

Transboundary Renewable Resource and International Trade

2009

Yasuhiro Takarada

Nanzan University, Japan

Transboundary Renewable Resources

- Fish and other wildlife stocks that straddle (or migrate) the boundaries of the territory or the Exclusive Economic Zones (EEZs) of two or more countries.

Transboundary Fishery Resources

- Categories (*FAO (2004) Fisheries Technical Paper No.465.*)
 1. Highly migratory stocks, which in fact refer to tuna.
 2. The so-called “straddling” fish stocks, i.e., those stocks that migrate between the EEZs of one or more coastal states and the high seas.
- The number of such resources: *Caddy (1997)*
 1. An estimate of 1000 to 1500 kinds in the world.
 2. Only a small percentage of those is subject to effective and cooperative management.

Research Questions

- Does international trade reduce a transboundary renewable resource stock?
- A resource good exporting country with a higher harvesting technology is suffered from opening trade?
- Does trade benefit a resource good importing country?
- A win-win situation can arise without resource management?

Outline

- Backgrounds
- Related literatures
- Basic model
- Autarkic steady state
- Trading steady state
- Summary

Backgrounds (1)

- **Depletion of fishery resources**
 1. *FAO (2009) The State of World Fisheries and Aquaculture 2008* : fully exploited stocks, 50%; overexploited+depleted+recovering stocks, 25%-30%;
 2. *Worm et al. (2006)* : the global collapse of all currently fishes will occur at the middle of the 21st century (in the year 2048).
- **Increase in consumption and production of fishery resources**

Figure 21

Global trends in the state of world marine stocks since 1974

Percentage of stocks assessed

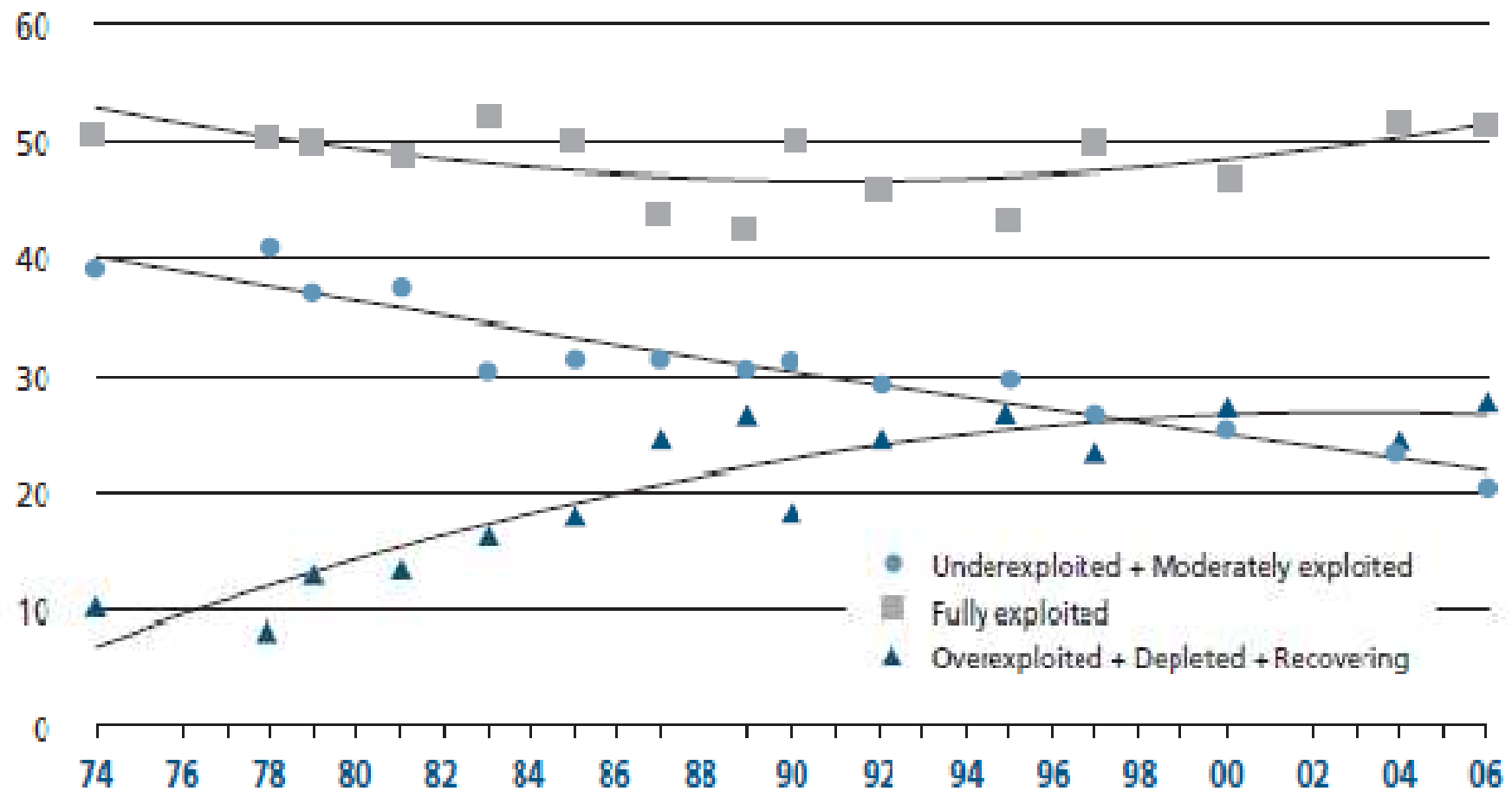
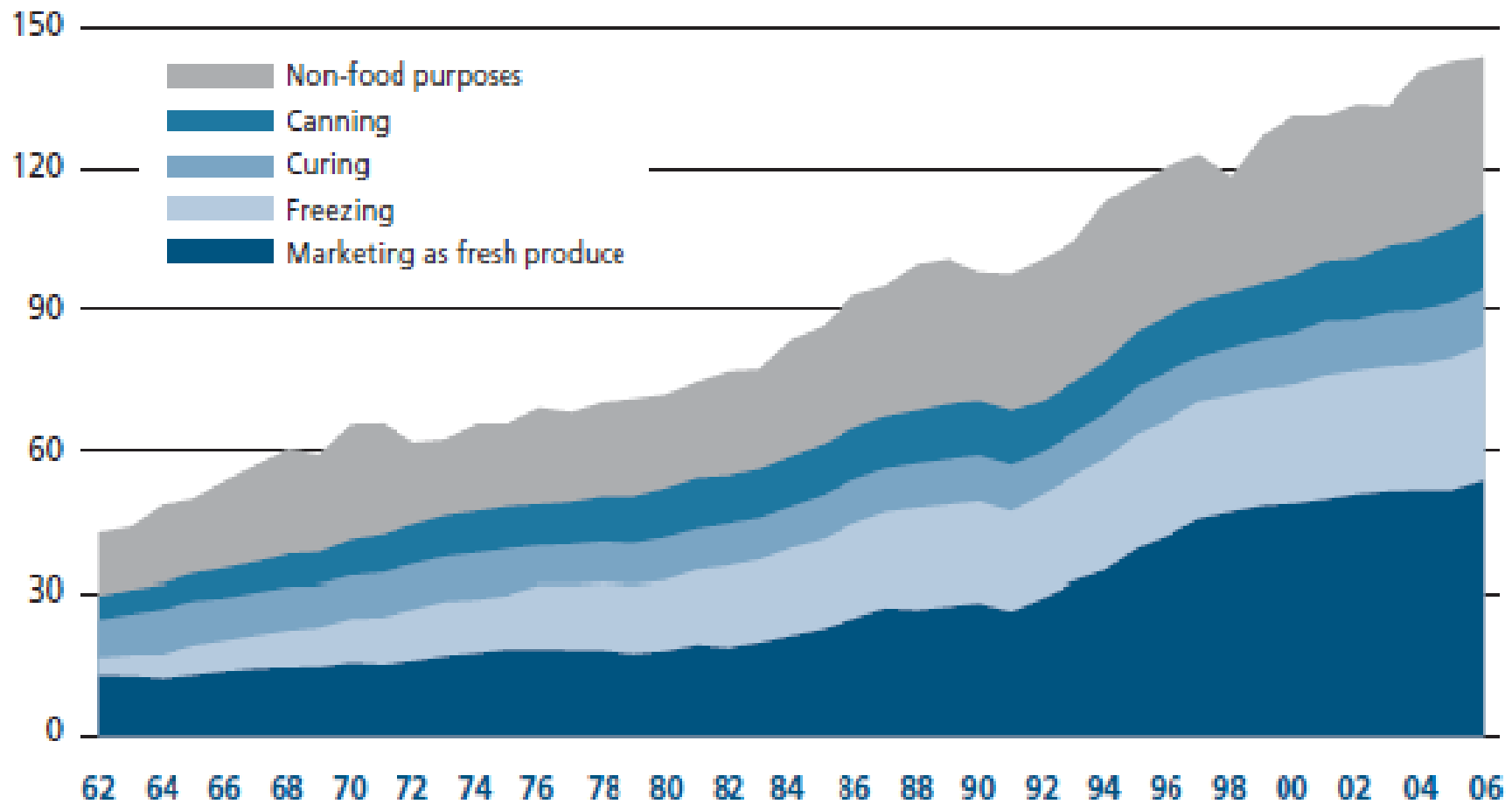


