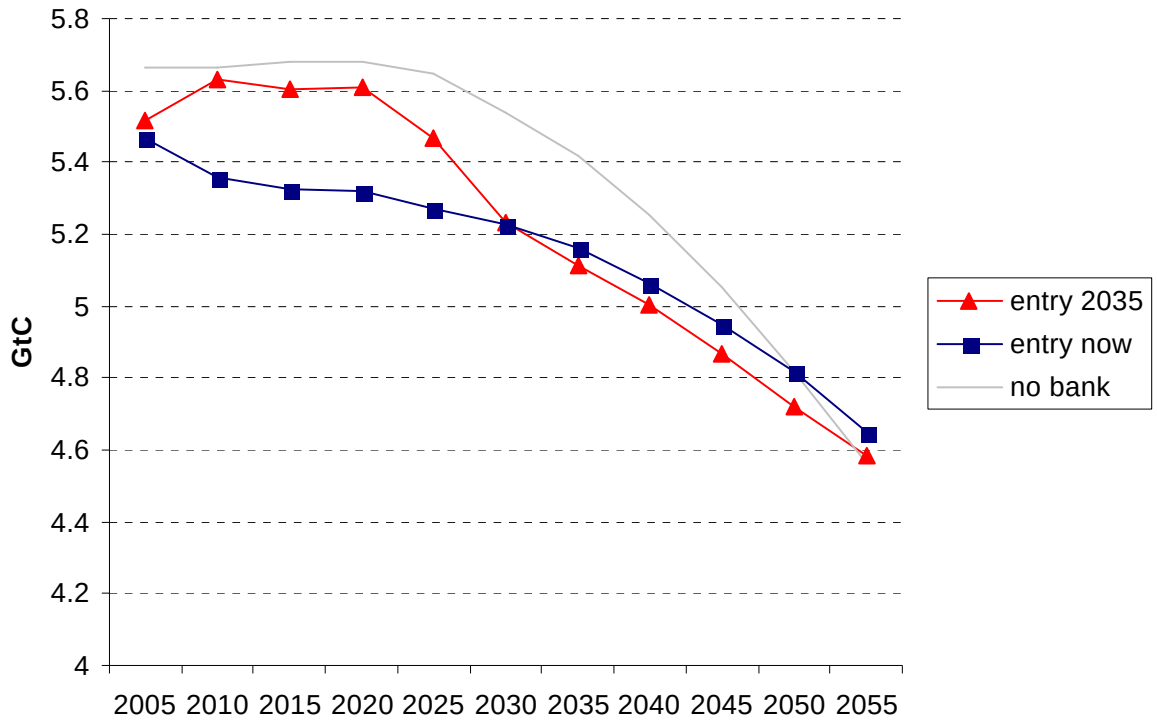
Deterministic Set up

PARTECIPATING PERIOD:
Deterministic analysis

» Investigate the implications of different entry times of NON-Annex1 countries into an international agreement

World Carbon emissions

NON-A1 participation: now and in 2035. Optimal emissions:



Later participation of nonAnnex1 countries implies some abatement is postponed

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Recap savings

Focus on the behavior of SAVINGS

For each region j:

$EMI_j = ALLOWANCE_j + NIP_j - SAV_j$

Summing over regions

WORLD EMI= sum(j, EMI_j) =

= total emissions + 0 – sum(j, SAV_j)

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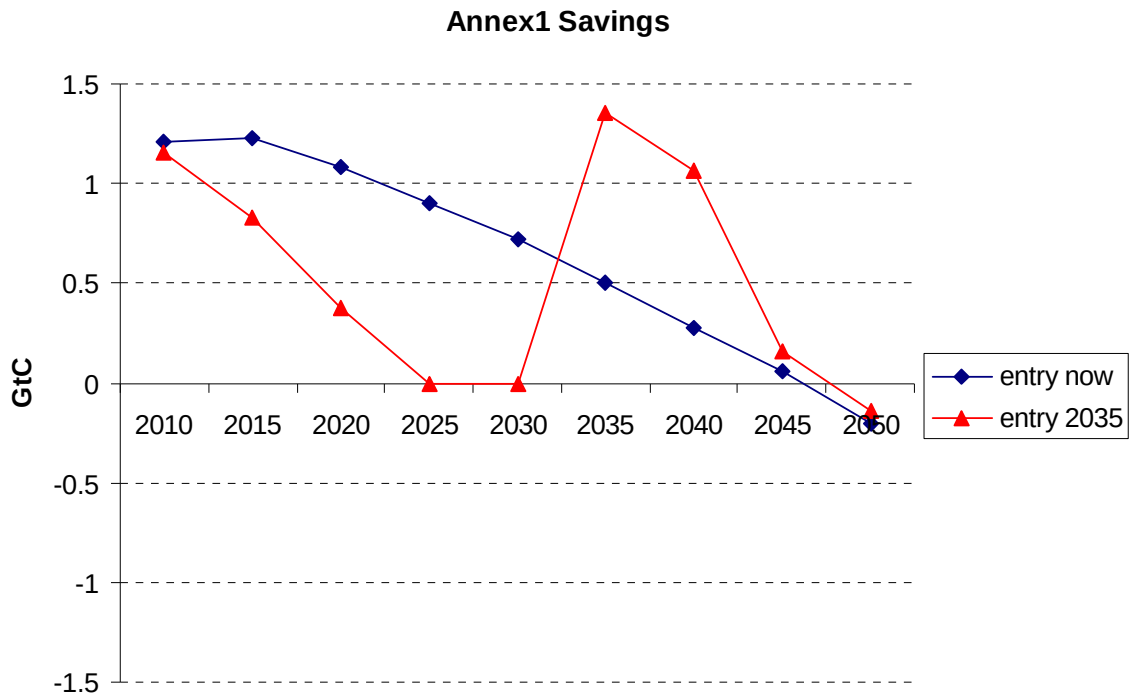
A1 Savings

