Comparative Advantage and Optimal Trade Taxes

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Motivation

- Two central questions...

  1. *Why do nations trade?*
  2. *How should they conduct trade policy?*

- Theory of comparative advantage
  - ➔ Influential answer to #1
  - ➔ Virtually no impact on #2

This Paper

- Take canonical Ricardian model
  - simplest and oldest theory of CA
  - new workhorse model for theoretical and quantitative work
- Explore relationship...

CA ⟷ Optimal Trade Taxes

Main Result

- Optimal trade taxes:
  1. uniform across imported goods
  2. monotone in CA across exported goods

Main Result

- Examples:

zero import tariff	+	export taxes increasing in CA
Positive import tariff	+	export subsidies decreasing in CA

Simple Economics

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- More room to manipulate prices in comparative advantage sectors

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- New perspective on targeted industrial policy

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  - larger subsidies for less competitive sectors not from desire to *expand* output ...

Simple Economics

- More room to manipulate prices in comparative advantage sectors
- New perspective on targeted industrial policy
    - larger subsidies for less competitive sectors not from desire to *expand* output ...
    - ... but greater constraints to *contract* exports to exploit monopoly power

Two Applications

- Agriculture and Manufacturing examples
  - GT under optimal trade taxes are 20% and 33% larger than under no taxes
  - GT under under optimal uniform tariff are only 9% larger than under no taxes

→ Micro-level heterogeneity matters for design and gains from optimal trade policy

Related Literature

- Optimal Taxes in an Open Economy:
  - General results: Dixit (85), Bond (90)
  - Ricardo: Itoh Kiyono (87), Opp (09)
- Lagrangian Methods:
  - Lagrangian methods in infinite dimensional space: AWA (06), Amador Bagwell (13)
  - Cell-problems: Everett (63), CLW (13)

Roadmap

- Basic Environment
- Optimal Allocation
- Optimal Trade Taxes
- Applications

Basic Environment

A Ricardian Economy

- Two countries: Home and Foreign
  - Labor endowments: L and L^*
  - CES utility over continuum of goods:

$$U \equiv \int_i u_i(c_i)di$$

$$u_i(c_i) \equiv \beta_i \left(c_i^{1-1/\sigma} - 1\right) \Big/ (1 - 1/\sigma)$$

  - Constant unit labor requirements: a_i and a_i^*
- Home sets trade taxes $t \equiv (t_i)$ and lump-sum transfer T
- Foreign is passive

Competitive Equilibrium

Competitive Equilibrium

$$c \in \operatorname{argmax}_{\tilde{c} \geq 0} \left\{ \int_i u_i(\tilde{c}_i) di \middle| \int_i p_i \left(1 + t_i\right) \tilde{c}_i di \leq wL + T \right\}$$

Competitive Equilibrium

$$c \in \operatorname{argmax}_{\tilde{c} \geq 0} \left\{ \int_i u_i(\tilde{c}_i) di \middle| \int_i p_i \left(1 + t_i\right) \tilde{c}_i di \leq wL + T \right\}$$

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$$T = \int_i p_i t_i \left(c_i - q_i\right) di$$

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Government Problem

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Government Problem

$$\max_{t,T,w,w^*,p,c,c^*,q,q^*} U(c)$$

s.t.

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Optimal Allocation

Let us Relax

- Primal approach (Baldwin 48, Dixit 85):

→ No taxes, no competitive markets at home

→ Domestic government directly controls domestic consumption, c, and output, q

Planning Problem

$$\max_{t,T,w,w^*,p,c,c^*,q,q^*} U(c)$$

s.t.

$$c \in \text{argmax}_{\tilde{c}\geq 0}\left\{\int_i u_i(\tilde{c}_i)di \middle| \int_i p_i\left(1+t_i\right)\tilde{c}_i di \leq wL+T\right\}$$

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Planning Problem

$$\max_{w^*, p, c, c^*, q, q^*} \quad U(c)$$

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Planning Problem

- Convenient to focus on 3 key controls:

$$q, m = c - q, w^*$$

- Equilibrium abroad requires...

$$p_i\left(m_i, w^*\right) \equiv \min\left\{u_i^{*\prime}\left(-m_i\right), w^* a_i^*\right\},$$

$$q_i^*\left(m_i, w^*\right) \equiv \max\left\{m_i + d_i^*(w^* a_i^*), 0\right\}$$

