GERALD R. Ford School OF PUBLIC POLICY

UNIVERSITY OF MICHIGAN

How Robust is Comparative Advantage?

Alan V. Deardorff

Gerald R. Ford School of Public Policy

University of Michigan

For presentation at Beijing Institute of Technology

June 7, 2012, Beijing

The Issue

- How well does the concept of Comparative Advantage (CA) work beyond the simple 2×2 framework in which Ricardo explained it?
  - The answer depends, in part, on what you interpret CA to mean:
    - If it refers to the gains from trade, then it is very robust
    - If it is meant to predict trade in particular goods, then it generalizes poorly
    - But weak generalizations are possible and robust.
  - Overall, CA is a fundamental and valuable concept.

The Source

Alan V. Deardorff, "How Robust is Comparative Advantage?," *Review of International Economics* 13(5), November 2005, pp. 1004-1016.

Which draws on:

- "Weak Links in the Chain of Comparative Advantage," *Journal of International Economics* 9 (1979):197–209.
- "The General Validity of the Law of Comparative Advantage," *Journal of Political Economy* 88 (1980):941–57.
- "Exploring the Limits of Comparative Advantage," *Weltwirtschaftliches Archiv* 130 (1994):1–19.

CA in Ricardo

The Ricardian Model:

- 2 goods: 1, 2
- 2 countries: 1, 2
- 1 factor: L = labor
- Constant costs: a_g^c = labor needed to produce one unit of good g in country c
- Perfect competition

CA in Ricardo

A country has comparative advantage in the good whose relative labor cost (compared to the other good) is ***lower*** than in the other country.

Country 1 has CA in good 1,

relative to good 2,

compared to country 2,

if

$$\frac{a_1^1}{a_2^1} < \frac{a_1^2}{a_2^2} \qquad (1)$$

Note, this is the same as

$$\frac{a_1^1}{a_1^2} < \frac{a_2^1}{a_2^2} \qquad (1)$$

CA in Ricardo

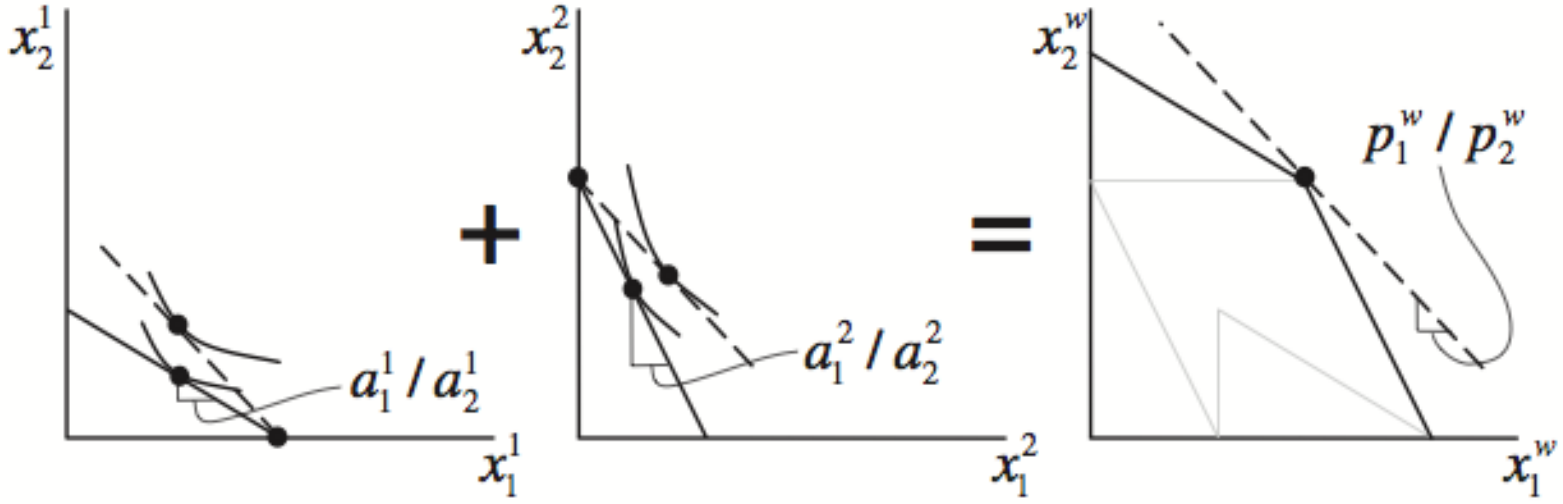


Figure 1. The Ricardian Model: Production Possibilities and a Free-Trade Equilibrium

CA in Ricardo

- Implications
  - CA gives the opportunity for the world to increase output of everything by specializing
  - Thus CA implies Gains from Trade
  - These gains are obtained by each country…
    - …specializing in...
    - …and exporting…
      - …the good in which it has comparative advantage.

