Issue Linkage

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December 2015
Introduction

- Broad definition of “issue linkage”. Consider two issue areas in which countries try to cooperate through international agreements (e.g. trade and environment). If the two agreements are completely separate, there is no issue linkage. If they are connected in some way, we say there is issue linkage.

- We can distinguish three modes of linkage:
  - *Enforcement* linkage: a violation in one issue area met by punishment in other issue areas
  - *Negotiation* linkage: multiple issue areas simultaneously on the bargaining table
  - *Participation* linkage: e.g. trade sanctions on countries that do not participate in IEAs

- Main questions: What are the benefits and costs of issue linkage? Can we explain the patterns of issue linkage we observe in reality? And at the normative level, what “should” be done?
Note, distinction b/w enforcement and participation linkage may not be obvious, but nature of linkage and potential gains/losses are different.

- Interestingly, participation linkage discussed only for IEAs.

I will present a unified formal framework to understand how these modes of linkage compare/interact with each other, and to bring together insights from a pretty fragmented literature.

I will focus mostly on linkages between trade policy and non-economic policies (e.g. environmental policies).

- Common feature of non-economic policy areas: non-pecuniary international externalities.
Where do we see issue linkage in reality?

Examples of linkage:

- Many b/w trade and security policies. E.g., 56 of 648 security alliances include trade concessions (Poast, 2013).
- Rare b/w trade and environmental policies. Most prominent case: Montreal Protocol.
- Frequent examples of “coercive” trade sanctions, such as the U.S. embargo on Cuba (see book by Hufbauer, Schott and Elliott, 1999).
A couple of interesting “facts”:

- Non-linkage is much more prevalent than linkage. Sometimes an agreement in policy area A includes a clause about policy area B, but we rarely see truly integrated agreements/institutions.
- Asymmetries in enforcement linkage: (i) trade sanctions sometimes used to enforce security and human-rights policies; (ii) military sanctions never used to enforce non-security agreements; (iii) trade sanctions rarely used to enforce agreements in “softer” policy areas (e.g. environment).
A unifying framework

- Existing models focus on a single type of linkage. Papers on enforcement linkage use repeated games; papers on negotiation linkage use bargaining games; papers on participation linkage use coalition-formation games.

- To examine all types of linkage within a unified framework, ideally we need a “grand game” with (1) coalition formation (to examine linkage for participation), (2) within-coalition bargaining (to examine negotiation linkage), (3) repeated-game component (to examine enforcement linkage).

- Here I consider a “little grand game” in the same spirit. Consider $N$ govs and two issue areas (trade and non-trade). Gov $i$’s per-period payoff: $U^i(\tau, x)$. Consider only global agreements (no regional agreements), but govs can choose not to participate.
A unifying framework

- Broad timing (specifics will vary):
  1. Participation phase: at $t = -1$ each gov chooses whether to participate in the agreement(s).
  2. Negotiation phase: at $t = 0$, participants within each agreement Nash-bargain over the set of self-enforcing policies.
  3. Enforcement phase: from $t = 1$ on, govs choose policies repeatedly until the end of time. Policies are self-enforcing if they can be sustained as a SPE of this subgame.
The modes of linkage

- Enforcement linkage:
  - A deviation in a given policy area is followed by punishment in both policy areas.

- Negotiation linkage:
  - Both issues are on the bargaining table. Assume Nash bargaining with threat point given by one-shot Nash equil.
  - If negotiations not linked, can distinguish b/w simultaneous and sequential bargains. I focus on a scenario where $t$-negotiation occurs before $x$-negotiation (convenient for what follows).

- Participation linkage:
  - The $t$-agreement includes a clause providing for tariff increases against countries that do not participate in $x$-agreement.
  - Weaker than “negotiation linkage”: can have participation linkage w/o negotiation linkage (threat of $t$-sanctions encourage participation in $x$-negotiations, but negotiations can be separate), but not vice-versa (if negotiations linked, participation automatically linked).
The modes of linkage

Compared with absence of linkage,

- Enforcement linkage means coordinating on a different equilibrium of the repeated (sub)game;
- Negotiation linkage means adopting a different bargaining protocol;
- Participation linkage means including a contingent clause in the t-agreement, providing for trade sanctions in case of non-participation in x-agreement.
Endogenous linkage

