International Trade: Costs and Benefits

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Questions

- Why do countries trade?
- Is trade beneficial?
- How can we compete with low wage countries?

Concerns about trade

Popular concerns:

- Imports cost jobs
- Trade reduces wages
- We cannot compete with low wage countries?

The AS/AD model suggests that all of these concerns are **misguided**.

But how does it really work?

And what do we gain from trade anyway?

2. Comparative Advantage

Comparative Advantage

The key benefit of trade:

Countries can **specialize** in what they are particularly good at.

A major insight of economics:

International trade is determined by comparative advantage.
(So is within country trade)

Absolute advantage

Absolute advantage just means higher productivity

Simple example:

- there are 2 good (Apples, Computers)
- there 2 countries (North, South).
- productivities are $z_{i,c}$
- i.e.: one unit of labor produces $z_{A,N}$ Apples in North.

N has an absolute advantage in A, if $z_{A,N} > z_{A,S}$.

Absolute advantage

Rich countries have an absolute advantage in most goods.

- Except for highly localized goods (bananas), rich countries are highly productive at making just about anything.

This is where the (poor country's) concern about competitiveness comes from.

- How can we compete with the U.S., if our productivity is so much lower?

Fact

Absolute advantage is irrelevant for international trade.

Absolute advantage

Fact

Absolute advantage is irrelevant for international trade.

How surprising is this result?

Think about trade within a country ...

Do we see wide spread unemployment in Mississippi because it trades with New York?

What matter for trade (within or between countries) is

comparative advantage

Comparative advantage

Definition

N has a comparative advantage in A, if it has higher **relative productivity** (lower relative unit costs):

$$\frac{z_{A,N}}{z_{C,N}} > \frac{z_{A,S}}{z_{C,S}} \tag{1}$$

In words:

N's productivity **advantage** for good A $(z_{A,N}/z_{A,S})$ is greater than for good C.

Comparative advantage

Key result

In competitive equilibrium, countries (and people) specialize in goods where they have comparative advantage.
That allocation also maximizes output.

How surprising is this result?

When applied to people, it seems obvious.

- Should Tiger Woods mow his own lawn?
- Even if he is the faster mower in the world, the answer is obviously "no."

Comparative advantage example

Productivities:

	North	South
Apples $z_{A,j}$	10	2
Computers $z_{C,j}$	10	1

North has an **absolute advantage** in both goods:

- $10 > 2$ and $10 > 1$.

South has a **comparative advantage** in Apples:

- $\frac{2}{1} > \frac{10}{10}$.

Looking ahead: South will (successfully) export Apples to North.

3. A Simple Model of International Trade

3.1 The Setup

2 countries:

- North (N) and South (s)

2 goods:

- Apples (A) and Computers (C)

Households spend half of their incomes on each good.

- harmless simplification

North is more productive in all goods (**absolute advantage**).

The point: there are still gains from trade for both countries.

Notation

Prices

- Price of apples = 1 (why can we do this?)
- Price of computers = p_j [where $j \in \{S, N\}$ is the country]

Prices are in units of computers.

- $p_S = 2$ means: in the S a $2A$ cost as much as $1C$.

Wage rate w_j.

- in units of apples (the numeraire)

All differ across countries

Technologies

Labor is the only factor of production (simplicity).

$$\underbrace{Y_{g,j}}_{\text{output}} = \underbrace{z_{g,j}}_{\text{productivity}} \times \underbrace{L_{g,j}}_{\text{employment}} \tag{2}$$

for each good g (A, C) and country j (N, S).

Example

$z_{A,S} = 100$
$L_{A,S} = 50$ workers in the S produce
$Y_{A,S} = z_{A,S} \times L_{A,S} = 1,000$

Incomes

Total income = total earnings = $w_j L_j$.

- because there are no other factors of production.

Income per capita: w_j.

Wages differ by country j but not by sector g.

- Key assumption: **labor is mobile**

Demand functions

Everyone spends half of their income of each good.

$$\underbrace{p_{A,j}}_{1} C_{A,j} = p_{C,j} C_{C,j} = 0.5 \times \underbrace{w_j L_j}_{\text{income}} \tag{3}$$

This is for analytical simplicity only.

Example "Data"

	North	South
Labor force L_j	100	400
Productivity: apples / worker $z_{A,j}$	160	100
Productivity: computers / worker $z_{C,j}$	16	2
Productivity ratio: z_A/z_C	10	50

Country index j (N or S).

Absolute advantage:

- Productivity is higher in the North for all goods.

Comparative advantage:

- $\frac{160}{16} < \frac{100}{2}$
- South has comparative advantage in A

Popular concerns about trade

South:

- Can we compete with the productive North?
- We need protection.

