COMPARATIVE ADVANTAGE AND OPTIMAL TRADE POLICY

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1　引言

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- Arnaud Costinot
- CV
- Publications
- Papers

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- ***Nonparametric Counterfactual Predictions** in Neoclassical Models of **International Trade***
- *Evolving **Comparative Advantage** and the Impact of Climate Change in Agricultural Markets: Evidence from 1.7 Million Fields Around the World*
- *What Goods Do Countries Trade? A Quantitative Exploration of **Ricardo's Ideas***
- *New Trade Models, Same Old **Gains**?*
- *On the Origins of **Comparative Advantage***

- **Two Questions in International Economics:**

✓Why do nations trade? The theory of comparative advantage

?

☐How should a nation conduct its trade policy?

- **Comparative Advantage & Optimal Trade Policy**

- **Environment:**

a canonical Ricardian model of trade

- **Approach：**

Lagrange multiplier methods

Infinite constrained, dimensional——simple unconstrained, low dimensional

Non-CES utility & arbitrary neoclassical production functions

➢Apply to quantitative work : Two separate exercises

- **Main Result:**

Optimal trade taxes: should be uniform across imported goods and weakly monotone with respect to comparative advantage across exported goods

- **Two Distinct Contributions**

2　基础假设

基础设定

- 两个国家：外国（*），本国
- 一个要素：劳动
- 李嘉图模型
- CES效用函数

$$U(c) \equiv \int_i u_i(c_i)di \qquad u_i(c_i) \equiv \frac{\beta_i(c_i^{1-\frac{1}{\sigma}}-1)}{1-\frac{1}{\sigma}} \qquad \text{其中} \int_i \beta_i di = 1$$

- 对税收t_i的衡量：

$t_i \geq 0$ 代表进口税或出口补贴

$t_i \leq 0$ 代表出口税或进口补贴

- 总税收T将全部返还给国内消费者

国内市场

(1) $$c \in \text{argmax}_{\tilde{c} \geq 0} \left\{ \int_i u_i(\tilde{c}_i) di \middle| \int_i p_i (1 + t_i) \tilde{c}_i di \leq wL + T \right\}$$ ——国内消费者效用最大化

(2) $$q_i \in \text{argmax}_{\tilde{q}_i \geq 0} \{ p_i (1 + t_i) \tilde{q}_i - w a_i \tilde{q}_i \}$$ ——国内企业利润最大化

(3) $$T = \int_i p_i t_i (c_i - q_i) di$$ ——国内政府支出平衡

(4) $$L = \int_i a_i q_i di$$ ——本国劳动力市场出清

现有的变量： $t, T, w, w^*, p, c, c^*, q, q^*$

(5) $$c^* \in \text{argmax}_{\tilde{c}\geq 0}\left\{\int_{\mathrm{i}} u_i^*(\tilde{c}_i)di \,\middle|\, \int_i p_i\tilde{c}_i di \leq w^* L^*\right\}$$ ——外国消费者效用最大化

(6) $$q_i^* \in \text{argmax}_{\tilde{q}_i\geq 0}\{p_i\tilde{q}_i - w^* a_i^* \tilde{q}_i\}$$ ——外国企业利润最大化

(7) $$L^* = \int_i a_i^* q_i^* di$$ ——外国劳动力市场出清

(8) $$c_i + c_i^* = q_i + q_i^*$$ ——世界范围内商品出清

现有的变量: $t, T, w, w^*, p, c, c^*, q, q^*$

现有的变量: $t, T, w, w^*, p, c, c^*, q, q^*$

$$T = \int_i p_i t_i (c_i - q_i) di \qquad (3)$$

现有的变量: $t, \cancel{T}, w, w^*, p, c, c^*, q, q^*$

3　国内最优化

现有的变量： $\cancel{t}, \cancel{T}, \cancel{w}, w^*, p, c, c^*, q, q^*$

- 一个全知全能的政府，直接安排好本国的生产、消费
- 不依靠市场的力量，没有税收t、工资w

Definition 3. Home's planning problem is:

$$\max_{w^*\geq 0, p\geq 0, c\geq 0, c^*, q\geq 0, q^*} \quad U(c) \equiv \int_i u_i(c_i)di$$

s.t. (5) $\quad c^* \in \text{argmax}_{\tilde{c}\geq 0}\left\{\int_{\text{i}} u_i^*(\tilde{c}_i)di \middle| \int_i p_i\tilde{c}_i di \leq w^* L^*\right\}$

(6) $\quad q_i^* \in \text{argmax}_{\tilde{q}_i\geq 0}\{p_i\tilde{q}_i - w^* a_i^*\tilde{q}_i\}$