Planning Problem

$$\max_{w^*, p, c, c^*, q, q^*} \quad U(c)$$

s.t.

$$c^* \in \operatorname{argmax}_{\tilde{c} \geq 0} \left\{ \int_i u_i^*(\tilde{c}_i) di \middle| \int_i p_i \tilde{c}_i di \leq w^* L^* \right\}$$

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$$\max_{w^*, p, c, c^*, q, q^*} U(c)$$

s.t.

$$\int_i a_i q_i di \leq L,$$

Planning Problem

$$\max_{w^*, p, c, c^*, q, q^*} \quad U(c)$$

s.t.

$$\int_i a_i q_i di \leq L,$$

$$\int_i a_i^* q_i^* (m_i, w^*) \, di \leq L^*,$$

Planning Problem

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s.t.

$$\int_i a_i q_i di \leq L,$$

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Planning Problem

$$\max_{w^*, m, q} \quad U(m+q)$$

s.t.

$$\int_i a_i q_i di \leq L,$$

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Three Steps

1. Decompose
   (i) inner problem m, q
   (ii) outer problem w^*
2. Concavity of inner problem
   → Lagrangian Theorems (Luenberger 69)
3. Additive separability implies... (Everett 63)
   one infinite-dimensional problem
   → many low-dimensional problems

Inner Problem

$$\max_{w^*, m, q} \quad U(m+q)$$

s.t.

$$\int_i a_i q_i di \leq L,$$

$$\int_i a_i^* q_i^* \left(m_i, w^*\right) di \leq L^*,$$

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Inner Problem

$$\max_{m,q} \quad U(m+q)$$

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Lagrangian

$$\mathcal{L}\left(m, q, \lambda, \lambda^{*}, \mu; w^{*}\right) \equiv \int \mathcal{L}_i\left(m_i, q_i, \lambda, \lambda^{*}, \mu; w^{*}\right) di$$

$$\begin{aligned}\mathcal{L}_i\left(m_i, q_i, \lambda, \lambda^{*}, \mu; w^{*}\right) \equiv\ & u_i\left(q_i + m_i\right) - \lambda a_i q_i \\ & -\lambda^{*} a_i^{*} q_i^{*}\left(m_i, w^{*}\right) - \mu p_i(m_i, w^{*}) m_i\end{aligned}$$

Lagrangian Theorem

- (m^0, q^0) solves inner problem iff

$$\max_{m,q} \; \mathcal{L}\left(m, q, \lambda, \lambda^*, \mu; w^*\right)$$

for some $(\lambda, \lambda^*, \mu)$ and

$$\lambda \geq 0, \; \int_i a_i q_i^0 di \leq L, \text{ with complementary slackness,}$$

$$\lambda^* \geq 0, \; \int_i a_i^* q_i^* \left(m_i^0, w^*\right) di \leq L^*, \text{ with complementary slackness,}$$

$$\mu \geq 0, \; \int_i p_i(m_i, w^*) m_i^0 di \leq 0, \text{ with complementary slackness.}$$

Cell Structure

- (m^0, q^0) solves inner problem iff (m_i^0, q_i^0) solves

$$\max_{m_i, q_i} \mathcal{L}_i\left(m_i, q_i, \lambda, \lambda^*, \mu; w^*\right)$$

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$$\lambda \geq 0, \int_i a_i q_i^0 di \leq L, \text{ with complementary slackness,}$$

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High-School Math: Optimal Output