North:

- Can we compete with the low wage South?
- It will drive down our wages.

The point we will make

Countries can always compete with each other.
Competitiveness applies to firms, but not to countries.

Thinking ahead: what is the key difference between countries and firms?

4. Autarky Summary

Let's solve for the equilibrium without trade (autarky).

	North	South	Note
Employment	100	400	L
Wage	160	100	$w = z_A$
Price of computers	10	50	$p = z_A/z_C$
Income	16,000	40,000	wL
Consumption: A	8,000	20,000	$0.5wL$
Consumption: C	800	400	$0.5wL/p$
Fraction working in A sector	50%	50%	cost = revenue
Fraction working in C sector	50%	50%	
Apple output	8000	20,000	$z_A L_A$
Computer output	800	400	$z_C L_C$

Wages

Workers are paid their marginal products in both sectors

North:

- producing apples (the numeraire):

$$w_N = z_{A,N} = 160\,[apples] = 160 \times \underbrace{p_A}_{1} \tag{4}$$

- producing computers:

$$w_N = 16\,[computers] = 16 p_N \tag{5}$$

Mobile labor: there is only one wage in N.

Autarky prices

Mobile labor:

$$w_N = 160 = 16p_N \tag{6}$$

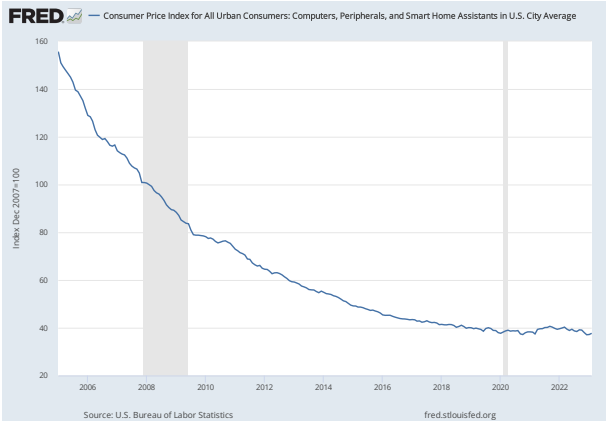
Price:

$$p_N = 10\,[apples/computer] \tag{7}$$

Relating back to micro:

- the relative price equals the marginal rate of transformation
- with our technology: the MRT equals the productivity ratio $z_{A,N}/z_{C,N}$
- goods are cheap in sectors where productivity is high

Prices and Productivities



Example: As the computer industry become more productive, prices for computers declined.

Autarky wages: South

Producing apples:

$$w_S = z_{A,S} = 100$$

Producing computers:

$$w_S = z_{C,S} \times p_S = 2p_S$$

$$p_S = 50\,[apples/computer] \tag{8}$$

No surprise:

Computers are expensive where they are difficult to make.

Employment and output

How is labor allocated across sectors?

That's determined by the demand for goods.

Assumption: half of income $(0.5wL)$ is spent on each good

- $C_{A,j} = p_j C_{C,j} = 0.5 w_j L_j$

The value of output equals factor costs

Apples:

- labor is the only input; cost $w_j L_{A,j}$
- demand: $0.5 w_j L_j$
- $L_{A,j} = 0.5 L_j$

Half of employment is in apples, half in computers

Autarky summary

	North	South	Note
Employment	100	400	L
Wage	160	100	$w = z_A$
Price of computers	10	50	$p = z_A/z_C$
Income	16,000	40,000	wL
Consumption: A	8,000	20,000	$0.5wL$
Consumption: C	800	400	$0.5wL/p$
Fraction working in A sector	50%	50%	cost = revenue
Fraction working in C sector	50%	50%	
Apple output	8000	20,000	$z_A L_A$
Computer output	800	400	$z_C L_C$

For intuition: what happens when z_A doubles?

Autarky Summary

Concept	Equation
Income = earnings	$Y_j = w_j L_j$
Output = productivity $\times L$	$Y_{g,j} = z_{g,j} \times L_{g,j}$
Wage = value marginal product	$w_j = z_{A,j} = p_j z_{C,j}$
Demand = half of income	$p_{g,j} C_{g,j} = 0.5 Y_j$
Goods market clearing	$C_{g,j} = Y_{g,j}$
Labor market clearing	$L_j = L_{A,j} + L_{C,j}$

$j \in \{N, S\}$; $g \in \{A, C\}$

Endogenous (9×2): $Y_j, Y_{g,j}, L_{g,j}, C_{g,j}, w_j, p_j$

What changes when we open up trade?

5. Free trade: What Changes?

Goods are traded internationally.