Figure 28

Utilization of world fisheries production (breakdown by quantity), 1962–2006

Million tonnes (live weight)



Backgrounds (2)

International Trade of Fishery Resources

- Fish and fishery products are highly traded with more than 37% (live weight equivalent) of total production. *FAO (2009)*
- Over 75% of the world marine fishery catch (over 80 million tons per year) is sold on international markets. *Watson and Pauly (2001) Nature 414*
- By 2006, 194 countries reported exports of fish and fishery products, and world exports reached US\$85.9 billion (an increase of 9.6% on 2005 and of 62.7% on 1996). *FAO (2009)*

Figure 31

World fishery exports by major commodity groups

FOR HUMAN CONSUMPTION

US\$ billions

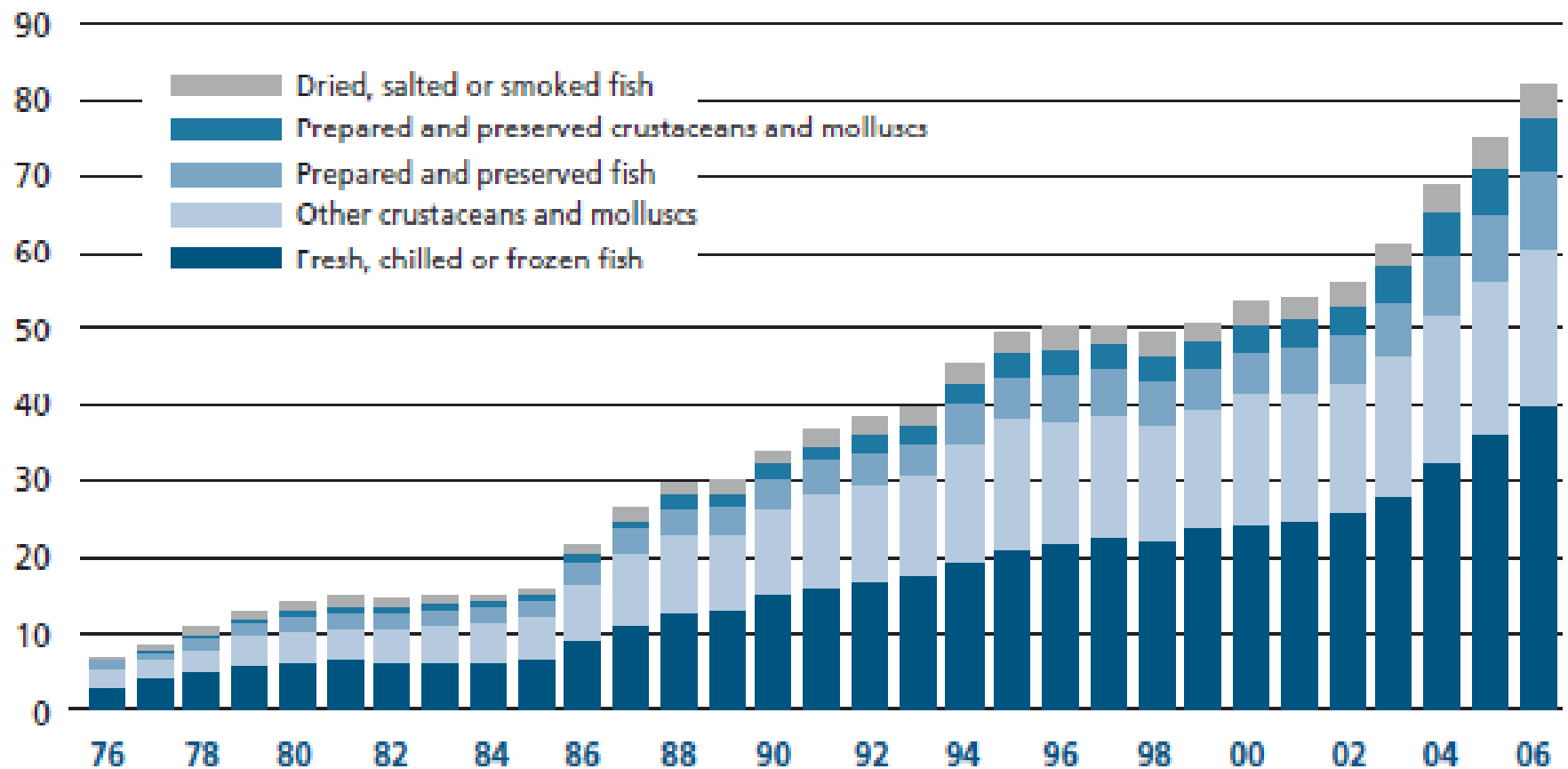
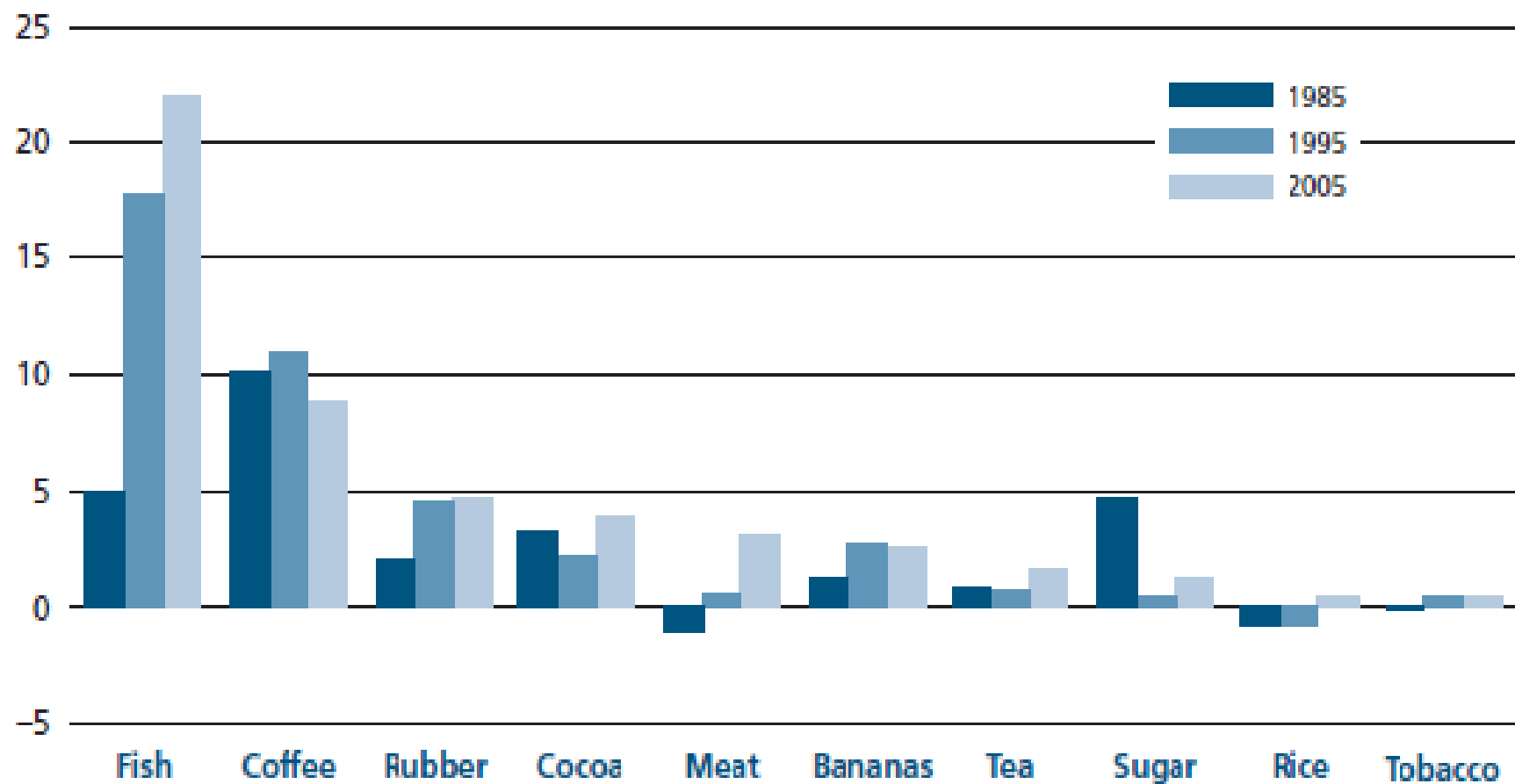


Figure 32

Net exports of selected agricultural commodities by developing countries

US\$ billions



Backgrounds (3)

Fisheries Management and Open Access

- Managements are enforced (e.g., the Common Fisheries Policy (CFP) by EU and International Commission for the Conservation of Atlantic Tunas (ICCAT)).
- However
 1. we still observe illegal, unreported and unregulated (IUU) fishing activities; (e.g., the plunder of bluefin tuna in the Mediterranean and East Atlantic, *WWF (2006)*: over-quota catch is 40% above the total quota set by ICCAT in 2004 and 2005.)
 2. fishery resources in some areas are in fact open access because of the jurisdiction problem.

