

# MIT 14.662 Spring 2018: Lecture 7 – Trade and Labor Markets

David Autor, MIT and NBER

February 28, 2018

# Agenda

- 1 **Rising Trade Flows**
- 2 **Trade and Inequality—Is There a Connection?**
- 3 **Factor-Biased Technical Change in a One Good Economy**
- 4 **A  $2 \times 2$  Heckscher-Ohlin Economy**
  - From autarky to free trade
  - Factor-Biased Technical Change
  - Pervasive factor-biased technical change
- 5 **Some Evidence**
- 6 **The Silence of the Lerner Diagram**

# Trade Flows Fell at Start of WW I, Did Not Rebound Until 1970s!

Ratios of Merchandise Trade to GDP (percent)

Country	1890	1913	1960	1970	1980	1990
Australia	15.7	21.0	13.0	11.5	13.6	13.4
Canada	12.8	17.0	14.5	18.0	24.1	22.0
Denmark	24.0	30.7	26.9	23.3	26.8	24.3
France	14.2	15.5	9.9	11.9	16.7	17.1
Germany	15.9	19.9	14.5	16.5	21.6	24.0
Italy	9.7	14.4	10.0	12.8	19.3	15.9
Japan <sup>a</sup>	5.1	12.5	8.8	8.3	11.8	8.4
Norway	21.8	25.5	24.9	27.6	30.8	28.8
Sweden	23.6	21.2	18.8	19.7	25.0	23.5
United Kingdom	27.3	29.8	15.3	16.5	20.3	20.6
United States <sup>b</sup>	5.6	6.1	3.4	4.1	8.8	8.0

Notes: Merchandise trade is measured as the average of imports and exports, except as noted below.

<sup>a</sup> Data for 1890–1950 uses three-year averages.

<sup>b</sup> Data recorded under 1890 is for 1889, and along with that in 1913, measures the ratio of merchandise exports to GNP.

Sources:

1960–1990: Data for the United States are taken from *Economic Report of the President, 1997*, Tables B-10 and B-101; data for other countries are calculated from *World Tables of Economic and Social Indicators, 1950–1992*, The World Bank, 1993.

1890–1913: Data for the United States from Irwin (1996, Table 1); data for Japan from Bairoch and Kozul-Wright (1996); data for other countries from Williamson (1996, Table 1).

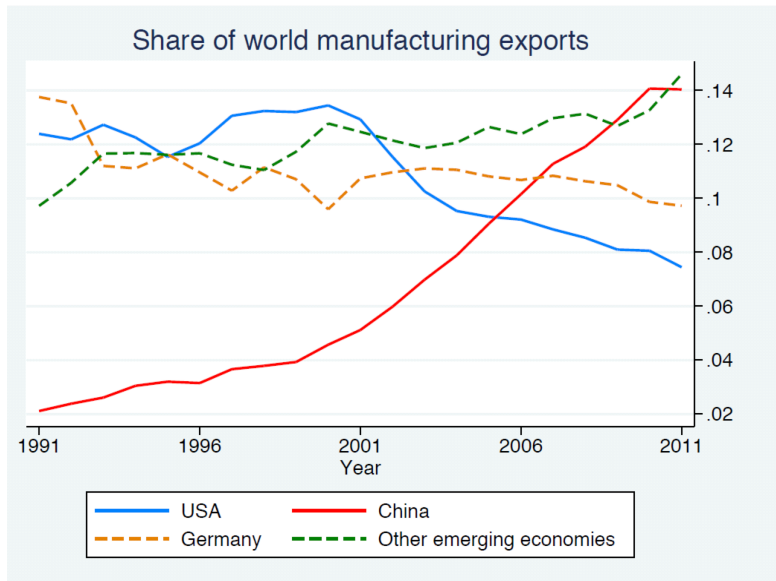
## Merchandise Trade to GDP 1960 – 2009: Rising

	1960	1970	1980	1990	2000	2009
Australia		23.6	29.4	26.0	32.5	34.6
Canada	28.9	36.0	48.4	43.1	71.9	48.4
China	8.5	5.0	20.1	32.3	39.6	44.3
Denmark	52.8	46.8	51.8	51.7	60.5	56.9
France	21.0	25.3	36.3	36.2	50.2	39.4
Germany		30.7	41.4	45.3	55.2	62.0
India	9.9	6.8	12.8	13.1	20.4	29.9
Italy	20.8	25.8	38.9	31.1	43.7	38.7
Japan	19.3	18.5	25.4	17.1	18.4	22.3
Norway	45.4	48.4	55.7	52.1	56.1	49.8
Singapore	380.0	211.7	369.8	308.1	293.7	282.9
Sweden	36.8	39.1	48.8	45.7	64.7	61.8
United Kingdom	32.7	33.1	41.6	40.3	42.9	38.4
United States	7.1	8.4	17.4	15.8	20.6	18.8