- Only one market clearing condition for each good.
- Therefore only **one world price** for each good
- Law of one price

Goods market clearing changes to

$$\underbrace{Y_{g,S} + Y_{g,N}}_{\text{world Y}} = \underbrace{C_{g,S} + C_{g,N}}_{\text{world C}} \tag{9}$$

Free trade: Prices

There is one world price for each good: p_A and p_C.

Normalize the price of apples to $p_A = 1$.

- Numeraire

Autarky prices were 10 and 50.

We try to find an equilibrium with $10 < p < 50$ (strict inequalities).

Let's try $p = 25$ and verify that it clears all markets.

Free trade summary

Concept	Equation
Income = earnings	$Y_j = w_j L_j$
Output = productivity $\times L$	$Y_{g,j} = z_{g,j} \times L_{g,j}$
Wage = value marginal product	$w_j = z_{A,j} = p z_{C,j}$
Demand = half of income	$pC_{g,j} = 0.5 Y_j$
Goods market clearing	$C_{g,S} + C_{g,N} = Y_{g,S} + Y_{g,N}$
Labor market clearing	$L_j = L_{A,j} + L_{C,j}$

Endogenous: $Y_j, Y_{g,j}, L_{g,j}, C_{g,j}, w_j, p$

What changed:

- only one goods market clearing condition per good
- only one price p

Equilibrium Intuition

Let's say the price is $p = 25$.

What happens in the North?

- autarky price $p_N = 10$

Trade increases the price of computers - why?

Firms move labor to computer production (profits)

Intuition: Wages

Wages must rise (in terms of the numeraire A)

- firms compete for workers
- until $w_N = p \times z_{C,N}$

Key point

As long as N produces C, the real wage $w_N/p = z_{C,N}$ is fixed!

Even with trade, **wages are determined by own productivity**.

- Our wages are not set in Beijing!

Equilibrium in the South

Trade increases the price of apples (relative to computers)

- $1/p$ falls

Firms move labor to apples production

Do wages rise?

How does the South gain?

Why do changes in the South look different from the North?

Free trade: South

Apple sector:

- $z_{A,S} = 100$
- price is normalized to 1

That pins down

$$w_S = z_{A,S} \times p_S = 100 \tag{10}$$

for both sectors!

The South's real wage (in terms of A) is unchanged.

- It's wages, too, are determined by it's productivity.

Free trade: South

Computer sector:

- $z_{C,S} = 2$

Price of home grown computers:

- determined by "wage = value marginal product"
- $p_S z_{C,S} = p_S \times 2 = w_S = 100$
- $p_S = 50 > p$

South cannot produce computers - it specializes in **apples**.

Free trade: South

Let's compute prices and quantities produced.

- employment in apples (everyone): $L_{A,S} = 400$
- apple production = income:

$$Y_{A,S} = z_{A,S} \times L_{A,S} = 100 \times 400 = 40,000 \quad (11)$$
$$= w_S L_{A,S} \quad (12)$$

- consumption of apples (half of income): $C_{A,S} = 20,000$
- consumption of computers (half of income): $p \times C_{C,S} = 20,000$

With $p = 25$: $C_{C,S} = 800$

Free trade: North

The example is rigged so that the North only produces computers.

In general, one country would produce both goods and the other would produce the good with comparative advantage.

Employment in computers (everyone): $L_{C,N} = 100$

Computer production:

$$Y_{C,N} = z_{C,N} L_{C,N} = 160 L_c = 1,600 \tag{13}$$

Income: $1,600p$.

Spending on apples (half of income): $C_{A,N} = 800p$

Spending on computers (half of income): $pC_{C,N} = 800p$

$C_{C,N} = 800$

Free trade: Market clearing

Computers:

$$Y_{C,N} = C_{C,N} + C_{C,S} \tag{14}$$
$$1,600 = 800 + 800 \tag{15}$$

Spending on computers:

$$\underbrace{pC_{C,S} = 20,000}_{\text{South budget}} = p \times 800 \tag{16}$$

This pins down $p = 20,000/800 = 25$

- and verifies our guess for p

Income: $Y_N = 1,600p = 40,000$

Free trade

	North	South	
Wage	400	100	$z_{C,N}p$ and $z_{A,S}$
Price of computers	25	25	equilibrium
Income	40,000	40,000	wL
Consumption: apples	20,000	20,000	$0.5 \times wL$
Consumption: computers	800	800	$0.5 \times wL/p$
Frac. working in apple sector	0%	100%	
Frac. working in computer sector	100%	0%	
Apple output	0	40,000	$z_{A,S}L_S$
Computer output	1,600	0	$z_{C,N}L_N$

Note: The fact that income and consumption are the same in N and S is a coincidence.