1) Annex1 countries get a more stringent target when nonAnnex delay their participation into the agreement, and thus have less room to anticipate abatement.



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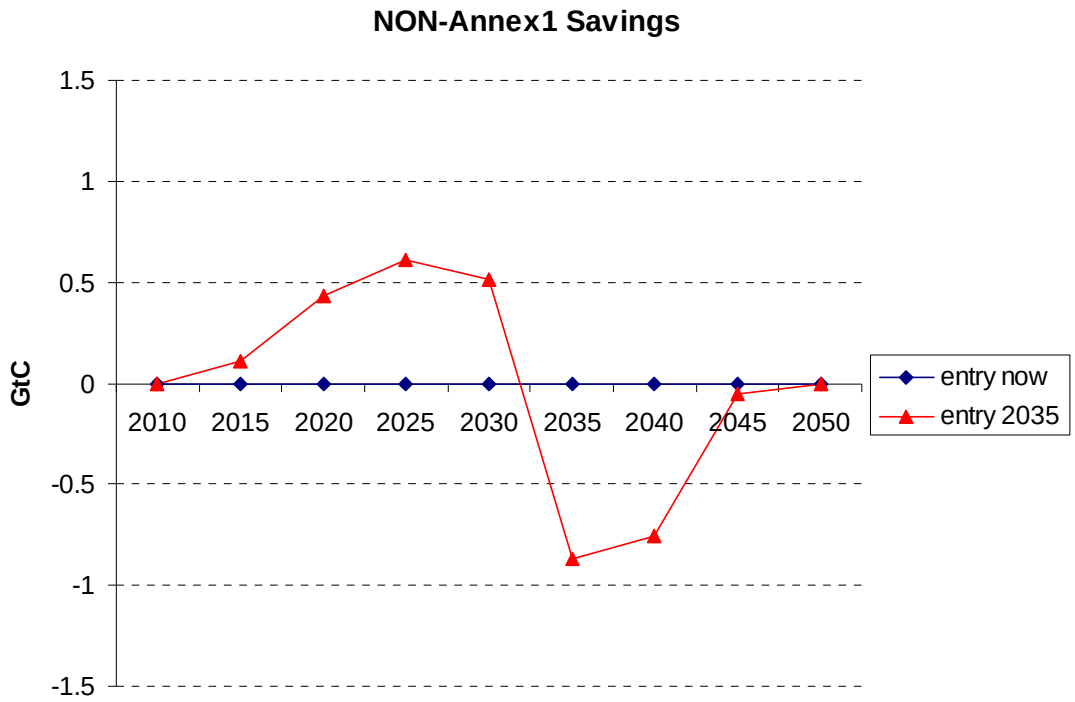
NON A1 Savings

2) Opposite behavior holds for nonAnnex1.



nonAnnex1 can shift abatement to the early periods only in the case of delayed (2035) partecipation. Immediate involvement reduces (to zero in this case) the incentives to anticipate abatement

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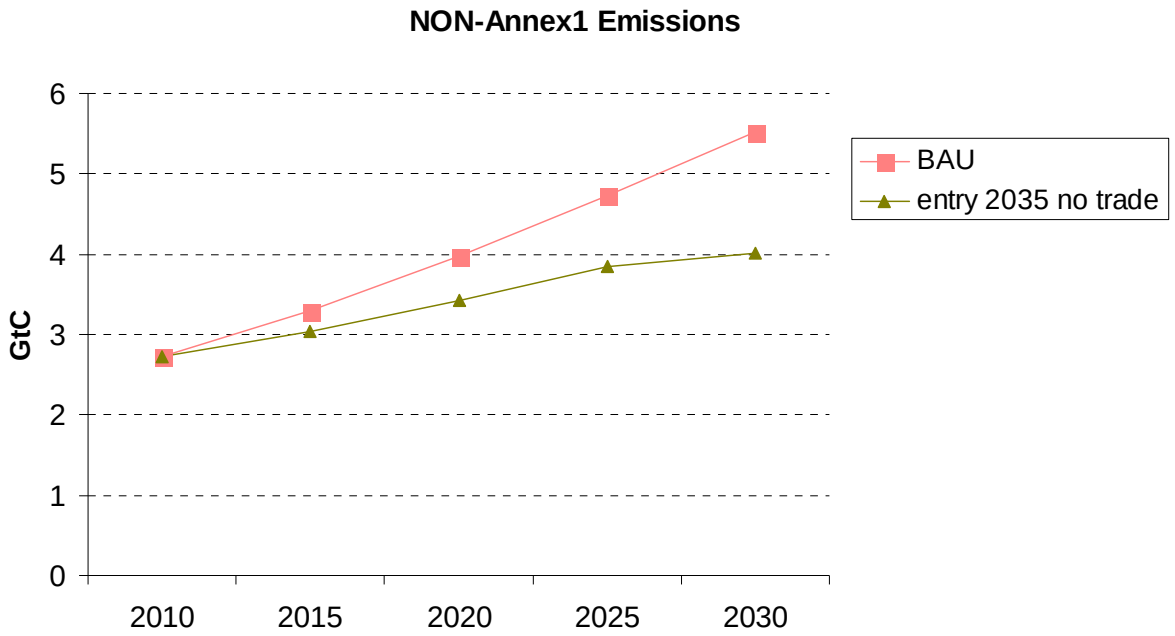
Non-participatory out of the carbon market