# China's Opening



# Changing Shares of World Manufacturing

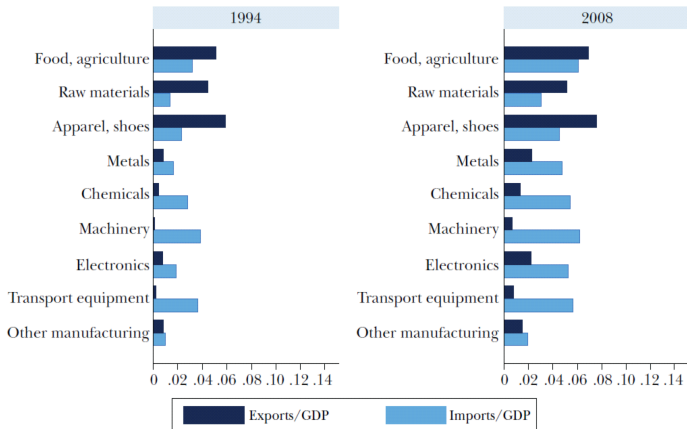


# Changing Composition of Trade

## Sector Trade Shares of GDP, by Income Group

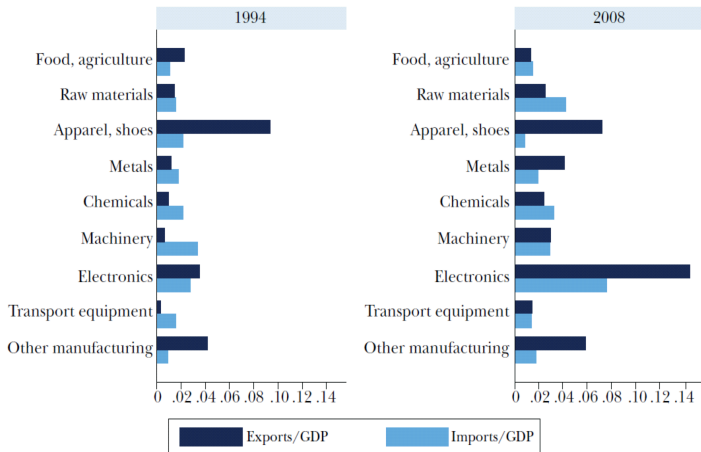
A: Low-income countries

Per capita GDP of less than \$800 (in 2000 U.S. dollars);



# Changing Composition of Trade

B: China and India

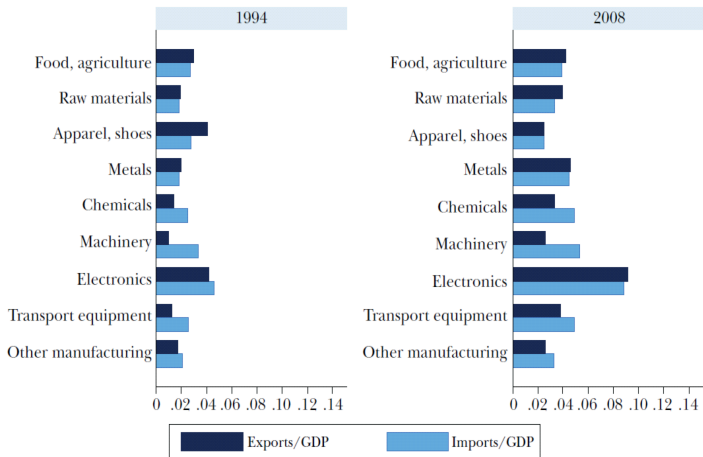




# Changing Composition of Trade

## C: Middle-income countries

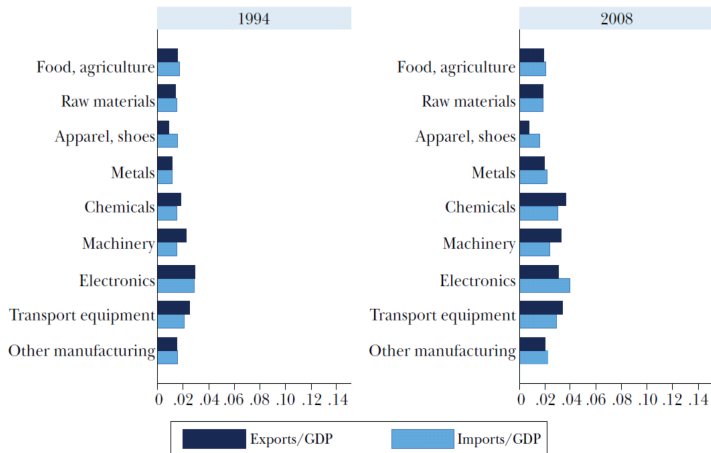
Per capita GDP of \$800 to \$10,000: Brazil, Korea, Mexico, Russia, Argentina, Turkey, Indonesia, Poland, South Africa, Thailand, Egypt, Colombia, Malaysia, the Philippines, and Chile.



# Changing Composition of Trade

D: High-income countries

Per capita GDP of \$10,000 to \$33,000.

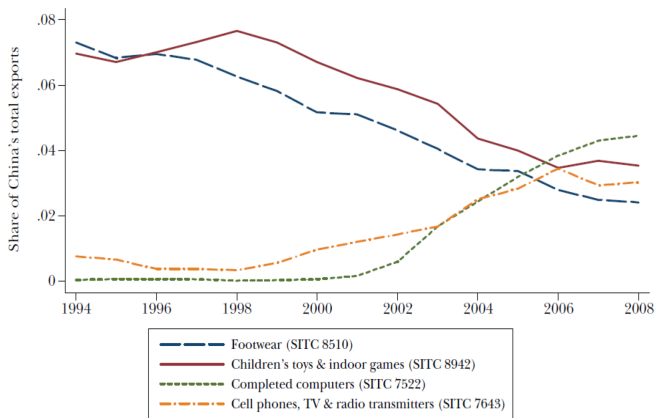


# China's Changing Specialization

Figure 3

China's Top Export Products, 1994–2008

Per capita GDP of \$10,000 to \$33,000.



