Global Climate Governance in the Light of Geoengineering: A Shot in the Dark?

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Global Warming

mitigation

adaptation

geoengineering

carbon capture technology (CCT)

solar radiation management (SRM)

- Does the possibility of deploying geoengineering (SRM) reduce mitigation efforts?

- How does SRM affect the governance architecture of climate agreements and what are the prospects of avoiding the unilateral deployment of SRM?

Weitzmann 2015

“gob” (good and bad)

unilateral action: “free-driving behaviour”

voting on the deployment of SRM by super majority

grand coalition managing SRM

Ricke et al. (2013)

- coalition formation game
- only signatories decide on SRM
- non-signatories want to join to have a say
- grand coalition stable managing SRM

Heyen et al. (2019)

geoengineering and "counter-geoengineering"

Fabre and Wagner (2020)

mitigation as a weakest-link game, geoengineering can be avoided

Millard-Ball (2012)

mitigation as a summation game

geoengineering as a second strategy

coalition formation: cartel formation game

mitigation and geoengineering are strategic substitutes

Millard-Ball (2012)

Result: The grand coalition can be stable, avoiding the deployment of geoengineering (Avoidance-equilibrium) in the light of the threat to deploy geoengineering if a country leaves the agreement. This works if the collateral damages of geoengineering are sufficiently large.

→ lower bound of collateral damages

Millard-Ball (2012)

Problems:

- parameter space of scenario not observed
- incorrect specification of free-rider payoff
- other possible policy scenarios not treated
- only grand coalition considered

Model

1. countries chose membership

2. countries chose mitigation level

3. countries chose geoengineering

$$\pi_{i\in K}\left(k\right)\geq\pi_{i\notin K}\left(k-1\right)$$

$$\pi_{j\notin K}\left(k\right)\geq\pi_{j\in K}\left(k+1\right)$$

Model

$$\pi_i = \boxed{bQ - \frac{c}{2}q_i^2} + \boxed{\frac{1}{n}(g - Q)\cdot z_i - \frac{(n-1)}{n}d \cdot z_i}$$

$$Q = \sum_{i=1}^{n} q_i \qquad z_i = \{0, 1\}$$

g = benefits from geoengineering

d = collateral costs from geoengineering

$Q < g$ geoengineering deployed

$Q \geq g$ geoengineering not deployed

Model

Possible equilibria for a coalition of size *k*:

1. Mitigation-Equilibrium, standard mitigation game if
$$Q^*(k) \geq g \;\; (z_i^* = 0).$$

2. Geoengineering-Equilibrium with some mitigation, $Q^*(k) < g$ and $z_i^* = 1$.

3. Avoidance-Equilibrium with sufficient mitigation, $Q^*(k) = g \;\; (z_i^* = 0)$.

Figure 1: Policy Scenarios

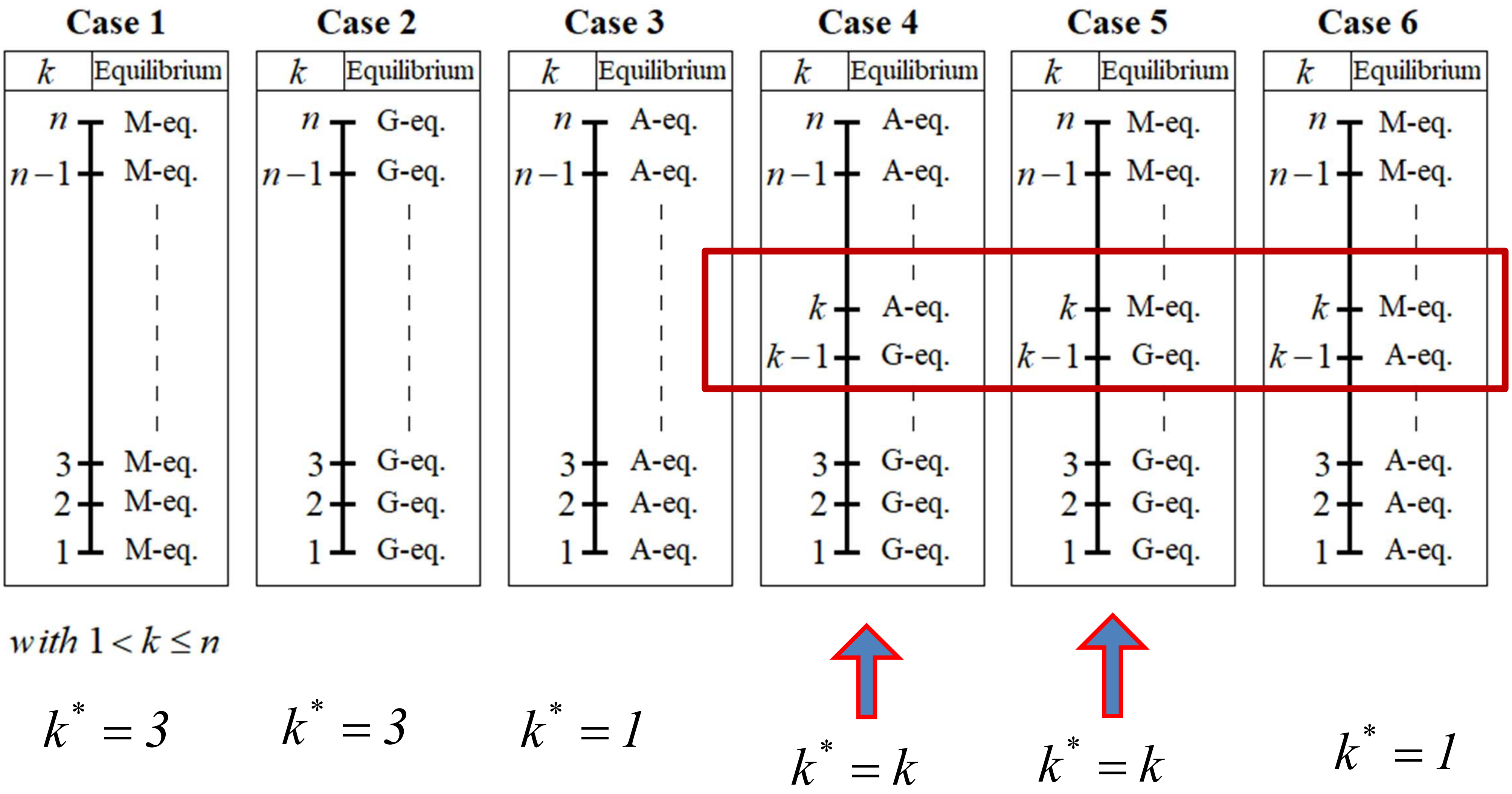
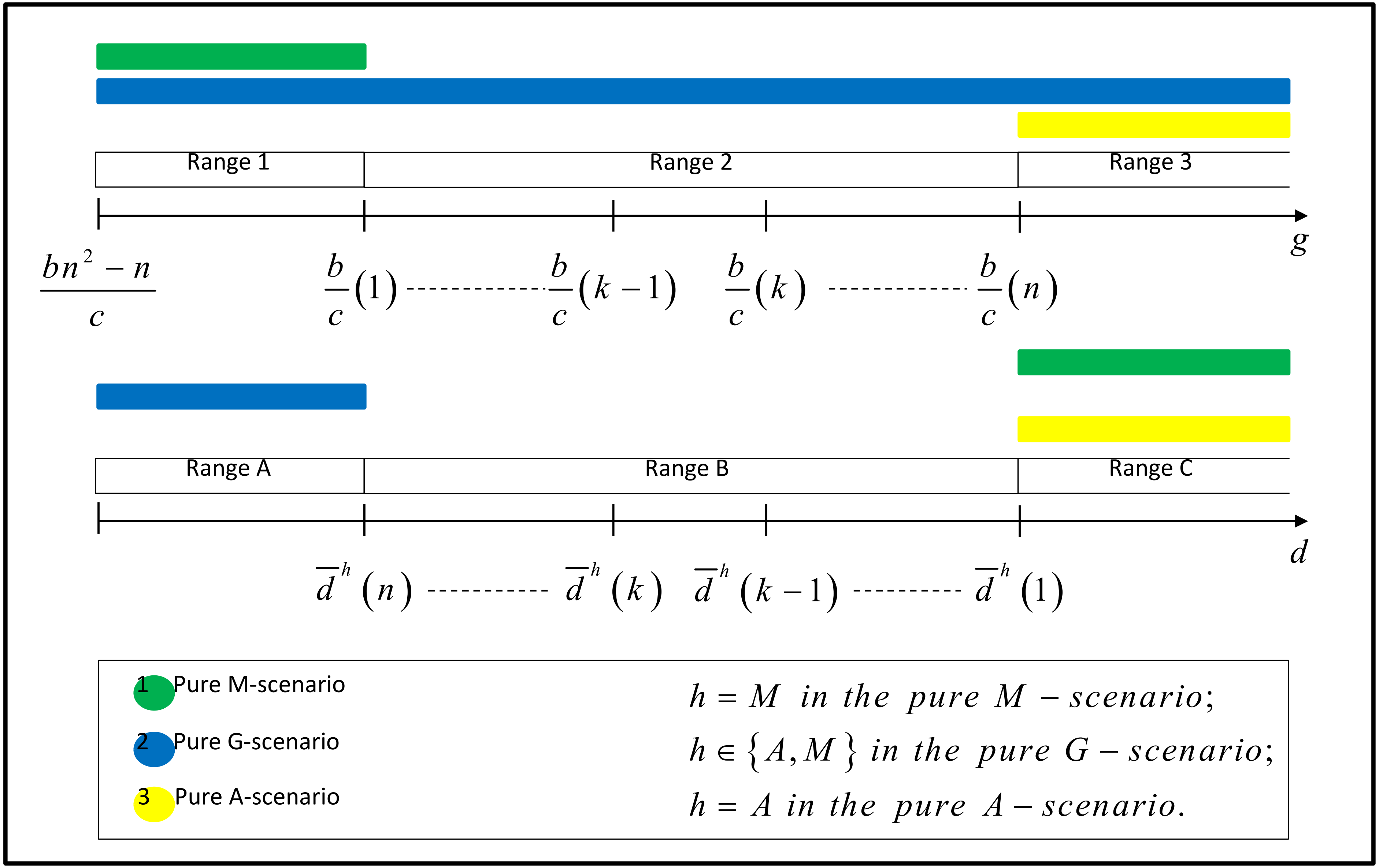