NON A1 participate in 2035, but are not allowed to trade/save before.

Emissions ?

1. A1 policy lowers fossil fuel prices (+)
2. A1 policy fosters technical change in low carb techs (-)
3. Foresee coming target (long lifetime of investments) (-)
4. Foresee higher climate damages (-)



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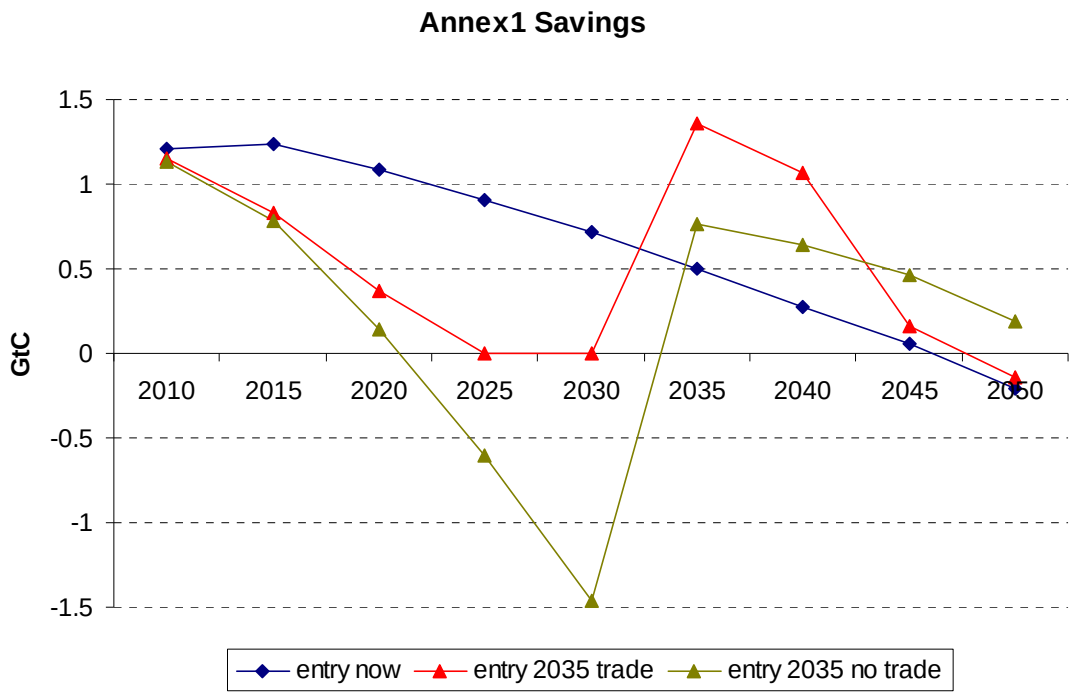
Non-participatory out of the carbon market

A1 savings:



This is equivalent to tightening A1 effort, and as before less A1 savings are observed in this case