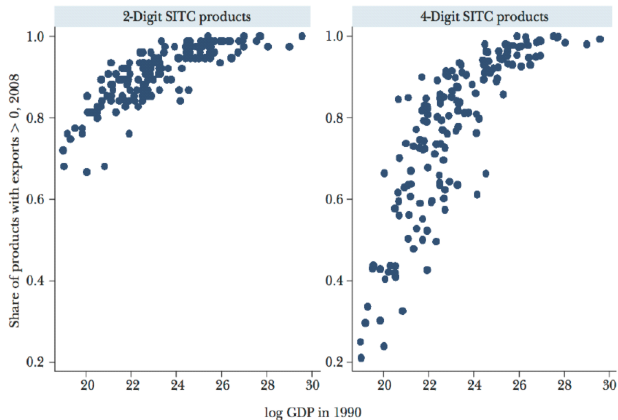
Source: Author's calculations using (World Bank) World Development Indicators and UN Comtrade.



# Hyper-Specialization

Figure 5

Share of Products with Positive Exports by Country



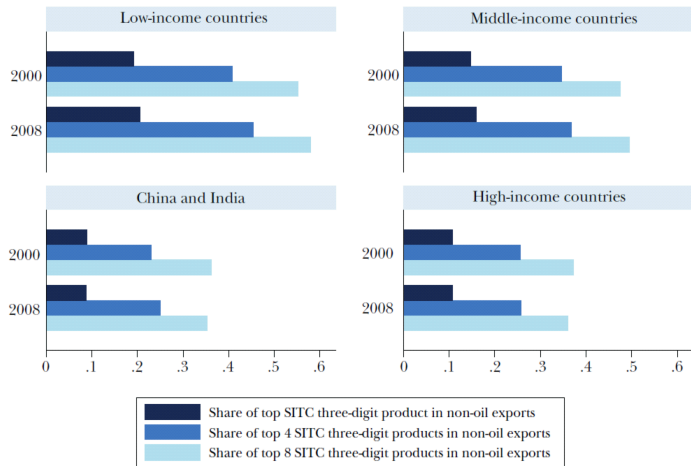
Source: Author's calculations using (World Bank) World Development Indicators and UN Comtrade.

Note: Using data for 2008, Figure 5 shows the fraction of products in which countries have greater than zero exports, plotted against log real GDP, as a measure of country size.

# Hyper-Specialization

Figure 6

Concentration of Non-Oil Exports in Top Products



# Agenda

- 1 Rising Trade Flows
- 2 Trade and Inequality—Is There a Connection?
- 3 Factor-Biased Technical Change in a One Good Economy
- 4 A  $2 \times 2$  Heckscher-Ohlin Economy
  - From autarky to free trade
  - Factor-Biased Technical Change
  - Pervasive factor-biased technical change
- 5 Some Evidence
- 6 The Silence of the Lerner Diagram

## Was/Is Trade Responsible for Rising Global Inequality?

- Until 1990s, most economists said “probably not”
- But... things have changed a lot since then.
  - Rising share of low-income countries in world trade (China!)
  - Increasing trade flows b/w low and middle income countries
  - China's rise



# Trade and Inequality

- Opening up to trade: equivalent to skill transfers b/w economies
- North-South trade: trade b/w skill-endowed and unskilled economies
  - Implications for the (relative) supply of skills in developed countries?
  - Which skill group should be better off in the US?

## Trade and Inequality: Simple Example

- Suppose the final good is produced according to

$$Y = \left[ Y_L^\rho + Y_H^\rho \right]^{\frac{1}{\rho}}$$

where

$$Y_j = A_j J \text{ for } j = H, L$$

- Each intermediate good is tradable, and its US price is given by  $p_j$
- What happens when the US moves from autarky to free trade?

## Trade and Inequality: Autarky

- Before trade, the US relative price is given by

$$\begin{aligned} p^{US} &\equiv \frac{p_H}{p_L} = \frac{Y_H^{\rho-1}}{Y_L^{\rho-1}} \\ &= \left( \frac{A_H H}{A_L L} \right)^{\rho-1} \end{aligned}$$

- Thus, the skill premium,  $\omega^{US} \equiv \frac{w_H}{w_L}$  is given by

$$\omega^{US} = p^{US} \frac{A_H}{A_L}$$

## Trade and Inequality: Opening Up to Trade

- Suppose the US starts trading w/ less developed countries (LDCs)
- LDCs relative skill supplies,  $\frac{\hat{H}}{\hat{L}}$ , are lower than in the US:

$$\frac{\hat{H}}{\hat{L}} < \frac{H}{L}$$

- After full trade opening, there is a unique world relative price,  $p^W$
- Relative skill supplies are now given by

$$\frac{H + \hat{H}}{L + \hat{L}}$$

## Trade and Inequality: World Relative Prices

Thus, the world relative price will be *higher* than the US one price

$$p^W = \left( \frac{(H + \hat{H}) A_H}{(L + \hat{L}) A_L} \right)^{\rho-1} > p^{US}$$

- What is the intuition?

## Trade and Inequality: World Relative Wages

- Since  $\omega^W = p^W \frac{A_H}{A_L}$ , it follows directly that

$$\omega^W > \omega^{US}$$

- *That is, trade with LDCs increases US wage inequality*
- What happens in LDCs, instead?
- See Krugman (2000)

## Rising US Inequality: Trade and Technical Change

- Trade and technology are both considered causes of rising inequality
- How can we incorporate SBTC in a standard H-O trade model?
- In H-O models, SBTC is equivalent to a *factor-biased* technical change
  - Change that raises the relative quantity demanded of a specific factor
  - How does this differ from *sector-biased* technical change?

