

# Emissions trading with non-signatories in a climate agreement

## An analysis of coalition stability

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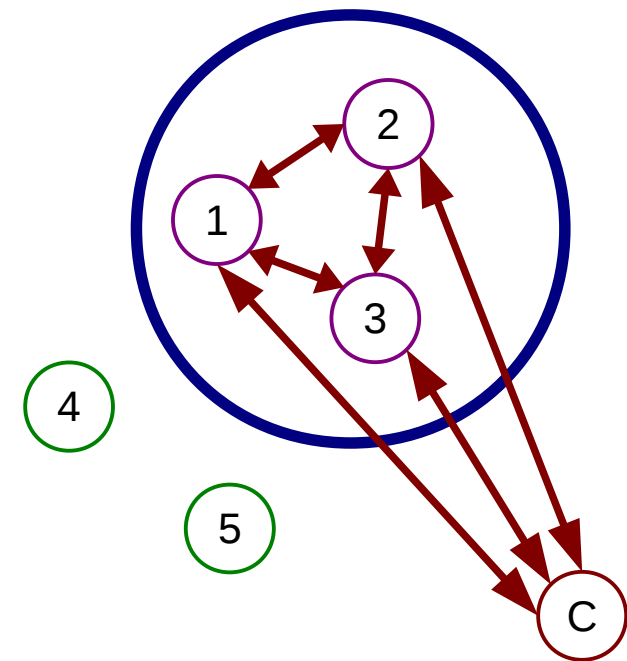
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WCERE 2010, Montreal

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# International Environmental Agreements (IEA)

- Coalition formation: two stage game

- Stage 1: **Membership game**

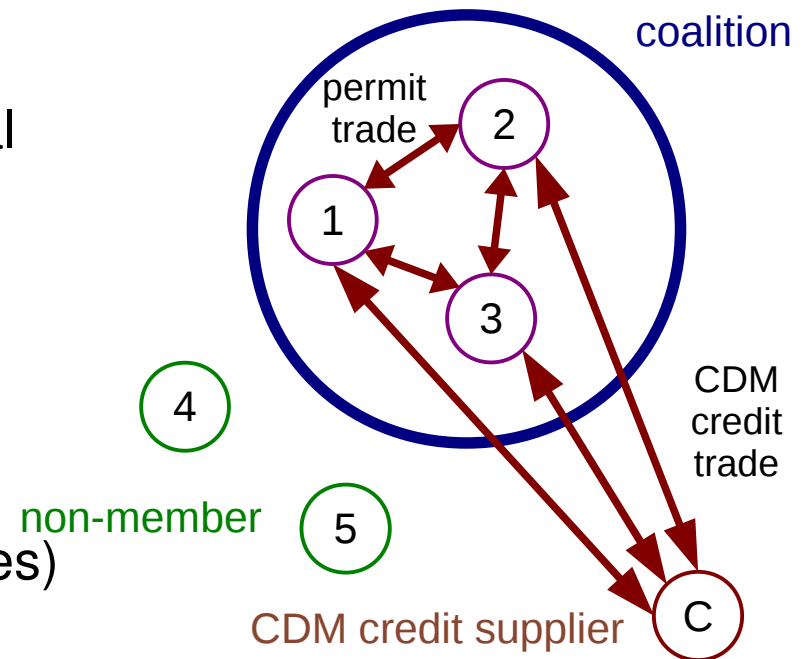
- Players either sign the IEA or do not
    - *CDM credit supplier* remains impartial
    - Internal/external stability  
(→ Carraro/Siniscalco 1993)

- Stage 2: **Emission game**

- Players decide on investments (→ emission trajectories) and trade (→ allowances choice)
    - Partial Agreement Nash Equilibrium  
(→ Chander/Tulkens 1995)

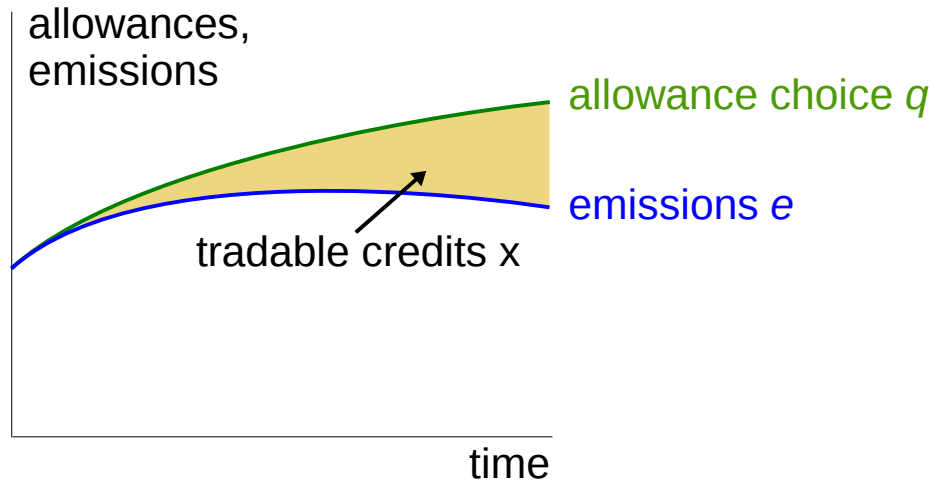
- Our aim:

Design **permit trade** with *non-members* (“*CDM*”) to improve the IEA



# Modeling Endogenous Allowance Choices

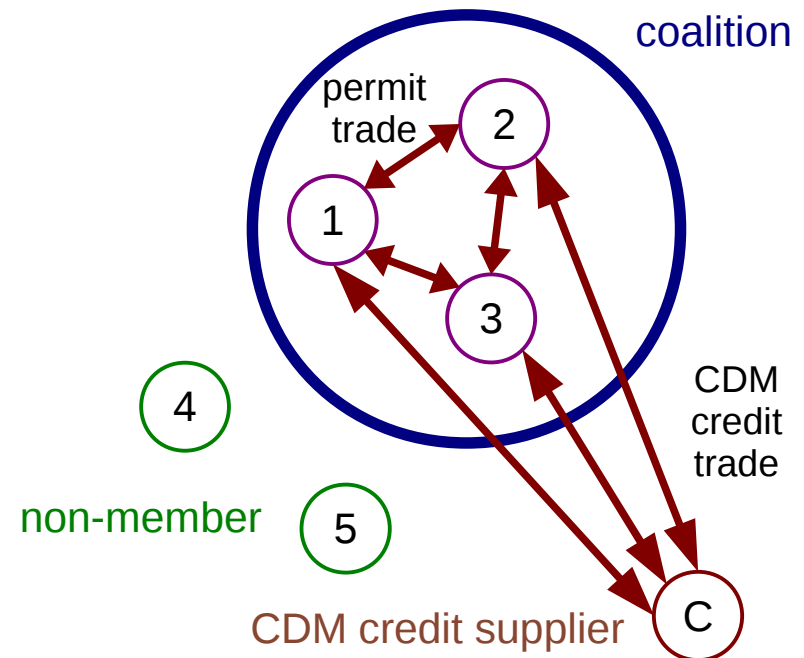
- Trading allowances: net permit exports = allowances - emissions



