ADVANCED INTERNATIONAL TRADE

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Theweek.com

Trade in India today

- Atma Nirbhar Bharat:

- https://www.youtube.com/watch?v=Xvrsjr47KL8

Introduction

- Before we start, what does world trade look like today?
  - *Differentiation within sectors and products*
    - http://comtrade.un.org/data/
  - *Fragmentation of production*
    - http://apps.npr.org/tshirt/#/title
  - *Trade in services*
- Implications?

Structure of the Course

- Explore theories of International Trade
- Ask if data supports theories
- If not, ask why not?
- Get hands on experience with data
- Talk about trade policy

Introduction

Questions

- Why do countries trade?
- Why do countries trade the way they do?
- Is trade good? Always?
- Who really benefits from trade?

Introduction

Models:

- Ricardian: because countries are good at different things
- HO: because countries are endowed differently

Introduction

- These models make too many assumptions
  - *2 x 2 x 2, CRS, homogenous agents*

- Let's relax some of them
  - *What happens in a 'realistic' world with many countries and infinite products?*
  - *What happens if there is IRS?*
  - *Not all firms are the same, what happens when you account for this?*

Course Structure

Week/Module	Topic
1	Theories of comparative advantage: Ricardian model
2	Factor Endowment Models, Trade and Imperfect Competition, Trade and Heterogenous firms
3	Computer lab session
4	Trade Policy

Empirical Exercises

- Gravity models
- Firm productivity and performance
- Use STATA

Resources

- *Texts*:
  - *Feenstra, C. Robert (2004), Advanced International Trade: Theory and Evidence, Princeton University Press.*

- *Additional texts:*
  - *Dixit, Avinash K. and Victor Norman (1980), Theory of International Trade. Cambridge, U.K.: Cambridge University Press.*
  - *Jagdish N. Bhagwati, Arvind Panagariya, and T. N. Srinivasan (1998), Lectures on International Trade, 2nd edition, Cambridge, MA: MIT Press.*

- Readings: See syllabus

The Ricardian Model

- 2 x 2 Ricardian model
- Extend to multiple countries, multiple goods
  - *Dornbusch, Fischer and Samuelson (1977), AER*
  - *Eaton, Kortum (2012), JEP*
- Productivity and competitiveness

Why Trade?
Comparative Advantage

A thought experiment:

Ruth Porat and Indira Nooyi

Table: Unit labour requirements (hours/unit)

	Manage investments	**Cook**
Ruth	1 hr/unit	2 hrs/unit
Indira	6 hrs/unit	4 hrs/unit

How best should they allocate time during the day?

Options:

1. No trade: Both manage investments and cook
2. Trade A: Ruth manages investments and Indira cooks
3. Trade B: Indira manages investments and Ruth cooks

Solutions

Solution	Hours for **Ruth**	Hours for **Indira**
No trade	3	10
Trade A	2 (= 2x1)	8 (=2x4)
Trade B	4 (= 2x2)	12 (= 2x6)

2 x 2 Ricardian model

Table: Unit labour requirements (hours/unit)

	Wool	Coffee
Australia	a^A_{LW} = 1 hr/unit	a^A_{LC} = 2 hr/unit
Brazil	a^B_{LW} =6 hr/unit	a^B_{LC} = 3 hr/unit

How does trade happen?

Kenya, coffee

India, pepper

2 x 2 Ricardian model

Table: Unit labour requirements (hours/unit)

	Wool	**Coffee**
Australia	a^{A}_{LW} = 1 hr/unit	a^{A}_{LC} = 2 hr/unit
Brazil	a^{B}_{LW} =6 hr/unit	a^{B}_{LC}= 3 hr/unit

How does trade happen? Through different relative prices:

<u>Australia</u>

The opportunity cost of producing 1 unit of wool is to sacrifice ½ units of Coffee

= ½ before trade

<u>Brazil</u>

The opportunity cost of producing 1 unit of wool is to sacrifice 2 units of coffee

= 2 before trade

2 x 2 Ricardian model

Table: Unit labour requirements (hours/unit)

	Wool	**Coffee**
Australia	a^A_{LW} = 1 hr/unit	a^A_{LC} = 2 hr/unit
Brazil	a^B_{LW} =6 hr/unit	a^B_{LC}= 3 hr/unit

How does trade happen? Through different relative prices:
Equilibrium requires that workers are paid their marginal product in both sectors.