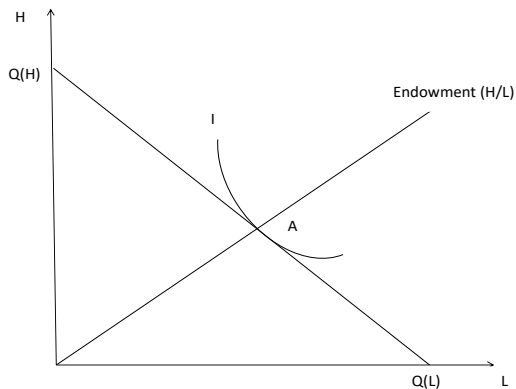
# Agenda

- 1 Rising Trade Flows
- 2 Trade and Inequality—Is There a Connection?
- 3 Factor-Biased Technical Change in a One Good Economy**
- 4 A  $2 \times 2$  Heckscher-Ohlin Economy**
  - From autarky to free trade
  - Factor-Biased Technical Change
  - Pervasive factor-biased technical change
- 5 Some Evidence
- 6 The Silence of the Lerner Diagram



## Factor Biased Technical Change in a One Good Economy

An economy with 1 sector, 2 factors: high- & low-skilled labor

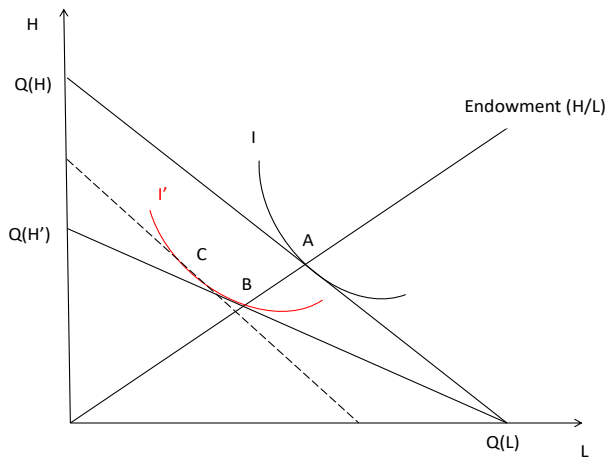


$$\frac{W_H}{W_L} = \frac{Q_L}{Q_H}$$

## Factor Biased Technical Change in a One Good Economy

- Hicks neutral technical change moves isoquant  $I$  towards the origin
  - This raises real earnings but leaves relative skill prices unchanged
- Instead, SBTC moves  $I$  and shifts its slope
  - High skilled wage rises
  - *What happens to the unskilled wage?*

# Factor Biased Technical Change in a One Good Economy



$$\frac{w'_H}{w'_L} = \frac{Q_L}{Q'_H} > \frac{Q_L}{Q_H}$$

## Factor Biased Technical Change in a One Good Economy

- In a one good economy, SBTC moves  $l$  to  $l'$
- At baseline prices, there will be excess demand for  $L_S$
- Thus, in the new equilibrium,  $\omega' > \omega$

## Factor Biased Technical Change in a One Good Economy

- Familiar predictions: SBTC will...
  - Increase real wages of high skilled workers
  - Increase wage inequality
  - Possibly lower real wages of low skilled workers
- Note that productivity *must* rise
  - Cannot have a demand shift towards more expensive factor without a rise in productivity—otherwise, should use the less expensive factor!
- These predictions match our Katz-Murphy style facts well
  - But, what happens when we introduce a second good?

# Agenda

- 1 Rising Trade Flows
- 2 Trade and Inequality—Is There a Connection?
- 3 Factor-Biased Technical Change in a One Good Economy
- 4 **A  $2 \times 2$  Heckscher-Ohlin Economy**
  - From autarky to free trade
  - Factor-Biased Technical Change
  - Pervasive factor-biased technical change
- 5 Some Evidence
- 6 The Silence of the Lerner Diagram

## A $2 \times 2$ Heckscher-Ohlin Economy

- Suppose the economy produces two goods,  $S$  and  $U$
- Using two factors of production,  $H$  and  $L$  labor
- Sector  $S$  is skill-intensive ( $H$ -intensive), and sector  $U$  is unskilled-intensive ( $L$ -intensive)
- H-O framework assumes
  - Constant return to scale production technology
  - Perfect competition
  - Homothetic preferences
  - Incomplete specialization (i.e., in the cone of diversification)
- Start by assuming that all countries are price takers
  - Why does this matter?

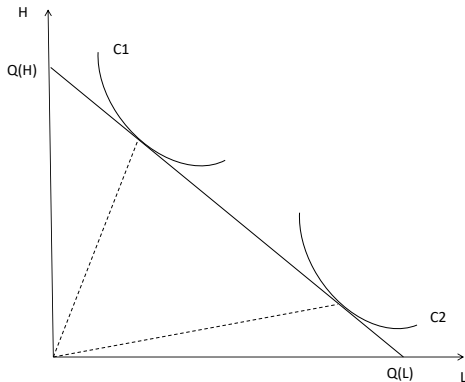
**This Guy**





## Lerner Diagram (Abba Lerner, 1903 – 1982)

A  $2 \times 2$  Heckscher-Ohlin Economy:  $\frac{W_H}{W_L} = \frac{Q(L)}{Q(H)}$



## Math Version: $2 \times 2$ Heckscher-Ohlin Economy

- Let the economy be characterized by the following production functions

$$Y_S = \alpha_1 H^{\beta_1} L^{1-\beta_1}$$

$$Y_U = \alpha_2 H^{\beta_2} L^{1-\beta_2}$$

with  $\beta_1 > \beta_2$

- In this economy,  $S$  good is relatively skill-intensive
  - How do we model a sector-biased technical change?
  - What about a factor biased technical change?