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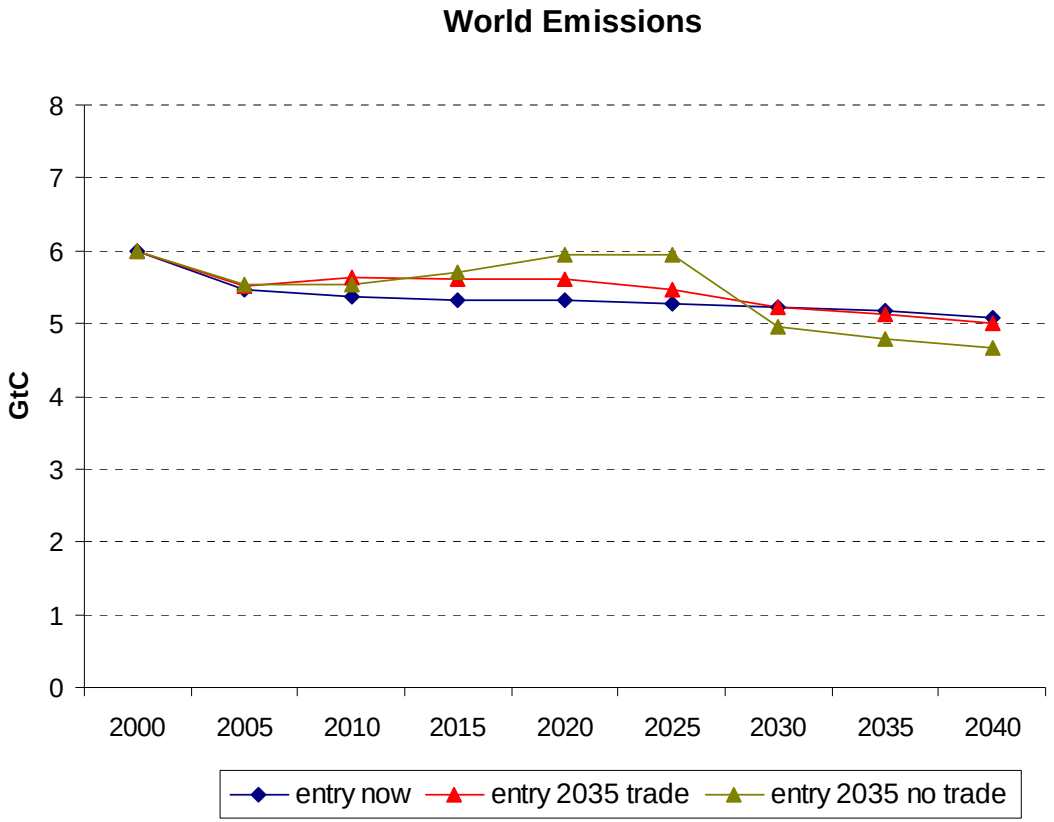
Global Emissions



Global emissions are higher when non-participatory are not allowed to trade

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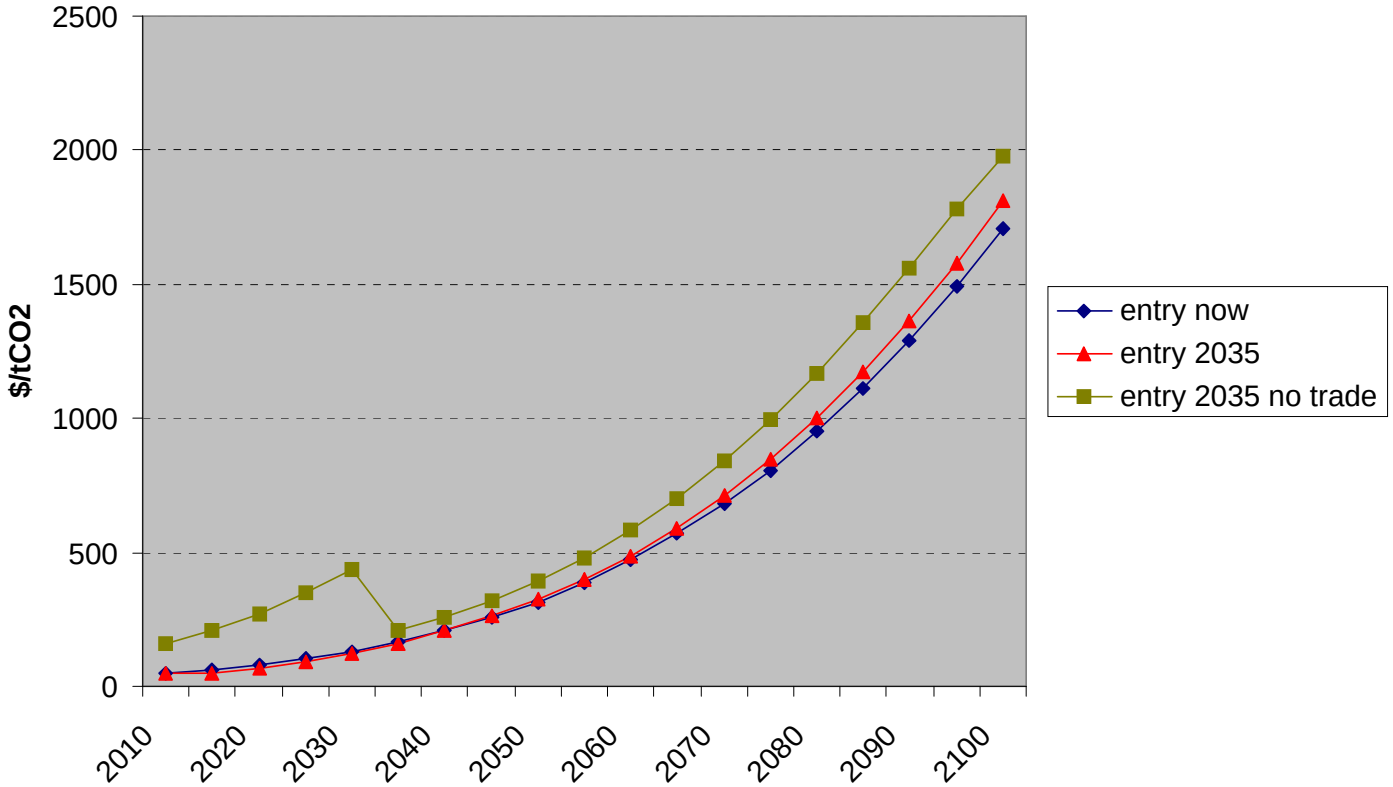
Policy costs