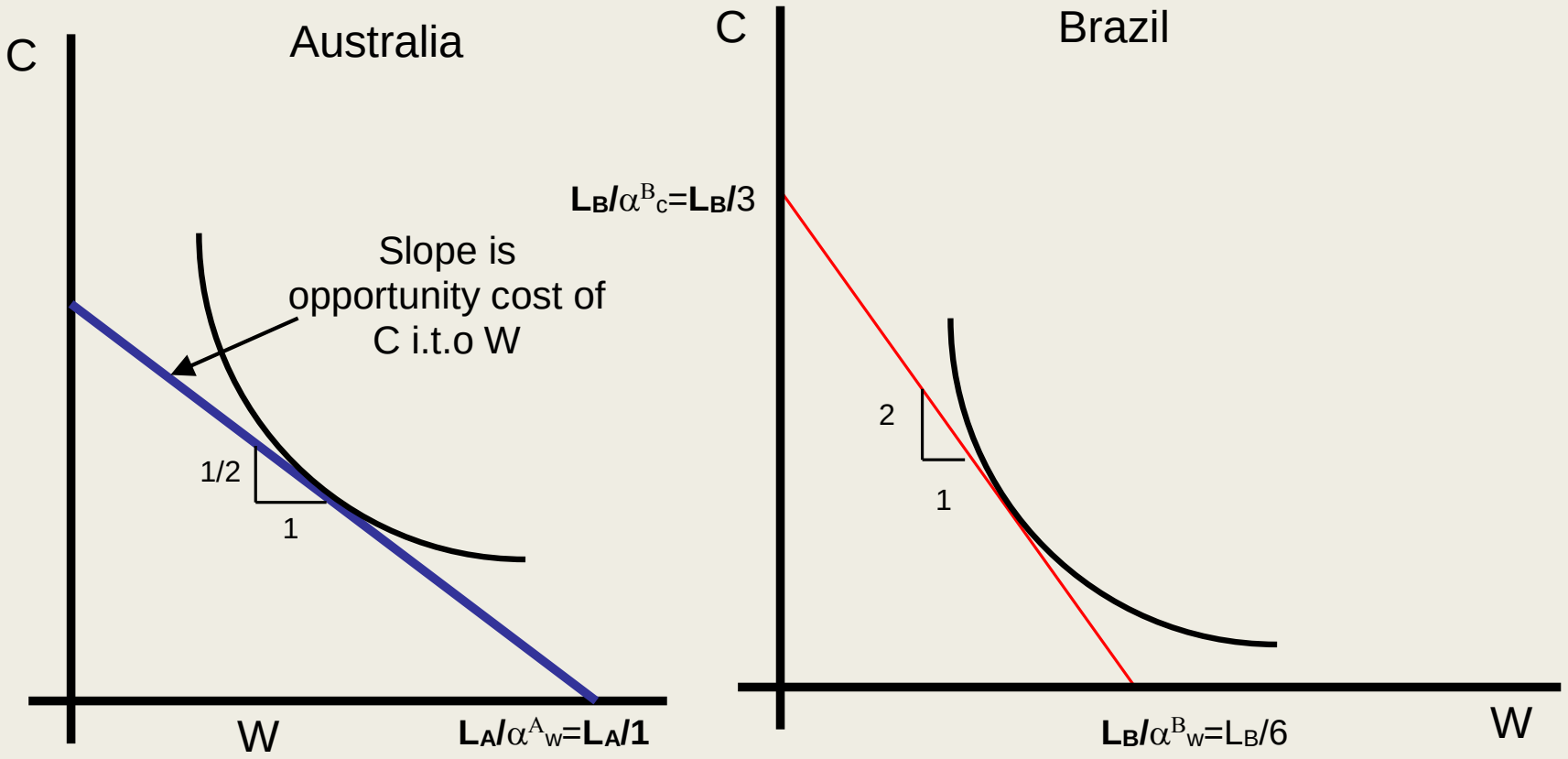
<u>Australia</u>
Wage = $P_w/1 = P_c/2$
Implies P_w/P_c = ½ before trade