# Agenda

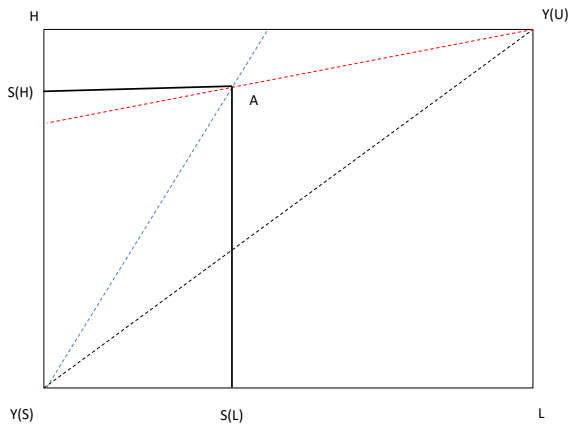
- 1 Rising Trade Flows
- 2 Trade and Inequality—Is There a Connection?
- 3 Factor-Biased Technical Change in a One Good Economy
- 4 **A  $2 \times 2$  Heckscher-Ohlin Economy**
  - From autarky to free trade
  - Factor-Biased Technical Change
  - Pervasive factor-biased technical change
- 5 Some Evidence
- 6 The Silence of the Lerner Diagram

## From Autarky to Free Trade

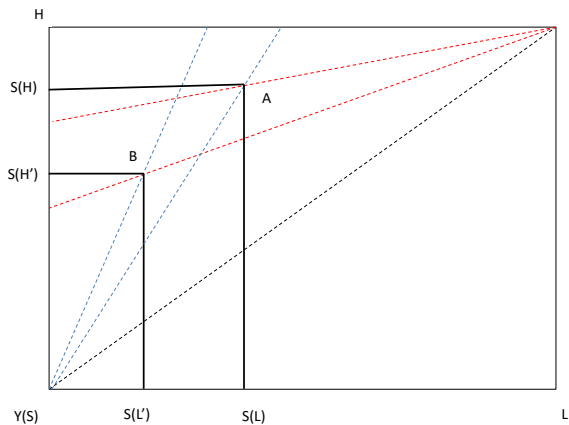
- Consider a small open economy that is relatively skill-intensive
- What happens when this economy *opens up to trade* from autarky?
  - ① The relative price of the skill-intensive good,  $p_s$ ?
  - ② Skill intensity in both sectors  $\left(\frac{H}{L}\right)_S, \left(\frac{H}{L}\right)_U$ ?
  - ③ Skill premium  $W_S/W_U$ ?



# Factor Allocations by Sector



## Factor Allocations by Sector: After $P_S/P_U$ Increase



## From Autarky to Free Trade

- Consider a small open economy that is relatively skill-intensive
- What happens when this economy *opens up to trade* from autarky?
- Isoquant  $C_1$  shifts to the origin
- Relevant margins
  - ① The relative price of the skill-intensive good,  $p_S$ ? *Rises*
  - ② Skill intensity in both sectors  $\left(\frac{H}{L}\right)_S, \left(\frac{H}{L}\right)_U$ ? *Declines*
  - ③ Skill premium  $W_S/W_U$ ? *Rises*
- How does this compare to a Hicks neutral technical change in the S sector?



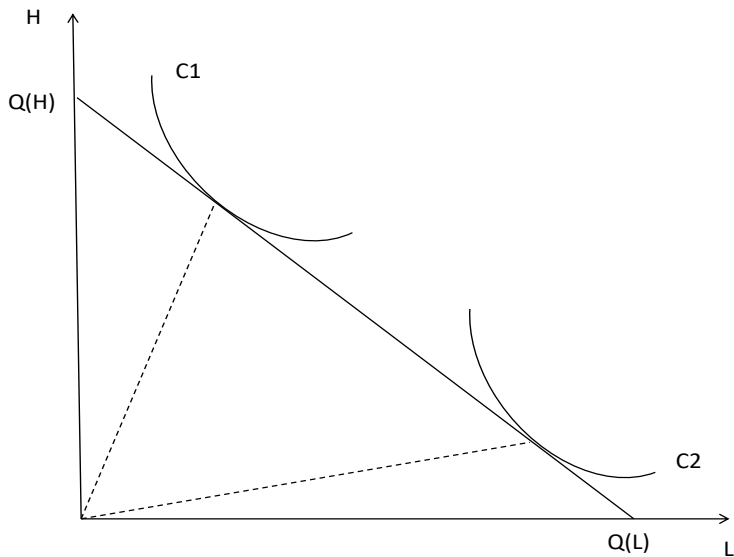
# Agenda

- 1 Rising Trade Flows
- 2 Trade and Inequality—Is There a Connection?
- 3 Factor-Biased Technical Change in a One Good Economy
- 4 **A  $2 \times 2$  Heckscher-Ohlin Economy**
  - From autarky to free trade
  - Factor-Biased Technical Change
  - Pervasive factor-biased technical change
- 5 Some Evidence
- 6 The Silence of the Lerner Diagram

