Currency Wars or Efficient Spillovers?
A General Theory of International Policy Cooperation

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Motivation

- In a globalized world, national economic policies frequently create international spillover effects.

- Examples: quantitative easing, devaluation policies, exchange rate & capital flow management, fiscal policy, etc.

  → concerns about “global currency wars”
  → repeated demands for greater global cooperation

BUT: premise for successful cooperation = Pareto inefficiency
Main Questions

- When are spillovers from national economic policies inefficient?
- If they are, how can cooperation improve welfare?
Key Considerations

- multi-country model of international linkages
- optimizing private agents and national policymaker
- compare national and global optimum

→ our framework nests a wide range of open economy macro models
Main Contribution 1: Inefficient Spillovers arise from three categories of problems:

1. monopoly power
2. imperfect *external* policy instruments
3. international market imperfections

→ focus policy cooperation on areas where it can bear fruit

Main Contribution 2: If these problems are absent/addressed, the global allocation is Pareto efficient

→ no further scope for global cooperation
Main Contribution 3: Provide guidelines for cooperation

Address Three Areas of Inefficiency:

1. ensure competitive behavior
2. deal with incomplete/imperfect policy instruments
   - create new/better instruments
   - use existing instruments more efficiently
3. address imperfections in international markets
   - correct market imperfections
   - use existing markets more efficiently

All successful policy cooperation can be mapped into these areas
Literature on policy cooperation:

- **Monopolistic behavior:** Adam Smith (1776), ..., Bagwell and Staiger (1999, 2001, etc.), ..., Costinot et al. (2013), ...

- **Imperfect external instruments:** Tinbergen (1952), Theil (1954), ...

- **International market imperfections:** Arrow, Debreu, ..., Geanakoplos and Polemarchakis (1986), Greenwald and Stiglitz (1986), ..., Farhi and Werning (2016), ...
Example I of Spillovers

Real spillovers

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

\[
\max U_i = u(c_0^i) + u(c_1^i) \\
c_0^i = y_0^i + m_0^i \\
c_1^i = y_1^i + m_1^i \\
m_0^i + m_1^i / R \leq 0
\]

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

\[
\max_{m^i} V(m^i) = u(y_0^i + m_0^i) + u(y_1^i + m_1^i) \quad \text{st.} \quad Q \cdot m^i \leq 0
\]

Real shock: consider an increase in endowment \( dy_0^i > 0 \),

\[
\frac{dm^i}{dy_0^i} \bigg|_R = \begin{pmatrix} -s \\ Rs \end{pmatrix} \quad \text{where} \quad s = \frac{1}{1 + R^{\theta-1}}
\]

Spillovers: smaller \( t = 0 \) and greater \( t = 1 \) inflows/imports.
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  m_0^i + m_1^i / R \leq 0
  \]

- in vector notation: define $m^i = (m_0^i, m_1^i)^T$, $Q = (1, 1/R)$, etc.
  \[
  \max_{m^i} V \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 \leq 0
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Real shock: consider an increase in endowment \( dy^i_0 > 0 \),

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\]

Spillovers: smaller \( t = 0 \) and greater \( t = 1 \) inflows/imports
Spillovers of current account (CA) intervention

- simple rationale for CA intervention: learning-by-exporting
- extend Example I by assuming \( y_i' = y_i'(-M_i^0) \) with \( y_i''(-M_i^0) > 0 \)
  (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

\[
\tau_0^i = y_i'' \cdot \frac{u'(c_i^1)}{u'(c_0^i)}
\]

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

\[
\frac{d m_i^i}{d \tau_0^i} \bigg|_Q = \begin{pmatrix} -s \\ R s \end{pmatrix}
\]

where

\[
s = \frac{y_0^i + y_1^i / R}{(2 - \tau_0^i)^2}
\]
Example III of Spillovers

Spillovers of export stimulus policy at the ZLB:

- consider zero lower bound on the nominal interest rate:
  \[ \nu_1 \geq 0 \]

- 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

- if world interest rate high enough: \( (1 + \pi_1^i) R - 1 > 0 \) → no problem

- if world interest rate too low: \( (1 + \pi_1^i) R - 1 = 0 \) → imports \( M_0^i \) eat into domestic aggregate demand

Optimal policy: CA intervention to increase net exports
Spillovers: greater CA deficit in other countries
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Spillovers of macroprudential policy or capital controls following Jeanne and Korinek (AERPP 2010)

- consider a three period economy with a representative agent

\[ U^i = u(c^i_0) + u(c^i_1) + c^i_2 \]

- each agent owns a tree that trades at date 1 price \( q \)
  - tree generates borrowing capacity

\[ m^i_2 + \phi p^i (M^i_1) \geq 0 \]

→ price-dependent financial constraint

Optimal policy: imposing macroprudential policy in period 0

Spillovers: lower borrowing in period 0, more borrowing (smaller CA reversal) in period 1
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Example IV 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)

Spillover: reduced opportunities to trade for other countries
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Generalized Model Setup