- First step: examine impact of linkage on govs’ payoffs taking mode of linkage as exogenous.
- Then one can think about endogenous linkage. But how?
  - Participation linkage is a clause in the $t$-agreement, so we can suppose govs bargain over this at $t$-negotiation stage.
  - Enforcement linkage specifies punishment rules, so we can suppose govs bargain over this at negotiation stage.
  - But less obvious how to think about choice b/w linked and unlinked negotiations. Two possibilities:
    - A meta-negotiation on bargaining protocol at a prior stage;
    - History and path-dependence. E.g., when environmental issues emerged, trade agreements were already in place, so we can suppose the latter were the *status quo* for any renegotiation, so trade and env negotiations get linked only if all participants agree.
Gains from enforcement linkage

- Let’s focus first on *enforcement* linkage.
- Assume complete information and focus on stationary equilibria (constant policies $(\tau, x)$ on equil. path).
- Unlinked enforcement: a deviation in area A (B) is followed by trigger punishment only in area A (B).
- Linked enforcement: a deviation in area A (B) is followed by trigger punishment in both areas.
Incentive constraints for *unlinked enforcement*:

\[
U^i(\tau; x) \geq (1 - \delta) U^i(R^i_\tau(\cdot), \tau^{-i}; x) + \delta U^i(\tau^{NE}(x); x) \quad (IC_\tau)
\]

\[
U^i(\tau; x) \geq (1 - \delta) U^i(\tau; R^i_x(\cdot), x^{-i}) + \delta U^i(\tau; x^{NE}(\tau)) \quad (IC_x)
\]

\[
U^i(\tau; x) \geq (1 - \delta) U^i(R^i_\tau(\cdot), \tau^{-i}; R^i_x(\cdot), x^{-i}) + \delta U^{iNE}(IC_{\tau x})
\]

where \(R^i_\tau(\cdot)\) and \(R^i_x(\cdot)\) are country \(i\)'s best-response policies. These inequalities define the set of self-enforcing policies under unlinked enforcement, \(S^{ue}\).

**Linked enforcement**: if a country is to deviate, it will deviate in both areas, so there is only one relevant constraint for each country, namely \((IC_{\tau x})\). This IC defines the set of self-enforcing policies under linked enforcement, \(S^{le}\).

Since unlinked enforcement introduces two extra constraints, \(S^{ue}\) must be a subset of \(S^{le}\).
If countries are symmetric, so that the bargain maximizes their common payoff, countries are weakly better off under linked enforcement. But when are they strictly better off? Only if $IC_\tau$ and/or $IC_x$ is binding.

Bernheim and Whinston’s (1990) irrelevance result (they focus on multi-market firm collusion, but the logic is the same): if issue areas are symmetric and separable, there are no gains from enforcement linkage.

Intuition: linkage doubles the loss from cheating on each issue, but since the relevant deviation is to cheat on both issues, also gain from cheating is doubled.
Formally, if countries are symmetric and issue areas are symmetric+separable, can write $U^i(\tau, x) = V(\tau) + V(x)$, and IC’s are:

\[
V(\tau) \geq (1 - \delta)V^D(\tau) + \delta V^{NE} \\
V(x) \geq (1 - \delta)V^D(x) + \delta V^{NE} \\
V(\tau) + V(x) \geq (1 - \delta)[V^D(\tau) + V^D(x)] + \delta(2V^{NE})
\]

where $V^D(\tau)$ (resp. $V^D(x)$) is payoff from deviating on $\tau$ (resp. $x$). The optimal linked agreement maximizes the countries’ common payoff s.t. $\text{IC}_{\tau x}$. The solution is symmetric, with $V(\tau) = V(x)$ and $V^D(\tau) = V^D(x)$, so it satisfies IC$_\tau$ and IC$_x$, hence it is sustainable w/o linkage.
Strict gains from linkage can emerge with *asymmetries* or *non-separabilities* across issues.