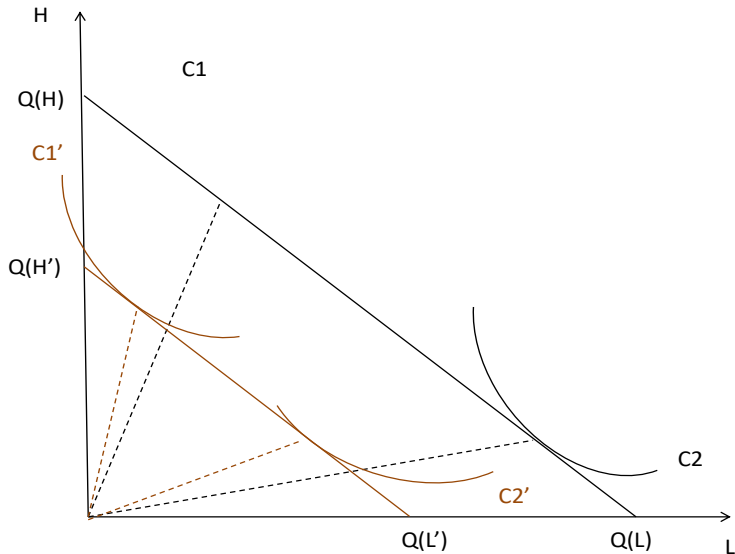
## Factor Biased Technical Change

- A small open economy that is relatively skill-intensive
- What happens when there is a *factor*-biased technical change in  $S$  sector?
  - ① The relative price of the skill-intensive good,  $p_s$ ?
  - ② Skill intensity in both sectors  $\left(\frac{H}{L}\right)_S, \left(\frac{H}{L}\right)_U$ ?
  - ③ Skill premium  $W_S/W_U$ ?

## Factor Biased Technical Change in a SOE



## Factor Biased Technical Change in an SOE



## Factor Biased Technical Change

- A small open economy that is relatively skill-intensive
- What happens when there is a *factor*-biased technical change in  $S$  sector?
  - ① The relative price of the skill-intensive good,  $p_s$ ? *Unchanged*
  - ② Skill intensity in both sectors  $\left(\frac{H}{L}\right)_S, \left(\frac{H}{L}\right)_U$ ? *More skill intensive*
  - ③ Skill premium  $W_S/W_U$ ? *Unchanged*
- When we are 'in the cone' and prices are pinned down by trade, we have 'factor price insensitivity'

# Agenda

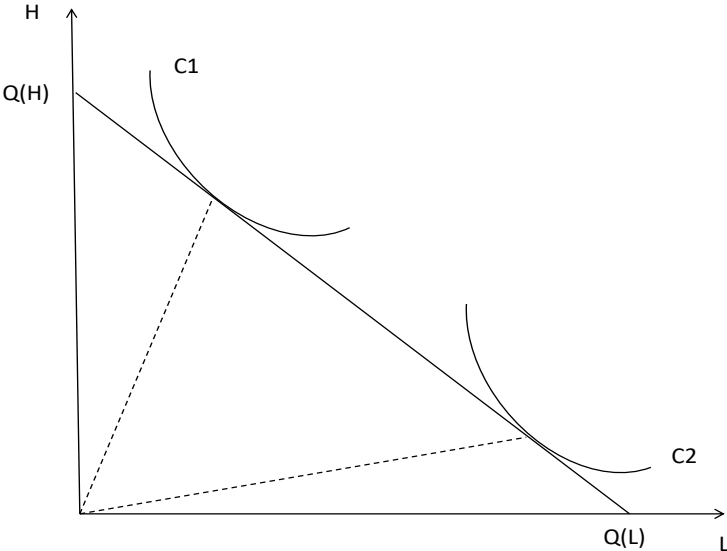
- 1 Rising Trade Flows
- 2 Trade and Inequality—Is There a Connection?
- 3 Factor-Biased Technical Change in a One Good Economy
- 4 **A  $2 \times 2$  Heckscher-Ohlin Economy**
  - From autarky to free trade
  - Factor-Biased Technical Change
  - Pervasive factor-biased technical change
- 5 Some Evidence
- 6 The Silence of the Lerner Diagram

# Pervasive Factor Biased Technical Change

## What if SBTC occurs simultaneously in many economies?

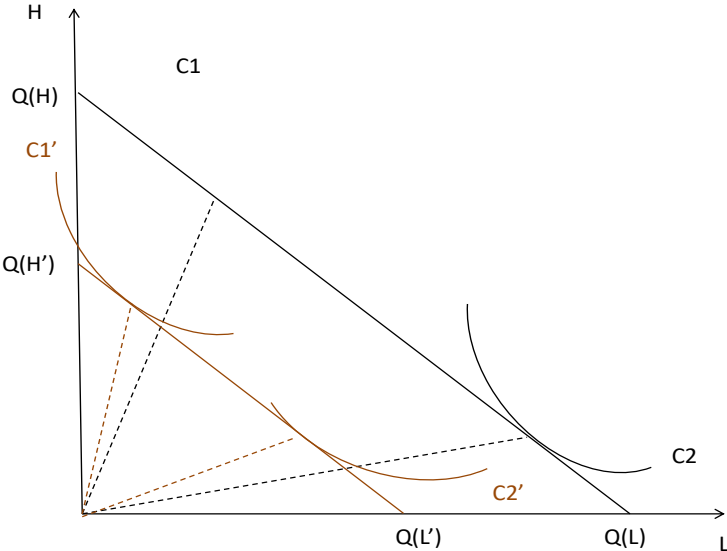
- In this case, the world market acts like a single country in autarky
- What happens to...
  - ① The relative price of the skill-intensive good,  $p_s$ ?
  - ② Skill intensity in both sectors  $\left(\frac{H}{L}\right)_S, \left(\frac{H}{L}\right)_U$ ?
  - ③ Skill premium  $W_S / W_U$ ?
- Pervasive SBTC is consistent with...