	NPV GWP loss (3% disc)
Entry now	3.18%
Entry 2035	3.21%
Entry 2035 no trade	4%

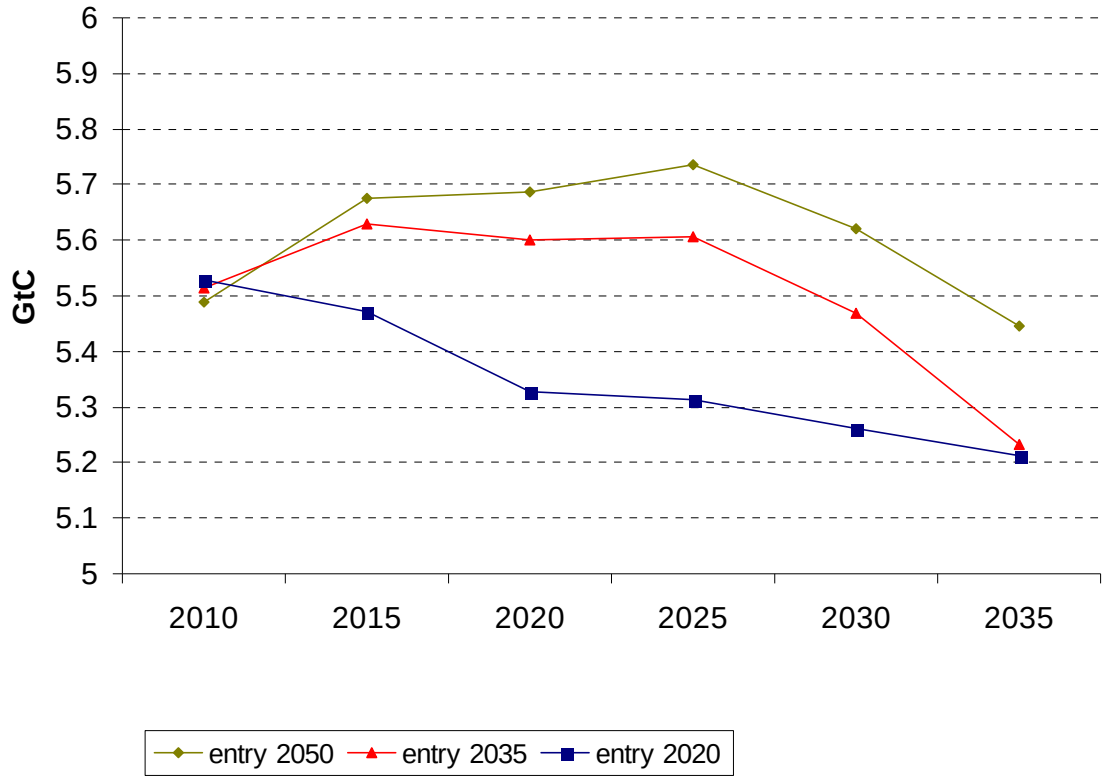
Stochastic Set up

PARTECIPATING PERIOD:
Stochastic analysis

» Entry time of NON-A1 is uncertain