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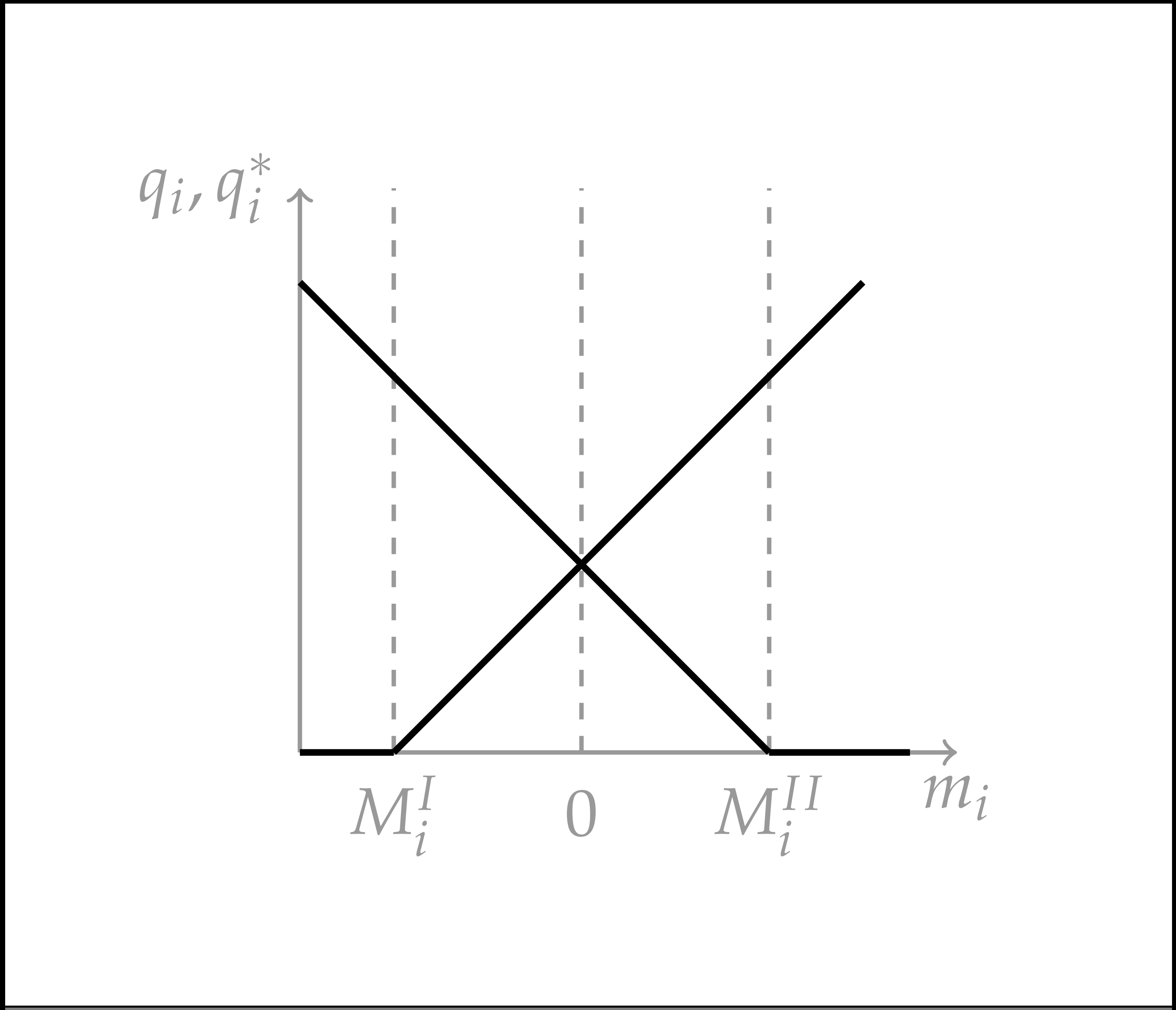