# Pervasive Factor Biased Technical Change

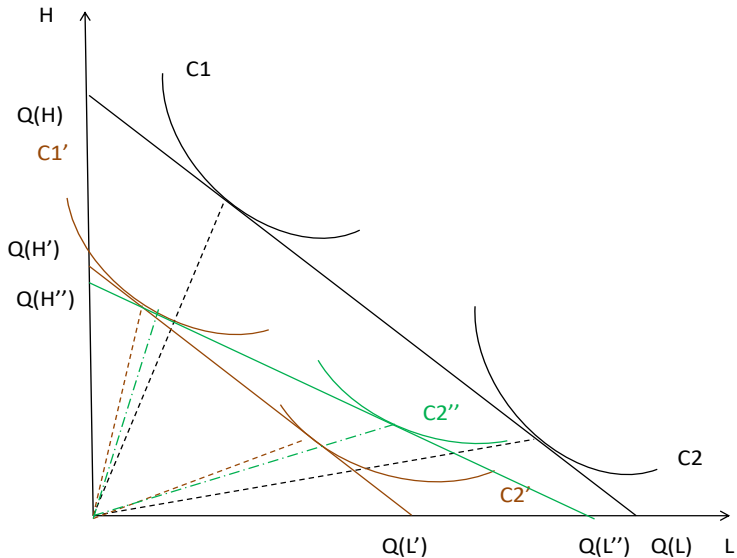




# Pervasive Factor Biased Technical Change



# Pervasive Factor Biased Technical Change



# Pervasive Factor Biased Technical Change

## What if SBTC occurs simultaneously in many economies?

- In this case, the world market acts like a single country in autarky
  - SBTC releases unskilled labor in both sectors
  - The unskilled-intensive sector expands
- What happens to...
  - ① The relative price of the skill-intensive good,  $p_s$ ? *Rises*
  - ② Skill intensity in both sectors  $\left(\frac{H}{L}\right)_S, \left(\frac{H}{L}\right)_U$ ? *Rises*
  - ③ Skill premium  $W_s / W_u$ ? *Rises*
- Pervasive SBTC is consistent with a simultaneous rise in both
  - Demand for high skilled labor
  - Wages of high skilled labor

## Pervasive Factor Biased Technical Change

**To distinguish trade from SBTC, must consider**

- $\Delta$ Relative price of goods  $P_S/P_L$

## Pervasive Factor Biased Technical Change

**To distinguish trade from SBTC, must consider**

- $\Delta$ Relative price of goods  $P_S/P_L$
- $\Delta$ Skill premium  $W_H/W_L$

## Pervasive Factor Biased Technical Change

**To distinguish trade from SBTC, must consider**

- $\Delta$ Relative price of goods  $P_S/P_L$
- $\Delta$ Skill premium  $W_H/W_L$
- $\Delta$ Skill intensity by sector  $\left(\frac{H}{L}\right)_S, \left(\frac{H}{L}\right)_U$

## Pervasive Factor Biased Technical Change

**To distinguish trade from SBTC, must consider**

- $\Delta$ Relative price of goods  $P_S/P_L$
- $\Delta$ Skill premium  $W_H/W_L$
- $\Delta$ Skill intensity by sector  $\left(\frac{H}{L}\right)_S, \left(\frac{H}{L}\right)_U$
- $\Delta$ Relative size of the two sectors sector, measured by output  $\frac{Y_S}{Y_U}$  or labor inputs  $\frac{H_S}{H_U}, \frac{L_S}{L_U}$

# Agenda

- 1 Rising Trade Flows
- 2 Trade and Inequality—Is There a Connection?
- 3 Factor-Biased Technical Change in a One Good Economy
- 4 **A  $2 \times 2$  Heckscher-Ohlin Economy**
  - From autarky to free trade
  - Factor-Biased Technical Change
  - Pervasive factor-biased technical change
- 5 **Some Evidence**
- 6 **The Silence of the Lerner Diagram**



# Within vs. Between-Industry Shifts in Skill Composition

TABLE III  
PROPORTION OF INCREASED WAGE BILL SHARE OF SKILL "WITHIN" INDUSTRIES

Country	1970–1980			1980–1990			Note
	Change in % nonpro- duction (annualized)	% within	Change in wage ratio (%)	Change in % nonpro- duction (annualized)	% within	Change in wage ratio (%)	
U. S.	0.19	86	-2	0.51	76	7	
Norway	0.33	76	-3	—	—	—	1970,80,n/a
Luxembourg	0.90	95	6	0.73	123	12	
Sweden	0.38	81	3	0.07	25	-3	
Australia	0.07	51	-17	0.42	92	2	1970,80,87
Japan	—	—	—	0.14	84	3	n/a*,81,90
Denmark	0.12	42	-11	0.64	89	7	1973,80,89
Finland	0.27	82	-11	0.70	83	-2	
W. Germany	0.67	95	5	—	—	—	1970,79,n/a
Austria	0.69	93	7	0.36	76	7	1970,81,90
U. K.	0.39	91	-3	0.62	92	14	
Belgium	0.77	86	6	-0.06	92	-5	1973,80,85
Average	0.43	79.8	-1.8	0.41	83.2	4.2	

