When Is International Policy Cooperation Useful?

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Motivation

- In a globalized world, national economic actions frequently have international spillover effects and stir up controversy
- Examples: monetary policy, fiscal policy, exchange rate policy, trade policy, capital flow management, etc.

$\rightarrow$ concerns about currency wars, trade wars, etc.

$\rightarrow$ repeated demands for greater global cooperation

BUT: premise for successful global cooperation = Pareto inefficiency

Main Question

When are global allocations Pareto efficient?

$\rightarrow$ need 1$^{\text{st}}$ welfare theorem for open economies

Key Considerations

Key deviations from standard 1st welfare theorem:

- Two layers of interacting agents: world economy consists of
  - countries that each have a national policymaker
  - who interacts with optimizing private agents
- Each country may be subject to
  - domestic market imperfections and
  - incomplete domestic policy instruments

$\rightarrow$ framework nests a wide range of open economy models

Comparison:

- Uncoordinated equilibrium among national policymakers
- Optimum of global planner with the same instruments & markets

Main Contributions

Main Contribution 1: Establish an efficient benchmark

1st Welfare Theorem for Open Economies

A global allocation is constrained Pareto-efficient if:

1. policymakers have perfect *external* policy instruments
2. *international* markets are free of imperfections
3. policymakers act competitively

$\rightarrow$ under these conditions, there is no scope for Pareto-improving cooperation

Note: domestic incomplete instruments/market imperfections do not matter

Main Contributions

Main Contribution 2:
Focus cooperation on areas where it can bear fruit:

Address the three areas of inefficiency:

1. deal with imperfect external policy instruments
2. address imperfections in international markets
3. ensure competitive behavior

$\rightarrow$ scope for global cooperation is limited to deviations from these three

$\rightarrow$ all successful cooperation can be mapped into these areas

Literature

Literature on the three motives for policy cooperation:

- **Imperfect external instruments:** Tinbergen (1952), Theil (1954), ...
- **International market imperfections:** Arrow, Debreu, ..., Geanakoplos and Polemarchakis (1986), Greenwald and Stiglitz (1986), ... , Farhi and Werning (2016), ...
- **Monopolistic behavior:** Adam Smith (1776), ..., Bagwell and Staiger (1999, 2001, etc.), ..., Costinot et al. (2013), ...

Literature on cooperation in specific policy areas:

- E.g. monetary policy: Corsetti et al. (2010), ...

Example I

Real shocks and spillovers

- representative private agent in country i with $u(c) = c^{1-\theta}/(1-\theta)$

$$\max U^i = u(c_0^i) + u(c_1^i) \quad \begin{aligned} c_0^i &= y_0^i + m_0^i \\ c_1^i &= y_1^i + m_1^i \\ m_0^i &+ m_1^i/R \le 0 \end{aligned}$$

- in vector notation: define $m^i = \left(m_0^i, m_1^i\right)^T$, $Q = (1, 1/R)$, etc.

$$\max_{m^i} V^i\left(m^i\right) = u\left(y_0^i + m_0^i\right) + u\left(y_1^i + m_1^i\right) \quad \text{st.} \quad Q \cdot m^i \le 0$$

- *Spillovers* of an endowment shock $dy_0^i > 0$,

$$\left.\frac{dm^i}{dy_0^i}\right|_R = \begin{pmatrix} -s \\ Rs \end{pmatrix} \qquad \text{where} \qquad s = \frac{1}{1 + R^{\frac{\theta-1}{\theta}}}$$

  $\rightarrow$ smaller $t = 0$ and greater $t = 1$ inflows/imports

- *Simple extensions:* domestic goods, money & monetary spillovers

Example II

Spillovers of current account (CA) intervention

- simple rationale for CA intervention: learning-by-exporting
- extend Example I by assuming $y_1^i = y_1^i(-M_0^i)$ with $y_1^{i\prime}(-M_0^i) > 0$ (upper-case variables represent country-wide aggregates; individual agents do not internalize that $m^i = M^i$ in equilibrium)