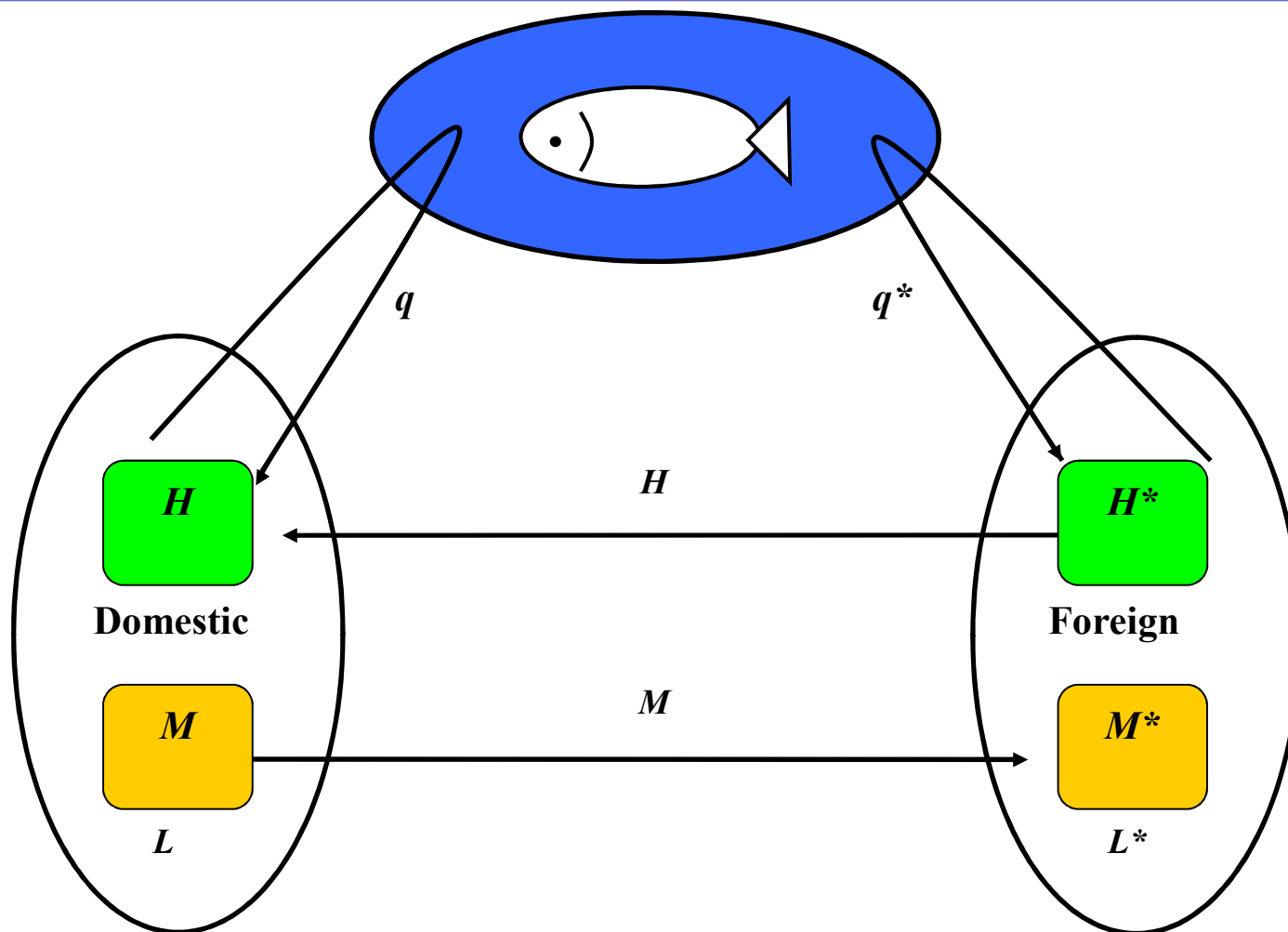
Related Literatures (1)

- Patterns of trade and gains from trade
Assumption: renewable resource is subject to open access by residents of that country only
 1. Basic model
Brander and Taylor(1997, CJE), Brander and Taylor (1998, JIE)
 2. With resource management
Brander and Taylor(1997), Chichilnisky(1993, 1994), Emami and Johnston(2000), Hotte et al. (2000), and Jinji (2007)

Related Literatures (2)

- Considerable and various papers about transboundary fishery resources
- Focus is on strategic interactions between harvesting countries
 1. *without trade*: e.g., Munro (1979), Levhari and Mirman (1980)
(See, e.g., Munro and Scott (1985) and Clark (1990, 2006) for the development of this field.)
 2. *with trade*: Bulte and Damania (2005, CJE)
- No analysis about patterns of trade and gains from trade under transboundary renewable resource

Basic Model (1)



Main Results

- The transboundary renewable resource stock is likely to be reduced by trade.

Consistent with the empirical evidence (*McWhinnie 2009, JEEM*)

- However, both countries may still benefit from trade.
- Even the importer of the resource good specializes in manufactures, it may still suffer the steady state utility loss.

Basic Model (2)

Production

- Manufactures: $M_S = L_M$
- Harvest: $H_S = qSL_H$
- Input of labor: L_M, L_H
- Harvesting technology: q
- Transboundary renewable resource stock: S
- The unit labor requirement:
$$a_{LH}(S) = L_H / H_S = 1/(qS)$$
- Zero profit condition: $p = wa_{LH} = w/(qS)$
- The price of M is 1 (assume numeraire)
- $w = 1$ if M is produced.

Basic Model (3)

Demand

- The utility function: $u = h^\beta m^{1-\beta}$
 β , preference to the resource good, $0 < \beta < 1$
- Budget constraint: $ph + m = wL$
- Consumption: $H_D = w\beta L / p$
 $M_D = w(1-\beta)L$

Basic Model (4)

- Market clearing condition

$$H_D = \frac{w\beta L}{p} = w\beta L \frac{1}{wa_{LH}} = w\beta L \frac{qS}{w} = q\beta LS$$

$$H_S = qSL_H$$

$$H_D = H_S = q\beta LS$$

- Full employment condition

$$L_H + L_M = L$$

$$H_S a_{LH} + M = L \quad (\text{PPF})$$

Autarkic Steady State (1)

- The dynamic function of resource stock at time t :

$$dS/dt = G(S) - H_S - H_S^*$$

- The growth function

$$G(S) = rS(1 - S/K)$$

- “Carrying capacity”, K is the maximum possible size for the resource stock
- “Intrinsic” growth rate, r
- A steady state: $S_A = K(1 - q\beta L/r - q^* \beta L^*/r)$
- The steady state autarky prices:

$$p_A = 1/(qS_A) \quad p_A^* = 1/(q^* S_A^*)$$

Autarkic Steady State (2)