Focus on asymmetries first. Gains from linkage emerge e.g. if there is slack in IC$\tau$ but not in IC$\times$. Formally, suppose:

- “first best” (unconstrained-optimal) trade policies $\tau^{FB}$ satisfy IC$\tau$ with slack: $V^{\tau}(\tau^{FB}) > (1 - \delta)V^{\tau D}(\tau^{FB}) + \delta V^{\tau NE}$, so can be sustained w/o linkage;
- $x^{FB}$ violates IC$\times$, so optimal $x$ under unlinked enforcement is $x^{U}$, defined by $V^{x}(x^{U}) = (1 - \delta)V^{xD}(x^{U}) + \delta V^{xNE}$.

Then IC$\tau x$ is satisfied with slack at $(\tau^{FB}, x^{U})$. Under linkage only IC$\tau x$ matters, so $x$ can be moved slightly toward $x^{FB}$ (keeping $\tau = \tau^{FB}$) without violating IC$\tau x$.

Basic insight: when issue areas are asymmetric, linkage allows beneficial *reallocation of enforcement power.*
Can show that, with asymmetric issues, linkage allows beneficial reallocation of enforcement power even if there is no slack in either IC_x or IC_τ.

Gains from linkage can emerge also w/o asymmetries, if issue areas are interdependent → linkage may create enforcement power. Limão (2005) considers tariffs and pollution taxes, shows that linkage creates enforcement power if \( U^i_{\tau_i x_i}(\cdot) > 0 \).

Intuition: linkage increases loss from punishment and one-time gain from deviation (b/c relevant deviation is now joint on \( \tau, x \)). If \( \tau, x \) complements, gain from deviating jointly (\( \tau \uparrow \) and \( x \downarrow \)) < sum of gains from separate deviations.

Whether or not policies are complementary depends on the specifics of the problem and needs to be checked case by case.
Optimal cross-issue punishments

- Enforcement linkage can’t hurt if punishments never occur in equilibrium. But if punishments occur in equil, e.g. due to imperfect monitoring, maximal punishments may be suboptimal, and thus full cross-issue punishments (e.g. permanent Nash reversion) may be a bad idea (Ederington, 2003; Chisik, 2009).

- But we can consider limited and one-way cross-issue punishments. Two observations:

- With perfect monitoring, maximum cross-punishments are not needed: same outcome can be sustained with less-than-maximum cross-issue punishments.
  - Intuition: with symmetry+separability, no cross-issue punishments are needed, so with small departure from this benchmark, small cross-issue punishments are sufficient.
Example. Suppose issue areas are asymmetric but separable. Consider *partial* cross-issue punishments: deviation in area A punished by permanent Nash reversion in area A and $T$-period Nash reversion in area B (if $T = 0 \Rightarrow$ no linkage, if $T = \infty \Rightarrow$ full linkage). Then ICs are:

\[
V^\tau(\tau) \geq (1 - \delta) V^{\tau D}(\tau) + \delta V^{\tau NE} - \Delta_x
\]
\[
V^x(x) \geq (1 - \delta) V^{x D}(x) + \delta V^{x NE} - \Delta_\tau
\]
\[
V^\tau(\tau) + V^x(x) \geq (1 - \delta) [V^{\tau D}(\tau) + V^{x D}(x)] + \delta(V^{\tau NE} + V^{x NE})
\]

where $\Delta_x$ ($\Delta_\tau$) is the loss from cross-punishment in trade (non-trade) area.

Intuition. Recall: if issues are symmetric, IC$_\tau$ and IC$_x$ not binding even with $\Delta_x = \Delta_\tau = 0$. Now introduce a small asymmetry, so that with $\Delta_x = \Delta_\tau = 0$, either IC$_\tau$ or IC$_x$ is slightly binding. Suppose it is IC$_x$. Then we can make IC$_x$ non-binding by choosing a small $\Delta_\tau$ and $\Delta_x = 0$, and thus replicate the full-linkage solution.
If we introduce a small prob of mistakenly perceived violations, then “minimal” cross-punishments (i.e. the least severe that can do the job under perfect info) are strictly preferable to maximum cross-punishments. Intuition: small noise breaks indifference in favor of minimal cross-punishments.

Perhaps this can help explain parsimonious and asymmetric use of cross-punishments (even when there is no major noise in monitoring).
Gains from negotiation linkage

- Gains from negotiation linkage first discussed informally in political science: Tollison and Wilkett (1979), Raiffa (1982), Sebenius (1983). Then more formally explored in economics (Copeland, 2000; Horstmann et al., 2005; Limão, 2007).