Optimal policy: subsidize net exports/capital outflows in period 0

$$\tau_0^i = y_1^{i\prime} \cdot \frac{u'(c_1^i)}{u'(c_0^i)}$$

Spillovers: greater outflows in period 0/inflows in period 1

$$\left.\frac{dm^i}{d\tau_0^i}\right|_Q = \begin{pmatrix} -s \\ Rs \end{pmatrix} \qquad \text{where} \qquad s = \frac{y_0^i + y_1^i/R}{\left(2-\tau_0^i\right)^2}$$

Example III

Aggregate demand externalities at the ZLB:

- consider zero lower bound on the nominal interest rate:

$$\iota_1^i = \frac{(1+\pi_1^i)u'(C_0^i)}{\beta\, u'(C_1^i)} - 1 \geq 0$$

- if world interest rate high enough: $\left(1+\pi_1^i\right) R - 1 > 0$
  - $\rightarrow$ no problem
- if world interest rate too low: $\left(1+\pi_1^i\right) R - 1 = 0$
  - $\rightarrow$ period 0 output is demand-determined: $\tilde{Y}_0^i = C_0^i - M_0^i$ with the usual (New) Keynesian frictions in the background
  - $\rightarrow$ imports M_0^i eat into domestic aggregate demand

Optimal policy: CA intervention to increase net exports
Spillovers: greater CA deficit in other countries

Example IV of Spillovers

Macroprudential policy to lean against booms and busts
following Jeanne and Korinek (AER, 2010)

- add a third period to our earlier examples

$$U^i = u(c_0^i) + u(c_1^i) + c_2^i$$

- agent owns a collateralizable tree trading at date 1 price p^i

$\rightarrow$ period 2 repayment borrowing is constrained to a fraction ϕ of p^i

$$-m_2^i \leq \phi p^i$$

- note: in general equilibrium, $p^i = p^i\left(M_1^i\right)$

Optimal policy: macroprudential tax $1 - \tau_0^i = 1 / \left(1 + \frac{\mu^i \phi p^{i\prime}\left(M_1^i\right)}{u'\left(C_1^i\right)}\right)$

Spillovers: multi-faceted across the three periods:

$$-\frac{dm^i}{dm_0^i}\bigg|_Q = \begin{pmatrix} -1 \\ \frac{R_1}{1-\phi p^{i\prime}\left(M_1^i\right)} \\ -\frac{R_1 R_2 \phi p^{i\prime}\left(M_1^i\right)}{1-\phi p^{i\prime}\left(M_1^i\right)} \end{pmatrix}$$

Example V of Spillovers

Exchange rate stabilization to insure traded/non-traded sector

- consider a developing economy with two types of agents:
  - financial elite: have access to international capital market
  - workers: live hand-to-mouth: no access to capital markets
    work either in traded or non-traded sector
- all agents value consumption:

$$U^i = \sum \beta^t u(c^i_{T,t}, c^i_{N,t})$$

- under autarky and no shocks: income of workers is stable
  $\rightarrow$ consumption smooth
- under open capital accounts: fluctuations in world interest rate lead to inflows/outflows
  $\rightarrow$ workers suffer positive/negative income shocks

Optimal policy: smoothing CA (leaning against the wind)

Spillovers: reduced opportunities to trade for other countries

Generalized Model Setup

- set of countries $\mathcal{I}$ of total measure $\omega(\mathcal{I}) = 1$
- utility of representative domestic agent in each country $i \in \mathcal{I}$

$$U^i(x^i) \quad \text{s.t.} \quad \begin{aligned} f^i(x^i, X^i, m^i, M^i) &\leq 0 \\ \frac{Q}{1-\tau^i} \cdot m^i &\leq T^i \end{aligned}$$