- Choose

- $q > e$  to sell CDM credits
- $q < e$  to import CDM credits
- $q$  low to reduce global warming, as total allowances cause damages

- *Additionality* – CDM trader must reduce below “no trade” baseline  
→ no “hot air”



Cf. Helm (2003) *JPE*, Carbone, Helm and Rutherford (2009) *JEEM*

# Model of International Climate Agreements (MICA)

- Model builds on Lessmann et al. 2009, Lessmann/Edenhofer 2010

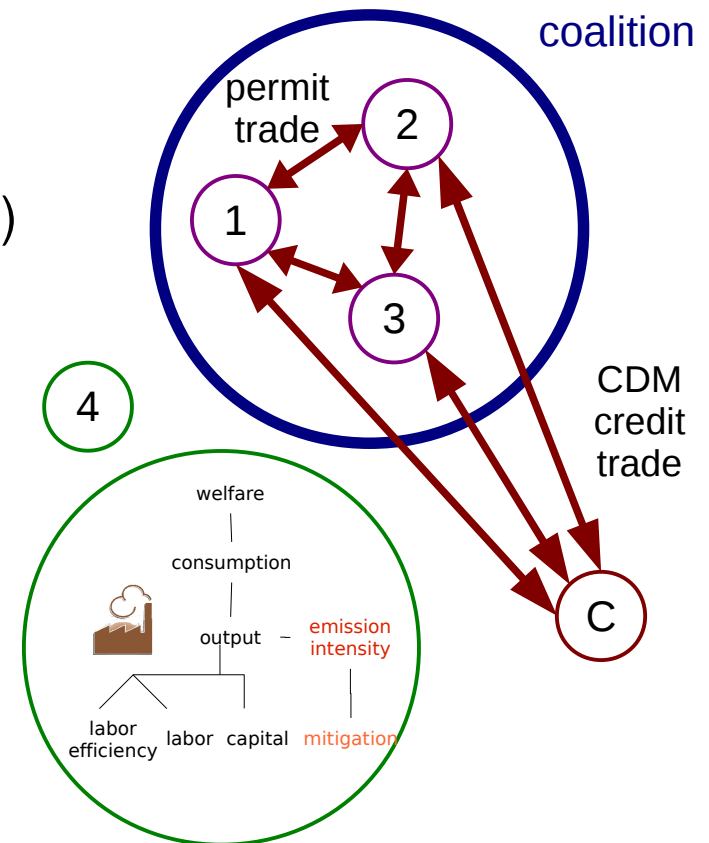
- Economic dynamics:

- Regions maximize intertemporal welfare (cf. Nordhaus' RICE)
- Trade in one good and emission allowances
- Eight symmetric regions + CDM supplier

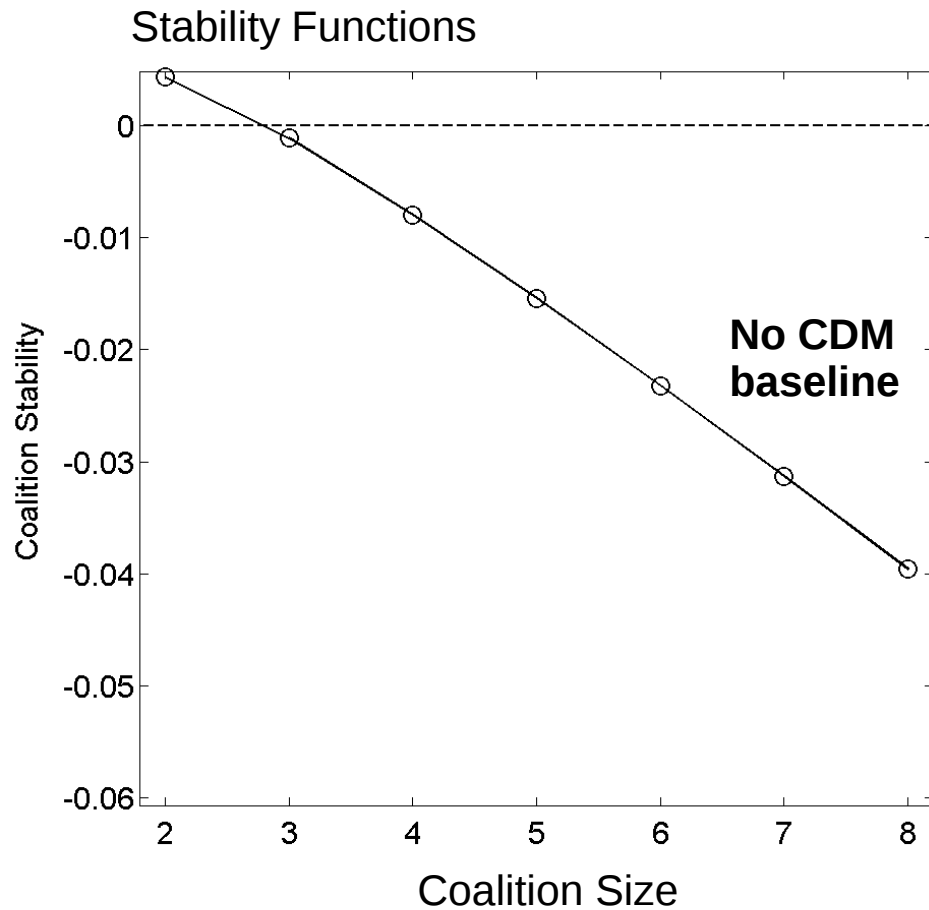
- Climate dynamics:

- emissions → concentration → temperature
- climate change damages

- Data: global aggregates calibrated to common scenarios

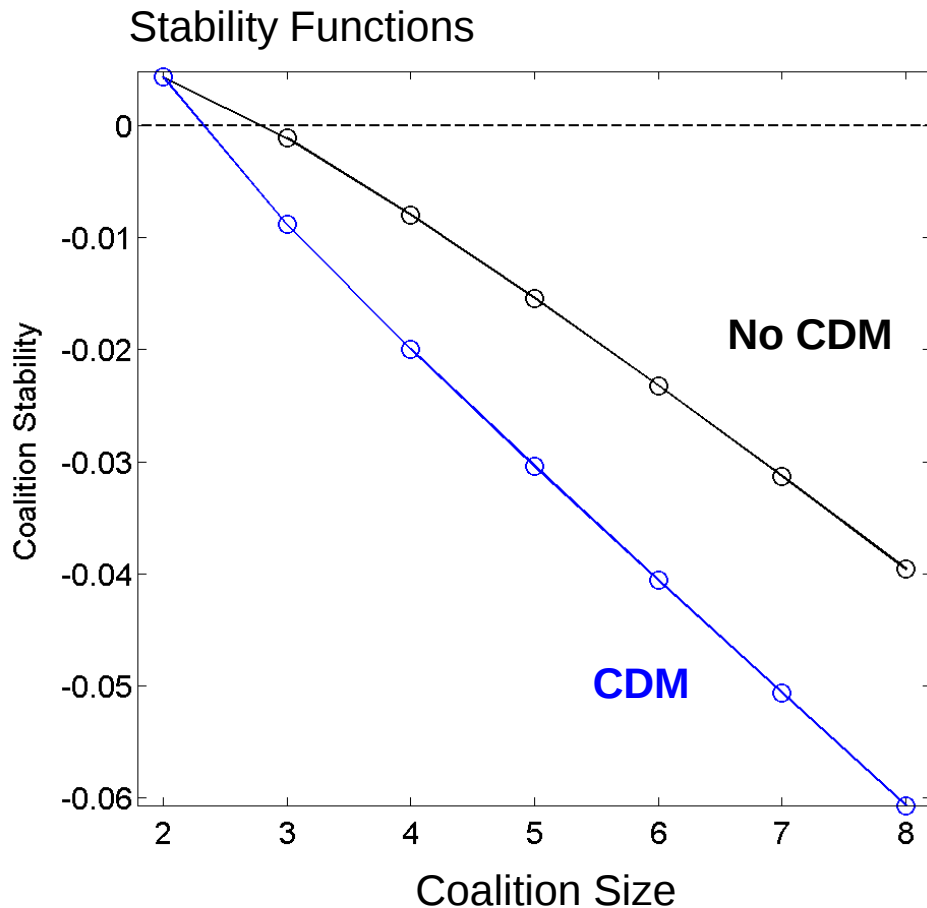


# Impact on Coalition Stability



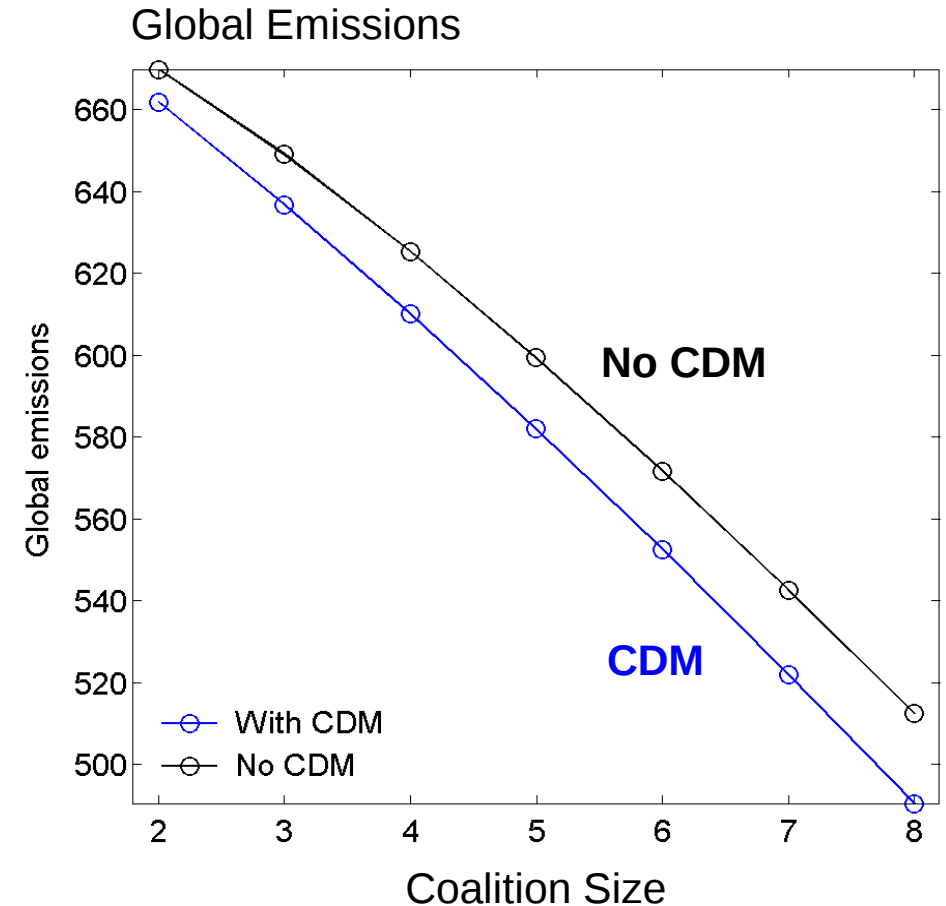
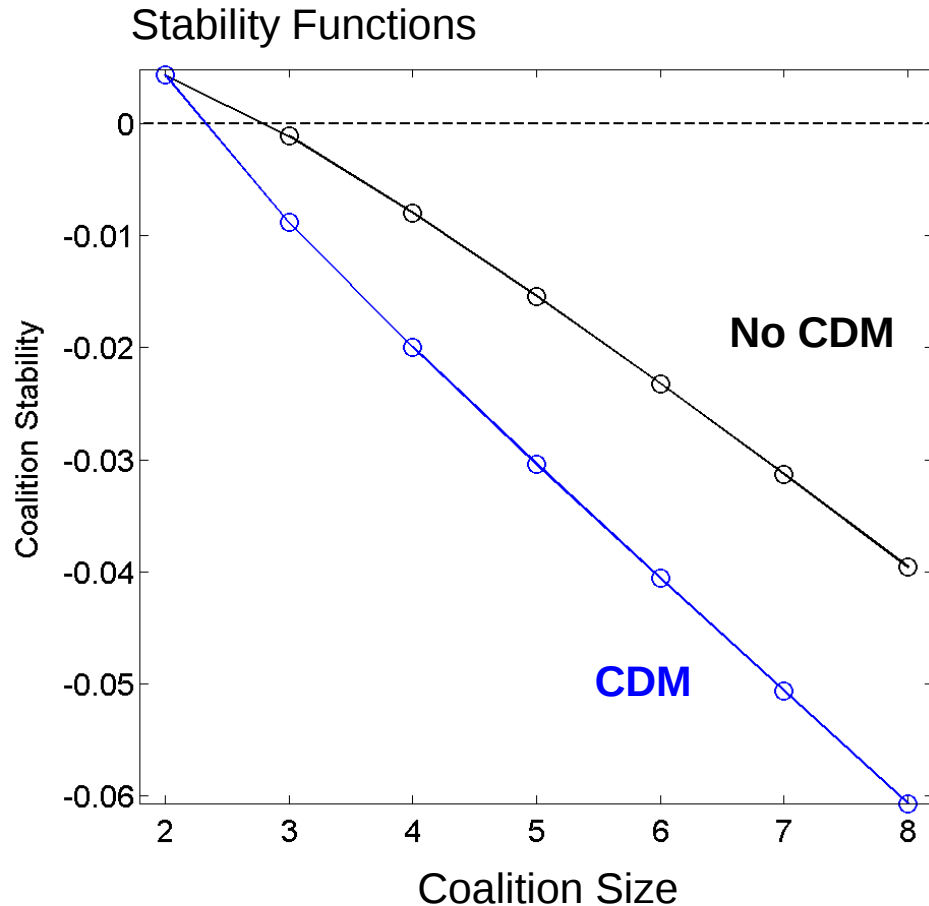
- Stability Function:  
*inside payoff – outside payoff*
- Largest stable coalition: 2