- A positive stock level requires $r > q\beta L + q^*\beta L^*$

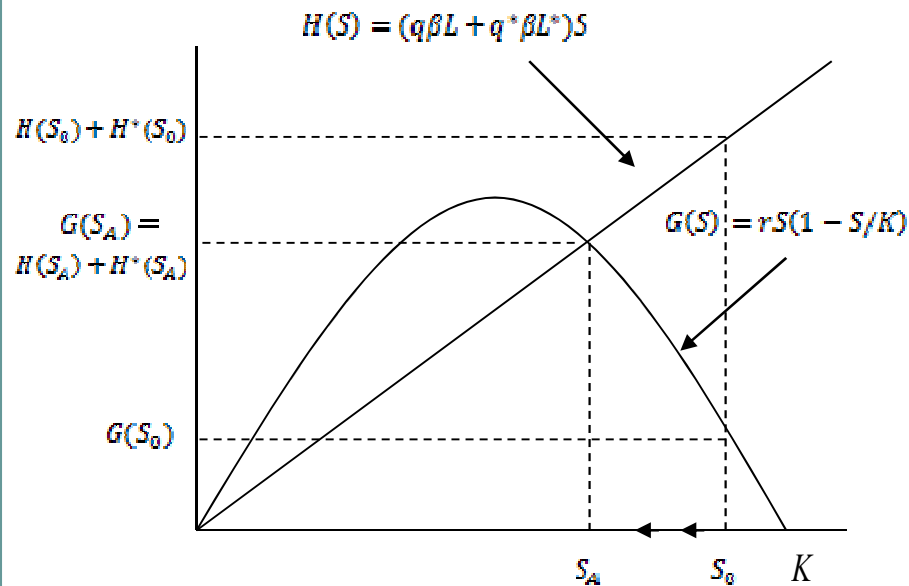


Figure 1. Transboundary Renewable resource dynamics

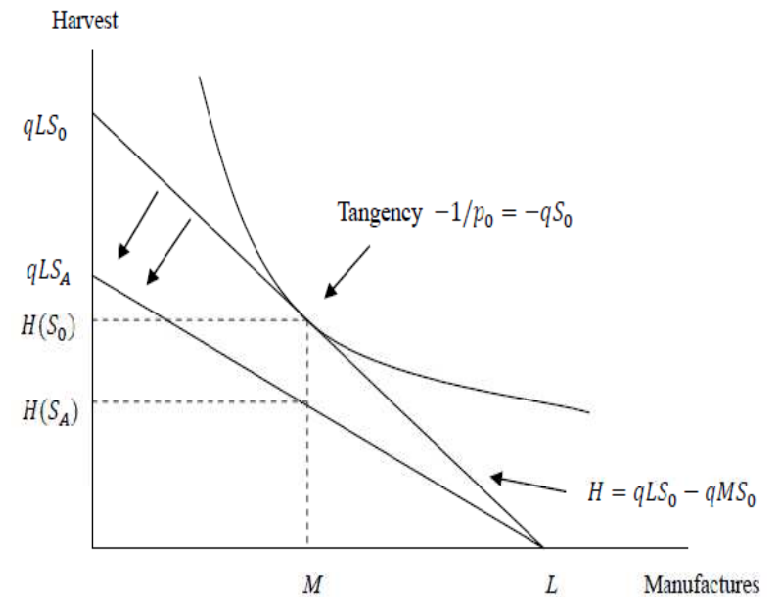


Figure 2. Temporary equilibrium dynamics in the domestic country

Steady State Patterns of Trade

Without loss of generality, we assume

$$q < q^* \longrightarrow a_{LH} > a_{LH}^* \longrightarrow p_A > p_A^*$$

1. The foreign country has a comparative advantage in producing H .

→ the foreign country exports H .

2. Three patterns of trade:

(i) Domestic specializes in M , Foreign produces both H and M ;

(ii) Domestic specializes in M , Foreign country specializes in H ;

(iii) Domestic produces both H and M , Foreign specializes in H .

- $q=q^*$ must hold when both countries are diversified.

Case (i): Domestic country, M ; Foreign country, H and M

- Conditions for this case:

$$[\beta L / (1 - \beta) L^*] < 1$$

$$w = w^* = 1 \quad 0 < L_H^* < L^*$$

- The post-trade resource stock:

$$S_{T1} = K(1 - q^* \beta L / r - q^* \beta L^* / r)$$

$$S_{T1} < S_A \quad (q < q^*)$$

- A positive stock level requires

$$r > q^* \beta L + q^* \beta L^*$$

Case (i) (cont.)

- The nominal income after trade
In each country, the income remains the same
- The post-trade steady state utility levels depend on how the world price of H changes.

- Domestic country:

$$\begin{array}{ll} p_{T1} > p_A & r < (q + q^*)\beta L + q^*\beta L^* \\ p_{T1} < p_A & r > (q + q^*)\beta L + q^*\beta L^* \end{array} \quad u \uparrow \text{ or } \downarrow$$

- Foreign country: $p_{T1} > p_A^* \longrightarrow u^* \downarrow$

Proposition 1

If the trading steady state is specialized for the domestic country and diversified for the foreign country, then

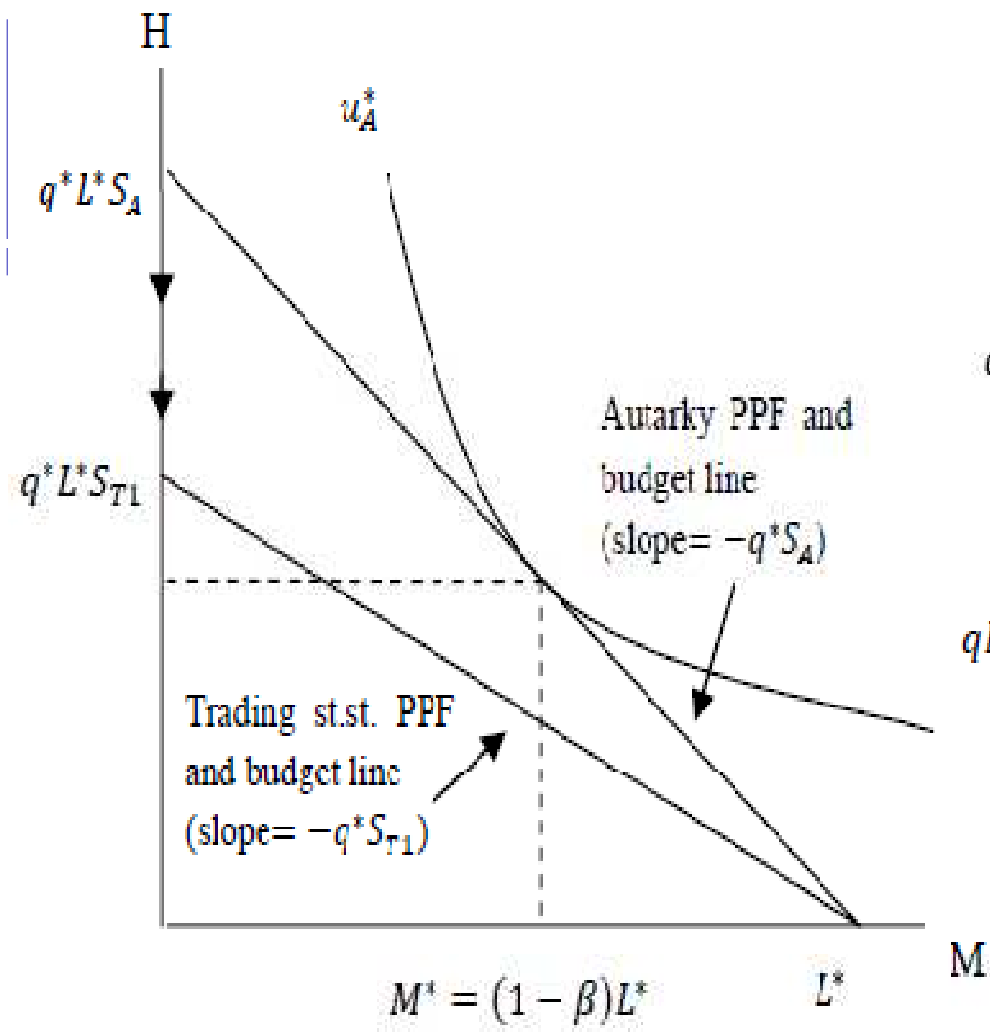
i) the necessary and sufficient condition for this case is