  - x^i, X^i ... bundle of domestic variables
  - m^i, M^i ... bundle of international transactions
    (upper-case variables denote country aggregates)
  - Q ... vector of world market prices of m^i, M^i
  - τ^i ... full set of tax instruments on intl transactions rebated via T^i

Mapping into General Model

Example: Canonical open economy macro models:

$$\max_{(c_t^i, b_{t+1}^i)_i} \sum_t \beta^t u(c_t^i) \quad \text{s.t.} \quad c_t^i + (1-\xi_t^i) b_{t+1}^i / R_{t+1} = y_t^i + b_t^i$$

Mapping:

- define net i*m*ports $m_t^i = c_t^i - y_t^i = b_t^i - b_{t+1}^i / R_{t+1}$
- domestic variables $x^i = \{c_t^i\}$
- world market prices $Q_t = 1/\Pi_{s=0}^t R_{s+1}$
- external policy instruments $(1-\tau_t^i) = 1/\Pi_{s=1}^t (1-\xi_{s+1}^i)$

$\rightarrow$ utility $U^i(x^i) = \sum_t \beta^t u(c_t^i)$

$\rightarrow$ constraints $f_t^i(\cdot) = c_t^i - y_t^i - m_t^i \leq 0 \; \forall t$

Mapping into General Model

Further Examples:

- multiple traded goods and states: $m^i = (m^i_{t,k,s})$ with $k = 1...K$, $s \in \mathcal{S}$
- non-traded goods: $x^i = (c^i_{T,t}, c^i_{N,t}, y^i_{N,t})$ and $f^i_{t,2} = y^i_{N,t} - c^i_{N,t}$
- labor: $x^i = (c^i_t, \ell^i_t)$ and $U^i(x^i) = \sum_t \left[u(c^i_t) - d(\ell^i_t)\right]$
- capital: $x^i = (c^i_t, k^i_t)$ and f^i_t includes law of motion
- domestic market imperfections $\rightarrow$ capture in $f^i(\cdot)$
- domestic policy measures $\rightarrow$ capture in X^i with constraint $x^i = X^i$
- multiple types of agents, political preferences

$\rightarrow$ framework nests a wide range of open economy macro models

Efficient Benchmark

Impose three conditions to obtain an efficient benchmark:

1. policymakers have perfect *external* instruments
2. *international* market is complete
3. policymakers do not have (do not exert) market power

Separability

Lemma (Separability)

Given perfect external policy instruments, the domestic and international optimization problems can be solved separately.

Outline of proof:

- perfect instruments imply IC for external allocation is slack
- slack IC implies external objectives irrelevant for domestic choices

Solution Step 1

Step 1: optimal domestic allocation *for given external* (m^i, M^i)

- representative agent optimizes
- domestic policymaker optimizes

$\rightarrow$ defines reduced-form utility function $V^i(m^i, M^i)$

Example: $V^i(m^i, M^i) = \sum_t \beta^t u(y_t^i + m_t^i)$

Solution Step 1 – Formal Description

Formal Description of Step 1: *for given external* (m^i, M^i)

- representative agent: takes X^i as given:

$$v^i(m^i, M^i, X^i) = \max_{x^i} U^i(x^i) \quad \text{s.t.} \quad f^i(m^i, M^i, x^i, X^i) \leq 0$$

$$\rightarrow \ FOC(x^i): \quad U^i_x = \lambda^i f^i_x \qquad \rightarrow \qquad \text{obtain } (IC)$$

- domestic planner (for consistent external allocations $m^i = M^i$):

$$\max_{X^i} U^i(x^i) \quad \text{s.t.} \quad (IC),\ x^i = X^i,\ f^i(M^i, M^i, X^i, X^i) \leq 0$$

$$\rightarrow \qquad \text{obtain optimal domestic } X^i(M^i)$$

- define reduced-form utility by combining agent's value function and planner's optimal policies:

$$V^i(m^i, M^i) = v^i(m^i, M^i, X^i(M^i))$$

Solution Step 2

Step 2: determine optimal external allocations M^i in country i:

- private agents solve for optimal external allocation m^i given τ^i
- planner sets τ^i to implement optimal external allocation M^i while internalizing externalities from external transactions

$\rightarrow$ determines global competitive equilibrium

Solution Step 2 – Formal Description

Formal Description of Step 2: determine external allocations M^i:

- representative agent:

$$\max_{m^i} V^i(m^i, M^i) \quad \text{s.t.} \quad \frac{Q}{1-\tau^i} \cdot m^i \leq T^i$$

$$\rightarrow \; FOC(m^i) : (1-\tau^i) V^i_m = \lambda^i_e Q$$

- planner in country i that acts competitively:

$$\max_{M^i} V^i(M^i, M^i) \quad \text{s.t.} \quad Q \cdot M^i \leq 0$$

$$\rightarrow \; FOC(M^i) : V^i_m + V^i_M = \Lambda^i_e Q$$

Lemma (Implementation)

The planner's optimal allocation can be implemented by setting

$$\tau^i = -\frac{V^i_M}{V^i_m}$$

General Equilibrium & Key Question

Global Competitive Equilibrium: feasible allocations (X^i, M^i), external policies (τ^i) and international prices Q such that:

- $x^i = X^i$ and $m^i = M^i$ is optimal for private agents in each country i
- each national planner chooses optimal X^i, τ^i taking Q as given
- global markets for M clear: $\int_{i \in \mathcal{I}} M^i d\omega(i) = 0$

Key Question

Is the uncoordinated equilibrium among national planners efficient?

Global Planning Problem

Global Planning Problem:

- global planner maximizes:

$$\max_{\{M^i\}} \int_{i\in\mathcal{I}} \left[\phi^i V^i(M^i, M^i) + \nu M^i\right] d\omega(i)$$

- optimality condition:

$$\phi^i \left[V^i_m + V^i_M\right] = \nu \quad \forall i$$

- if we pick $\nu = Q$ and $\phi^i = 1/\Lambda^i_e$, then this replicates optimality conditions of national policymakers $V^i_m + V^i_M = \Lambda^i_e Q$

$\rightarrow$ Competitive equilibrium among national planner is Pareto efficient

Global Planning Problem

1st Welfare Theorem for Open Economies

Under our three benchmark conditions, the uncoordinated equilibrium among national planners is constrained Pareto efficient.

Note:

- policy interventions (X^i, τ^i) entail spillover effects
- BUT: spillover effects are mediated through global prices Q

$\rightarrow$ first welfare theorem applies at the level of planners

$\rightarrow$ global reallocation of capital/goods is efficient market response

Result = extension of standard **1st FWT with two modifications**:

- two layers of optimizing agents: private agents and policymakers
- compatible with imperfections/missing instruments in domestic economy

Pareto Improvements

Can we obtain Pareto improvements (rather than just Pareto efficiency) when responding to economic shocks?

$\rightarrow$ generally requires global coordination

Two possible avenues:

1. either lump-sum transfers $\hat{T}^i$
2. or coordinated use of policy instruments (τ^i) to keep Q constant

Example of coordination that avoids spillovers via Q:

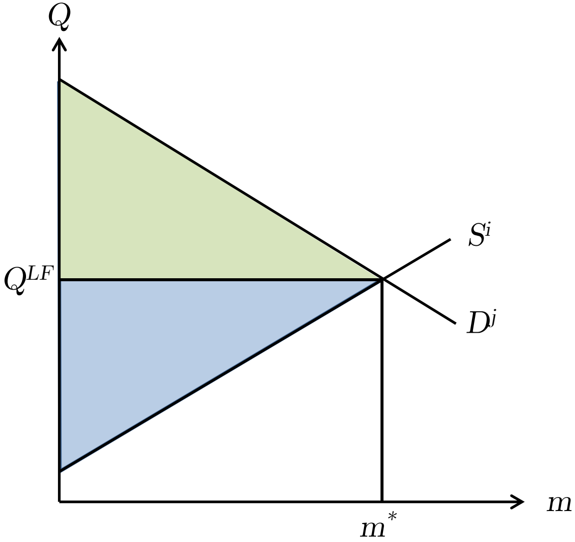
- N countries that are identical except they differ in size
- exogenous increase in country i externalities calling for $d\eta^i > 0$
- world prices remain constant if countries set