CA in Ricardo

- Thus CA is about two things:
  - The opportunity to Gain from Trade
  - Prediction of the Pattern of Trade

    (who exports what)
- As we'll see
  - Gain from Trade is very robust
  - Pattern of Trade is much weaker

CA in Haberler (1930)

- The Ricardian Model assumed
  - only labor as a factor, and
  - constant unit labor requirements (the a's).
- That is very restrictive, as more modern models drop both assumptions
  - The Heckscher-Ohlin Model
  - The Specific Factors Model
- These models are easily analyzed with a curved Production Possibility Frontier, together with Community Indifference Curves.

CA in Haberler (1930)

- CA is still easily defined in terms "opportunity cost," which is measured by relative autarky prices, $\tilde{p}_g^c$:

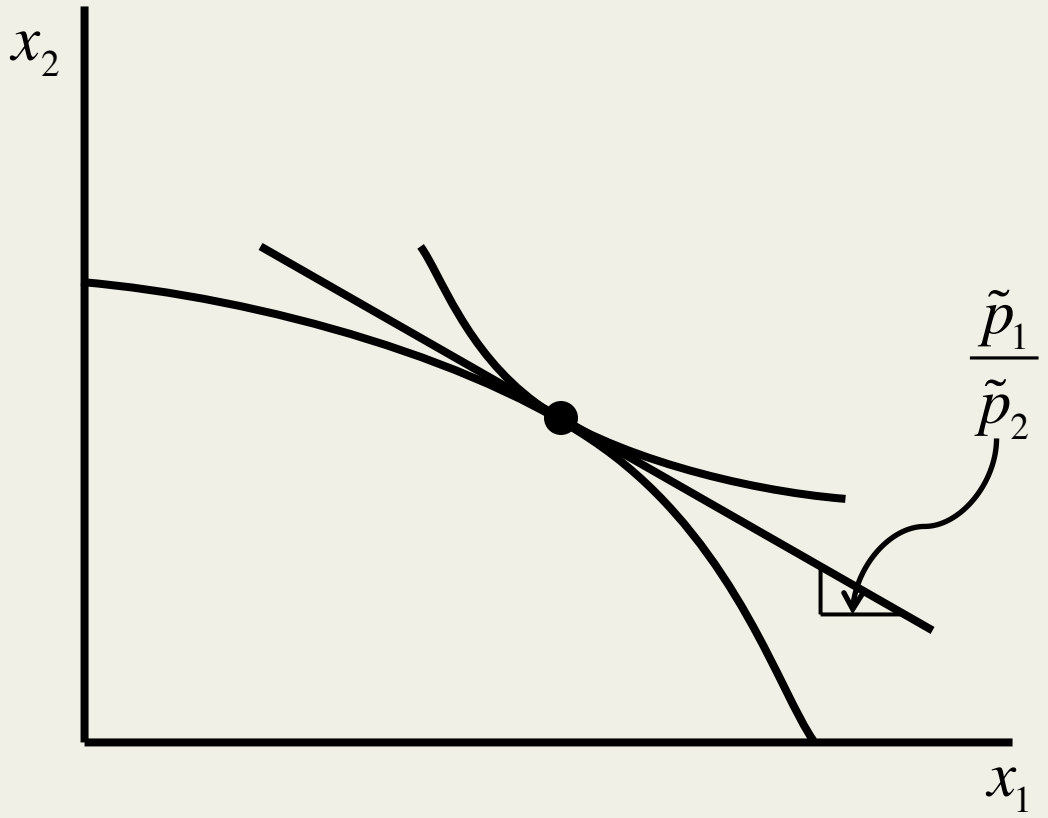
A country has comparative advantage in the good whose autarky price, relative to the other good, is ***lower*** than in the other country.