# Impact on Coalition Stability (2)



- Stability Function:  
*inside payoff – outside payoff*
- Largest stable coalition: 2
- Introduction of CDM
  - stability decreased
  - coalition size 2 remains
- Why?

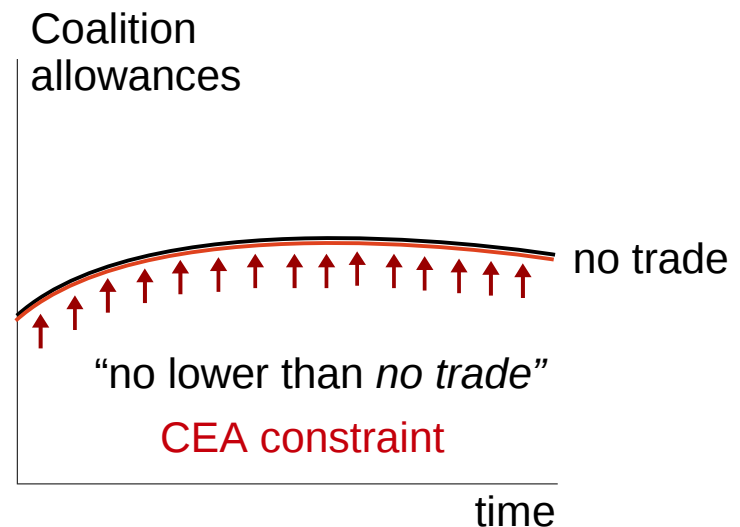
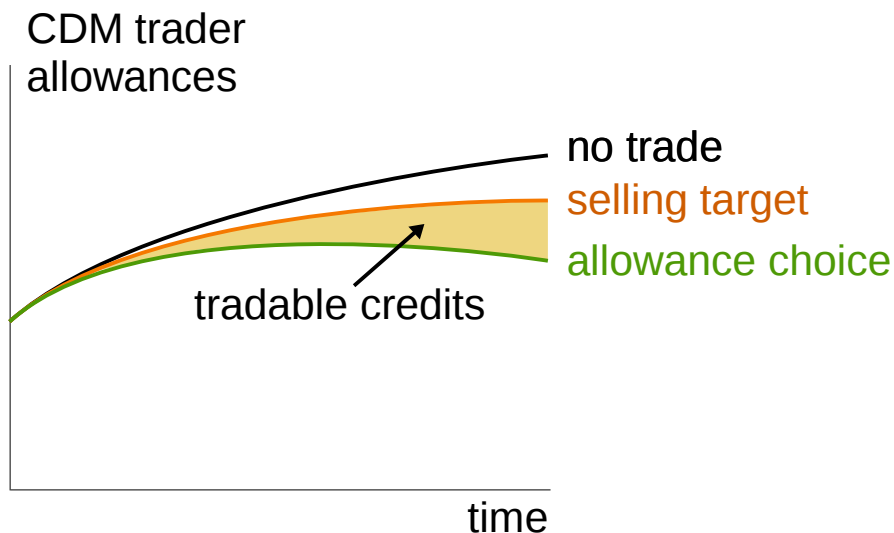
# Impact on Coalition Stability (3)



- More abatement in coalition → reduced global emissions
- Stronger incentive to free-ride