$$\begin{aligned} d\tau^i &= (1-\omega^i)d\eta^i \\ d\tau^j &= \qquad \omega^i \ d\eta^i \quad \forall j \neq i \end{aligned}$$

$\rightarrow$ optimal mix of inflow/outflow restrictions such that $d\tau^i + d\tau^j = d\eta^i \ \forall j$

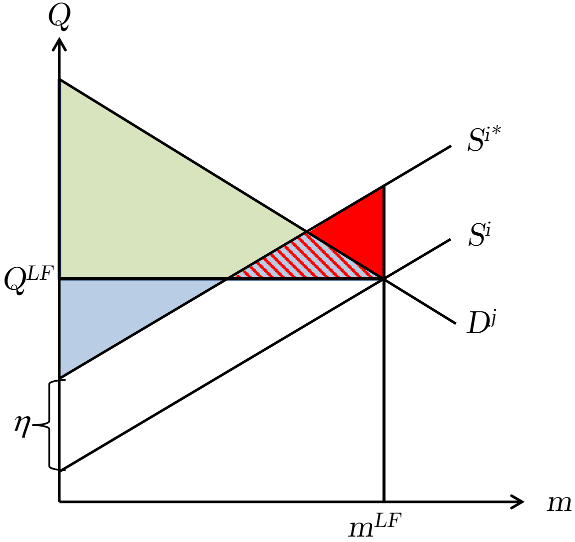
Coordination to Avoid Spillovers via Q

Equilibrium before shock:



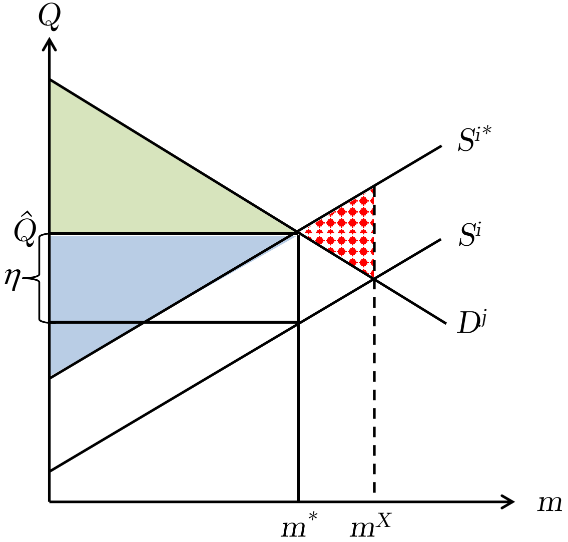
Coordination to Avoid Spillovers via Q

Welfare after externality realized:



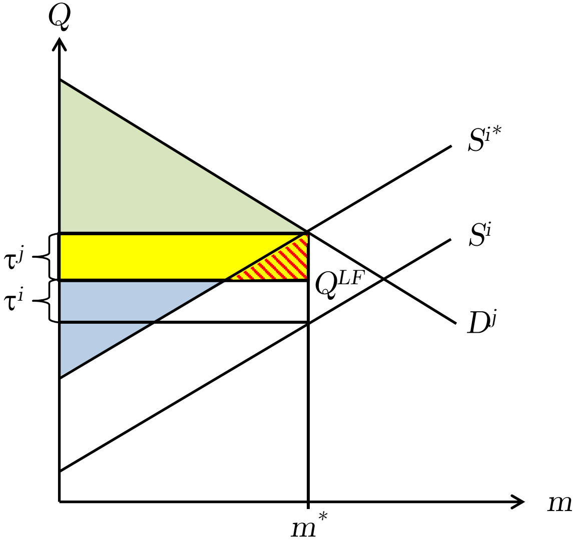
Coordination to Avoid Spillovers via Q

Unilateral intervention to correct externality:



Coordination to Avoid Spillovers via Q

Cooperative intervention that holds world price constant:



Case I for Coordination: Impf. External Instruments

A Model of Imperfect External Policy Instruments:

- capture imperfections by a cost function $C^i(\tau^i) \geq 0$
- interpretations:
  - direct implementation cost $C^i(\tau^i) = \sum \gamma^i_k (\tau^i_k)^2/2$
  - non-existing instruments if $\gamma^i_k \to \infty$
  - coarse instruments $C^i(\tau^i) = \sum \gamma^i_k (\tau^i_{k,s} - \tau^i_{k,0})^2/2$
  - restricted instruments if $\gamma^i_k \to \infty$

Note: even if instruments are imperfect, they can be *effectively* perfect,
e.g. if there are no externalities $V^i_M = 0$

Imperfect External Policy Instruments

Proposition (Imperfect External Policy Instruments)

- The uncoordinated equilibrium is generically inefficient.
- Constrained efficiency under imperfect policy instruments requires

$$\int_{i \in \mathcal{I}} C^{i\prime}(\tau^i)(1-\tau^i)d\omega^i = 0$$

Intuition:

- setting average marginal distortion to zero minimizes total implementation costs

Example 1 of Imperfect Policy Instruments

Example of Wasteful Competitive Intervention:

- consider N identical countries with externalities $V_M^i < 0$
- each country intervenes $\tau^i > 0$ at cost $C^i(\tau^i) > 0$
  - intervention is completely wasteful:
    same allocation but lower cost with $\tau^i = 0 \; \forall i$

Note: under perfect instruments ($C^i \equiv 0 \forall i$),
the uncoordinated equilibrium would be Pareto efficient!

Example 2 of Imperfect Policy Instruments

Example of Sharing the Regulatory Burden:

- consider 2 countries $i = A, B$ with cost $C^i(\tau^i) = \gamma^i \sum(\tau_t^i)^2/2$
- exogenous change in externalities calls for $d\tau^A = d\eta$
- in national planning equilibrium, unilateral intervention
- under global coordination,

$$d\tilde{\tau}^A = \frac{\gamma^B}{\gamma^A + \gamma^B} \cdot d\eta \qquad \text{and} \qquad d\tilde{\tau}^B = -\frac{\gamma^A}{\gamma^A + \gamma^B} \cdot d\eta$$

- stark cases: if $\gamma^B = 0$ or $\gamma^A \to \infty$, then only τ^B is used

Imperfect Instruments and Domestic Policy

Lemma (Imperfect Instruments and Domestic Policy)

If the set of external policy instruments τ^i is imperfect:

- *national planners will distort domestic policies X^i to target external transactions*
- *global coordination needs to involve domestic policies X^i*

Case II: Imperfections in International Markets

Examples:

- Limited risk markets
- Financial constraints
- Price rigidities and AD externalities
- Cross-border externalities

Formal description:

$$\Phi^i \left(M^i, Q \right) \leq 0$$

Case II: Imperfections in International Markets

Lemma (Intl Market Imperfections and Domestic Instruments)

If the set of external policy instruments τ^i is

perfect: *coordinate only external policies τ^i to fix intl market imperfections*
never need to involve domestic policies X^i

imperfect: *use combination of τ^i and X^i to fix intl market imperfections*

Intuition:
Separability results continue to hold

- Fixing international imperfection only requires external instruments

Case II: Imperfections in International Markets

Proposition: Power over Market Prices and Resolving Imperfections

(i) If *rank* $\Phi_Q = 0$, then a global planner cannot improve on the uncoordinated equilibrium.
(ii) If *rank* $\Phi_Q \geq \dim Q$, then a global planner can generally set world prices to restore the first-best.