Country 1 has CA in good 1,
relative to good 2,
compared to country 2,
if

$$\frac{\tilde{p}_1^1}{\tilde{p}_2^1} < \frac{\tilde{p}_1^2}{\tilde{p}_2^2} \qquad (1')$$

CA in Haberler (1930)

- Autarky equilibrium:



CA in Haberler (1930)

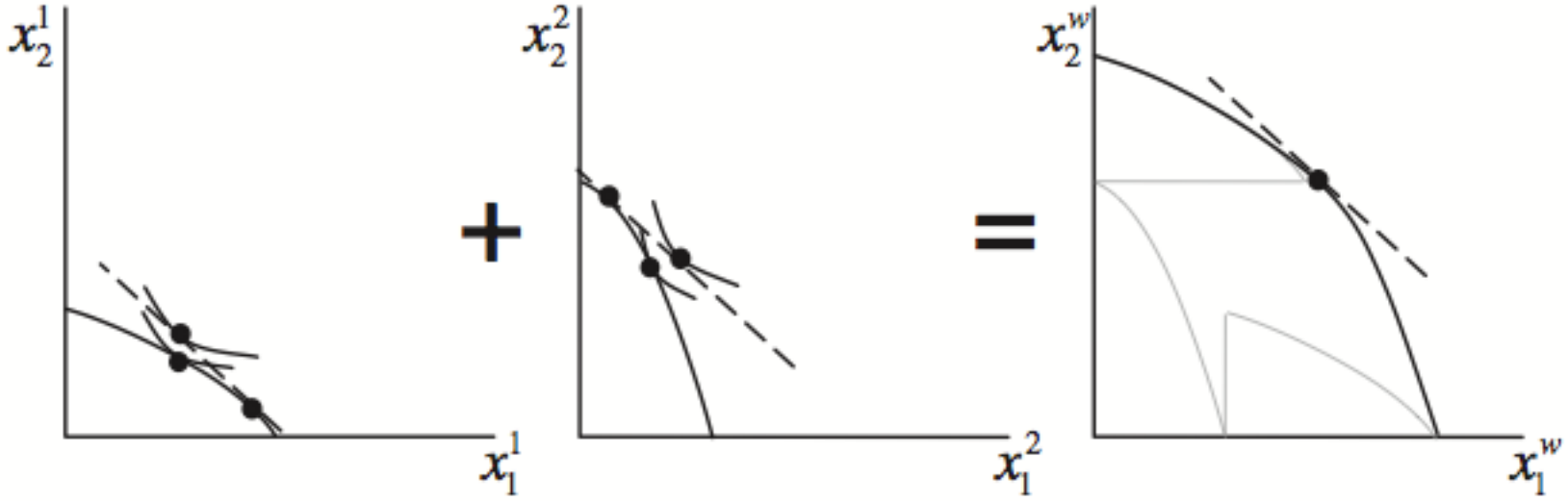


Figure 2. Haberler Model: Production Possibilities and a Free-Trade Equilibrium

CA and Gains from Trade

- In Haberler's model, it is again true that
  - If countries differ in relative autarky prices, there is both CA and Gain from Trade
  - In order to gain from trade, they must export the good in which they have CA
- Note that trading in accord with CA is necessary, but not sufficient for gain from trade.

CA and Gains from Trade

- CA is necessary for Gain from Trade:

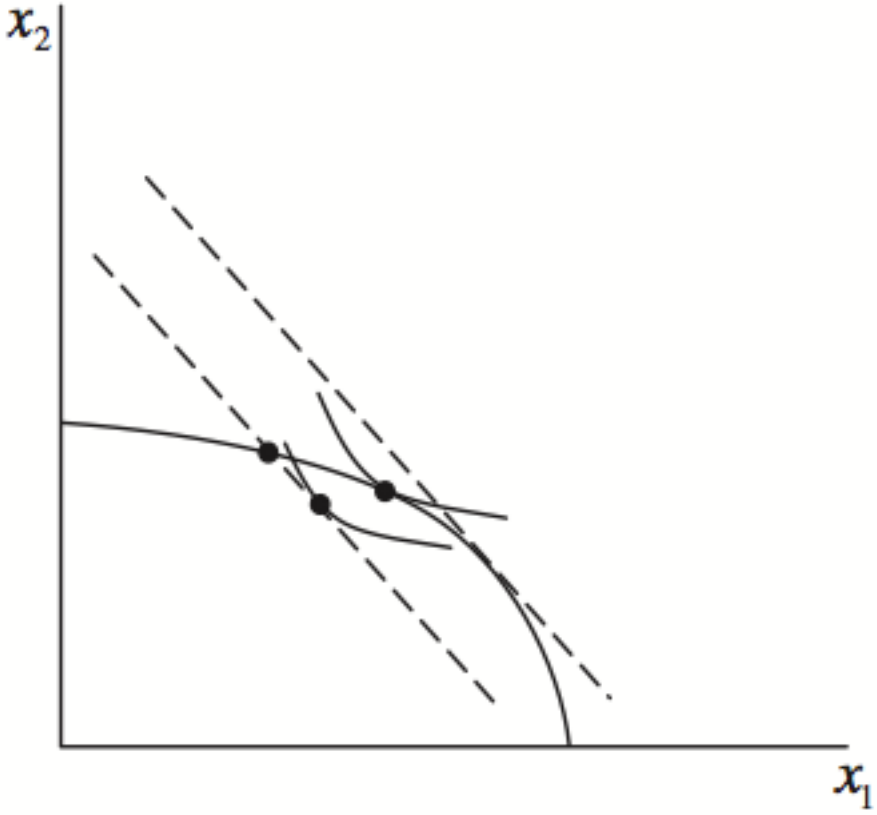


Figure 3. Trade Contrary to Comparative Advantage Reduces Welfare

CA and Gains from Trade

- It is <u>not</u> sufficient:

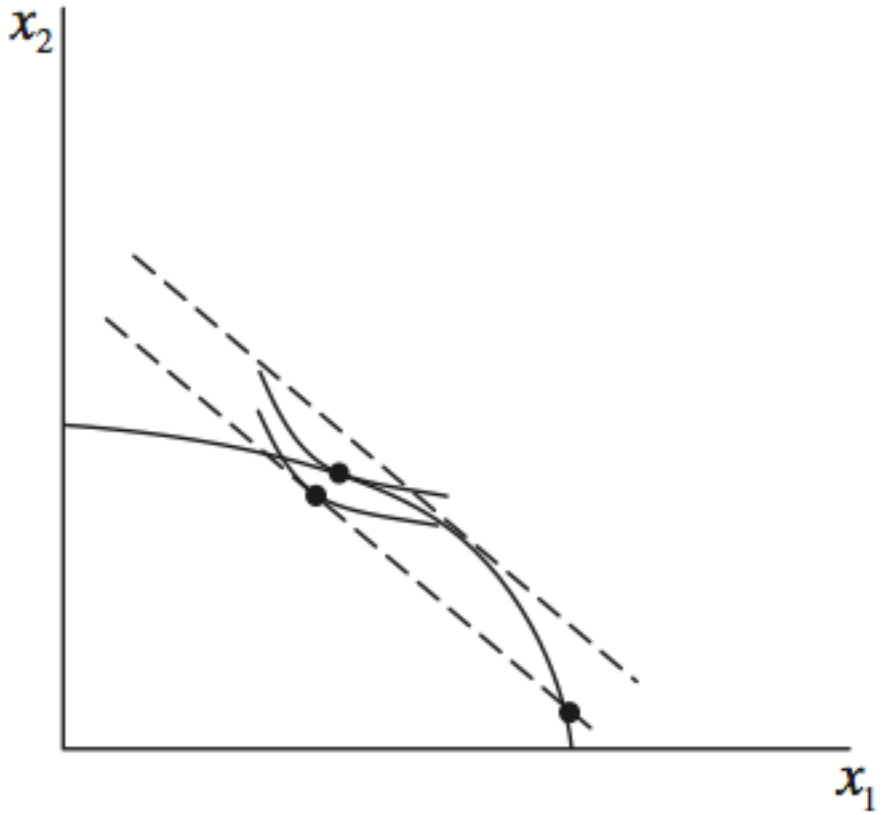


Figure 4. Too Much Trade in Accord with Comparative Advantage Reduces Welfare

Strong Generalizations of CA

- With many (C) countries and only 2 goods:
  - Rank the countries in order of $\frac{\tilde{p}_1^c}{\tilde{p}_2^c}$:

$$\frac{\tilde{p}_1^1}{\tilde{p}_2^1} < \frac{\tilde{p}_1^2}{\tilde{p}_2^2} < \ldots < \frac{\tilde{p}_1^C}{\tilde{p}_2^C}$$

- Then all countries that export good 1 will lie to the left of all that export good 2

$$\frac{\tilde{p}_1^1}{\tilde{p}_2^1} < \ldots < \frac{\tilde{p}_1^{c_1}}{\tilde{p}_2^{c_1}} < \frac{\tilde{p}_1^{c_2}}{\tilde{p}_2^{c_2}} \ldots < \frac{\tilde{p}_1^C}{\tilde{p}_2^C}$$

Export 1 Export 2

- Location of the line (c_1, c_2) depends on country sizes.