$$[\beta L / (1 - \beta)L^*] < 1$$

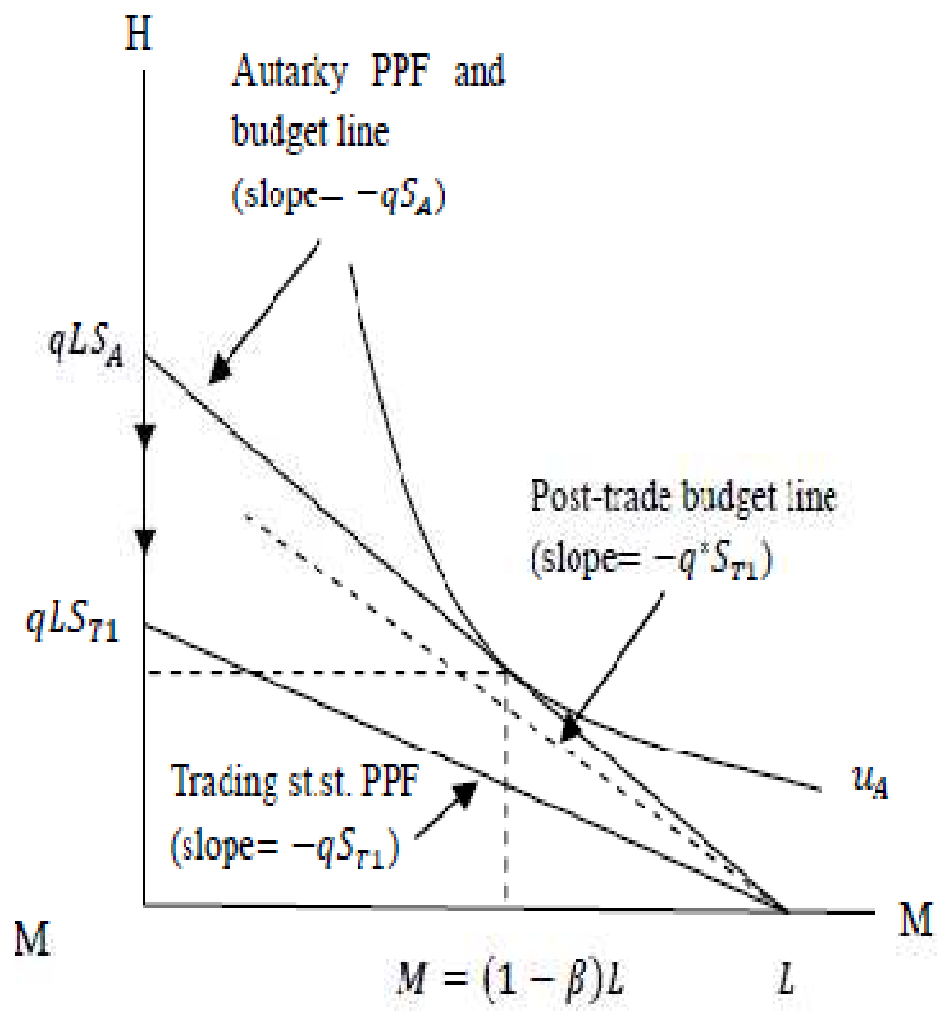
ii) the post-trade transboundary renewable resource stock is reduced by trade;

iii) trade causes steady state utility to fall or rise in the domestic country depending on the condition;

iv) trade causes steady state utility to fall in the foreign country.



3.1 The foreign country



3.2 The domestic country

Figure 3. Transition to a steady state in case (i)

Implication of Proposition 1

- The foreign country with a higher harvesting technology suffers welfare loss because the decrease of the resource stock causes the decrease of the productivity.
- A resource good importing country, even it specializes in M , also may suffer welfare loss.
 1. Brander and Taylor (1997a, 1998): in the case of local renewable resources, a resource good importing country necessarily gains from trade.
 2. Overexploitation of the resource stock will occur when the intrinsic growth rate, r , is too small.

Case (ii): Domestic country, M; Foreign country, H

- Conditions for specialization:

$$1 \leq [\beta L / (1 - \beta) L^*] \leq (q^* / q)$$

$$w = 1 \quad w^* \geq 1$$

- The post-trade resource stock:

$$S_{T2} = K(1 - q^* L^* / r)$$

$$S_{T2} \leq S_A$$

- A positive stock level requires

$$r > q^* L^*$$

Proposition 2

If the trading steady state is specialized for both domestic and foreign country, then

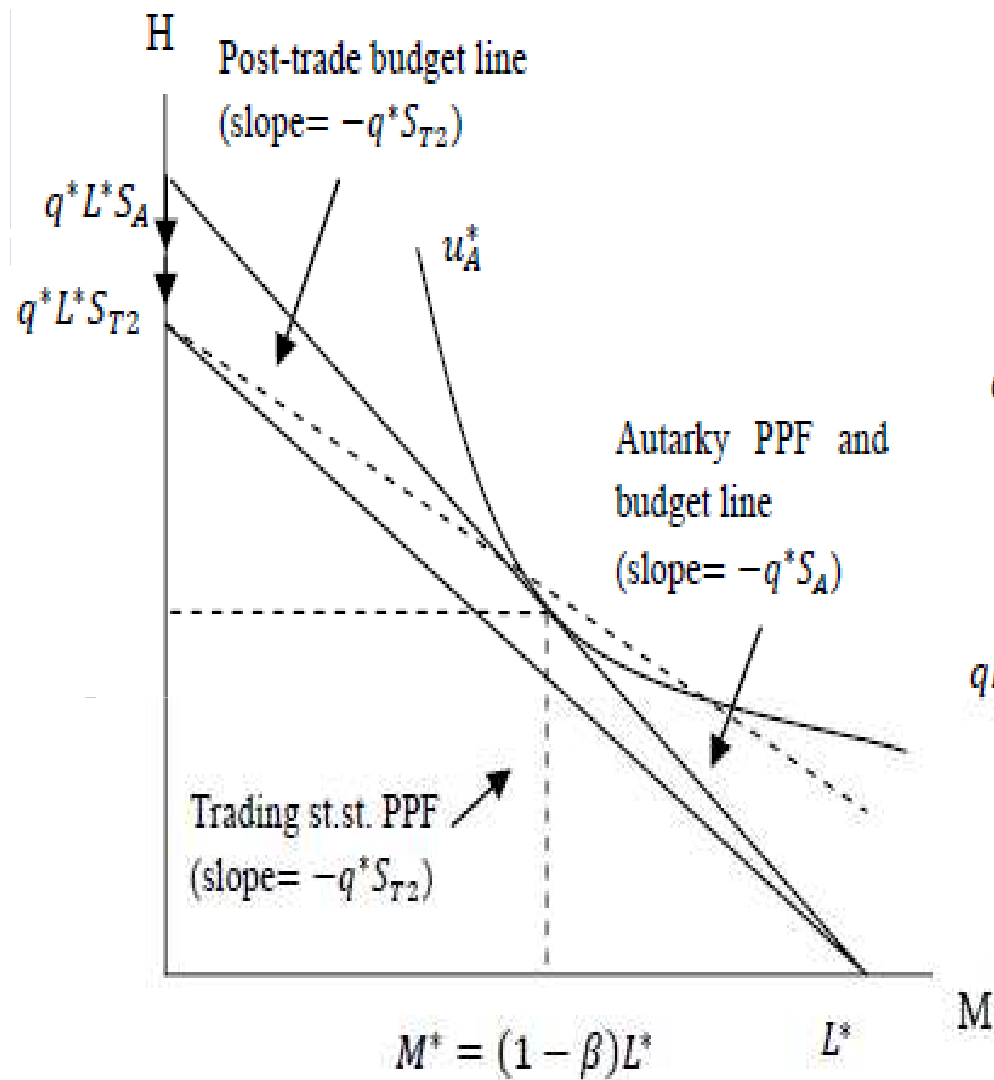
i) the necessary and sufficient condition for this case is