- Assume \( \delta \) close to one, so self-enforcement constraints don’t bind and enforcement linkage is immaterial. Then govs Nash-bargain over whole set of feasible policies, with threat point = noncooperative equil. policies.

- Basic idea: if issue areas are asymmetric, linking negotiations allows govs to exchange concessions efficiently across issue areas.
A stark example gives the basic intuition. Consider two countries.

- Separable issues, transfers not available. In trade area, only country 1 chooses a policy \((\tau)\), in non-trade area only country 2 chooses a policy \((x)\).
- Country 1’s payoff: \(V_1^\tau(\tau) + V_1^x(x)\), country 2’s payoff: \(V_2^\tau(\tau) + V_2^x(x)\), with \(V_1^x < 0, V_2^\tau < 0\).
- Threat point: \(\tau^N\) s.t. \(V_1^\tau(\tau^N) = 0\), and \(x^N\) s.t. \(V_2^x(x^N) = 0\).
- Can Pareto-improve over \((\tau^N, x^N)\) if \(\tau \downarrow \) slightly and \(x \downarrow \) slightly, b/c reducing each policy causes second-order loss for the country applying the policy but first-order gain for the other.
- Consider unlinked negotiations. In \(\tau\) negotiation, govs cannot achieve Pareto improvement by changing \(\tau\) from \(\tau^N\), and similarly in \(x\) negotiation. So unlinked negotiations yield \((\tau^N, x^N)\).
- By linking negotiations, govs can exchange concessions across issue areas and thus achieve Pareto improvement.
• More generally, unlinked negotiations are typically Pareto-inefficient, b/c slopes of issue-specific Pareto frontiers are not equalized. This inefficiency is more severe when issues are more asymmetric.

• Formally, gov $i$’s payoff is $U_i = V^\tau_i(\tau) + V^x_i(x)$. Define issue-specific Pareto frontiers: $V^\tau_1 = F^\tau(V^\tau_2)$ and $V^x_1 = F^x(V^x_2)$, assumed strictly concave. The overall Pareto frontier is $U_1 = G(U_2)$.

• Consider linked Nash bargaining:

$$\max[\sigma_1 \ln(U_1 - \bar{U}_1) + \sigma_2 \ln(U_2 - \bar{U}_2)] \text{ s.t. } U_1 = G(U_2)$$

where $\sigma_i = $ bargaining power and $\bar{U}_i = $ disagreement payoff. Or equivalently,

$$\max[\sigma_1 \ln(F^\tau(V^\tau_2) + F^x(V^x_2) - \bar{U}_1) + \sigma_2 \ln(V^\tau_2 + V^x_2 - \bar{U}_2)]$$

• Can show that FOCs imply $F^\tau'(V^\tau_2) = F^x'(V^x_2)$, i.e. slopes of single-issue Pareto frontiers must be equalized. This is necessary and sufficient for overall Pareto efficiency. Each point of overall Pareto frontier corresponds to a different value of slope $F^\tau'(V^\tau_2) = F^x'(V^x_2)$. 

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Now consider unlinked Nash bargaining. This implies

$$\max \left[ \sigma_1 \ln \left( F_\tau^\tau (V_2^\tau) - \bar{V}_1^\tau \right) + \sigma_2 \ln \left( V_2^\tau - \bar{V}_2^\tau \right) \right]$$

$$\max \left[ \sigma_1 \ln \left( F_\times^\times (V_2^\times) - \bar{V}_1^\times \right) + \sigma_2 \ln \left( V_2^\times - \bar{V}_2^\times \right) \right]$$

If issues are symmetric ($F_\tau^\tau (\cdot) = F_\times^\times (\cdot)$ and $V_i^\times = V_i^\tau$ for $i = 1, 2$), this yields points with equal slopes on single-issue Pareto frontiers, so outcome is overall Pareto efficient. But with asymmetries, generically these slopes are not equalized.