<u>Brazil</u>
Wage = $P_w/6 = P_c/3$
Implies $P_w/P_c = 2$ before trade

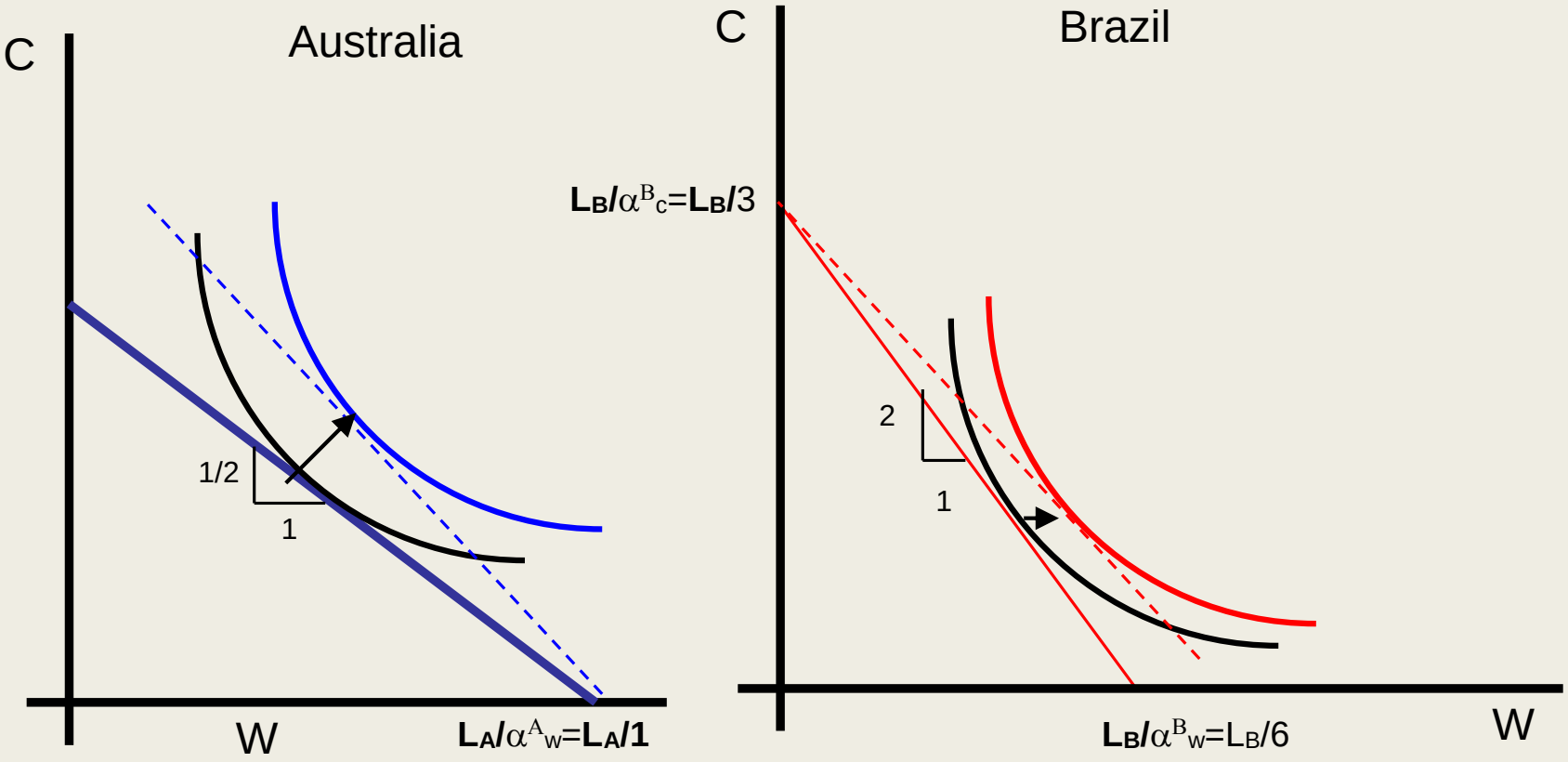
Post trade relative price: $1/2 < P_w/P_c^* < 2$

Graphical analysis: Gains from trade

Pre Trade



Post trade


C
Australia
1/2
1
W
$L_A/\alpha^A_w=L_A/1$
C
Brazil
$L_B/\alpha^B_c=L_B/3$
2
1
$L_B/\alpha^B_w=L_B/6$
W

Questions

- Who gains most?
- What are sources of gain?
- Who earns higher wages?

Extensions

- Dornbusch, Fischer and Samuelson (1977), AER
  - Unit labor costs and export comeptitiveness
  - Analyze impacts of technological change and growth

- Eaton, Kortum (2012), JEP
  - Foundation for the gravity model
  - Gains from trade

DFS Continuum of goods model

Extend model to multiple goods
Main model used in empirical analysis

We are dealing with a general equilibrium model, which requires equilibrium in three markets:

- Production/technology side
- Consumer demand
- Equilibrium (Markets clear)

Assumptions

- Perfect competition
- Identical homothetic tastes
- Continuum of goods, $z \in [0,1]$
- L and L* labour endowments
- Technology: $a(z) = l(z)/y(z)$

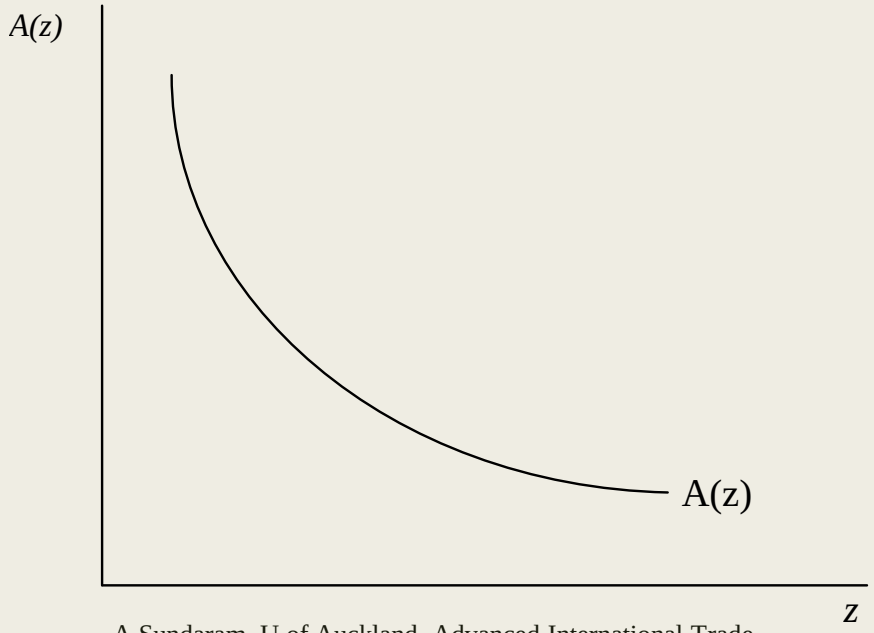
Production equilibrium

The productivity of the home country relative to the foreign country (*):

Eq. 1 $$A(z) \equiv \frac{a^*(z)}{a(z)}$$

Index z such that the unit labour requirements are ranked in terms of diminishing home country advantage, *A(z)*.