$$1 \leq [\beta L / (1 - \beta) L^*] \leq (q^* / q)$$

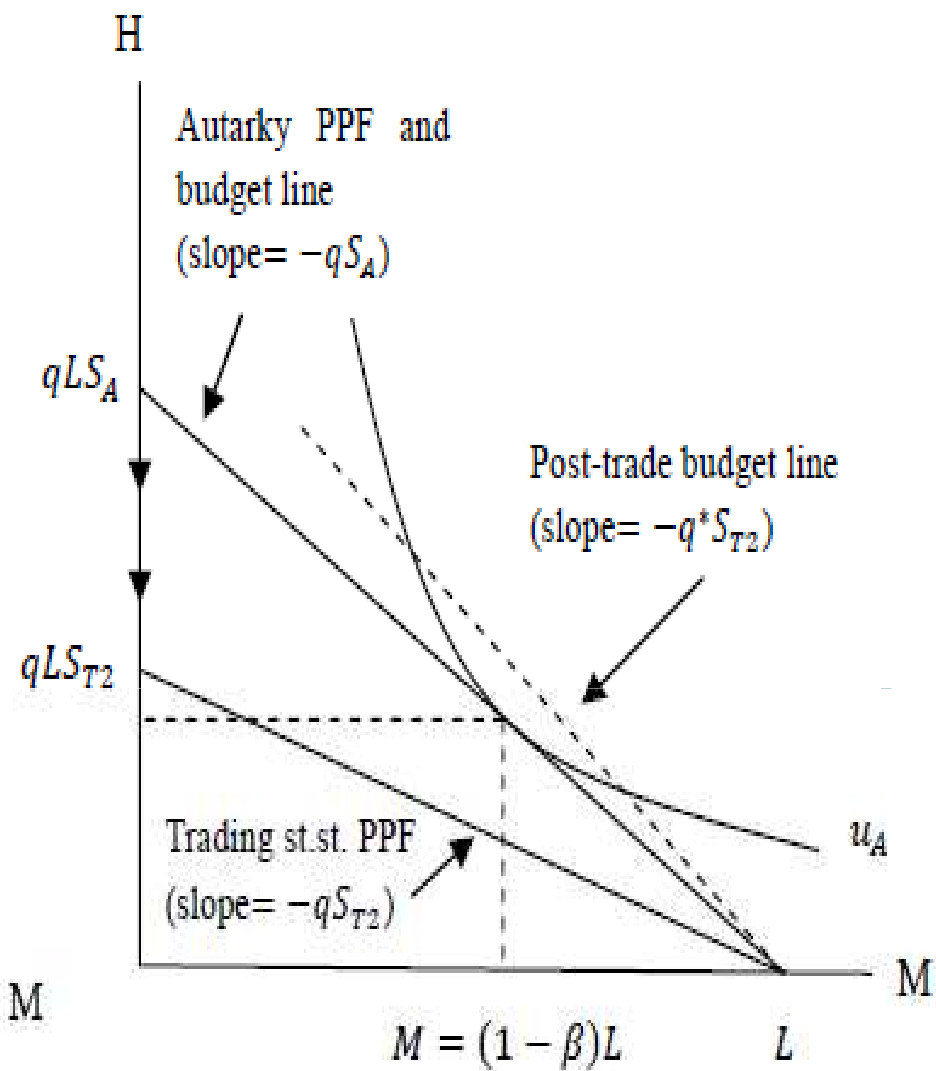
ii) the post-trade renewable resource stock is likely to be reduced by trade (it never increases);

iii) a) trade doesn't change the steady state utility level in domestic country; b) trade causes steady state utility to fall or rise in the domestic country depending on the parameters

iv) trade causes steady state utility to rise or fall in the foreign country



4.1 The foreign country



4.2 The domestic country

Figure 4. Transition to a steady state in case (ii)

Implication of Proposition 2

- Both countries can benefit from trade, although the renewable stock is reduced by trade.
- Note without any resource management, a win-win situation may arise.
- Unfortunately, a lose-lose situation may also occur.

Case (iii): Domestic country, H and M; Foreign country, H

- Conditions for this case:

$$[\beta L / (1 - \beta) L^*] > (q^* / q)$$

$$w = 1 \quad w^* > 1$$

- The post-trade resource stock:

$$S_{T3} = K(1 - q\beta L / r - q^* \beta L^* / r)$$

$$S_{T3} = S_A$$

If the stock changes, the zero-profit condition cannot hold.

Proposition 3

If the trading steady state is diversified for domestic country and specialized for foreign country, then