Figure 1: Pure Policy Scenarios (Case 1, 2 and 3)



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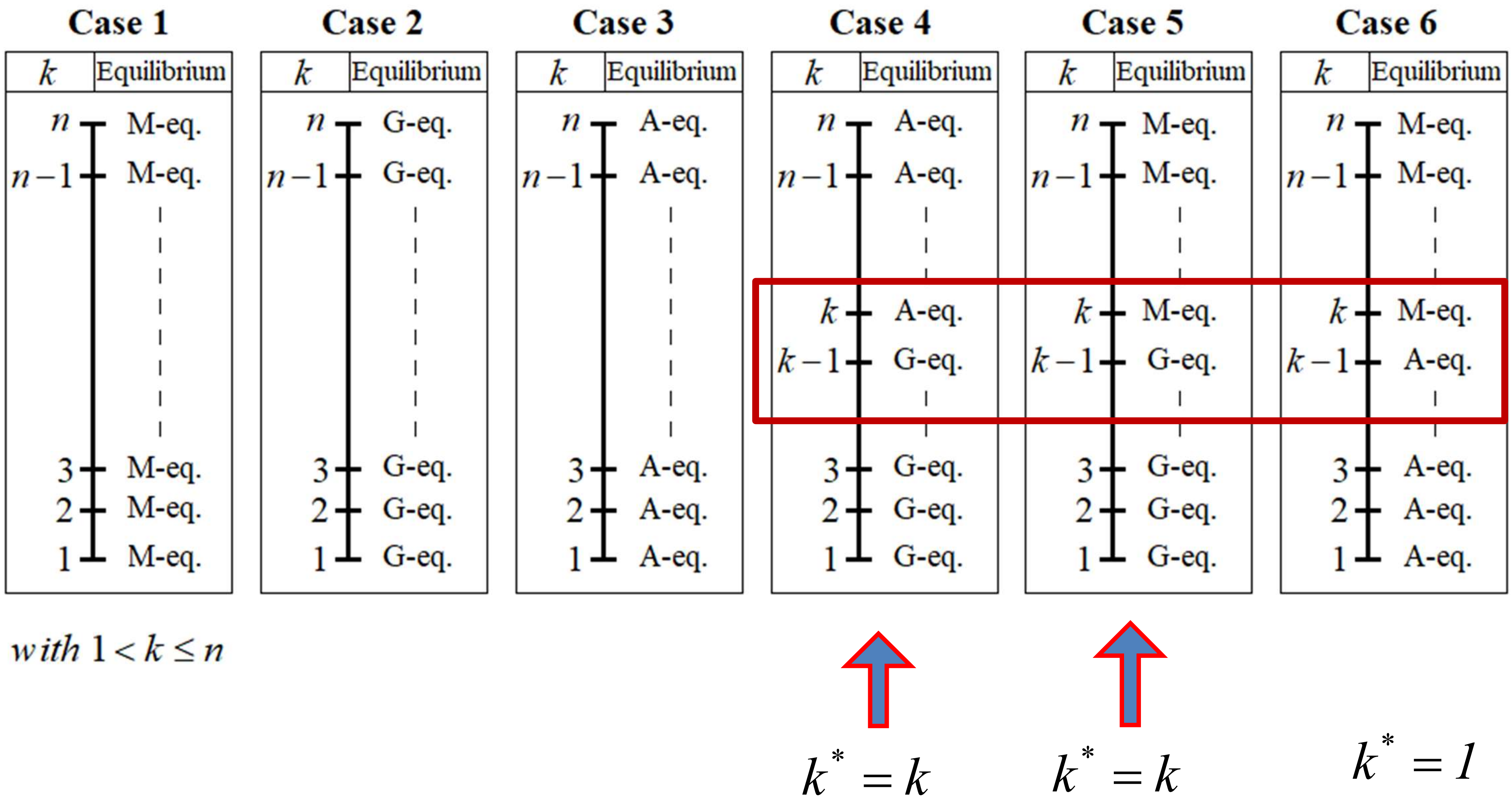
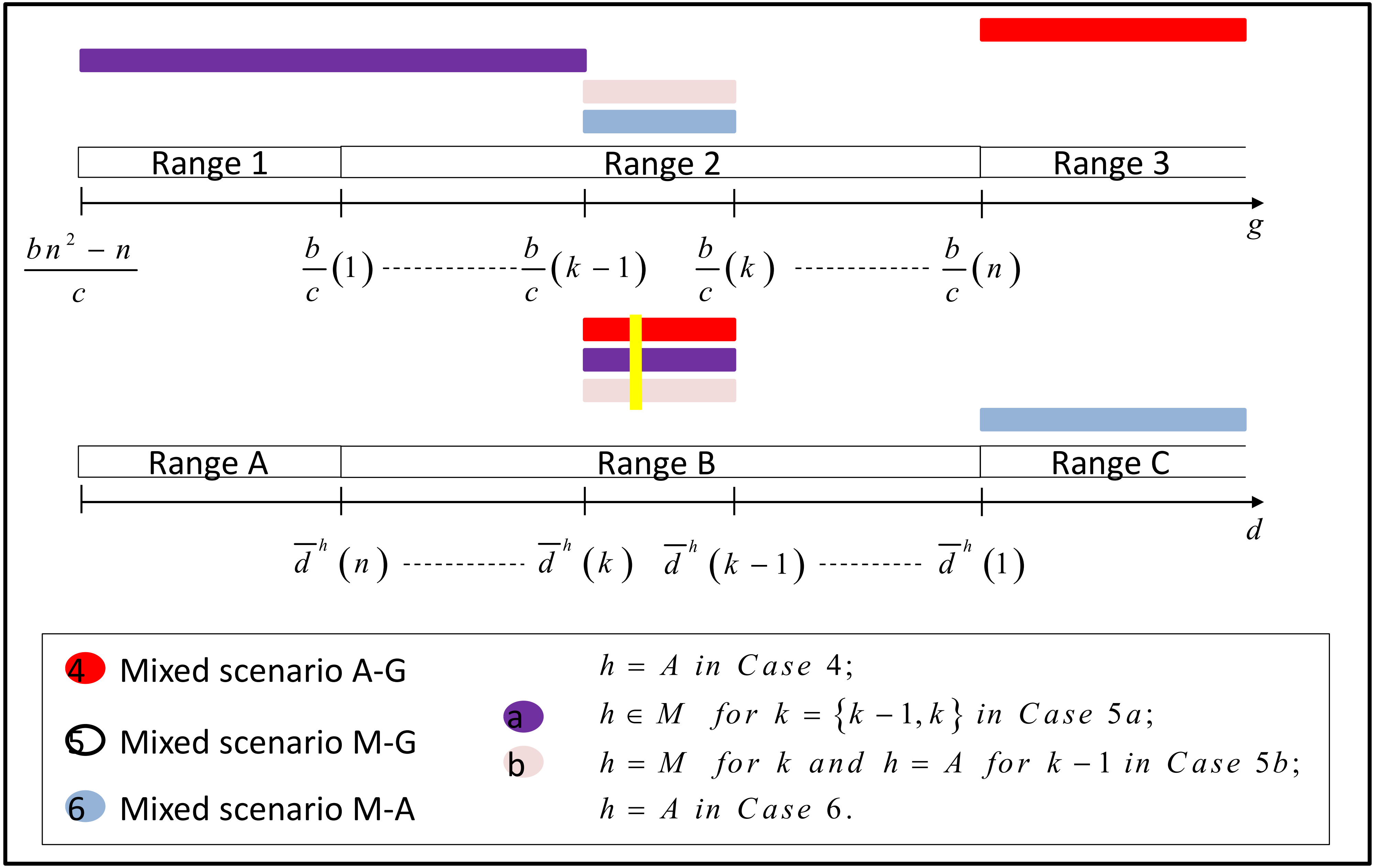


Figure 2: Mixed Policy Scenarios (Case 4, 5 and 6)



CONCLUSIONS

- An Avoidance and Mitigation-Equilibrium can be enforced through the threat of the deployment of geoengineering in case a signatory leaves the agreement.

- This requires that collateral damages are sufficiently high so that the deployment of geoengineering does not pay when cooperating.

- However, collateral damages cannot be too high, as otherwise the threat of the deployment of geoengineering is not credible if a country takes a free-ride.

CONCLUSIONS

- Results also hold if the assumption is given up that only one random country deploys geoengineering.

- Results also hold if analyzed in a repeated game.

- The larger the agreement which shall be stabilized, the lower!!! must be the range of collateral damages.