(7) $\quad L^* = \int_i a_i^* q_i^* di$

(8) $\quad c_i + c_i^* = q_i + q_i^*$

(9) $\quad \int_i a_i q_i di \leq L$ ——放松本国劳动力市场出清的条件

现有的的变量： $w^{0*}, p^{0}, c^{0}, c^{0*}, q^{0}, q^{0*}$

- $m \equiv c - q$ 本国进口或外国出口
- 外国需求函数 $d_i^*(\cdot) \equiv u_i^{*\prime -1}(\cdot)$
- 如果该种商品是本国生产的，则让外国生产的成本无穷大

$$u_i^{*\prime}(-m_i) \equiv \infty \text{ if } m_i \geq 0$$

现有的的变量： $w^{0*}, p^0, c^0, c^{0*}, q^0, q^{0*}$

$m_i \geq 0$ ⇨ 外国生产该种产品

$$p_i = p_i(m_i, w^*) \equiv w^* a_i^*$$

$$c_i^* = c_i^*(m_i, w^*) \equiv d_i^*(w^* a_i^*)$$

$$q_i^* = q_i^*(m_i, w^*) \equiv m_i + d_i^*(w^* a_i^*)$$

$m_i \leq 0$ ⇨ 本国生产该种产品

$$p_i = p_i(m_i, w^*) \equiv u_i^{*\prime}(-m_i)$$

$$c_i^* = c_i^*(m_i, w^*) \equiv -m_i$$

$$q_i^* = q_i^*(m_i, w^*) \equiv 0$$

LEMMA 2. Suppose that $(w^{0*}, p^0, c^0, c^{0*}, q^0, q^{0*})$ solves Home's planning problem. Then $(w^{0*}, m^0 = c^0 - q^0, q^0)$ solves

$$(P) \qquad \max_{w^* \geq 0, m, q \geq 0} \int_i u_i(q_i + m_i) di$$

s.t.

$$(15) \quad \int_i a_i q_i di \leq L \qquad \text{本国资源禀赋限制}$$

$$(16) \quad \int_i a_i^* q_i^*(m_i, w^*) di \leq L^* \qquad \text{外国资源禀赋限制}$$

$$(17) \quad \int_i p_i(m_i, w^*) m_i di \leq 0 \qquad \text{本国贸易盈余}$$

现有的的变量：$w^{0*}, \sout{m^0 = c^0 - q^0}, \sout{q^0}$

- 先将w^*视为给定

$$(P_{w^*}) \qquad V(w^*) \equiv \max_{m,q\geq 0} \int_i u_i(q_i + m_i)di$$

$$\text{s.t.} \quad (15) \int_i a_i q_i di \leq L \qquad \text{本国资源禀赋限制}$$

$$(16) \int_i a_i^* q_i^*(m_i, w^*)di \leq L^* \qquad \text{外国资源禀赋限制}$$

$$(17) \int_i p_i(m_i, w^*)m_i di \leq 0 \qquad \text{本国贸易盈余}$$

- 再将w^*视为变量

$$\max_{w^* \in \mathcal{W}^*} V(w^*)$$

现有的的变量：w^{0*}

- 拉格朗日方法优化！优化！优化！

$$(P_{w*}) \qquad V(w^*) \equiv \max_{m,q\geq 0} \int_i u_i(q_i + m_i)di$$

$$\text{s.t.} \quad (15) \int_i a_i q_i di \leq L$$

$$(16) \int_i a_i^* q_i^*(m_i, w^*)di \leq L^*$$

$$(17) \int_i p_i(m_i, w^*)m_i di \leq 0$$

$$\mathcal{L}(m, q, \lambda, \lambda^*, \mu; w^*) \equiv \int_i u_i(q_i + m_i)di - \lambda \int_i a_i q_i di - \lambda^* \int_i a_i^* q_i^*(m_i, w^*)di - \mu \int_i p_i(m_i, w^*)m_i di$$

⇩ 可加可分

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

现有的变量： w^{0*}

- 先将w^*视为给定

LEMMA 3. For any $w^* \in \mathcal{W}^*$, (m^0, q^0) solves (P_{w^*}) if and only if (m_i^0, q_i^0) solves

$$\max_{m_i, q_i \geq 0} \mathcal{L}_i(m_i, q_i, \lambda, \lambda^*, \mu; w^*)(P_i) \equiv u_i(q_i + m_i) - \lambda a_i q_i - \lambda^* a_i^* q_i^*(m_i, w^*) - \mu p_i(m_i, w^*) m_i$$