High-School Math: Optimal Net Imports

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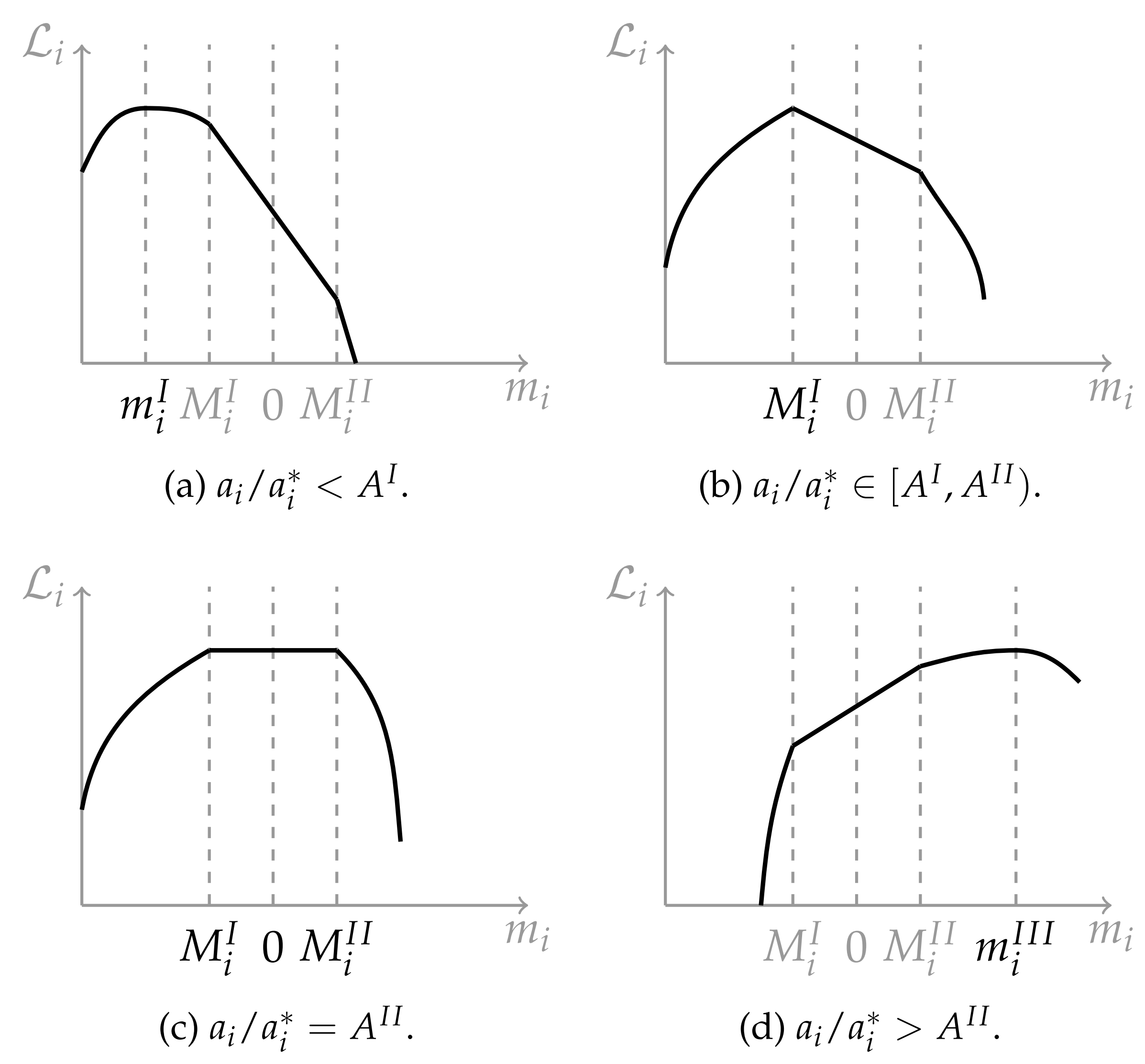


Optimal Trade Taxes

Wedges

- Wedges at planning problem's solution:

$$\tau_i^0 \equiv \frac{u_i'\left(c_i^0\right)}{p_i^0} - 1$$

- Previous analysis implies:

$$\tau_i^0 = \begin{cases} \frac{\sigma^*-1}{\sigma^*}\mu^0 - 1, & \text{if } \frac{a_i}{a_i^*} < A^I \equiv \frac{\sigma^*-1}{\sigma^*}\frac{\mu^0 w^{0*}}{\lambda^0}; \\ \frac{\lambda^0 a_i}{w^{0*} a_i^*} - 1, & \text{if } A^I < \frac{a_i}{a_i^*} \leq A^{II} \equiv \frac{\mu^0 w^{0*} + \lambda^{0*}}{\lambda^0}; \\ \frac{\lambda^{0*}}{w^{0*}} + \mu^0 - 1, & \text{if } \frac{a_i}{a_i^*} > A^{II}. \end{cases}$$