Strong Generalizations of CA

- With many (G) goods and only 2 countries, a similar chain of comparative advantage works, but only in the Ricardian Model:
  - Rank the goods in order of relative labor requirements in the two countries:

$$\frac{a_1^1}{a_1^2} < \frac{a_2^1}{a_2^2} < \ldots < \frac{a_G^1}{a_G^2}$$

- Then all goods that country 1 exports will lie to the left of all that it imports.
- This does not work with variable costs in Haberler's model, since costs can be interdependent.

Strong Generalizations of CA

- Even these "chain propositions" fail, in both Ricardian and Haberler models, if there are both
  - Intermediate inputs
  - Barriers to trade
- This is shown in Deardorff (1979), in the context of the Heckscher-Ohlin trade model.
- It can be illustrated also in a Ricardian Model with intermediate inputs, as follows:

Impossibility of Strong CA

- Example: Assume…
  - 4 goods:

    Steel, input to Autos

    Wool, input to Cloth

    (1 unit → 1 unit, each)
  - 2 countries of equal size
  - Demands for autos and cloth: equal expenditure shares

Direct unit labor requirements	Goods			
	W Wool	A Autos	C Cloth	S Steel
Country 1	1	2	3	4
Country 2	4	3	2	1

Direct+Indirect unit labor requirements	Final Goods	
	A Autos	C Cloth
Country 1	2+4=6	3+1=4
Country 2	3+1=4	2+4=6

If all goods are traded without cost

Direct unit labor requirements	Goods			
	W Wool	A Autos	C Cloth	S Steel
Country 1	1	2	3	4
Country 2	4	3	2	1

Results:

- Country 1 exports autos (and wool)
- Country 2 exports cloth (and steel)

If only final goods are traded

Direct+Indirect unit labor requirements	Final Goods	
	A Autos	C Cloth
Country 1	2+4=6	3+1=4
Country 2	3+1=4	2+4=6

Results:

- Country 1 exports cloth
- Country 2 exports autos

Impossibility of Strong CA

- Results of Example: Summary
  - If all goods are traded without cost
    - Country 1 exports autos
    - Country 2 exports cloth
  - If inputs, steel and wool, are not traded
    - Country 1 exports cloth
    - Country 2 exports autos
  - Thus, trade in autos and cloth reverse if steel and wool are not traded.

Impossibility of Strong CA

- **Implication:** *Any* definition of CA that predicts trade correctly in one case will be wrong in the other.
  - (*Unless* the definition itself takes account of trade costs. That's something I won't address here, though I do in another place.)

Weak Generalizations of CA

- What does hold in general – with any numbers of goods and countries, as well as many other relaxed assumptions – is that CA predicts the Pattern of Trade On Average.
- Specifically, letting T_g^c be net exports of good g by country c (so that $T_g^c < 0$ for an import), then

Theorem:

$$\tilde{p}^c T^c = \sum_g \tilde{p}_g^c T_g^c < 0 \qquad (6)$$

- This says (since the vector T^c has positive elements for exports and negative for imports) that autarky prices of exports are lower than of imports.

Weak Generalizations of CA

$$\tilde{p}^c T^c = \sum_g \tilde{p}_g^c T_g^c < 0 \qquad (6)$$

- More formally, letting $X_g^c = \max\left\{T_g^c, 0\right\}$, $M_g^c = \max\left\{-T_g^c, 0\right\}$, & $\bar{X}^c = \bar{M}^c = \sum_g p_g^w X_g^c$

$$\sum_g \frac{\tilde{p}_g^c}{p_g^w} \frac{p_g^w X_g^c}{\bar{X}^c} < \sum_g \frac{\tilde{p}_g^c}{p_g^w} \frac{p_g^w M_g^c}{\bar{M}^c} \qquad (7)$$

- That is, the country's trade-weighted autarky prices relative to world prices, p^w, are lower for its exports than for its imports.