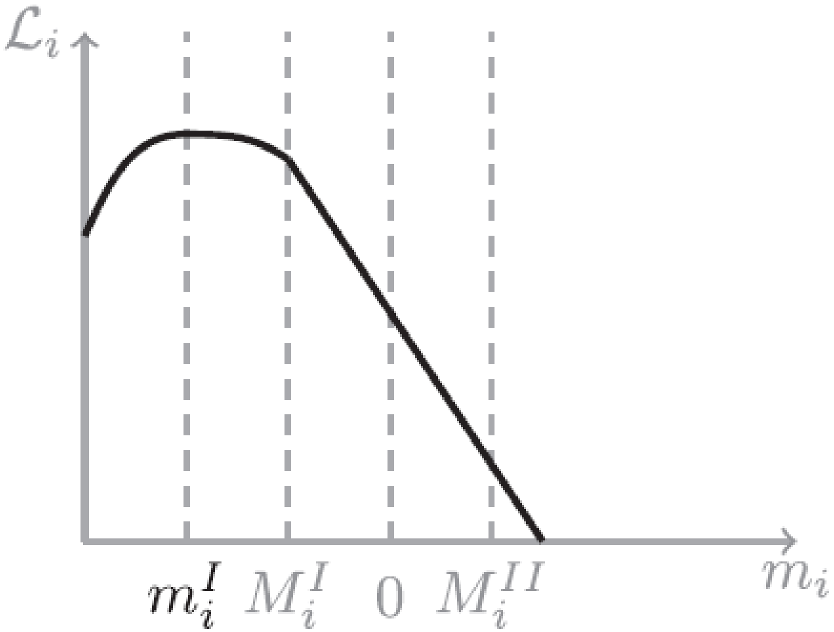
- 再最优化w^*

$$\max_{w^* \in \mathcal{W}^*} \quad U(c) \equiv \int_i u_i(c_i) di$$

- 最优 m_i 有两个临界点

不剩变量啦！解决问题啦！

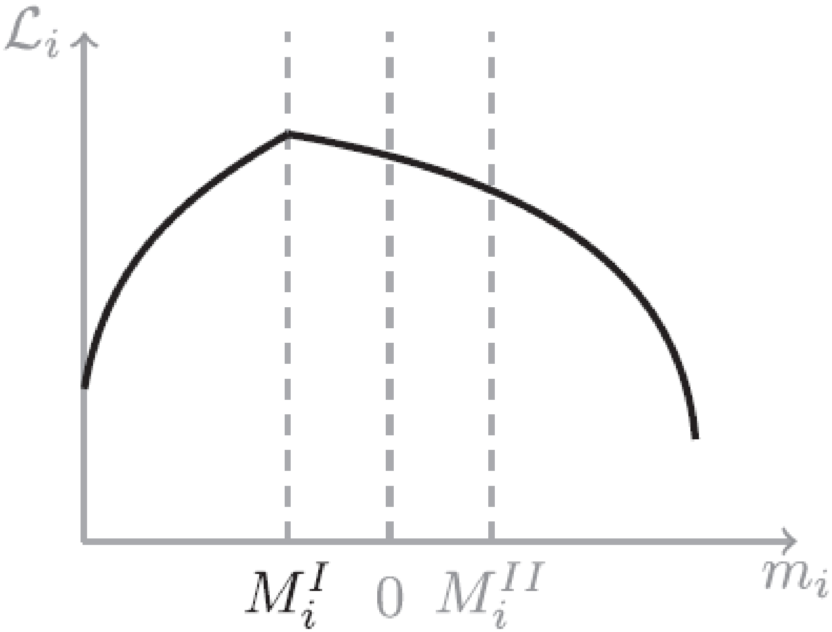
- 最优 m_i 取决于 $\frac{a_i}{a_i^*}$（具体计算详见附加材料）



(a) $\frac{a_i}{a_i^*} < A^I.$

本国 ***i*** 商品具有很大很大的比较优势

本国生产全部商品 ***i***



(b) $\frac{a_i}{a_i^*} \in [A^I, A^{II}).$

本国 ***i*** 商品具有一定比较优势

本国生产全部商品 ***i***

$$M_i^I \equiv -d_i^*(w^* a_i^*) < 0$$

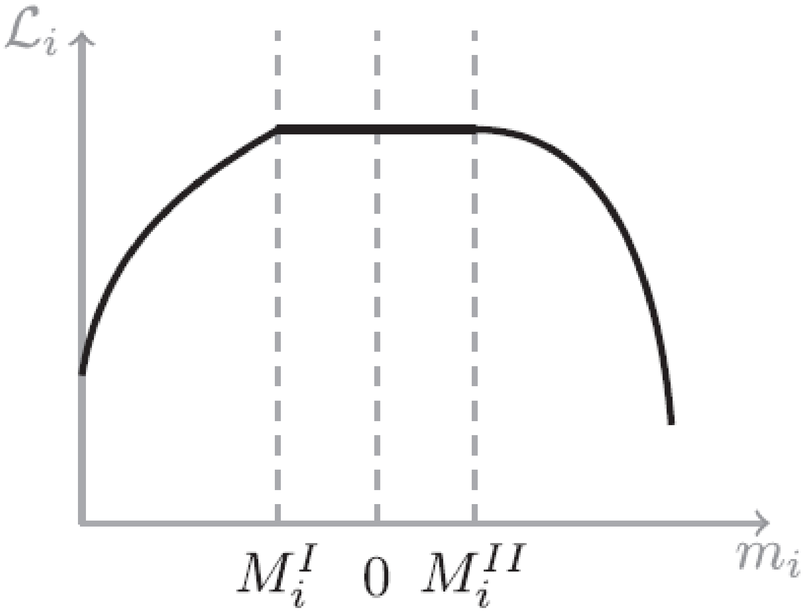
$$M_i^{II} \equiv d_i(\lambda a_i) > 0$$

$$m_i^I \equiv -\left(\frac{\sigma^*}{\sigma^*-1}\frac{\lambda a_i}{\mu \beta_i^*}\right)^{-\sigma^*} < 0$$