Figure 1: Diminishing home country relative productivity



What does home produce? All goods where home price is lower

Eq. 2 $P(z) = a(z)w$

Similarly, $P^*(z) = a^*(z)w^*$.

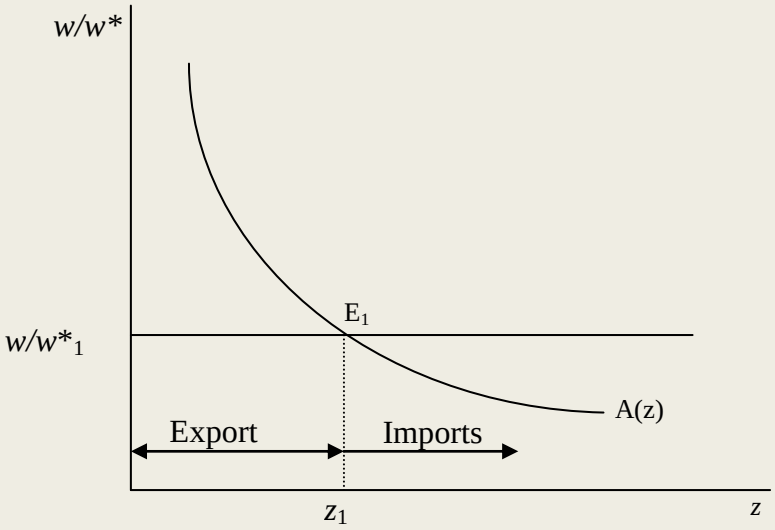
Eq.3 $a(z)w \leq a^*(z)w^*$.

or

Eq.4 $\frac{w}{w^*} \leq A(z) \equiv \frac{a^*(z)}{a(z)}$.

Relative wage ≤ relative productivity

Figure 2: The continuum goods model



Consumer Demand

Assume identical homothetic utility functions, which are represented by a Cobb Douglas function.

Let $b(z)$ be the share of income spent on good z

$$b(z) = P(z)C(z)/Y.$$

Fraction of income spent on domestic goods $[0, \bar{z}]$:

Eq.6 $$G(\bar{z}) = \int_0^{\bar{z}} b(z)dz$$

The share expenditure on foreign goods is equal to $1 - G(\bar{z})$. Note $G'(\bar{z}) > 0$.

Equilibrium in the home consumer market requires that
INCOME = EXPENDITURE
Or

Eq.7 $$wL = G(\bar{z})[wL + w^* L^*]$$

This can be manipulated to:

Eq.8 $$\frac{w}{w^*} = \frac{G(\bar{z})}{1 - G(\bar{z})}\left(\frac{L^*}{L}\right) \equiv B\left(\bar{z}, \frac{L^*}{L}\right)$$

Alternatively, we can manipulate Eq 8 into a balance of payments condition:

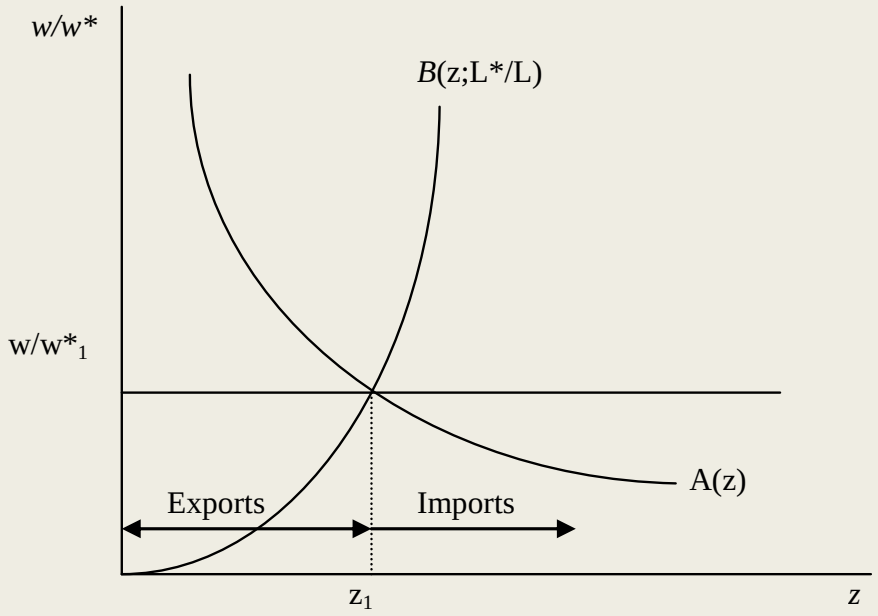
Eq. 1 $$wL[1-G(\bar{z})] = G(\bar{z})w^*L^*$$