Free trade

- Consumption of both goods rises in both countries (weakly).
- Welfare definitely improves.
- Real wages rise in both countries.
  - South: $w = 100$ (apples), but w rises in terms of computers
  - North: $w = 16p$ (computers), but w rises in terms of apples.

5.1 Competitiveness

Both countries worry about competitiveness:

- North: Wages are too low in the South
- South: Productivity is too high in the North

Both are mistaken.

- Wages are low because productivity is low.
- This ensures that both countries are competitive in some goods.

This logic works for countries, but low productivity firms go out of business.

- What's the difference?

Competing with low-wage countries

Even under free trade, wages equal marginal value products

- $w_S = p_A z_{A,S}$ and $w_N = p_C z_{C,S}$

Wages are not "set in Beijing".

Low cost competition drives down prices.

- but that's for goods that we cannot make efficiently
- wages in those sectors also fall, but we stop working there.

5.2 Productivity Growth in the South

	North	South	Note
Labor force	100	400	unchanged
Productivity: apples / worker	160	200	was 100
Productivity: computers / worker	16	4	was 2

We double productivity in the South.

What do you expect to happen?

- assume that countries' specialization does not change
- production in North:
- production in South:
- relative price of Apples:
- welfare:

Productivity Growth in the South

Try an equilibrium where the North specializes in computers and the South in apples.

South (specialize in A):

- everyone produces A: $L_{A,S} = 400$
- $Y_{A,S} = z_{A,S} L_{A,S} = 400 \times 200 = 80,000$ (doubles of course)
- $w_S = 200$ (doubles of course).
- income: $Y_S = 80,000$ ($p_A = 1$).
- consumption (half of income): $C_{A,S} = 0.5 \times 80,000 = 40,000$

Productivity, income, $C_{A,S}$ all double.

Productivity Growth in the South

North (specializes in C):

- $L_{C,N} = 100$ (unchanged).
- $Y_C = z_{C,N} L_{C,N} = 100 \times 16 = 1,600$ (unchanged of course).
- $w_N = 16 \times p$ (unchanged real wage).
- $pY_N = 1600p$ (unchanged).

Market clearing

- $C_{A,N} = 0.5 \times 1,600p = 40,000$ (not eaten in South; doubled)
- $p = 50$
- effectively: the price of apples fell by half

In both countries: $C_{A,j} = 40,000$ (doubles) and $C_{C,j} = 800$ (unchanged).

Welfare gains.

What Really Happens

In the South: gains from higher output

- just like a closed economy.

In the North:

- output unchanged: $Y_N = z_{C,N} L_N$ (computers)
- determined by technology
- C consumption unchanged (half of income)
- A imports got cheaper
- A consumption rises

More on productivity growth in South

	North	South	Note
Labor force	100	400	unchanged
Productivity: apples / worker	160	100	unchanged
Productivity: computers / worker	16	10	was 2

Productivity in computers rises in the South.

What happens now?

More on productivity growth in the South

Lessons:

- not all foreign productivity growth benefits us
- but trade remains better than autarky

Lessons

Both rich and poor countries **benefit from trade**.

- Your wages are not set in China.
- They are the marginal product of U.S. labor.
- The more different the countries, the more beneficial trade is.

Competitiveness is not an issue.

One way of thinking about trade: a production technology.

- make (U.S.) corn into (Japanese) cars.
- foreign productivity growth is good.

If trade is so great, why is it not popular?

5.4 Immobile Labor in the North

What happens if trade is opened up, but workers are stuck in the Apples sector in the North?

	North		South	
	A	C	A	C
L	50	50	360	40
z	160	16	100	2
w	160	800	100	100
Y	8,000	800	36,000	80
C	24,000	480	20,000	400

Computers get scarcer (b/c N cannot specialize). $p \uparrow$ to 50

Apple output and consumption rise everywhere.

Computer consumption falls everywhere.

Trade now benefits the North's computer workers.

Welfare Implications

North:

Workers in C sector gain

- their real wage $w_{C,N}/p$ stays the same $(z_{C,N})$
- apples get relatively cheaper

Workers in the A sector lose

- their real wage $w_{A,N}$ stays the same $(z_{A,N})$
- computers get more expensive

South:

- no change in p (b/c South produces both goods)
- no wage in w
- no change in consumption

Explanations

Assume that South no longer specializes.