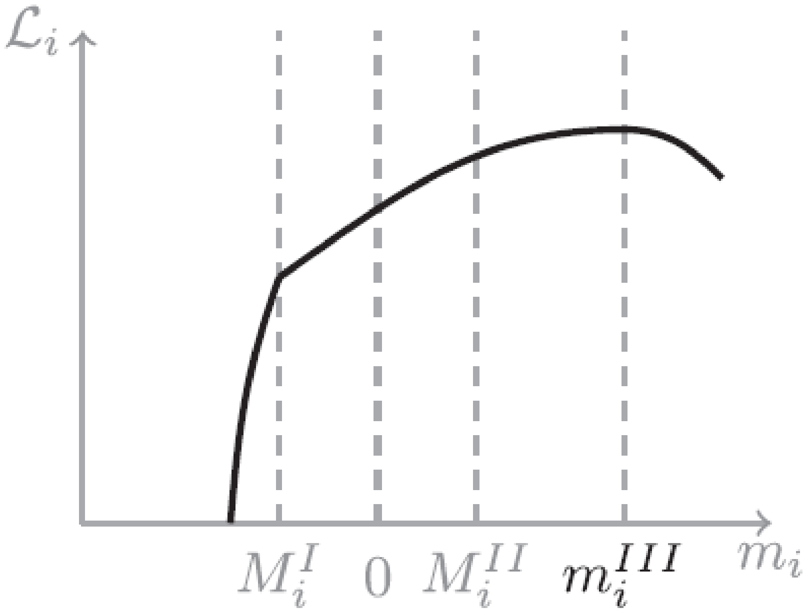
$$A^I \equiv \frac{\sigma^*-1}{\sigma^*}\frac{\mu w^*}{\lambda}$$

$$A^{II} \equiv \frac{\lambda^* + \mu w^*}{\lambda}$$

- 最优 m_i 取决于 $\frac{a_i}{a_i^*}$（具体计算详见附加材料）



(c) $\frac{a_i}{a_i^*} = A^{II}.$



(d) $\frac{a_i}{a_i^*} > A^{II}.$

$$M_i^I \equiv -d_i^*(w^* a_i^*) < 0$$

$$M_i^{II} \equiv d_i(\lambda a_i) > 0$$

$$m_i^{II} \equiv d_i\big((\lambda^* + \mu w^*)a_i^*\big) > 0$$

$$A^I \equiv \frac{\sigma^* - 1}{\sigma^*}\frac{\mu w^*}{\lambda}$$

$$A^{II} \equiv \frac{\lambda^* + \mu w^*}{\lambda}$$

本国 $\boldsymbol{i}$ 商品具有很小的比较优势

↓

本国和外国都有可能生产商品 $\boldsymbol{i}$，取决于政策

本国 $\boldsymbol{i}$ 商品不具有比较优势

↓

外国生产全部商品 $\boldsymbol{i}$

不剩变量啦！解决问题啦！

- 把以上的结论整理一下

PROPOSITION 1. If (m_i^0, q_i^0) solves equation (P_i), then optimal net imports are such that

(i) $m_i^0 = m_i^I$, if $\frac{a_i}{a_i^*} < A^I$

(ii) $m_i^0 = M_i^I$, if $\frac{a_i}{a_i^*} \in [A^I, A^{II})$

(iii) $m_i^0 \in [M_i^I, M_i^{II}]$ if $\frac{a_i}{a_i^*} = A^{II}$

(iv) $m_i^0 = m_i^{II}$, if $\frac{a_i}{a_i^*} > A^{II}$

$$M_i^I \equiv -d_i^*(w^* a_i^*) < 0$$

$$M_i^{II} \equiv d_i(\lambda a_i) > 0$$

$$m_i^I \equiv -\left(\frac{\sigma^*}{\sigma^*-1}\frac{\lambda a_i}{\mu \beta_i^*}\right)^{-\sigma^*} < 0$$