# Improving CDM Design

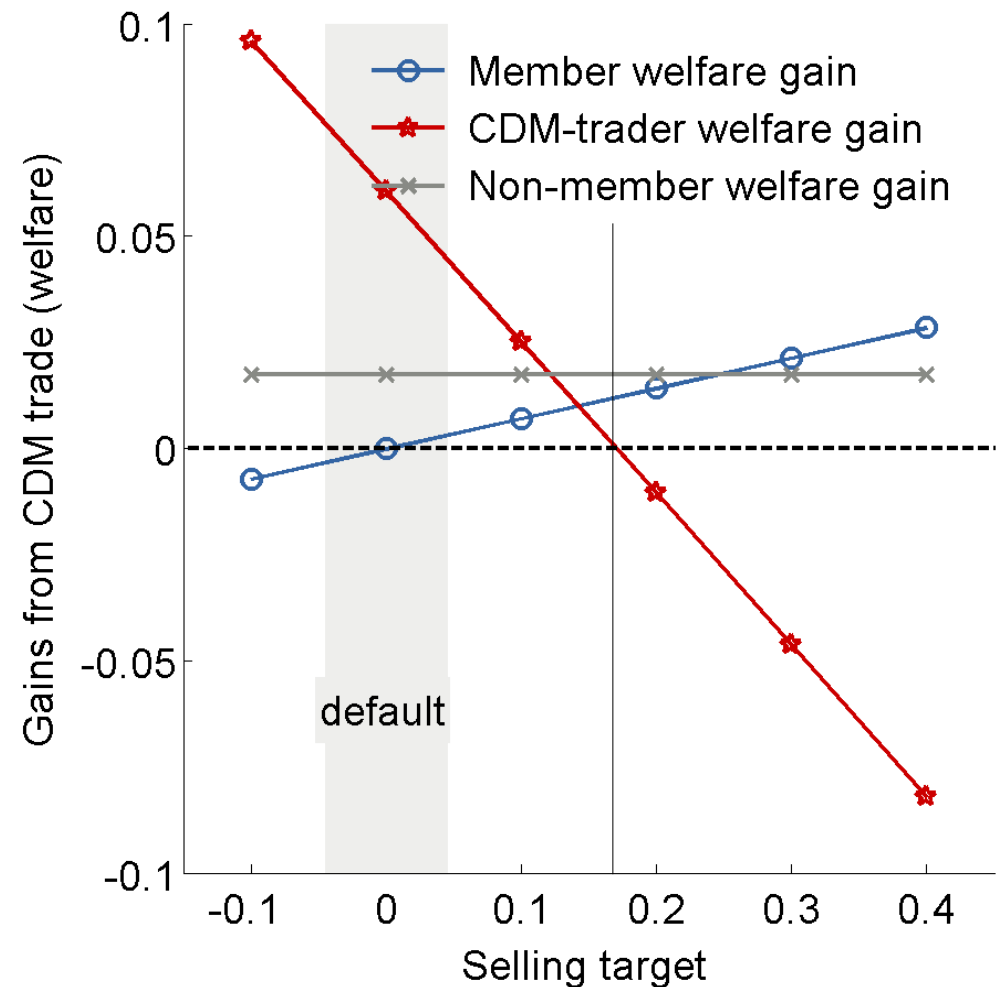
- Two approaches to (maybe) overcome this negative result:
  - *Selling targets*
    - Idea: Shift the gains from CDM trade to the coalition
    - Impose more stringent upper bounds on CDM-trader's allowance choice
  - *CEA CDM trade*
    - Idea: Negotiate CDM trade *after* coalition formation
    - CDM trade ensure *cost effectiveness*  
(but is not part of the *cost/benefit* trade-off in the allowance choice)