**Intuition.** Suppose $\tau$-negotiations deliver the point on the $\tau$-frontier with slope $-3$, while $\times$-negotiations deliver a point on the $\times$-frontier with slope $-4$: a Pareto improvement can be achieved if $\tau$ is changed slightly to reallocate utility toward country 2, and $\times$ is changed slightly to reallocate utility toward country 1.
Negotiation linkage is an *imperfect substitute for lump sum transfers*. Suppose transfers enter governments’ payoffs linearly. Absent transfers linked negotiations are more efficient than unlinked negotiations, but introducing transfers in unlinked negotiations is even more efficient (proof is straightforward).

Asymmetries across issues are the *only* source of gains from negotiation linkage: if issues are symmetric but non-separable, linking does not yield a Pareto-improvement.

So issue interdependence *per se* does not imply gains from linkage, even though trade policies have “externalities” on the non-trade issue (i.e. they affect optimal non-trade policies). Intuition: there are externalities across issues but not across countries, because the group of countries negotiating is the same.
Formally, assume \( U^i(\tau, x) \) symmetric in \( \tau \) and \( x \). Pareto efficiency requires \( \frac{\partial U^1}{\partial \tau_j} \) and \( \frac{\partial U^1}{\partial x_k} \) equalized across all policies (can be shown).

Consider (simultaneous) unlinked negotiations: \( \tau \) chosen via Nash bargaining taking \( x \) as given, and vice-versa. Then policies solve:

\[
\max_{\tau} \sum_{i=1,2} \sigma_i \ln(U^i(\tau, x) - U^i(\tau^N(x), x))
\]

\[
\max_{x} \sum_{i=1,2} \sigma_i \ln(U^i(\tau, x) - U^i(\tau, x^N(\tau))),
\]

where \( U^i(\tau^N(x), x) = \) disagreement payoff in \( \tau \)-negotiation given \( x \) (and similarly for \( U_i(x^N(\tau), \tau) \)).

Given symmetry, solution of above problem satisfies Pareto efficiency, i.e. \( \frac{\partial U^1}{\partial \tau_j} \) and \( \frac{\partial U^1}{\partial x_k} \) equalized for all policies.
When issues are interdependent, linked negotiations do not yield Pareto improvement over unlinked negotiations, but they select a different point on the overall Pareto frontier, so countries will have opposite preferences regarding linkage.

- The distributional effects of linkage depend on disagreement utilities. Under linkage, country $i$’s disagreement utility is $U^i(\tau^N, x^N)$. With no linkage, country $i$’s disagreement utility in $\tau$-negotiation is $U^i(\tau^N(x), x)$, and similarly for $x$-negotiation.

- Intuitively, linkage hurts the gov with higher (payoff from global disagreement — payoff from single-issue disagreement), b/c this gov’s threat point gets worse.

Note differences with enforcement linkage: there, structural interactions can be an independent source of gains from linkage, and transfers don’t remove gains from linkage.
Some countries can lose from negotiation linkage

- Another situation where countries may have different preferences over linkage is if unlinked bargains occur sequentially.
- If issues are interdependent, sequencing matters b/c one agreement affects threat point in the other agreement.
  - Copeland (2000) compares a linked trade/environment negotiation with two unlinked negotiations where trade is negotiated first. A country exporting pollution-intensive goods is likely to prefer non-linkage, because with a prior commitment to free trade this country has better threat point in environment negotiation.
Recent debate on possible use of trade sanctions to encourage participation in IEAs (e.g. Nordhaus, 2015; Barrett, 1997).

Basic idea: link cooperation on “public goods,” which suffer from free-riding problems (e.g. environment) to cooperation on “club goods,” where benefits from cooperation are largely excludable (e.g. trade).

Interestingly, participation linkage discussed only for IEAs. But non-excludability problem is present in many areas of cooperation (e.g. arms control).

Note difference from enforcement linkage: if govs are very patient they will comply with their commitments, hence no need for enforcement linkage. But participation linkage may still be useful to induce them to make commitments in the first place.
What’s missing from existing literature

- In existing models, trade sanctions are imposed exogenously on IEA non-participants. They do not model endogenous choice of trade policy or formation of TAs.
  - Consistency of trade sanctions with TAs? These need to be reflected in TAs as exceptions to baseline commitments.
  - Can trade sanctions on IEA non-participants emerge endogenously, and how severe will they be?
  - How does depth of trade cooperation affect scope for participation linkage?
  - Can this type of linkage affect participation and depth of cooperation in TA?
- To address these questions, need to model *jointly* the formation of TAs and IEAs, and tariff sanctions for non-participation in IEAs should be endogenized as part of TAs.
The free-rider problem in participation