Then $p = z_{A,S}/z_{C,S} = 100/2 = 50$

1. Wages: $w = p \times z$ as usual.
2. Income North: $Y_N = w_{A,N}L_{A,N} + w_{C,N}L_{C,N}$
   we know employment from autarky
3. Income South: simply $Y_S = w_S L_S = 100 \times 400$
4. Consumption: half of income.
5. Production South: $Y_{S,g} = Y_{N,g} - C_{N,g} - C_{S,g}$
   the South produces what is needed to match consumption.

Recap Questions

1. What happens when we trade with a country that has 1/10 of our productivity in all goods?.
2. Do we gain more from trading with Germany or with Thailand?

   Reality check: who do we actually trade more with?
3. How would **dumping** change the conclusions?

   Dumping: the foreign country exports its good below cost.
4. What happens if we have **fixed capital**?

   Example: automobile factories that cannot be repurposed when we import cars.

6. Automation

What happens when AI becomes more productive than humans at all tasks?

Automation

We may reinterpret our model to think about automation / AI.

South:

- Workers operating traditional technology
- Immobile

North:

- Small number of tech entrepreneurs operating AI
- Highly productive at all tasks

What happens?

Note: It actually doesn't matter whether workers live in different countries or not.

- What is a country?

A Worse Scenario

What if it takes a small amount of AI labor to work a traditional job?

- Workers need managers, computers, accountants, transportation, ...

Firms still pay workers their value marginal product: $w_S = z_{A,S}$.

But take home pay is now

$$z_{A,S} - \alpha \times \underbrace{z_{C,N} p}_{w_N} \tag{17}$$

Take home pay becomes negative when AI turns highly productive.

A Worse Scenario

The outcome:

- AI raises total output (by construction in this model).
- AI raises the share of income earned by "skilled" workers (L_N).
- "Unskilled" (L_S) workers may no longer be employable at any wage.

In principle, everyone can be made better off

- A distributional problem, not an efficiency problem.

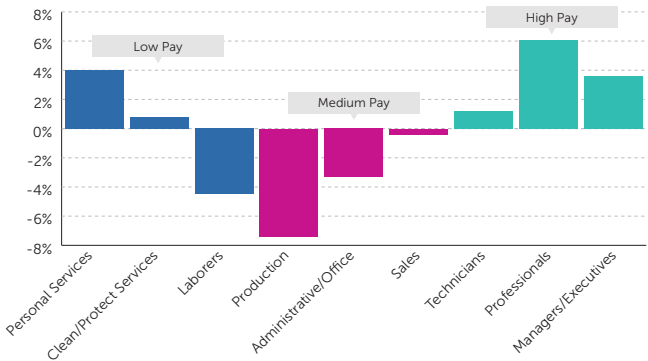
In practice: potentially a catastrophe for most workers.

Automation: Evidence

Automation has replaced "routine" jobs.

Figure 6. Employment Growth Has Polarized Between High- and Low-Paid Occupations

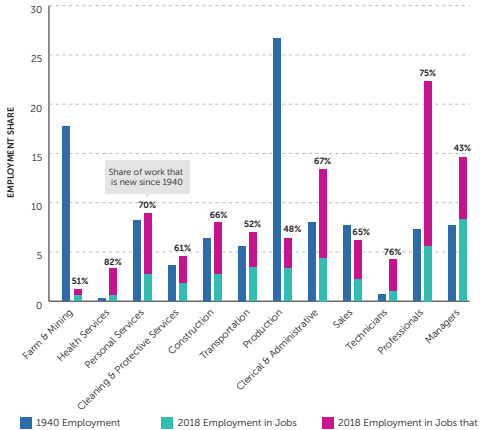
CHANGES IN OCCUPATIONAL EMPLOYMENT SHARES AMONG WORKING-AGE ADULTS, 1980–2015



Source: Autor (2020)

Automation also creates new jobs

Figure 2. More Than 60% of Jobs Done in 2018 Had Not Yet Been "Invented" in 1940



Source: Autor (2020)

What does the future hold?

We don't know.

> *"No economic law dictates that the creation of new work must equal or exceed the elimination of old work. Still, history shows that they tend to evolve together." – Autor (2020), p. 12*

Summary

Trade increases the size of the pie through

- **specialization** (comparative advantage)
- increased scale of production

Competitiveness is not an issue at the country level.

Trade also **redistributes** the pie.

Losers are:

- those employed in import competing sectors (textiles, toys, ...)
- the unskilled

It is not clear that trade restrictions are a good way of protecting the losers.

Reading

Blanchard / Johnson, Macroeconomics, 6th ed., ch. 19-6

Additional reading:

- Jones, Macroeconomics, ch. 14.

Advanced reading:

- Coughlin (2002) nicely summarizes the benefits of free trade.
- Autor (2016) summaries the costs of trade as well.

References I

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