IMPORT VALUE = EXPORT VALUE

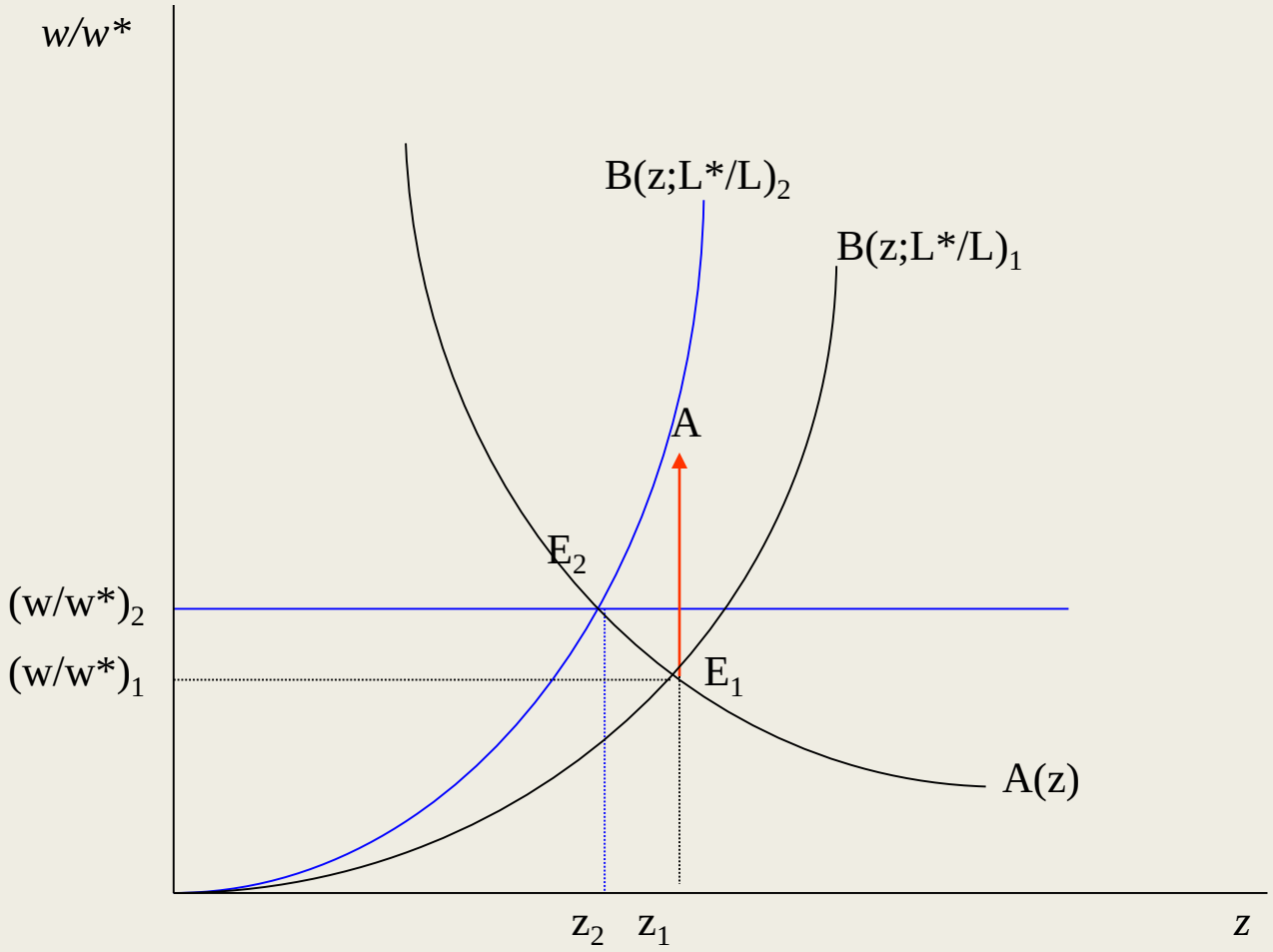
Markets clear

Figure 1 represents equilibrium in both the producer and consumer markets.

Figure 1: The continuum goods model



Increase in Foreign L* (↑ 10%)



Welfare Effects: Home

Goods produced at home [0,z_2]

- $P = w.a(z)$ or $P/w = a(z)$
- $\Delta\, a(z)=0$ => real wage in terms of home produced goods is constant

Goods previously imported [z_1,1]

- $P^* = w^*.a^*(z)$
- Dividing through by w, we obtain:

$$\frac{P^*}{w} = \frac{w^*}{w} a^*(z)$$

Goods previously produced [z1, z2]

- Because the goods are now imported, we know that
- $P^*(z) < w.a(z)$ or $P^*(z)/w < a(z)$
- Prior to prod improvements $P(z)/w = a(z)$