» 33% in 2020, 33% in 2035, 33% in 2050

Emissions

Optimal emissions path: deterministic



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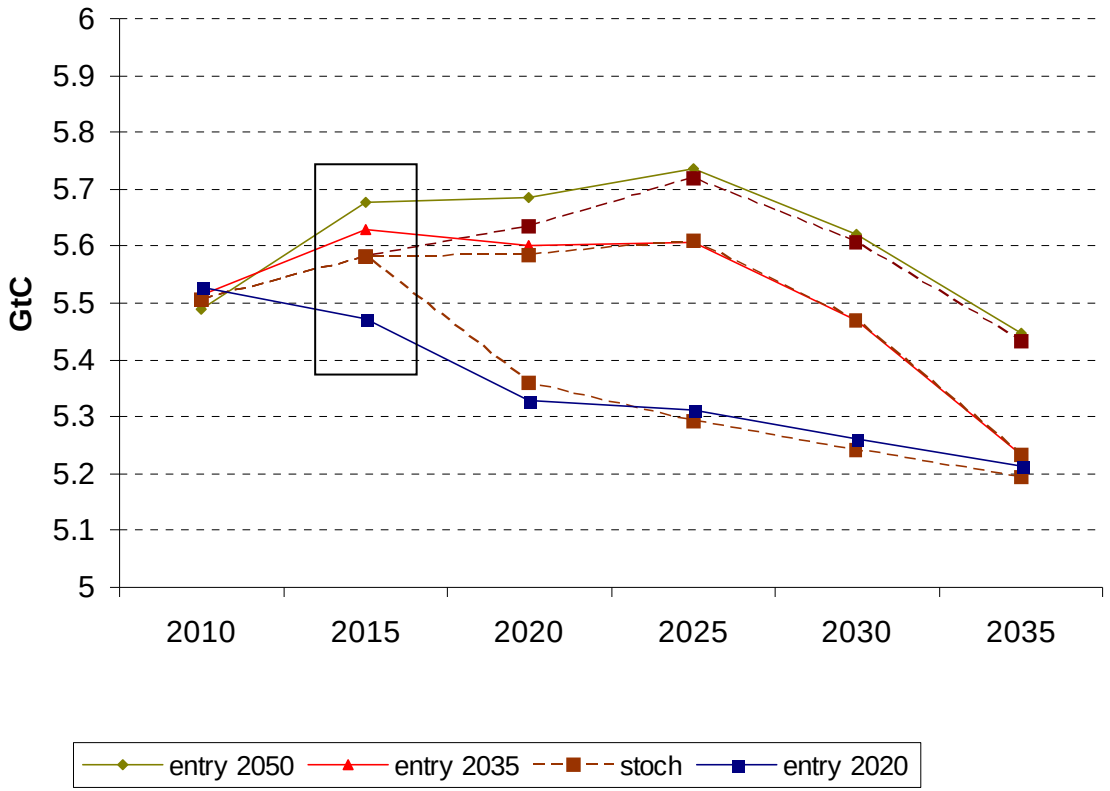
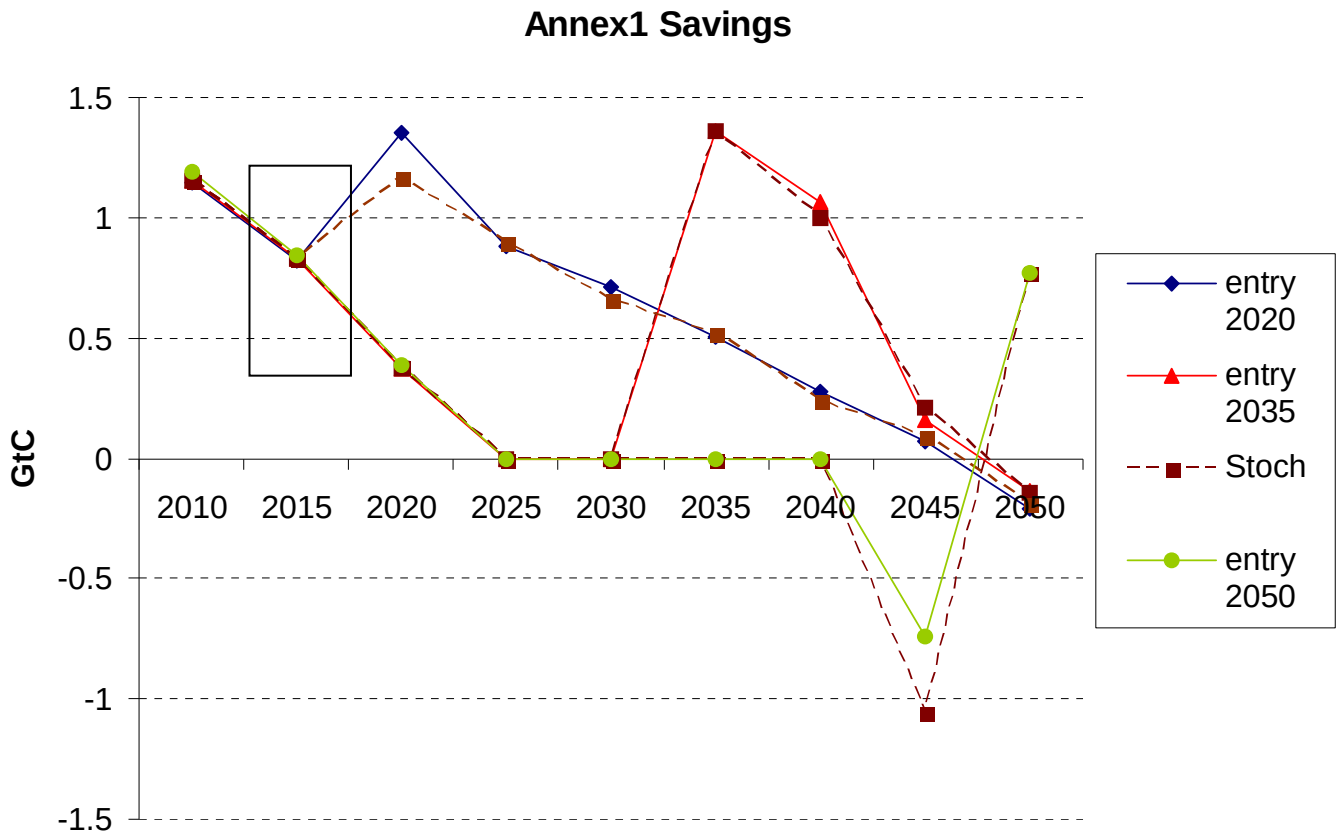
Emissions