Optimal Trade Taxes

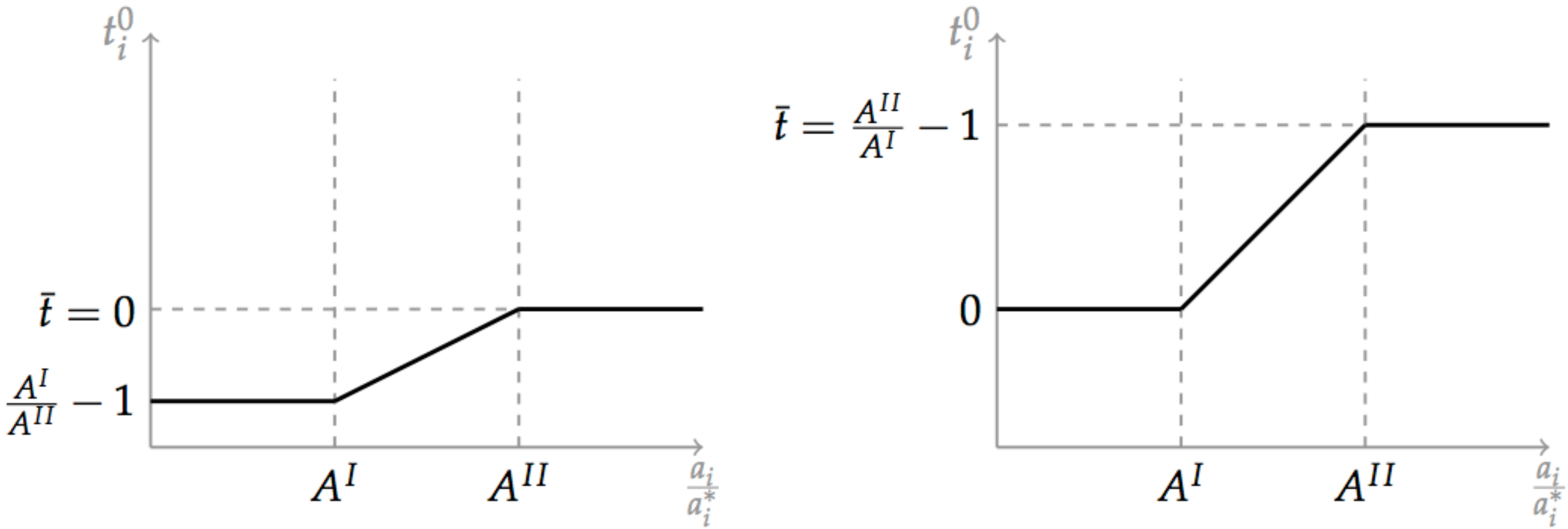
- Any solution to Home's planning problem can be implemented by $t^0 = \tau^0$

- Conversely, if t^0 solves the domestic's government problem, then the associated allocation and prices must solve Home’s planning problem and satisfy:

$$t_i^0 = \frac{u_i'\left(c_i^0\right)}{\theta p_i^0} - 1 \qquad \left(1 + t_i^0 = \frac{1 + \tau_i^0}{\theta}\right)$$

Optimal Trade Taxes

Optimal Trade Taxes



(a) Export taxes

(b) Export subsidies and import tariffs

Intuition

- When $a_i/a_i^* < A^I$, Home has incentives to charge *constant monopoly markup*
- When $a_i/a_i^* \in [A^I, A^{II}]$, there is *limit pricing*: foreign firms are exactly indifferent between producing and not producing those goods
- When $a_i/a_i^* > A^{II}$, *uniform tariff* is optimal: Home cannot manipulate relative prices

Industrial Policy Revisited

Industrial Policy Revisited

- At the optimal policy, governments protects a subset of less competitive industries
  - but targeted/non-uniform subsidies do not stem from a greater desire to *expand* production...
  - ... they reflect tighter constraints on ability to exploit monopoly power by *contracting* exports

Industrial Policy Revisited

- At the optimal policy, governments protects a subset of less competitive industries
  - but targeted/non-uniform subsidies do not stem from a greater desire to *expand* production...
  - ... they reflect tighter constraints on ability to exploit monopoly power by *contracting* exports
- Countries have more room to manipulate world prices in their comparative-advantage sectors

Robustness

- Similar qualitative results hold in more general environments:
  - Iceberg trade costs
  - Separable, but non-CES utility
- Additional considerations:
  - Trade costs imply that zero imports are optimal for some goods at solution of Home's planning problem
  - Non-CES utility leads to variable markups for goods with strongest CA