Weak Generalizations of CA

$$\tilde{p}^c T^c = \sum_g \tilde{p}_g^c T_g^c < 0 \qquad (6)$$

- Other interpretations involve correlations, stated as Corollaries of (6) in Deardorff (1980).

Corollary 1:

- The simplest – and similar to (7) – is a negative correlation between a country's autarky prices relative to the world and the value at world prices of its trade:

$$\text{cor}\left(\frac{\tilde{p}_g^c}{p_g^w}, p_g^w T_g^c \right) < 0$$

Weak Generalizations of CA

$$\tilde{p}^c T^c = \sum_g \tilde{p}_g^c T_g^c < 0 \qquad (6)$$

- Most broadly, autarky prices and trade are negatively correlated across all goods and countries:

Corollary 4:

- Let $\tilde{P}$ be a CG length vector of all $\tilde{p}_g^c, c = 1,...,C; g = 1,...,G$ and E be a vector of the same length of all $T_g^c, c = 1,...,C; g = 1,...,G,$ then

$$\text{cor}\left(\tilde{P}, E\right) < 0$$

Weak Generalizations of CA

$$\tilde{p}^c T^c = \sum_g \tilde{p}_g^c T_g^c < 0 \qquad (6)$$

- Proof of **Theorem** (omitting country superscript):
- Notation: $T = Q - C$, where Q and C are vectors of output and consumption with trade, and $\tilde{Q} = \tilde{C}$ are vectors of output and consumption in autarky .
- First the **Gains from Trade**:

$p^w T = p^w (Q - C) = 0$ by balanced trade

$p^w Q \geq p^w \tilde{Q} = p^w \tilde{C}$ by producer maximization

$\therefore p^w C \geq p^w \tilde{C}$ so that C is revealed prefered to $\tilde{C}$

Weak Generalizations of CA

- Proof (continued):

$$p^w C \geq p^w \tilde{C} \quad \Rightarrow \quad \tilde{p}C > \tilde{p}\tilde{C}$$

by Weak Axiom of Revealed Preference (WARP)

$\tilde{p}\tilde{Q} \geq \tilde{p}Q$ by producer maximization, again

$$\therefore \tilde{p}T = \tilde{p}(Q - C) < \tilde{p}(\tilde{Q} - \tilde{C}) = 0$$ Q.E.D.

Weak Generalizations of CA

- Result permits: (I used more assumptions for the simple proof above, but the paper allows much greater generality.)
  - Multiple goods and countries (also, implicitly, multiple factors of production)
  - Tariffs and other artificial trade costs
  - Transport costs and other real trade costs
  - Intermediate inputs
- Note that these assumptions are enough to include the example earlier, where CA failed to predict trade of cars and cloth, with inputs of steel and wool

Direct unit labor requirements	Goods			
	W Wool	A Autos	C Cloth	S Steel
Country 1	1	2	3	4
Country 2	4	3	2	1

Assume wages = $1 in both

Autarky prices				
	W	A	C	S
Country 1	1	6	4	4
Country 2	4	4	6	1

- Assume
  - Labor endowments = 120 in both
  - Consumers demand equal units of cloth and autos
- Without trade in inputs
  - Country 1
    - exports 15 cloth and
    - imports 15 cars

$$\tilde{p}^1 T^1 = 4(15) - 6(15) = -30 < 0$$

- With trade in inputs
  - Country 1
    - exports 20 wool and 20 autos
    - Imports 20 steel and 20 cloth

$$\tilde{p}^1 T^1 = 1(20) + 6(20) - 4(20) - 4(20) = -20 < 0$$

Wool Autos Steel CLoth

Weak Generalizations of CA

- Result also permits:
  - Arbitrary preferences of consumers
  - Services, traded or not
  - Dated goods
  - Differentiated goods
  - Unbalanced trade
  - Lumpy countries

Weak Generalizations of CA

- Result does not permit:
  - Domestic distortions
  - Increasing returns to scale

- Note though that while these can interfere with the result if they vary across sectors or countries so as to undermine CA, they could also do the opposite, enhancing CA.
- Thus their presence "suggests only that we are ignorant, not necessarily that we are wrong."