i) the necessary and sufficient condition for this case is

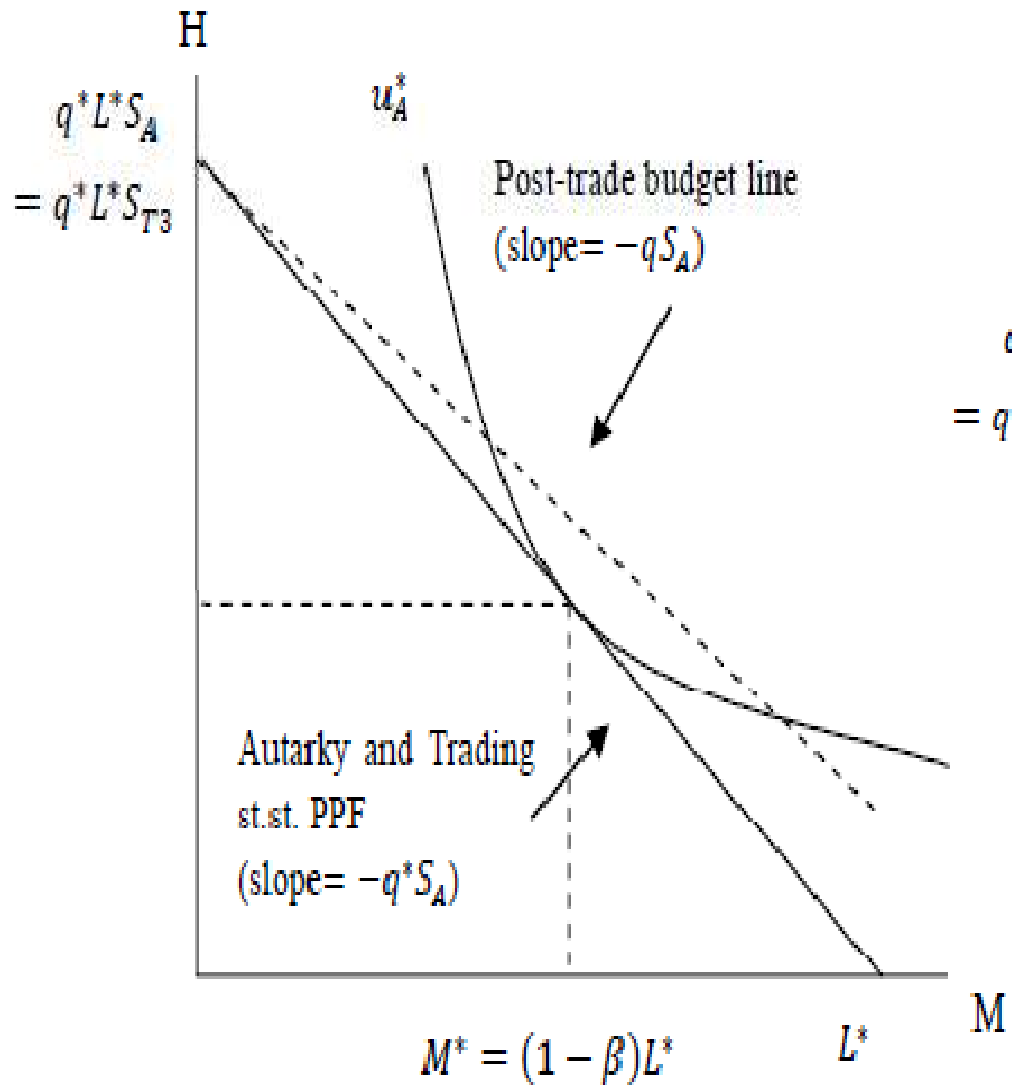
$$[\beta L / (1 - \beta) L^*] > (q^* / q)$$

ii) the post-trade transboundary renewable resource stock is the same as autarky;

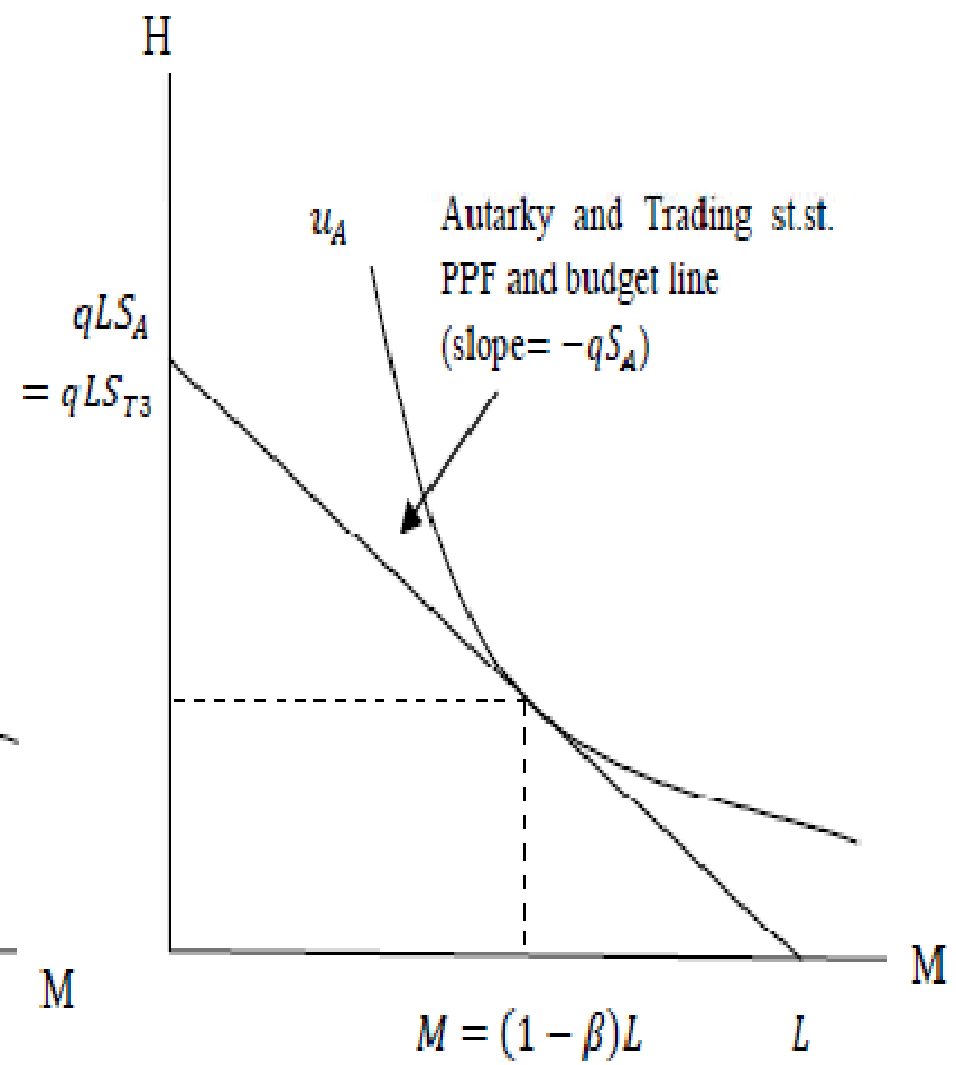
iii) trade does not change steady state utility in domestic country;

iv) trade causes steady state utility to rise in foreign country.

- A standard result in a Ricardian model



5.1 The foreign country



5.2 The domestic country

Figure 5. Transition to a steady state in case (iii)

Summary

	S	u	u^*
Case (i)	↓	↑ or ↓	↓
Case (ii)	↓ or —	↑ or ↓	↑ or ↓
Case (iii)	—	—	↑

Possible Extension

- Tax and tariff
- Resource management: input control, output control
- Dynamic analysis

Thank you for your attention!