$$m_i^{II} \equiv d_i((\lambda^* + \mu w^*)a_i^*) > 0$$

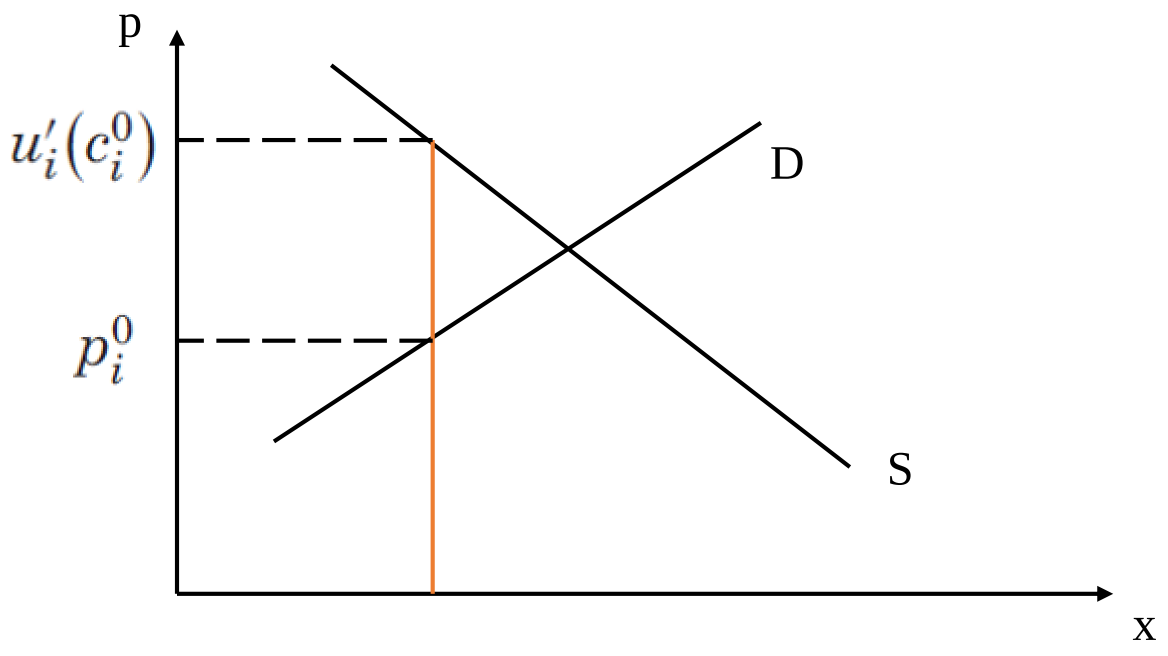
$$A^I \equiv \frac{\sigma^*-1}{\sigma^*}\frac{\mu w^*}{\lambda}$$

$$A^{II} \equiv \frac{\lambda^* + \mu w^*}{\lambda}$$

COROLLARY 1. At any solution to Home's planning problem, Home produces and exports goods in which it has a comparative advantage, $\frac{a_i}{a_i^*} < A^{II}$, whereas Foreign produces and exports goods in which it has a comparative advantage, $\frac{a_i}{a_i^*} > A^{II}$.

4　最优关税

- 楔子定义:　$\tau_i^0 \equiv \frac{u_i'(c_i^0)}{p_i^0} - 1$



- 楔子定义: $\tau_i^0 \equiv \dfrac{u_i'(c_i^0)}{p_i^0} - 1$

代入 $\begin{cases} p_i = p_i(m_i, w^*) \equiv \min\{u_i^{*\prime}(-m_i), w^* a_i^*\} \\ c_i^0 = q_i^0(m_i^0) + m_i^0 \end{cases}$

$$\tau_i^0 = \frac{u_i'(q_i^0(m_i^0) + m_i^0)}{p_i(m_i^0, w^{0*})} - 1$$

代入 $\begin{cases} \text{(i)}\ m_i^0 = m_i^I, \text{ if } \frac{a_i}{a_i^*} < A^I \\ \text{(ii)}\ m_i^0 = M_i^I, \text{ if } \frac{a_i}{a_i^*} \in [A^I, A^{II}) \\ \text{(iii)}\ m_i^0 \in [M_i^I, M_i^{II}] \text{ if } \frac{a_i}{a_i^*} = A^{II} \\ \text{(iv)}\ m_i^0 = m_i^{II}, \text{ if } \frac{a_i}{a_i^*} > A^{II} \end{cases}$

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

- 本国企业最优化： $u_i'(q_i^0+m_i^0)\le\lambda^0 a_i$, with equality if $q_i^0>0$.

↓ 代入 $u_i'(q_i^0+m_i^0)=u_i'(c_i^0)=p_i^0(1+\tau_i^0)$

if $t_i^0=\tau_i^0$

$$p_i^0(1+t_i^0)\le\lambda^0 a_i,\ \text{with equality if } q_i^0>0$$

↓ 结合条件2的一阶条件！

$$w^0=\lambda^0$$

劳动的报酬 = 劳动的影子价格！

注： (2) $q_i\in\operatorname{argmax}_{\tilde{q}_i\ge 0}\{p_i(1+t_i)\tilde{q}_i-wa_i\tilde{q}_i\}$

最优关税

- 最优关税定义： $t_i^0 = \frac{u_i'(c_i^0)}{\nu p_i^0} - 1$
- 楔子定义： $\tau_i^0 \equiv \frac{u_i'(c_i^0)}{p_i^0} - 1$
- 最优关税和楔子的关系： $1 + t_i^0 = \frac{1}{\nu}(1 + \tau_i^0)$

由条件（1）的一阶条件可得

v为条件（1）的拉格朗日乘子

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

Proposition 2. At any solution to the domestic government's problem, trade taxes, t^0