- Consider the framework above with $N$ symmetric countries and $\delta$ close to one (so ICs don't bind).
- Recall timing in the unlinked scenario: (i) each gov decides whether or not to participate in the $t$-agreement; (ii) participants choose $t$-policies by Nash bargaining; (iii) nonparticipants choose $t$-policies; (iv) the same sequence as above takes place in $x$ area.
- When do we have free riding in participation?
- To simplify, suppose countries are symmetric and payoffs are fully separable:

$$U^i = [\hat{U}_x(x^i) + \tilde{U}_x(x^{N\setminus i})] + [\hat{U}_t(t^i) + \tilde{U}_t(t^{N\setminus i})]$$

where $N^\setminus$ is the set of all countries.
Focus on the $\mathbf{x}$-agreement. The subset of participant is denoted $\mathcal{P}^x$. They select their policies $\mathbf{x}_C(\mathcal{P}^x)$ by efficient bargaining. A non-participant $i$ chooses its best-response policies, $\mathbf{x}^i_{BR}$.

Suppose efficiency requires participation by all countries in each agreement. When can we expect full participation?

Heuristic argument. Consider the grand coalition ($\mathcal{P}^x = \mathcal{N}$) and ask if country $i$ wants to deviate and stay out. No deviation iff

$$\hat{U}_x(\mathbf{x}^i_{BR}) + \tilde{U}_x(\mathbf{x}_C^{\mathcal{N}\setminus i}(\mathcal{N}\setminus i)) \leq \hat{U}_x(\mathbf{x}_C^i(\mathcal{N})) + \tilde{U}_x(\mathbf{x}_C^{\mathcal{N}\setminus i}(\mathcal{N})),$$

or

$$\hat{U}_x(\mathbf{x}^i_{BR}) - \hat{U}_x(\mathbf{x}_C^i(\mathcal{N})) \leq \tilde{U}_x(\mathbf{x}_C^{\mathcal{N}\setminus i}(\mathcal{N})) - \tilde{U}_x(\mathbf{x}_C^{\mathcal{N}\setminus i}(\mathcal{N}\setminus i)) \quad (\text{PC}_N)$$
\[ \hat{U}_x(x_{BR}^i) - \hat{U}_x(x_{C}^i(N^i)) \leq \tilde{U}_x(x_{C}^{N\setminus i}(N^i)) - \tilde{U}_x(x_{C}^{N\setminus i}(N\setminus i)) \] (PC_N)

- Interpretation: LHS = gain from unilateral deviation to best-response policy, RHS = loss due to coalition’s policy “reaction” if \( i \) stays out.
- LHS is typically sizable in any area of int’l cooperation (trade, environment etc.).
- RHS is higher if benefits of cooperation are more excludable, and this depends fundamentally on whether \( x \)-policies are targetable in nature.
  - Policies are targetable if they are bilateral, hence can discriminate across foreign countries (e.g. trade taxes), otherwise they are non-targetable (e.g. environmental standards).
Thus participation is more likely to be incomplete ("free riding") in areas where policies are non-targetable, hence the degree of excludability is low.

Consider e.g. climate policies, which are not bilateral in nature, hence non-targetable. If country \( i \) stays out, coalition policies \( x_{C}^{\mathcal{N}\setminus i}(\mathcal{N}\setminus i) \) may not be very different from \( x_{C}^{\mathcal{N}\setminus i}(\mathcal{N}) \), so 
\[
\tilde{U}_x(x_{C}^{\mathcal{N}\setminus i}(\mathcal{N})) - \tilde{U}_x(x_{C}^{\mathcal{N}\setminus i}(\mathcal{N}\setminus i))
\]
is likely to be small, hence \((PC_{\mathcal{N}})\) is likely to be violated.