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

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

- $x^i, X^i$ ... 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 $m^i, M^i$
- $\tau^i$ ... full set of tax instruments on intl transactions rebated via $T^i$
Example: Canonical open economy macro models:

$$\max_{(c^i_t, b^i_{t+1})} \sum_t \beta^t u(c^i_t) \quad \text{s.t.} \quad c^i_t + (1 - \xi^i_t)b^i_{t+1}/R_{t+1} = y^i_t + b^i_t$$

Mapping:

1. define net imports $m^i_t = c^i_t - y^i_t = b^i_t - b^i_{t+1}/R_{t+1}$
2. domestic variables $x^i = \{c^i_t\}$
   - world market prices $Q_t = 1/\Pi_{s=0}^t R_{s+1}$
   - external policy instruments $(1 - \tau^i_t) = 1/\Pi_{s=1}^t (1 - \xi^i_{s+1})$

$$\rightarrow \text{utility} \quad U^i(x^i) = \sum_t \beta^t u(c^i_t)$$
$$\rightarrow \text{constraints} \quad f^i_t(\cdot) = c^i_t - y^i_t - m^i_t \leq 0 \ \forall t$$
Further Examples:

- multiple traded goods and states: \( m^i = (m^i_{t,k,s}) \) with \( k = 1 \ldots K \), \( s \in S \)
- 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 \( \rightarrow \) capture in \( U^i(x^i) \)

\( \rightarrow \) framework nests a wide range of open economy macro models
Efficient Benchmark

Impose three conditions sufficient to obtain efficient benchmark:

1. policymakers do not have (do not exert) market power
2. policymakers have complete set of external instruments
3. international market is complete
Solution Step 1

Separability

Given the complete external policy instruments, we can separate the domestic and international optimization problems.

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

- representative agent optimizes
- domestic policymaker optimizes

\[ \rightarrow \text{ defines reduced-form utility function } V^i(m^i, M^i) \]

Example: \[ V^i(m^i, M^i) = \sum_t \beta^t u(y^i_t + m^i_t) \]
Solution Step 1 – Details

**Step 1**: formal problems *for given external* \((m^i, M^i)\)

- representative agent: takes \(X^i\) as given:

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

\[\rightarrow \quad \text{FOC}(x^i) : \quad U_x^i = \lambda f_x^i \quad \rightarrow \quad \text{obtain (IC)}\]

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

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

\[\rightarrow \quad \text{obtain optimal domestic } X^i(M^i)\]

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

\[
V^i(m^i, M^i) = v^i(m^i, M^i, X^i(M^i))
\]
**Step 2: determine optimal external allocations $M^i$ in country $i$:**

- planner solves for optimal external allocation $M^i$,

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

- while internalizing any externalities from flows

→ determines global competitive equilibrium
Solution Step 2 – Details

**Step 2:** optimal 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

Global Competitive Equilibrium: feasible allocations \((X^i, M^i)\), external policies \((\tau^i)\) 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 \(X^i, \tau^i\) taking \(Q\) as given
- global markets for \(M\) clear: \(\int_{i \in \mathcal{I}} M^i d\omega(i) = 0\)

Key Question

Is the Nash 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 \( Q = \nu \) and \( \Lambda^i_e = 1/\phi^i \), then the optimality conditions of all national planners \( V^i_m + V^i_M = \Lambda^i_e Q \) are satisfied

\( \rightarrow \) Nash equilibrium among national planner is Pareto efficient
Global Planning Problem

1st FWT for National Economic Policymaking

The Nash equilibrium among national planners is Pareto efficient.

Note:

- policy interventions \((X^i, \tau^i)\) entail spillover effects
- BUT: spillover effects are mediated through global prices \(Q\)
  - first welfare theorem applies at the level of planners
  - 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
- anything goes in the domestic economy
Scope of Results and Robustness

Efficiency result applies to all our earlier examples

Robustness: result holds under all discussed extensions:

- labor, capital, multiple goods, uncertainty, ...
- any domestic market imperfections
- heterogeneous agents, political preferences, ...

→ all these affect optimal level but not efficiency of intervention

Sufficient Conditions for Efficiency:

1. domestic planners are competitive (price-takers)
2. planners have sufficient external instruments to set $M^i$
3. no international market imperfections
Pareto Improvements

When can we obtain Pareto improvements (rather than just Pareto efficiency)?
→ generally requires global coordination

Two possible avenues:

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

Example:

- $N$ identical countries except different sizes $\omega^i$
- assume exogenous increase in externalities calling for $d\tau^i > 0$
- world prices remain constant if countries set

$$d\tilde{\tau}^i = (1 - \omega^i)d\tau^i$$

$$d\tilde{\tau}^i = \omega^id\tau^i$$

→ optimal mix of inflow/outflow restrictions
Unilateral Intervention

Currency Wars or Efficient Spillovers?

Anton Korinek (JHU and NBER)
Coordinated Intervention to Hold World Prices Constant
Arms Race of Intervention:

- assume externalities $V_i^M$ are increasing in flow of imports $M_i$
- shock in one country’s may lead to greater intervention $\tau^i$
- this diverts flows to other countries
- other countries experience larger externalities, also increase intervention
- this may in turn prompt initial country to raise $\tau^i$ further, etc.