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

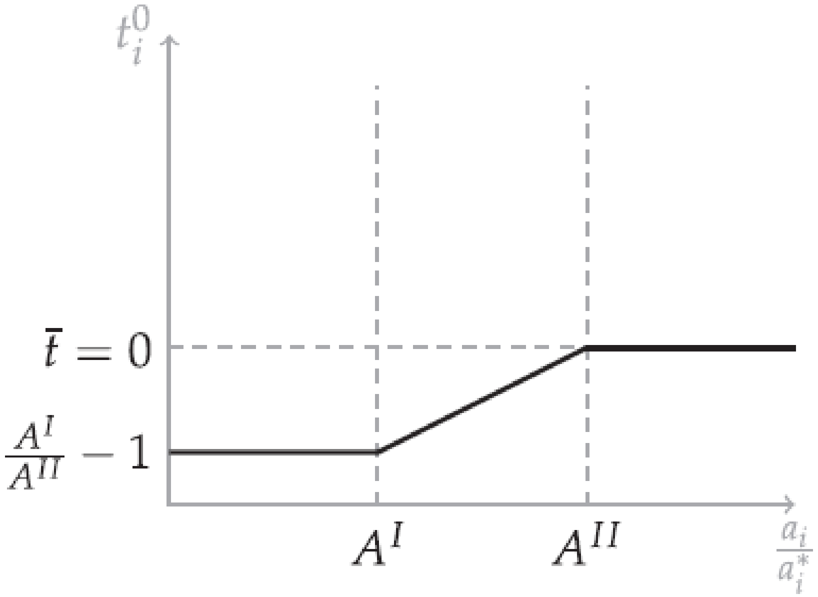
$$1 + t_i^0 = \frac{1}{\nu}(1 + \tau_i^0)$$

(i) $t_i^0 = (1 + \bar{t})\left(\frac{A^I}{A^{II}}\right) - 1$ if $\frac{a_i}{a_i^*} < A^I$

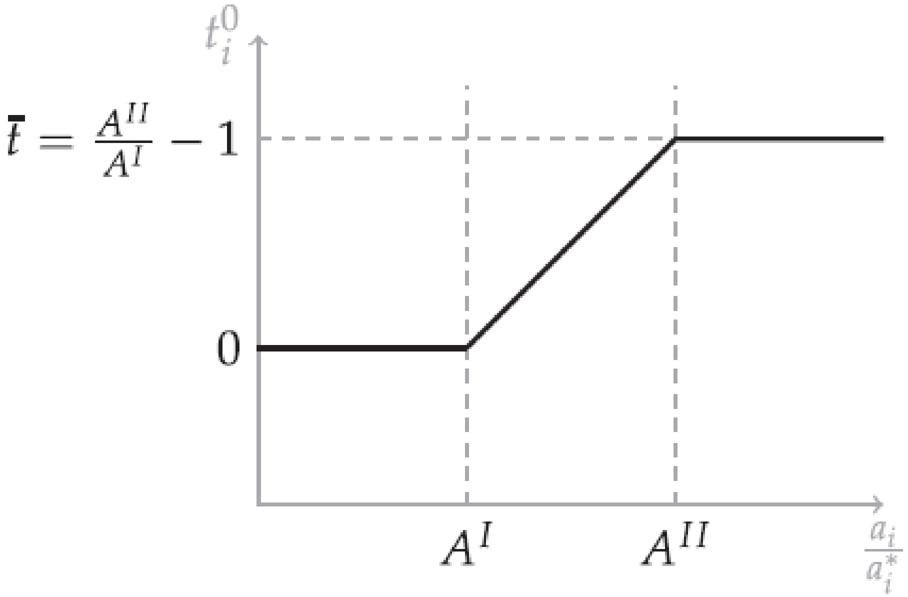
(ii) $t_i^0 = (1 + \bar{t})\left(\frac{a_i}{a_i^* A^{II}}\right) - 1$, if $\frac{a_i}{a_i^*} \in [A^I, A^{II}]$

(iii) $t_i^0 = \bar{t}$, if $\frac{a_i}{a_i^*} > A^{II}$

$\bar{t} > -1$ and $A^I < A^{II}$



(a) Export taxes.



(b) Export subsidies and import tariffs.

5　稳健性检验

5.稳健性检验

(1)constant elasticities of substitution：σ $\rightarrow$ separate preference： $s \in S$

$$U = F\left(U^1(c^1),\ldots,U^S(c^S)\right)$$

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

$$U^s(c^s) = \int_{i \in \mathcal{I}^s} u_i^s(c_i)di.$$

CES 函数（S=1）

$\downarrow$

$$m_i^I = -\left(\frac{\sigma^*}{\sigma^* - 1}\frac{\lambda a_i}{\mu \beta_i^*}\right)^{-\sigma^*}$$

$$(1+\bar{t})\left(\frac{A^{\mathrm{I}}}{A^{\mathrm{II}}}\right) - 1$$

$$\frac{a_i}{a_i^*} < A^I \equiv \frac{\sigma^* - 1}{\sigma^*}\frac{\mu^0 w^{0*}}{\lambda^0}$$