Intuition:
Global planner can coordinate international prices and improve functioning of price mechanism, but has no special powers to circumvent constraints on real quantities.

- Examples for (i): missing markets, incomplete markets, ...
- Examples for (ii): price stickiness, global ZLB, pecuniary externalities, ...

Case II: Example of Classic Externalities

Example of Classic Externalities (Arrow, 1969):

- set $\mathcal{I}$ of economies
- each country produces y^i at unit marginal (private) cost
- each unit also imposes externality $-\eta$ on every agent

$$U^i(y^i) = u(y^i) - y^i - \eta^i \int_{j\in\mathcal{I}} Y^j d\omega(j)$$

- introduce dim $\mathcal{I}$ international goods that capture "trade in externalities:"
  $M^j_i = Y^j$ ... exports of externalities from j to $i \neq j$
  $M^i_i = \int_{j\in\mathcal{I}\setminus\{i\}} Y^j d\omega(j)$ ... total externalities experienced by i
- market friction: $Q \equiv 0$ and trade is supply-determined

$\rightarrow$ uncoordinated equilibrium: over-production $u'\left(Y^i\right) = 1 + \eta\omega^i \; \forall i$
$\rightarrow$ global cooperation: $u'\left(Y^i\right) = 1 + \eta \; \forall i$

Case III for Cooperation: Monopolistic Policymakers

Monopolistic policymakers: internalize market power over Q

- global market clearing requires $\omega^i M^i + M^{-i}(Q) = 0$
- monopolistic planner internalizes ROW inv. demand $Q^{-i}(-\omega^i M^i)$

$$\max_{M^i} V^i(M^i, M^i) \quad \text{s.t.} \quad Q^{-i}(-\omega^i M^i) \cdot M^i \leq 0$$

- optimality condition

$$V^i_m + V^i_M = \Lambda^i Q^T \left[I - \mathcal{E}^i_{Q,M} \right] \qquad \text{where} \qquad \mathcal{E}^i_{Q,M} = \omega^i Q^{-i}_M M^i / Q^T$$

$\rightarrow$ "optimal" monopolistic intervention: $1 - \hat{\tau}^i = \dfrac{1 + V^i_M / V^i_m}{1 - \mathcal{E}^i_{Q,M}}$

Proposition: Monopolistic Policy Intervention

Monopolistic policy interventions designed to distort world prices/interest rates are inefficient.

Identifying Monopolistic Policy Intervention

Difficulty: distinguishing monopolistic behavior from correcting externalities

A negative result: any monopolistic intervention can be disguised as corrective intervention

But theory offers a few general guidelines:

- small economies in the world market have $Q^i_M = 0$
  $\rightarrow$ no market power over Q
- countries with little cross-country trade have $M^i \approx 0$
  $\rightarrow$ no welfare benefit to manipulating price
- sign of intervention $\hat{\tau}^i$ = sign of trade position $M^i_{t,k,s}$:
  - with multiple goods, tax imports and restrict exports
  - country with net inflows will restrict inflows and vice versa
  - under uncertainty, reduce insurance because each country has net long position in idiosyncratic risk

Market Power and Domestic Policy

Lemma (Market Power and Domestic Policy)

If the set of external policy instruments τ^i is

perfect:	*use only external policies τ^i to exert market power*
	never distort domestic policies X^i
imperfect:	*use combination of τ^i and X^i to exert market power*

Conclusions

International spillover effects are a natural part of the market's adjustment process in response to shocks

Scope for global cooperation is limited to:

1. dealing with imperfect external policy instruments
2. addressing imperfections in international markets
3. ensuring competitive behavior