Welfare Effects: Foreign

Goods imported $[0,z_2]$

- $P = w.a(z)$ or
- $P/w^* = w/w^*a(z)$

Goods previously imported $[z_1, z_2]$

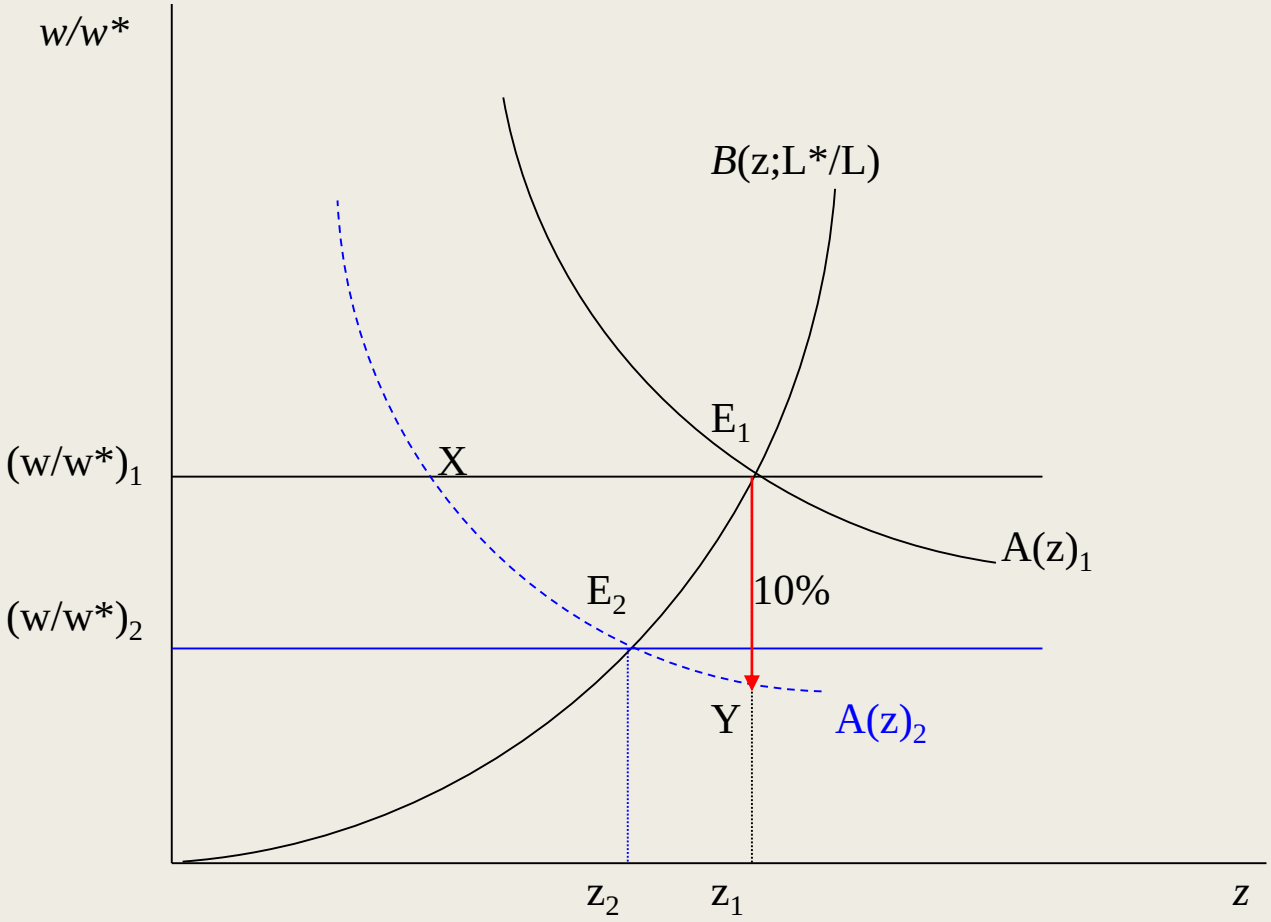
- Previously $P(z) < w^*a^* \Rightarrow P(z)/w^* < a^*$
- Now: $P^* < P \Rightarrow P^*/w^* = a^*$
- I.e. P^*/w^* has risen
- Decline in price faced by foreign over this range is less than decline in wage so welfare declines

Share world income

- Share Foreign in world income rises

  $w^*L^*/[wL+w^*L^*]$

Productivity shock: $a^*(z)$ drops by 10%



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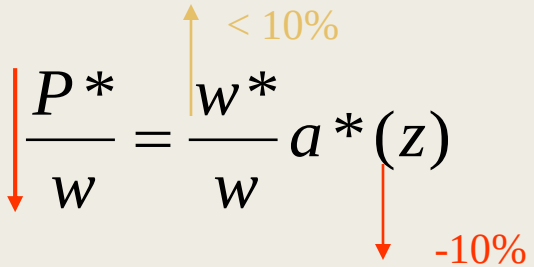

Goods previously produced [z1, z2]

- Because the goods are now imported, we know that
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- Prior to prod improvements $P(z)/w = a(z)$

"The Ricardo one-factor model is a very poor setting in which to study the impacts of technologies on trade flows, because the one-factor model is just too simple" (Leamer and Levinsohn, 1995)

Limitations

- Assumes complete specialisation
- Assumes labour is the only factor of production

BUT

- When capital is mobile and production is footloose between countries, it is the relative price of non-tradable *inputs*, notably labor, rather than *outputs* that matters.
- Evidence of technology gaps between countries is widespread (Harrigan, 1999) and the inclusion of technology differences improves the ability of the HOS model to predict trade flows on the basis of relative factor endowments (Trefler, 1995).