$$c^{s*} \in \text{argmax}_{\tilde{c} \geq 0} \left\{ U^{s*}(\tilde{c}) \middle| \int_{i \in \mathcal{I}^s} p_i^s \tilde{c}_i di \leq E^{s*} \right\}$$

$$p_i^s(m_i, w^*, E^{s*}) \equiv \min\{u_i^{s*\prime}(-m_i)\nu^{s*}(E^{s*}), w^* a_i^*\}$$

$$q_i^{s*}(m_i, w^*, E^{s*}) \equiv \max\{m_i + d_i^{s*}(w^* a_i^* / \nu^{s*}(E^{s*})), 0\}$$

LEMMA 1

$$\max_{\{L^s, L^{s*}, D^s\}_{s \in \mathcal{S}}, w^* \in \mathcal{W}^*} F(V^1(L^1, L^{1*}, D^1, w^*), \ldots, V^S(L^S, L^{S*}, D^S, w^*))$$

$$\text{s.t.} \quad \sum_{s \in \mathcal{S}} L^s = L,$$

$$\sum_{s \in \mathcal{S}} L^{s*} = L^*,$$

$$\sum_{s \in \mathcal{S}} D^s = 0,$$

$$V^s(L^s, L^{s*}, D^s, w^*) \equiv \max_{m^s, q^s \geq 0} \int_{i \in \mathcal{I}^s} u_i^s(m_i + q_i) di$$

$$\text{s.t.} \quad \int_{i \in \mathcal{I}^s} a_i q_i di \leq L^s,$$

$$\int_{i \in \mathcal{I}^s} a_i^* q_i^{s*}(m_i, w^*, w^* L^{s*} - D^s) di \leq L^{s*},$$

$$\int_{i \in \mathcal{I}^s} p_i^s(m_i, w^*, w^* L^{s*} - D^s) m_i di \leq D^s.$$

LEMMA 2

(2)technology one factor → multiple factors

$f_i(l_i) = \frac{l_i}{a_i}$ $f_i(l_i)$

$$\mathcal{L}_i(m_i, q_i, \lambda, \lambda^*, \mu; w^*) \equiv u_i(q_i + m_i) - \lambda \cdot a_i(\lambda) q_i - \lambda^* \cdot a_i^*(w^*) q_i^*(m_i, w^*) - \mu p_i(m_i, w^*) m_i$$

其中 $a_i(w) \equiv (a_{in}(w)) = \mathrm{argmin}_{a_i \equiv (a_{in})} \{a_i \cdot w | f_i(a_i) \geq 1\}$

Proposition 1

(i) $m_i^0 = m_i^I$, if $\frac{a_i}{a_i^*} < A^I$

(ii) $m_i^0 = M_i^I$, if $\frac{a_i}{a_i^*} \in [A^I, A^{II})$

(iii) $m_i^0 \in [M_i^I, M_i^{II}]$ if $\frac{a_i}{a_i^*} = A^{II}$

(iv) $m_i^0 = m_i^{II}$, if $\frac{a_i}{a_i^*} > A^{II}$

$\gamma_i \equiv \lambda \cdot a_i(\lambda)$

$\gamma_i^* \equiv w^* \cdot a_i^*(w^*)$

→

Proposition 3

(i) $m_i^0 = m_i^I \equiv -\left(\frac{\sigma^*}{\sigma^* - 1} \frac{\gamma_i}{\mu \beta_i^*}\right)^{-\sigma^*}$, if $\frac{\gamma_i}{\gamma_i^*} < \mu \frac{\sigma^* - 1}{\sigma^*}$;

(ii) $m_i^0 = M_i^I$, if $\frac{\gamma_i}{\gamma_i^*} \in \left[\mu \frac{\sigma^* - 1}{\sigma^*}, \frac{\lambda^* \cdot a_i^*(w^*)}{\gamma_i^*} + \mu\right)$

(iii) $m_i^0 \in [M_i^I, M_i^{II}]$ if $\frac{\gamma_i}{\gamma_i^*} = \frac{\lambda^* \cdot a_i^*(w^*)}{\gamma_i^*} + \mu$

(iv) $m_i^0 = m_i^{II} \equiv d_i(\lambda^* \cdot a_i^*(w^*) + \mu \gamma_i^*)$
if $\frac{\gamma_i}{\gamma_i^*} > \frac{\lambda^* \cdot a_i^*(w^*)}{\gamma_i^*} + \mu$