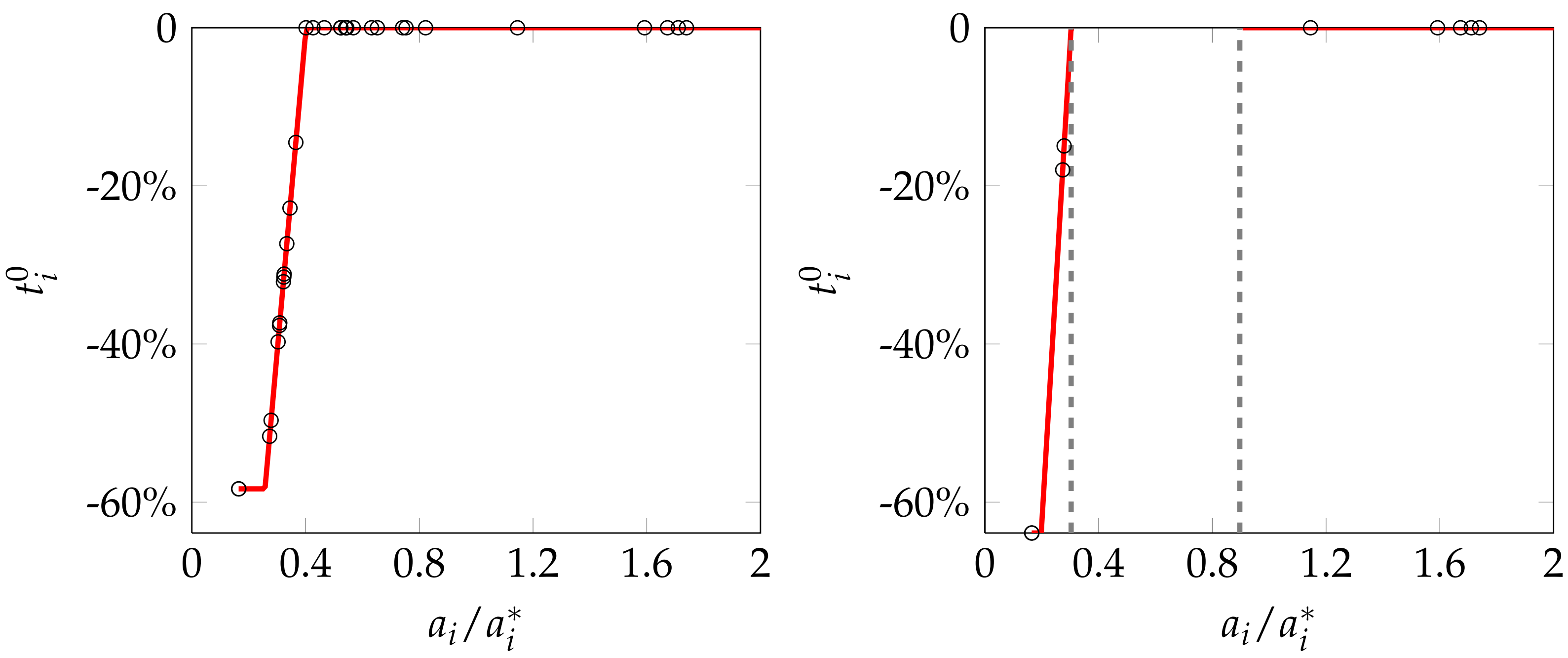
Applications

Agricultural Example

- Home = U.S.   Foreign = R.O.W.
- Each good corresponds to 1 of 39 crops
- Land is the only factor of production
  - Productivity from FAO's GAEZ project
  - Land endowments match acreage devoted to 39 crops in U.S. and R.O.W.
- Symmetric CES utility with σ=2.9 as in BW (06)

Optimal Trade Taxes

Optimal Trade Taxes



Gains from Trade

Gains from Trade

	No Trade Costs		Trade Costs	
	U.S.	R.O.W.	U.S.	R.O.W.
Laissez-Faire	39.15%	3.02%	5.02%	0.25%
Uniform Tariff	42.60%	1.41%	5.44%	0.16%
Optimal Taxes	46.92%	0.12%	5.71%	0.04%