Optimal emissions path: deterministic and stochastic

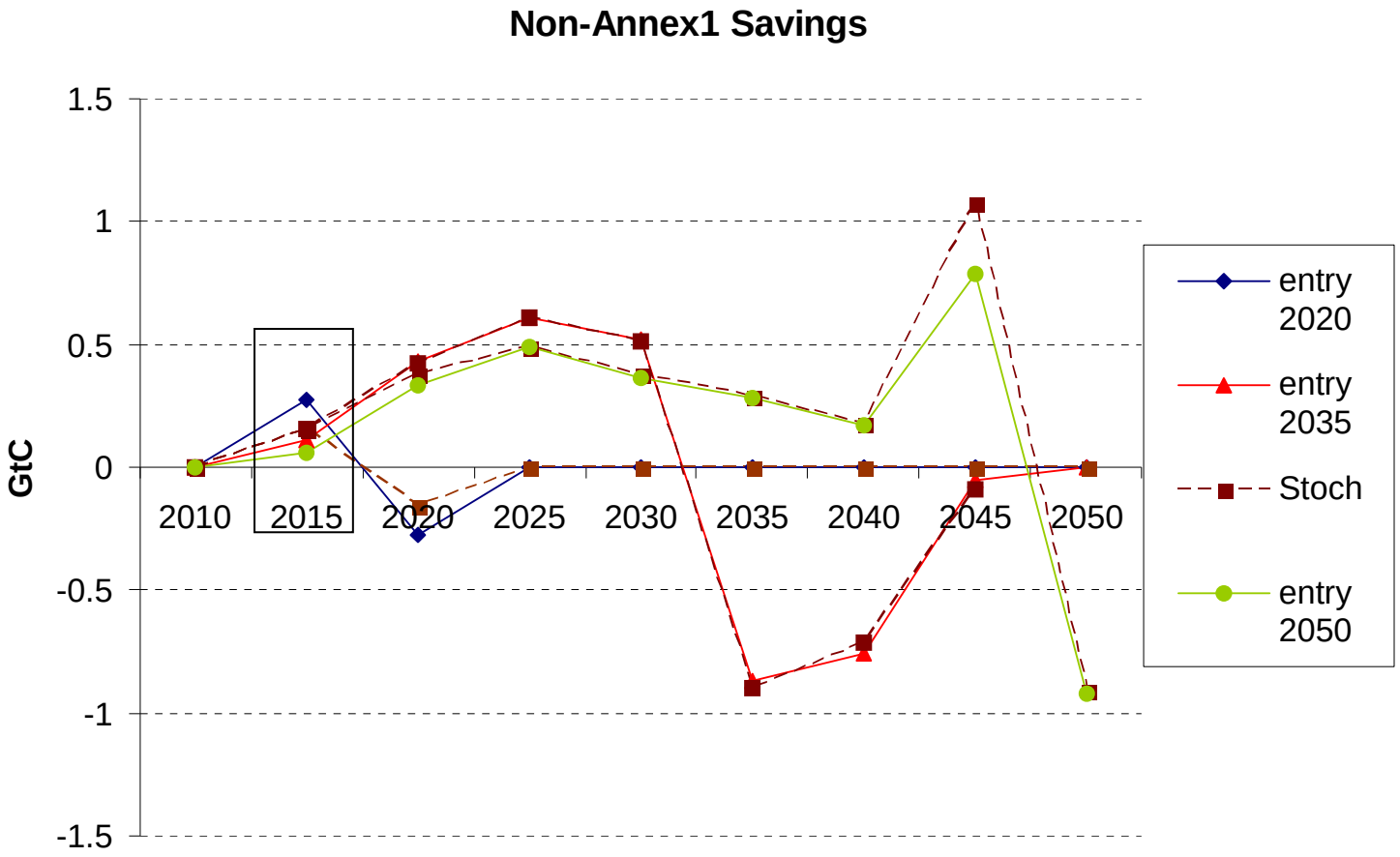


Annex1 savings: stochastic vs deterministic



Savings

NONAnnex1 savings: stochastic vs deterministic



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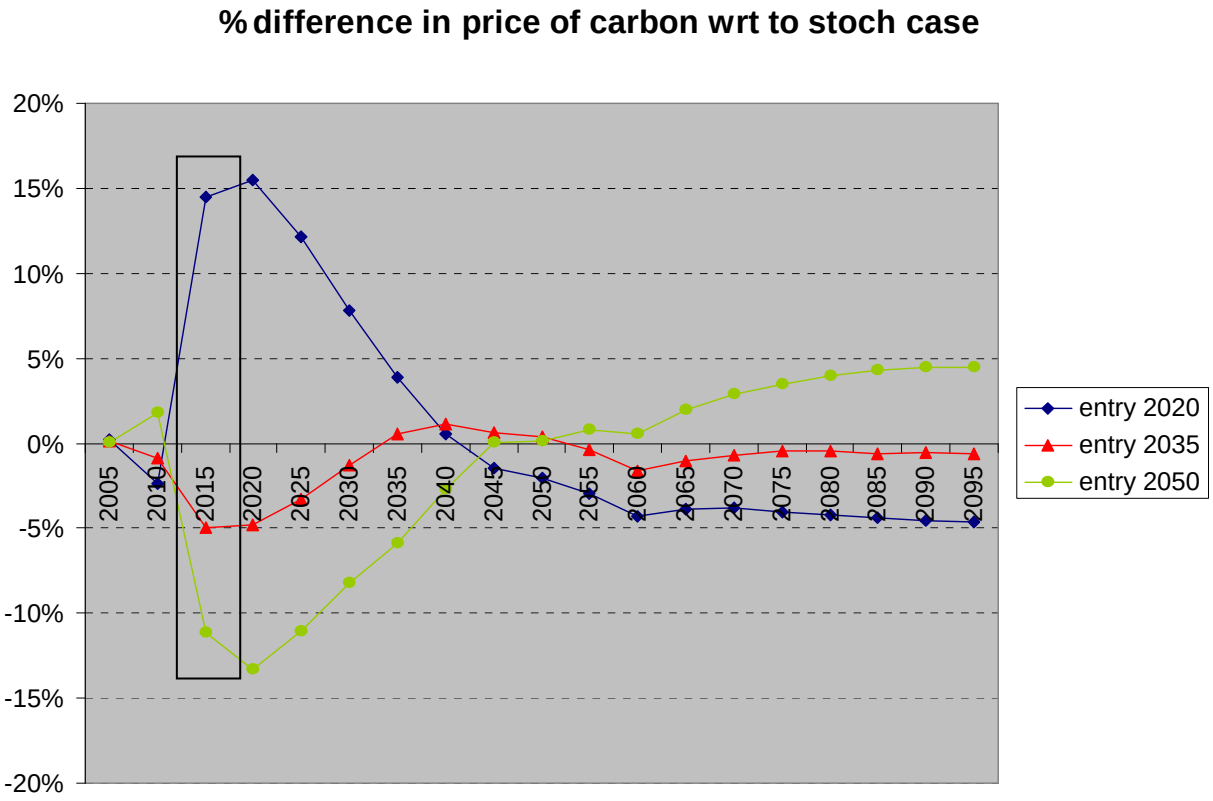
Policy costs: determ vs stoch