Now consider trade policies, which are bilateral in nature, hence targetable. If country \( i \) stays out, \( t_{C}^{\mathcal{N}\setminus i}(\mathcal{N}\setminus i) \) entails higher tariffs against \( i \), because the \( \mathcal{N}\setminus i \) countries set their tariffs against \( i \) at best-response levels rather than cooperative levels. Thus 
\[
\tilde{U}_t(t_{C}^{\mathcal{N}\setminus i}(\mathcal{N})) - \tilde{U}_t(t_{C}^{\mathcal{N}\setminus i}(\mathcal{N}\setminus i))
\]
is large, and \((PC_{\mathcal{N}})\) is likely to be satisfied.
For environmental-type agreements, condition \((PC_N)\) is more likely to be satisfied if total \# of countries \((N)\) is lower. E.g., if \(N = 2\), the condition simply states that a country is better off under cooperation than in the noncoop equilibrium.

Suppose \((PC_N)\) is violated, so there is some free riding. What’s the size of the equil. coalition? Ignoring integer nature of \(N\), an equil. coalition is s.t. a country is indifferent between staying in or out.

Indifference condition: a country’s gain from unilaterally changing its policy = loss from the “reaction” of the coalition (which, with one fewer member, internalizes less its pollution and hence relaxes its environmental standards).

Note, international transfers may not help with the free rider problem. Clearly transfers cannot help with symmetric countries. But even with asymmetric countries, several papers have shown that transfers do not help much.
Linkage to encourage participation

- Participation linkage can mitigate free-rider problem, but only if issues areas have $\neq$ degrees of excludability.
- Focus on trade and environment, where this asymmetry is stark. Recall, participation linkage = trade sanctions imposed on countries that don’t participate in IEA.
- By raising cost of non-participation in IEA, linkage can mitigate free-rider problem (Barrett, 1997, Nordhaus, 2015). However:
  - Credibility imposes a limit on the severity of trade sanctions. For ex., the max credible retaliation may be “Nash reversion” against the targeted country, i.e. a full reversal of negotiated tariff cuts.
  - If max credible sanctions not severe enough, full participation not achieved, and cost incurred in equilibrium by participants and non-participants.
  - Linkage may cause reduced participation in (or exit from) the trade agreement, if trade sanction is full reversal of negotiated tariff cuts.
  - Open question: What is the optimal severity of such trade sanctions?
Participation linkage more effective if tariff cuts negotiated in trade agreement are deeper. So when negotiating trade agreement, govs may want to cut tariffs more deeply than they otherwise would -> participation linkage may lead to more trade liberalization, rather than less.

Thus, participation linkage may have two opposite effects on equil. trade barriers: (i) reduction of negotiated baseline tariffs; (ii) (partial or full) reversal of negotiated tariff cuts for countries that choose not to participate in IEA. These effects are not explored in existing literature.
Consider the path-dependence approach mentioned above: suppose that, before IEAs emerge, a TA is already in place, and represents the status-quo for any renegotiation. Then the environmental-linkage clause will be introduced in the TA only if it makes all govs better off.

If countries are asymmetric, conflict of preferences seems likely. Suppose that, absent linkage, there is only one free rider. Is there any degree of participation linkage that can make this gov (weakly) better off? Intuitively, no.

Thus the use of trade sanctions to encourage participation in IEAs may be a good idea, but is likely to be opposed by some of the countries in the WTO.
Quick-and-loose summary

- **Benchmark:** if issue areas are symmetric and separable, no gains from any kind of linkage (enforcement, negotiation, participation).

- **Interdependence b/w policy issues** may imply gains from *enforcement* linkage (e.g. if policies are complements), but not from other types of linkage.

  - Overall, issue interdependence *per se* doesn’t provide a strong rationale for issue linkage.

- **Asymmetries b/w issue areas** offer a stronger rationale for linkage: they imply gains from all types of linkage. More specifically:
  - If Prisoners’ Dilemma is more severe in one issue than in the other → gains from enforcement linkage
  - If one country has stronger relative bargaining position in one issue than in the other → gains from negotiation linkage
  - If degree of excludability is asymmetric across issues (and there is free-riding) → gains from participation linkage.
Quick-and-loose summary

- Theory highlights several potential efficiency gains from linkage, but we don’t see much linkage in reality. Why?
- One possible explanation: countries may have different preferences over linkage, so some countries may oppose it.
- But explaining why there is so little linkage in reality is an open research question.
- Another set of open questions concern participation linkage b/w trade and environment: we need to go beyond models where trade sanctions are exogenously imposed on countries that free-ride on IEAs.