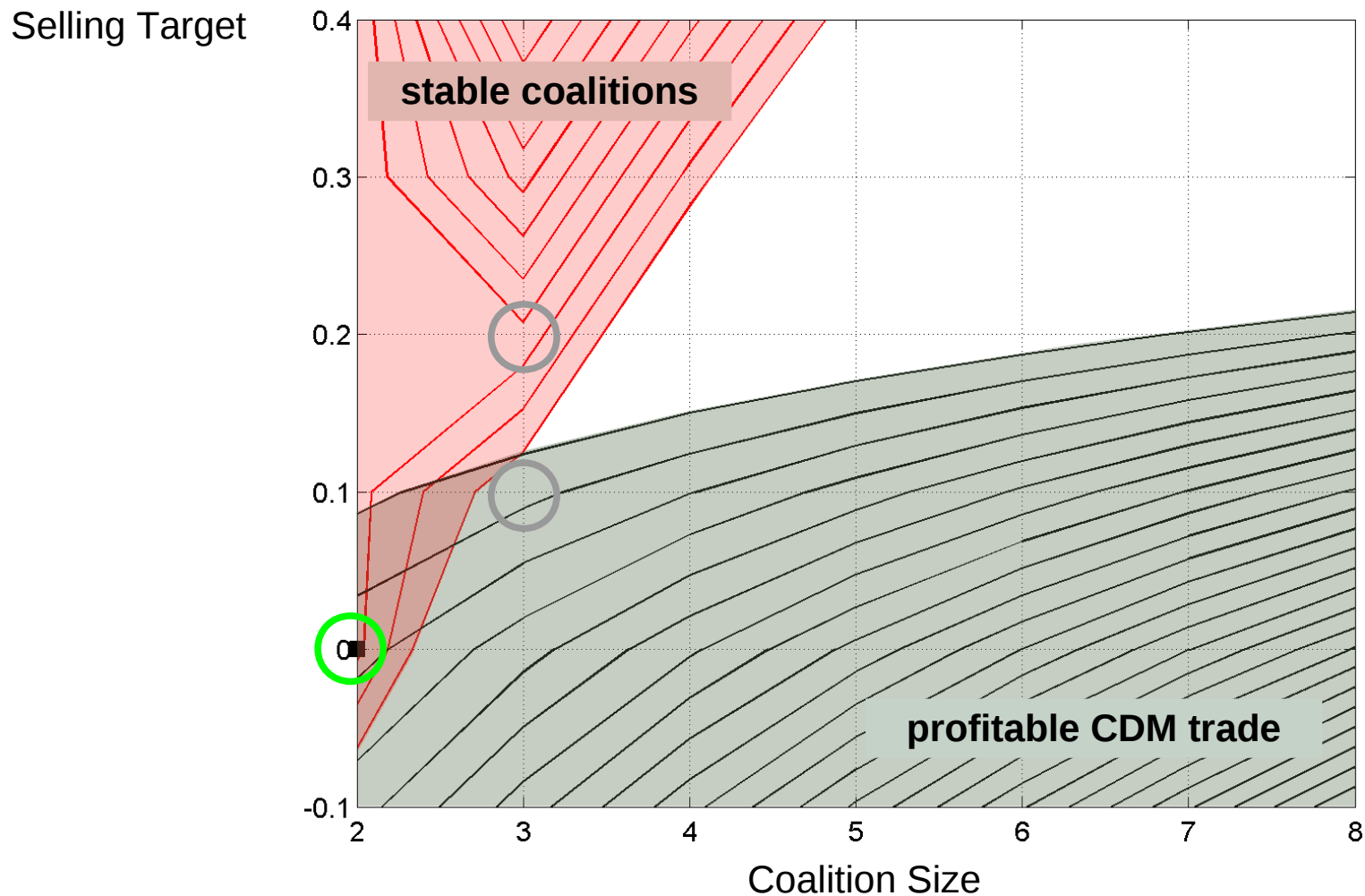
# Selling targets: Welfare effects

- No selling targets:
  - welfare gains from CDM-trade for
    - CDM-trader (—★—)
    - Non-member (—X—)
- Selling targets
  - shift welfare gains from CDM trader to Members, leaving Non-members unaffected
  - *free-riding incentive remains high*
- CDM-trader gain < 0:  
not profitable → no trade
- Trade-off: profitability vs. stability



fixed coalition size of 6

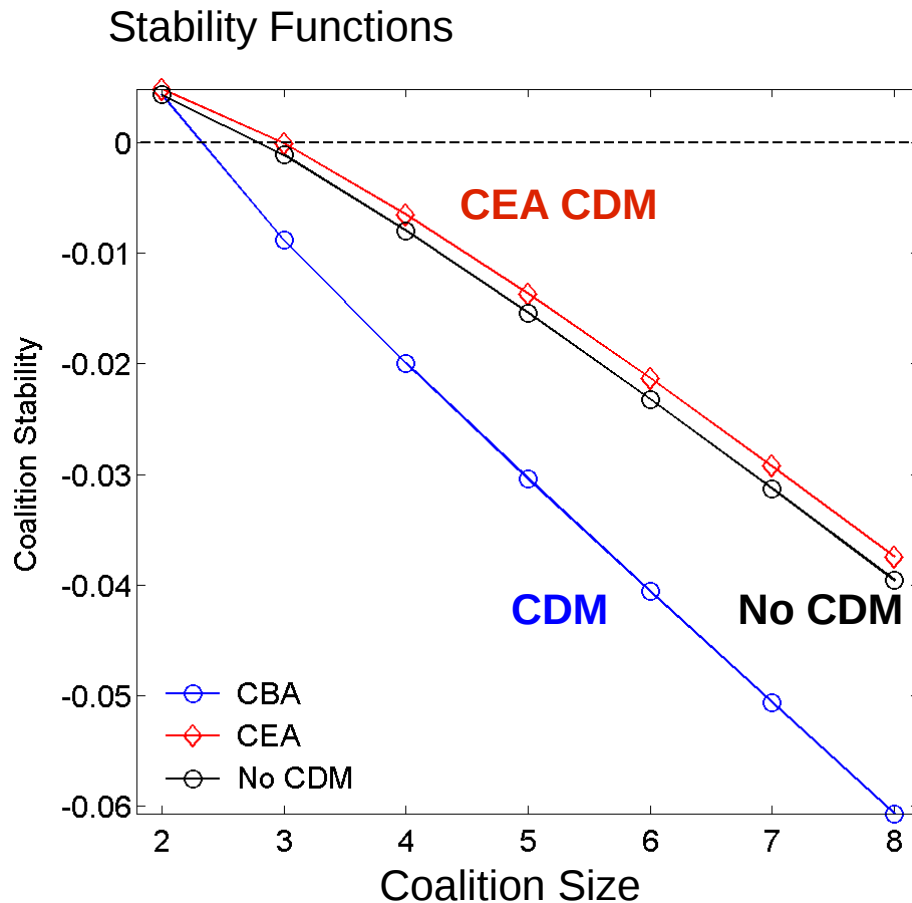
# Selling targets: Stability vs. Profitability



→ Selling targets work in principle, but are restricted by non-profitability

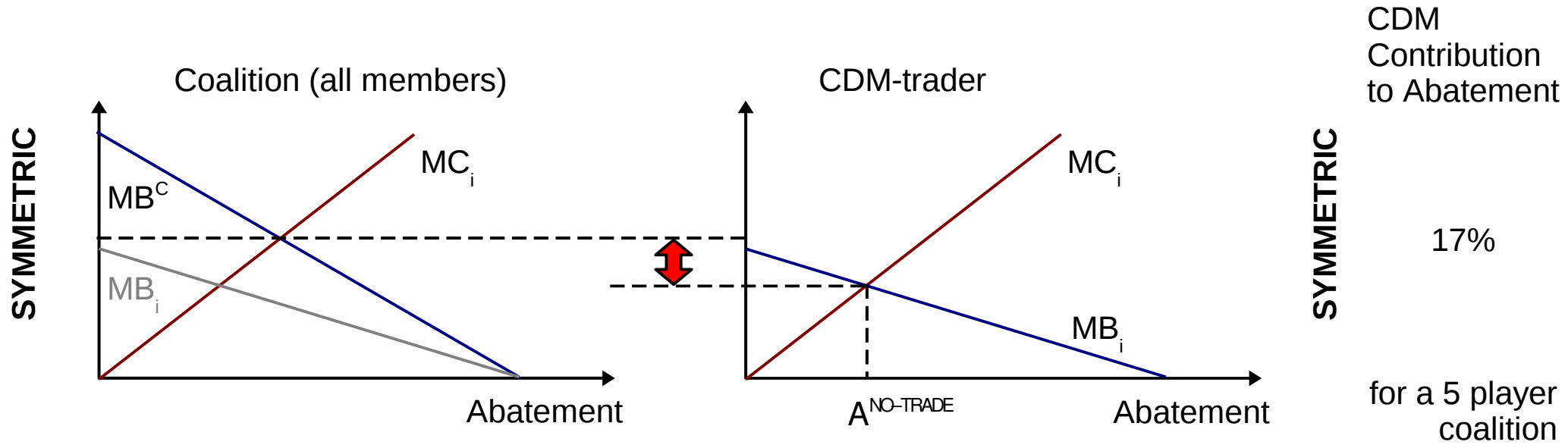
# CEA CDM: Coalition Stability

- Stability is improved, but the effect remains small
- This may be due to relatively small volume of CDM trade