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Manufacturing Example

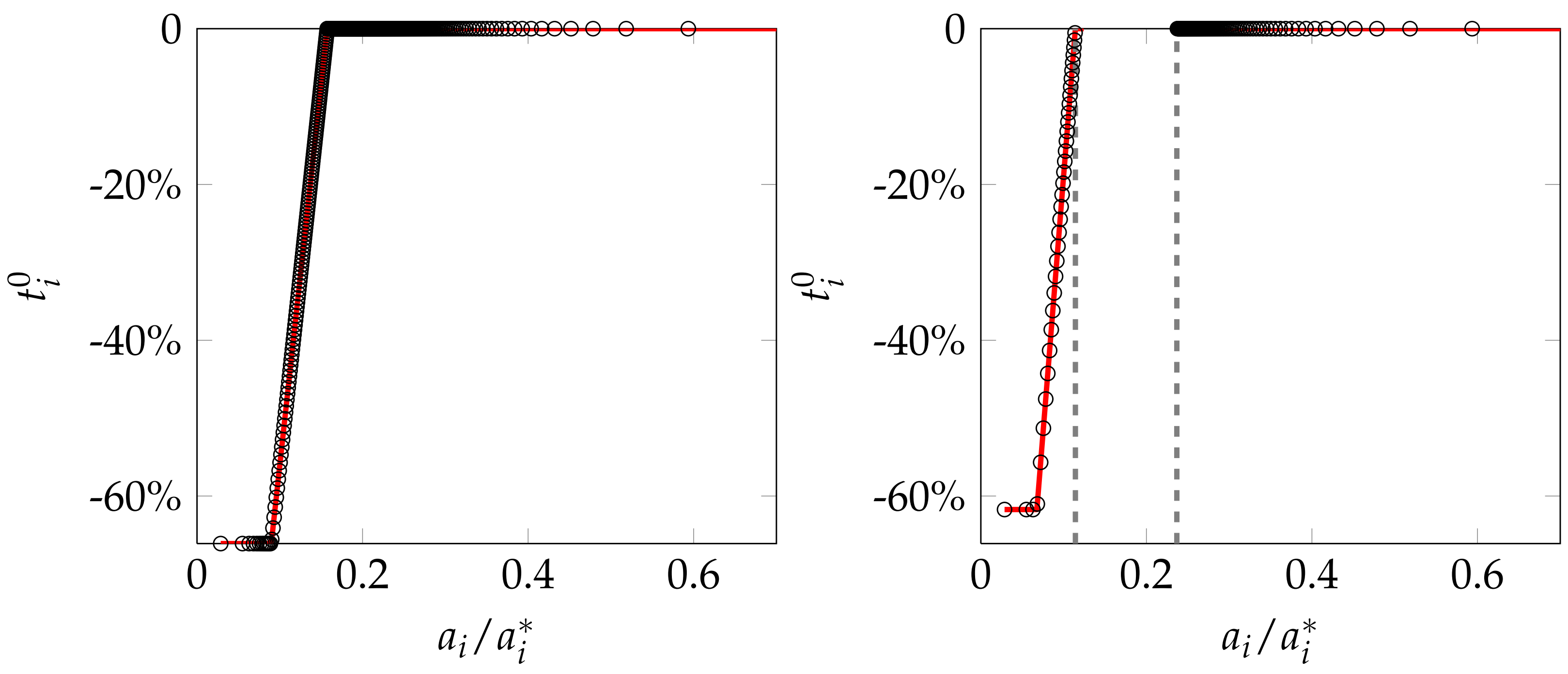
- Home=U.S. and Foreign=R.O.W.
- 400 goods. Labor is the only factor of production
  - Labor endowments set to match population in U.S. and R.O.W
- Productivity is distributed Fréchet:

$$a_i = \left(\frac{i}{T}\right)^{\frac{1}{\theta}} \qquad \text{and} \qquad a_i^* = \left(\frac{1-i}{T*}\right)^{\frac{1}{\theta}}$$

  - θ=5 set to match average trade elasticity in HM (13).
  - T and T* set to match U.S. share of world GDP.
- Symmetric CES utility with σ=2.5 as in BW (06)

Optimal Trade Taxes

Optimal Trade Taxes



Gains from Trade

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Laissez-Faire	27.70%	6.59%	6.18%	2.02%
Uniform Tariff	30.09%	4.87%	7.31%	1.31%
Optimal Taxes	36.85%	0.93%	9.21%	0.36%

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Concluding Remarks

- First stab at how CA affects optimal trade policy
- Simple economics: countries have more room to manipulate prices in their CA sectors
- New perspective on targeted industrial policy
  - Larger subsidies are not about desire to expand, but constraint on ability to contract

Concluding Remarks

- More applications of our techniques
  → $\neq$ market structures
  (e.g. BEJK, 2003; Melitz, 2003)
- Results suggest design and gains from trade policy depends on micro-level heterogeneity