In 2015, carbon prices in the stoch case are higher than in the 2035/2050 cases (higher savings), lower than in the 2020 case (lower savings)

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Conclusions

1. Target
   a. Target uncertainty motivates precautionary emission path

   b. 450 CO2 tgt (550all GHG) is hedging strategy

2. Participation
   a. NONA1 outside the carbon mkt: more emissions, higher costs. Therefore keep them in the mkt even without early commitments

   b. Uncertainty about timing of participation of NONA1 does not modify optimal strategy for A1. Late participation of NONA1 is not excuse for late abatement in A1.

Thank you !

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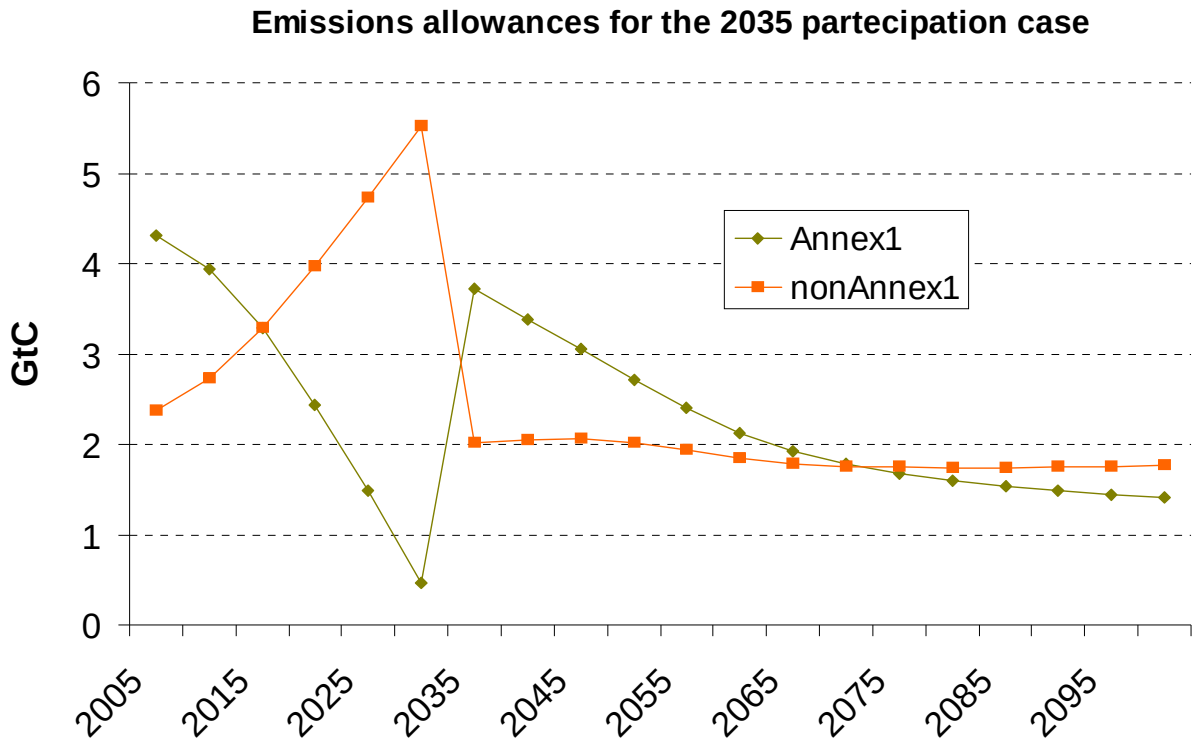
Allocation scheme

Final result will depend on the way emissions rights are allocated.

A tougher allocation for poor countries will increase the 2) effect, to the point that it could outweight the Annex1 incentive to postpone abatement for late participation cases.

However, the allocation rule used here is already very tough for nonAnnex1 countries, see below



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