Testable hypothesis

Export product if Relative wage less than relative productivity

$$\frac{w}{w^*} < A(z) \equiv \frac{a^*(z)}{a(z)}.$$

Alternatively, of relative unit labour costs (RULC) < 1

$$RULC = \frac{wa(z)}{w^* a^*(z)} < 1.$$

To estimate need data on (a) Wages, (b) Real output, (c) employment

Evidence

(1) MacDougal (1951, 1952):

$$\frac{X^{Tot}_{i,UK}}{X^{Tot}_{i,US}} = \beta_0 + \beta_1 \frac{\text{LProd}_{i,UK}}{\text{LProd}_{i,US}}$$

$\beta_1 > 0$, but level of trade small relative to predictions

(2) Golub (2004)

Sectoral Trade Balance on Relative Sectoral Unit Labor Costs:

Agriculture and Seven Manufacturing Sectors, 1970-1989 (Golub, 1994)

	Simple OLS Model	**Fixed Effect Model**
U.S.	-0.16 (7.6)**	-0.12 (3.2)**
Canada	0.44 (2.0)*	-0.13 (1.3)
Japan	-0.10 (3.6)**	-0.18 (7.4)**
Germany	-0.16 (2.2)*	-0.12 (5.3)**
France	0.10 (1.6)	-0.19 (5.5)**
Italy	-0.73 (8.9)**	0.03 (0.7)
U.K.	-0.10 (2.2)*	-0.38 (6.9)**

But explanatory power remains small.

What are the effects of a rise in foreign productivity?

Table: The following table presents data on relative productivity levels in Japan, and the US between 1950 - 90. (U.S. = 100)

	1950	**1965**	**1973**	**1979**	**1990**
Japan/US					
Food, beverages, tobacco	26.7	25.8	39.5	39.8	37
Textiles, apparel, leather	24.7	37.5	53.2	54.9	48
Chemicals	13	32.1	60.4	78	83.8
Basic, fabricated metals	12.5	23.1	61.4	84.3	95.6
Machinery, equipment	8	23.5	50.6	79.6	114.4
Other manufacturing	9.7	20	34	39.8	54.9

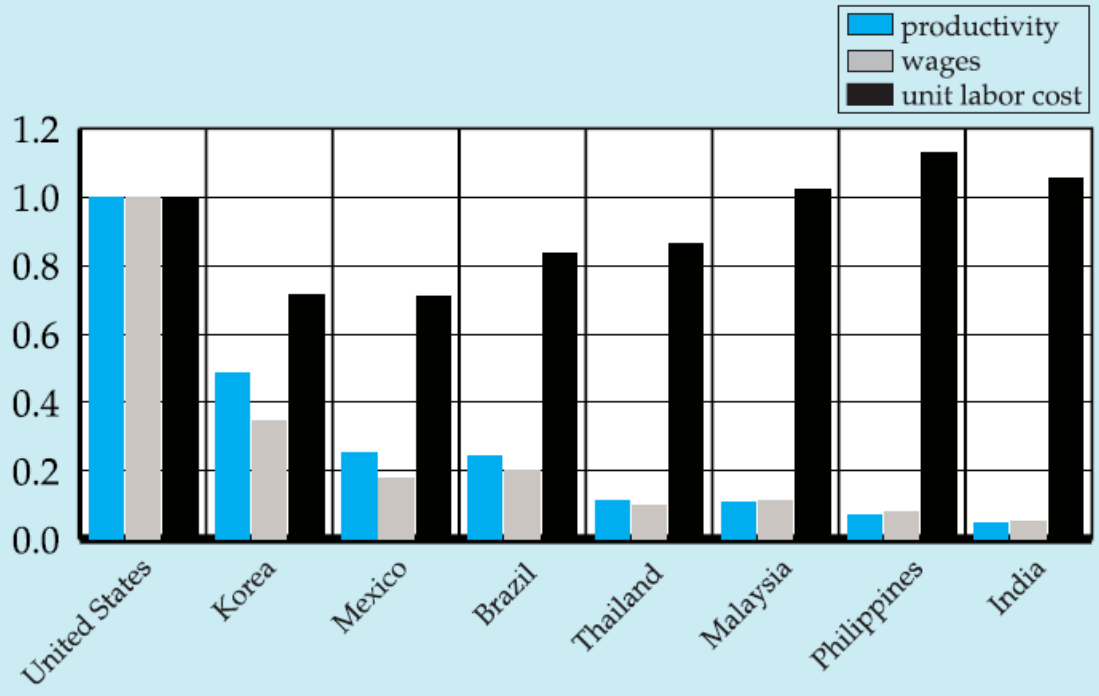
Source: Yarbrough and Yarbrough (2000)

So does trade with low wage countries like China hurt advanced countries like the US?

Does Trade with Low-Wage Countries Hurt American Workers? *Stephen Golub*

FIGURE 2

Labor Productivity, Wages, and Unit Labor Costs in Developing Countries, Relative to the United States



Source: Golub (1995)

India's case

- Regular and casual daily wage growth in India between 2004-05 and 2011-12 was approx. 20%
  - https://www.ilo.org/wcmsp5/groups/public/---asia/---ro-bangkok/---sro-new_delhi/documents/publication/wcms_638305.pdf
- What about India's export competitiveness?
- Look at productivity growth to get a sense of unit labor cost:
  - https://www.rbi.org.in/Scripts/KLEMS.aspx
  - KLEMS12072019.xlsx

Many Countries – EK model

Continuum of goods $u \in [0,1]$

N countries

CES preferences $U_i = \left(\int_0^1 q_i(u)^{(\sigma-1)/\sigma} du \right)^{\sigma/(\sigma-1)}$