6　应用

6.应用

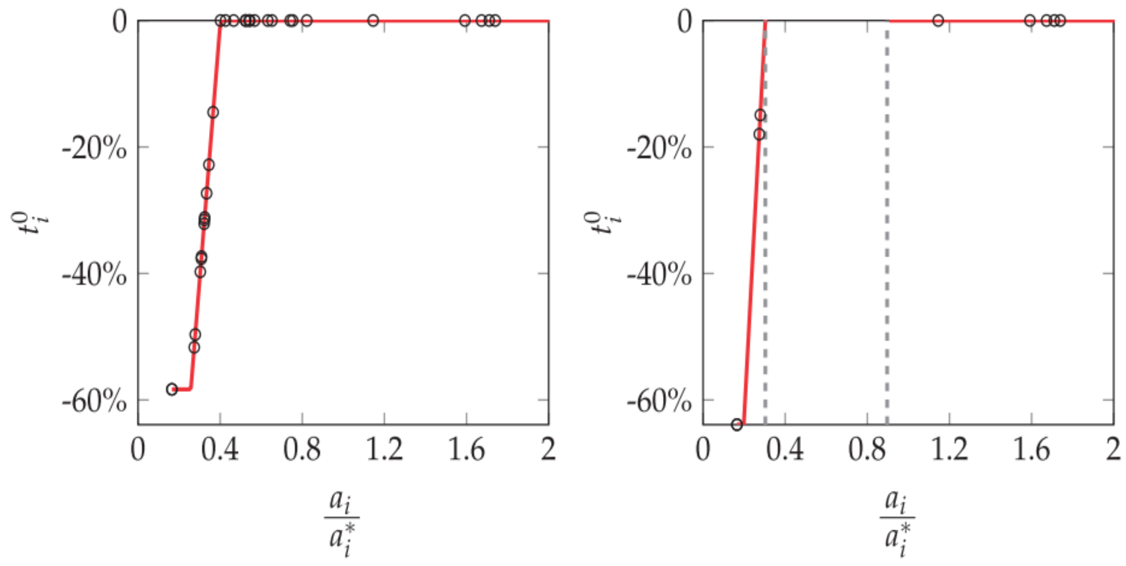


FIGURE III

Optimal Trade Taxes for the Agricultural Case

The left panel assumes no trade costs, $\delta = 1$. The right panel assumes trade costs, $\delta = 1.72$.

TABLE I

GAINS FROM TRADE FOR THE AGRICULTURAL CASES

	No trade costs ($\delta = 1$)		Trade costs ($\delta = 1.72$)	
	U.S.	ROW	U.S.	ROW
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%

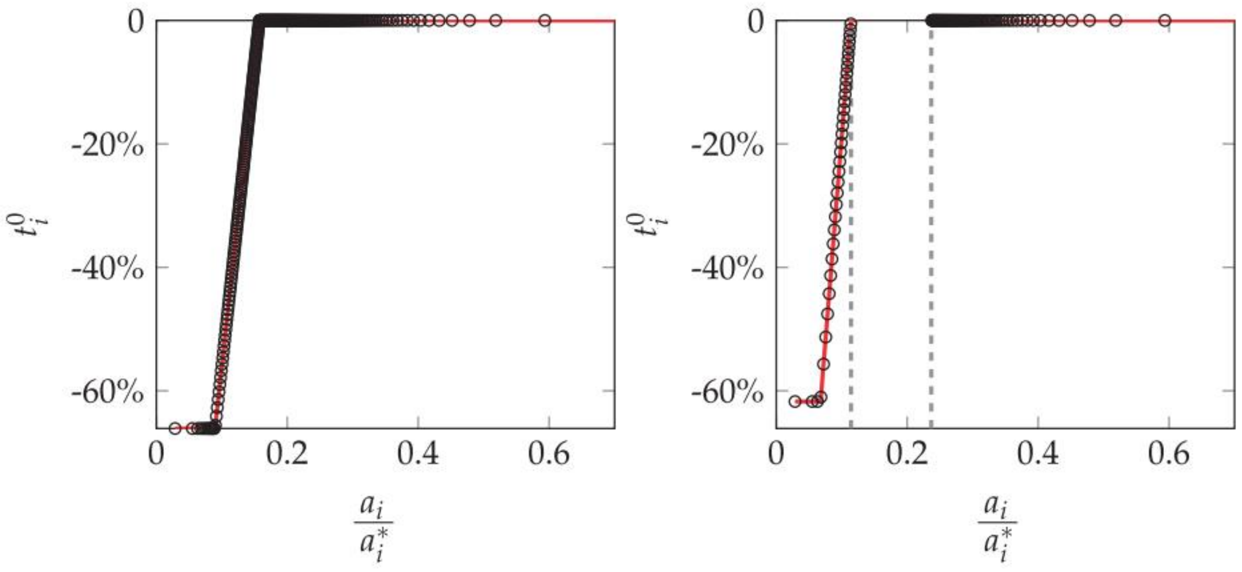


FIGURE IV

Optimal Trade Taxes for the Manufacturing Case

The left panel assumes no trade costs, $\delta = 1$. The right panel assumes trade costs, $\delta = 1.44$.

TABLE II

GAINS FROM TRADE FOR THE MANUFACTURING CASE

	No trade costs ($\delta = 1$)		Trade costs ($\delta = 1.44$)	
	U.S.	ROW	U.S.	ROW
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%