→ this may be the efficient process of equilibrium adjustment (tatonnement)
→ “arms race” not necessarily a sign of inefficiency
Case I 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

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

→ “optimal” monopolistic intervention: $1 - \hat{\tau}^i = \frac{1 + V^i_M / V^i_m}{1 - \mathcal{E}^i_{Q,M}}$

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**Proposition: Monopolistic Policy Intervention**

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

**Difficulty:** How do we distinguish monopolistic behavior from correcting externalities?

**Theory offers a few guidelines:**

- small economies in the world market have $Q_i^M = 0$ → no market power over $Q$
- countries with little cross-country trade have $M_i^t \approx 0$ → no welfare benefit to manipulating price so $\mathcal{E}_{Q,M}^i \approx 0$
- sign of intervention $\hat{\tau}_i = \text{sign of trade position } M_{t,k,s}^i$
  - country with net inflows will restrict inflows and vice versa
  - with multiple goods, tax imports and restrict exports
  - under uncertainty, reduce insurance because each country has net long position in idiosyncratic risk
If external policy instruments $\tau^i$ complete, a planner will never distort domestic policies $X^i$ to exert market power.

If external policy instruments imperfect, then domestic policies will also be distorted to exert market power.
Example: Market Power and Domestic Policies

Optimal ‘monopolistic’ allocation when \( \tau^i \equiv 0 \):

- assume no external policy instruments available at all \( \tau^i \equiv 0 \)

\[ \rightarrow \text{second-best: internalize indirect effect of domestic policy on } (m^i, M^i) \]

- domestic planner:

\[
\max_{X^i} U^i(X^i) \quad \text{s.t.} \quad (IC), \ x^i = X^i, \ f^i(M^i, M^i, X^i, X^i) \leq 0 \\
Q^{-i}(-M^i) \cdot M^i \leq 0 \\
\rightarrow \text{obtain optimal } \tilde{X}^i(M^i) \\
\]

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

\[
\tilde{V}^i(m^i, M^i) = v^i(m^i, M^i, \tilde{X}^i(M^i))
\]
Case II: Imperfect External Policy Instruments

Baseline model:
- complete set of external instruments \((\tau^i)\)
- allowed planner to implement desired external allocation (critical for argument of the first welfare theorem)

Imperfect Policy Instruments:
- can be captured by a convex cost function \(C^i(\tau^i) \geq 0\)
- interpretations:
  - costly instruments, e.g. \(C^i(\tau^i) = \gamma^i \sum (\tau^i_t)^2 / 2\)
  - missing instruments if \(\gamma^i \rightarrow \infty\)
  - coarse instruments, e.g. \(C^i(\tau^i) = \gamma^i \sum (\tau^i_{t,s} - \tau^i_{t,0})^2 / 2\) with \(\gamma^i \rightarrow \infty\)
- note: even imperfect set of instruments 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 equilibrium among national planners is generically inefficient if at least one country has effectively imperfect instruments.

- Constrained efficiency under imperfect policy instruments requires

\[ \sum \omega_i C_i''(\tau_i)(1 - \tau_i) = 0 \]

Intuition:

- setting average marginal distortion to zero minimizes total implementation costs

- if this is violated then there is generally scope for regulation
Example 1 of Imperfect Policy Instruments

Example of Wasteful Competitive Intervention:

- consider $N$ identical countries with externalities $V^i_M < 0$
- each country intervenes $\tau^i > 0$ at cost $C^i(\tau^i) > 0$
  - intervention is completely wasteful: same allocation but lower cost with $\tau^i = 0 \forall i$
Example of Sharing the Regulatory Burden:

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

\[
d\bar{\tau}^A = \frac{\gamma^B}{\gamma^A + \gamma^B} \cdot d\eta \quad \text{and} \quad d\bar{\tau}^B = -\frac{\gamma^A}{\gamma^A + \gamma^B} \cdot d\eta
\]

- extreme cases: $\gamma^B = 0$ or $\gamma^A \to \infty$
Further Results on Imperfect Policy Instruments

If set of *external* policy instruments effectively imperfect, it is optimal to distort *domestic* policies to target external transactions

→ global coordination needs to also involve domestic policies
Case III: Imperfections in International Markets

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

Formal description:

\[ \phi \left( \left( M^i \right)_{i=1}^N, Q \right) \leq 0 \]
Case III: Imperfections in International Markets

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

Formal description:
\[
\Phi \left( (M^i)^{N}_{i=1} , Q \right) \leq 0
\]
Lemma: Use of External Instruments under Imperfect Markets

Cooperation under imperfect intl markets is limited to external policy instruments, provided that the set of such instruments is complete.

Intuition:
Separability results continue to hold

- Fixing international imperfection only requires external instruments
- Otherwise: generally need to coordinate on domestic instruments as well
Conclusions

Intl. policy cooperation indispensable in three problem areas:

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

→ Any remaining spillover effects are efficient