Source: Berman, Bound and Machin 1998

# Does Inequality Fall in Low-Income Countries as it Rises in High Income Countries?

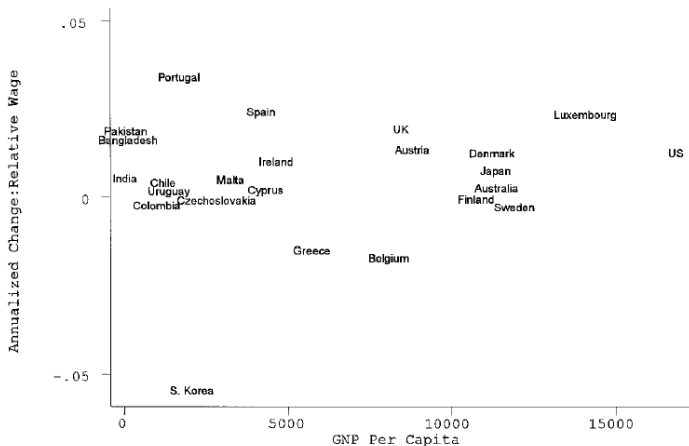


FIGURE IV  
Change in Relative Wages in 1980s by GNP

# Mechanical Tomato Harvester



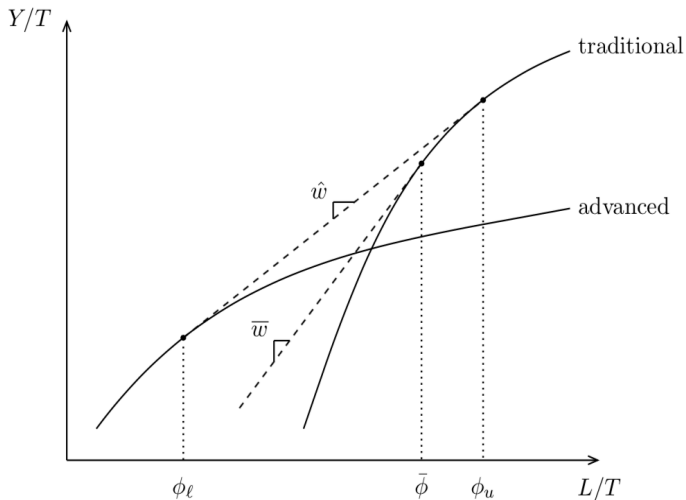
## Mechanical Tomato Harvester

“When plant breeder Jack Hanna and engineer Coby Lorenzen, two scientists at the University of California, Davis, teamed up in the mid-1950s to invent a machine that could mechanically harvest tomatoes, no one thought they could do it. The laughingstock of the Davis Plant Science department for more than a decade, the two made countless prototypes that failed — tomatoes split and turned to juice in the field, and the machine broke down after hitting clods of dirt.

Plus, when they started, it was cheap and efficient to pay farm laborers, many of whom were brought into the country from Mexico through the *Bracero* program. These guest workers harvested tomatoes by hand in much the same way that workers in places pick fresh tomatoes today: very gently.”

*UC Davis Department of Plant Sciences, Ann Filmer, July 24, 2015*

## Clemens et al. Theory Figure. Look Familiar?



**Figure 1.** The diversification cone  $[\phi_\ell, \phi_u]$  and shutdown margin  $\bar{\phi}$

# Are These Crops Cherry-Picked?

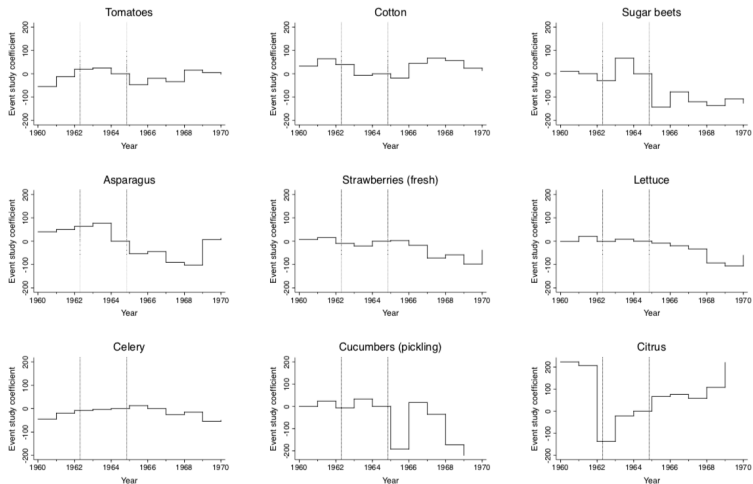


Figure 6. Event study regression coefficients: crop physical production index

# Agenda

- 1 Rising Trade Flows
- 2 Trade and Inequality—Is There a Connection?
- 3 Factor-Biased Technical Change in a One Good Economy
- 4 **A  $2 \times 2$  Heckscher-Ohlin Economy**
  - From autarky to free trade
  - Factor-Biased Technical Change
  - Pervasive factor-biased technical change
- 5 Some Evidence
- 6 **The Silence of the Lerner Diagram**

# The Silence of the Lerner Diagram

## Surprisingly difficult to say anything meaningful about trade and inequality in the H-O model

- ① In a small country, we have factor price insensitivity
- ② If all countries experience same technological change, we are in a pervasive technical change world. *Ironically, this is a lot like Katz-Murphy world*

## Model makes no direct connection b/w trade flows, wages, prices

- The single-intervening mechanism is change in goods prices
- No specific prediction on quantity of goods flows

## Few empirical toeholds. Only margins with clear predictions are

- ① Goods prices
- ② Skill prices
- ③ Factor intensities within sectors





## Illegal Immigrants Returning To Mexico For American Jobs

May 3, 2006 | [Issue 42•18](#)

“I hate these Mexicans, always coming back here to Mexico from America and taking American jobs from the Mexicans who stayed in Mexico,” said 55-year-old former Goodyear factory manager Juan-Miguel Diaz. “Why don’t they go back to where they went to?”