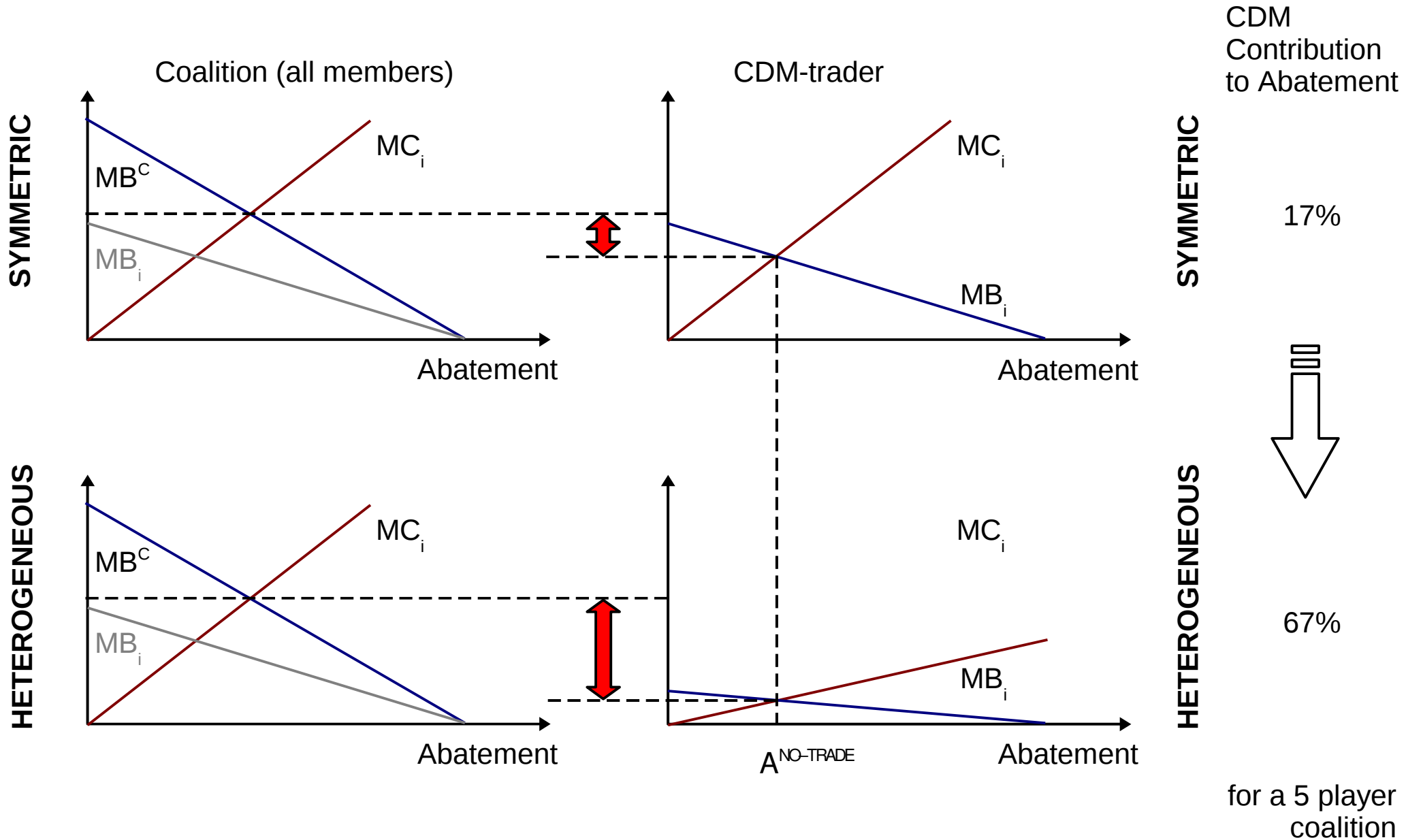


→ Boost CDM trade by introducing some heterogeneity

# CEA CDM: Introducing Heterogeneity

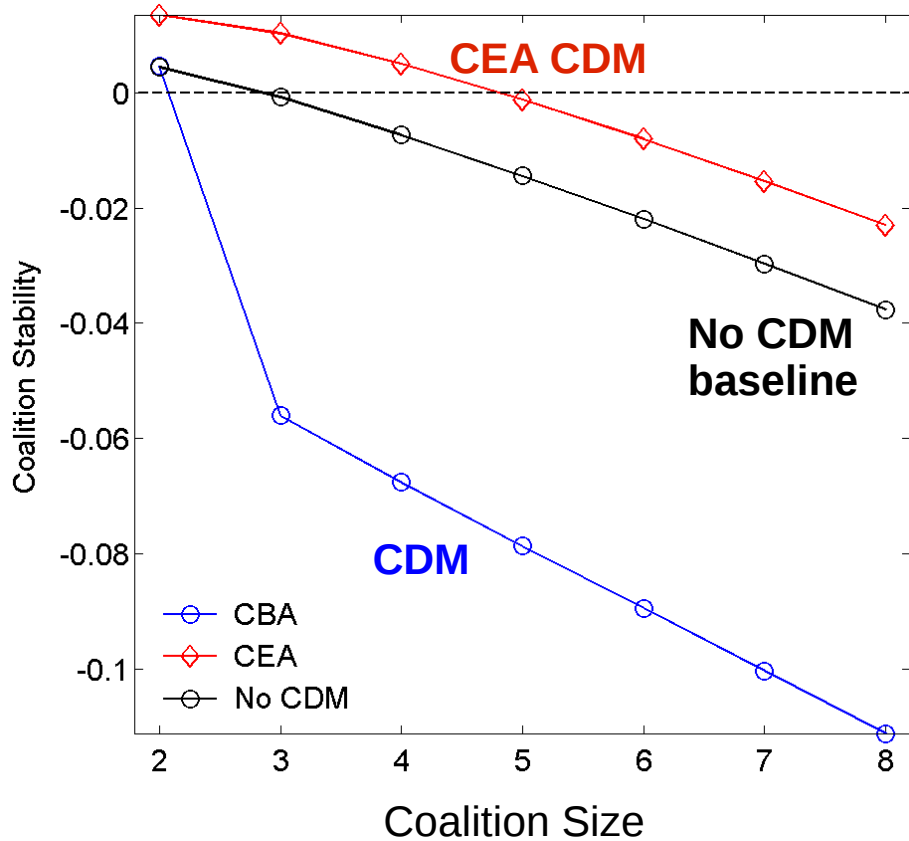


# CEA CDM: Introducing Heterogeneity

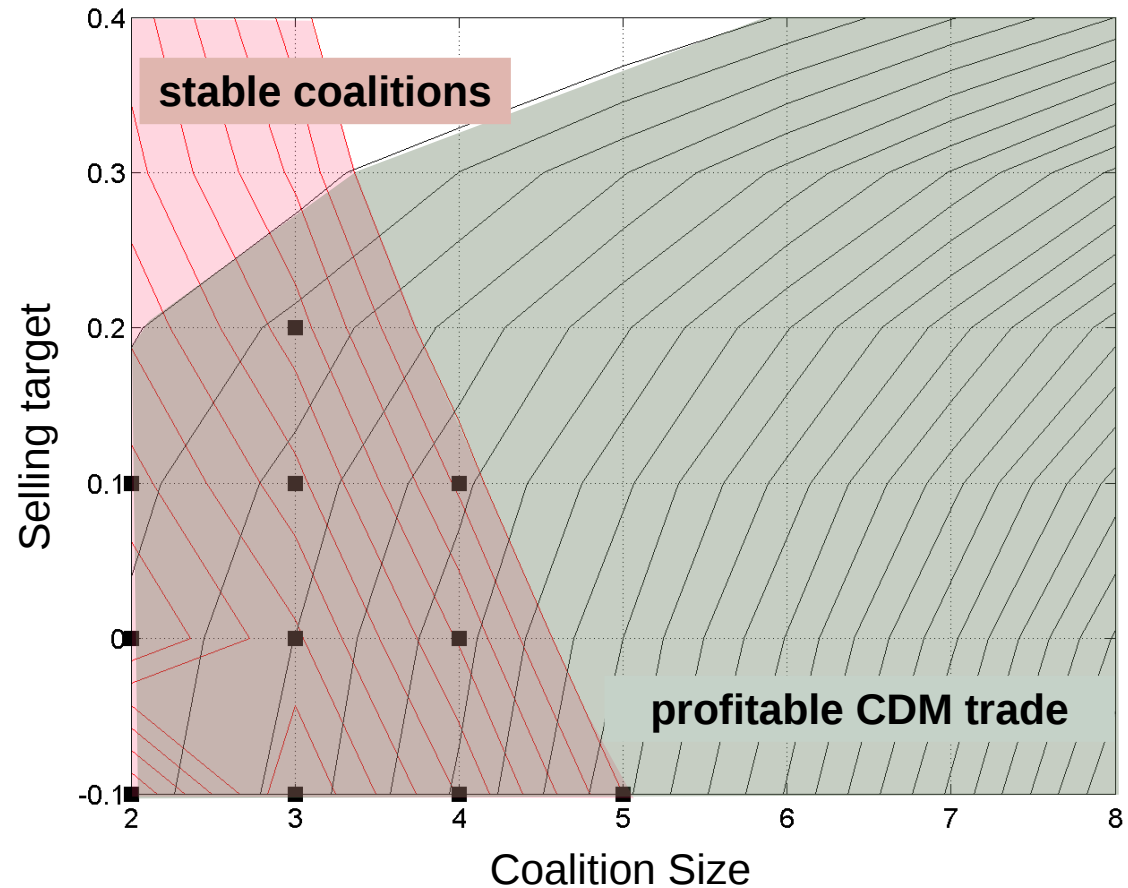


# CEA CDM: Results from heterogeneous players

## Stability Functions

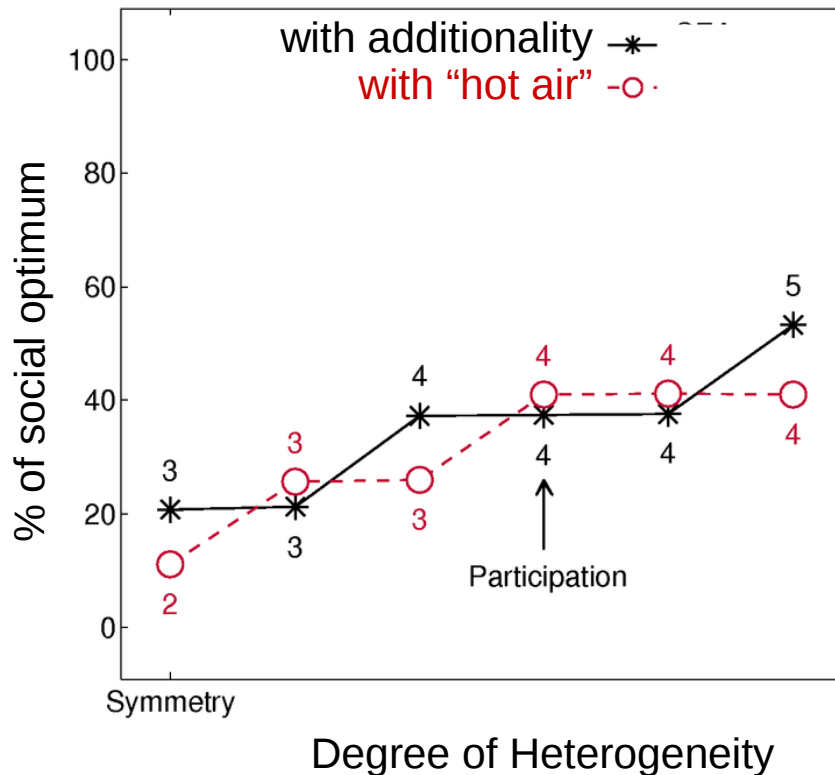


## Stability and profitability of trade



# CEA CDM: Welfare implication of hot air

- Positive effect of CDM trade on treaty participation **increases** with traded volume (heterogeneity)
- Net-effect of “hot air” ambiguous:
  - dilutes the agreement and thus causes welfare loss
  - improves participation – which may outweigh the welfare loss



# Summary

1. Depending on its design,
  - CDM may discourage participation (CBA) or
  - CDM may foster participation (CEA)
  
2. Selling targets may help the agreement in two ways:
  - by shifting welfare gains of CDM trade to coalition members (CBA)
  - by stabilizing a diluted agreement by allowing “hot air” (CEA)
  
3. Large enough differential, large credit trade volume necessary



Thank your for your time.