One factor – labor, wage w_i

Productivity $Z_i(u)$

Follows a Fréchet distribution (from now, disregard u)

$$\Pr(Z_i \leq z) = F_i(z) = e^{-T_i z^{-\theta}}$$

EK Model

Trade is subject to iceberg transport cost $d_{ni} \geq 1$

All markets perfectly competitive

Unit-cost of delivering from i to n: $P_{ni}(\mathbf{Z}) \equiv c_i d_{ni} / Z_i$

Note that if labor is the only factor, c=w

CDF of p:

$$G_{ni}(p) = \Pr\left(Z_i \geq c_i d_{ni} / p\right) = 1 - F_i(c_i d_{ni} / p)$$

EK model

Let $P_n(\mathbf{Z}) \equiv \min\{P_{n1}(\mathbf{Z}), ..., P_{nN}(\mathbf{Z})\}$

And $G_n(p) \equiv \Pr(P_n(\mathbf{Z}) \leq p)$

Now
$$\begin{aligned} \Pr(P_n \leq p) &= 1 - \Pi_i \Pr(P_{ni} \geq p) \\ &= 1 - \Pi_i [1 - G_{ni}(p)] \end{aligned}$$

Since $G_{ni}(p) = 1 - F_i(c_i d_{ni} / p)$

$$\begin{aligned} 1 - \Pi_i [1 - G_{ni}(p)] &= 1 - \Pi_i F_i(c_i d_{ni} / p) \\ &= 1 - \Pi_i e^{-T_i (c_i d_{ni})^{-\theta} p^{\theta}} \\ &= 1 - e^{-\Phi_n p^{\theta}} \end{aligned}$$

Where
$$\Phi_n \equiv \sum_{i=1}^{N} T_i (c_i d_{ni})^{-\theta}$$

EK model

Probability that country n buys from i is

$$\pi_{ni} = \Pr\left(P_{ni} \leq \min_{s \neq i} P_{ns}\right)$$

If $P_{ni} = p$

then the probability that i is the least cost supplier to n is equal to the probability that

$$P_{ns} \geq p \text{ for all } s \neq i$$

Or

$$\Pi_{s \neq i} \Pr(P_{ns} \geq p) = \Pi_{s \neq i} \left[1 - G_{ns}(p)\right] = e^{-\Phi_n^{-i} p^{\theta}}$$

$$\Phi_n^{-i} = \sum_{s \neq i} T_i \left(c_i d_{ni}\right)^{-\theta}$$

EK model

Integrating over p times density $dG_{ni}(p)$

$$\int_0^\infty e^{-\Phi_n^{-i} p^\theta} T_i \left(c_i d_{ni}\right)^{-\theta} \theta p^{\theta-1} e^{-T_i (c_i d_{ni})^{-\theta} p^\theta} dp$$

$$= \left(\frac{T_i \left(c_i d_{ni}\right)^{-\theta}}{\Phi_n} \right) \int_0^\infty \theta \Phi_n e^{-\Phi_n p^\theta} p^{\theta-1} dp$$

$$= \pi_{ni} \int_0^\infty dG_n(p) dp = \pi_{ni}$$

EK model

The exact price index for a CES utility function is:

This is

$$p_n \equiv \left(\int_0^1 p_n(u)^{1-\sigma} du \right)^{1/(1-\sigma)}$$

$$p_n^{1-\sigma} = \int_0^1 p_n(u)^{1-\sigma} du =$$

$$\int_0^\infty p^{1-\sigma} dG_n(p) = \int_0^\infty p^{1-\sigma} \Phi_n \theta p^{\theta-1} e^{-\Phi_n p^\theta} dp$$

Defining $x = \Phi_n p^\theta$, then $dx = \Phi_n \theta p^{\theta-1}$, $p^{1-\sigma} = (x/\Phi_n)^{(1-\sigma)/\theta}$, and

$$p_n^{1-\sigma} = \int_0^\infty (x/\Phi_n)^{(1-\sigma)/\theta} e^{-x} dx$$

$$= \Phi_n^{-(1-\sigma)/\theta} \int_0^\infty x^{(1-\sigma)/\theta} e^{-x} dx$$

$$= \Phi_n^{-(1-\sigma)/\theta} \Gamma\left(\frac{1-\sigma}{\theta} + 1 \right)$$

EK model

Hence $p_n = \gamma \Phi_n^{-1/\theta}$

If X_{ni} is the total spending by n on i's goods

Then $X_{ni}/X_n = \pi_{ni}$

Also, $$\pi_{nn} = \frac{X_{nn}}{X_n} = \frac{T_n w_n^{-\theta}}{\Phi_n}$$

Given $p_n = \gamma \Phi_n^{-1/\theta}$

We know that $\omega_n \equiv w_n / p_n = \gamma^{-1} T_n^{1/\theta} \pi_{nn}^{-1/\theta}$

Under autarky: $\omega_n^A = \gamma^{-1} T_n^{1/\theta}$

Hence, Gains from Trade - $\omega_n / \omega_n^A = \pi_{nn}^{-1/\theta}$

EK Gains from trade

Assume a $\theta = 5$

We can calculate gains if we know the share of n's production consumed by n.

For Belgium, $\pi_{nn} = 0.2$

Hence, Gains from Trade = $GT_n = 0.2^{-1/5} = 1.38$ or 38%.

Can you calculate Gains from Trade for India?