

FACTOR ABUNDANCE AND TRADE: HECKSCHER-OHLIN MODEL

NUMERICAL EXAMPLE

Two goods, Beer and Cheese. Two factors, Capital and Labor.
Both factors mobile across sectors.
Fixed input coefficients per unit of output:

	Beer	Cheese
Capital	4	5
Labor	1	2

Note: Ratio of Capital to Labor in Beer ($4/1$) is $>$ that in Cheese ($5/2$)
Beer is relatively more capital-intensive than Cheese
This is the key that will drive comparative advantage and trade
Ratios are what matters: absolute input coefficients irrelevant

Consider two countries. Denmark has 100 Labor, 310 Capital
Holland has 100 Labor, 280 Capital

Find output quantities, assuming full employment of both factors in both countries:

Denmark: $4B + 5C = 310, 1B + 2C = 100$ $B = 40, C = 30$

Holland: $4B + 5C = 280, 1B + 2C = 100$ $B = 20, C = 40$

More capital \implies

disproportionately more output of capital-intensive good ($40/20 > 310/280$)
and actually less output of the other good ($30 < 40$)

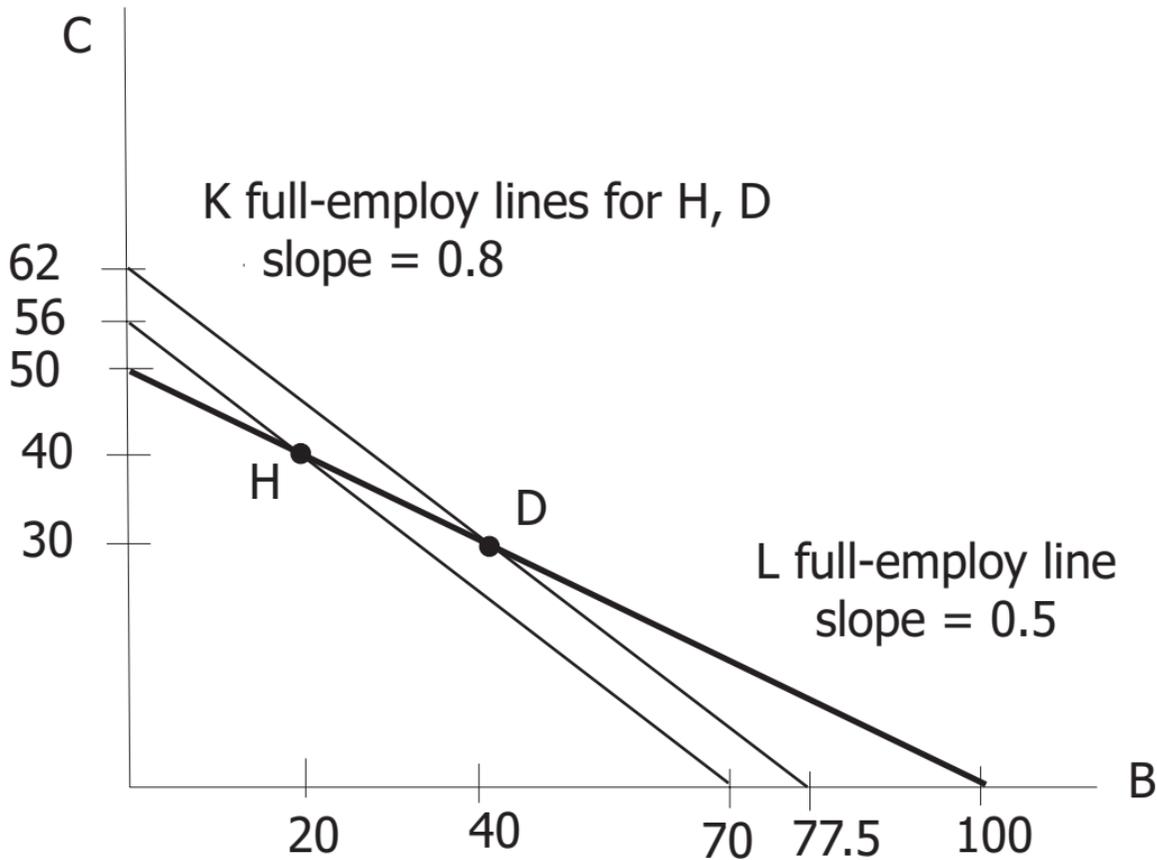
This is called the Rybczynski effect.

Remember we are assuming identical homothetic tastes

The relatively capital-rich country has

a relatively larger output of the relatively capital-intensive good
therefore a lower autarkic relative price of this good
therefore a comparative advantage in it

Will verify this in a more general setting, without fixed coefficients in production



We expect trade to increase the relative price P of Beer in Denmark.
 What will happen to the factor rewards W for Labor, R for capital in Denmark?
 Zero pure profit conditions for equilibrium:

$$W + 4R = P, 2W + 5R = 1$$

Solutions: $R = (2P - 1) / 3, W = (4 - 5P) / 3.$

Increase in P

raises R by an even greater proportion, so raises $R / P = (2 - [1/P]) / 3$
 and lowers W (so obviously lowers W/P)

Numerical example:

P	R	W
0.6	$0.2 / 3$	$1.0 / 3$
0.7	$0.4 / 3$	$0.5 / 3$

(Need $0.5 < P < 0.8$ to ensure positive R, W)

Result: Increase in the relative price of the capital-intensive good
 raises the return to capital, lowers the return to labor
 This is the source of distributive conflict in this model
 It is called the Stolper-Samuelson effect

ASSUMPTIONS OF THE MODEL

Two goods, two factors, two countries. (2-by-2-by-2 "Noah's Ark" model)

Goods can be traded but not factors across countries.

Both factors mobile across sectors within each country.

Constant returns to scale in each sector; perfect competition in all 6 markets:

2 worldwide for the two goods, and 2 for factors within each country

NOTATION

Goods, X and Y, prices P_X and P_Y

Capital endowment K, given. Quantities in the two sectors K_X and K_Y ; $K_X + K_Y = K$

Labor endowment L, given. Quantities in the two sectors L_X and L_Y ; $L_X + L_Y = L$

Production functions $X = F_X(K_X, L_X)$, $Y = F_Y(K_Y, L_Y)$.

Wage W; return to capital R .

Foreign country variables with asterisk * ; home without.

KEY CONCEPT: RELATIVE FACTOR INTENSITY

At any given relative factor price ratio R/W ,

the L/K ratio in each sector is chosen to minimize cost of production.

Therefore tangency between factor price ratio line slope = R/W

and production isoquant, slope = $MRTS = -dL/dK$, in each sector.

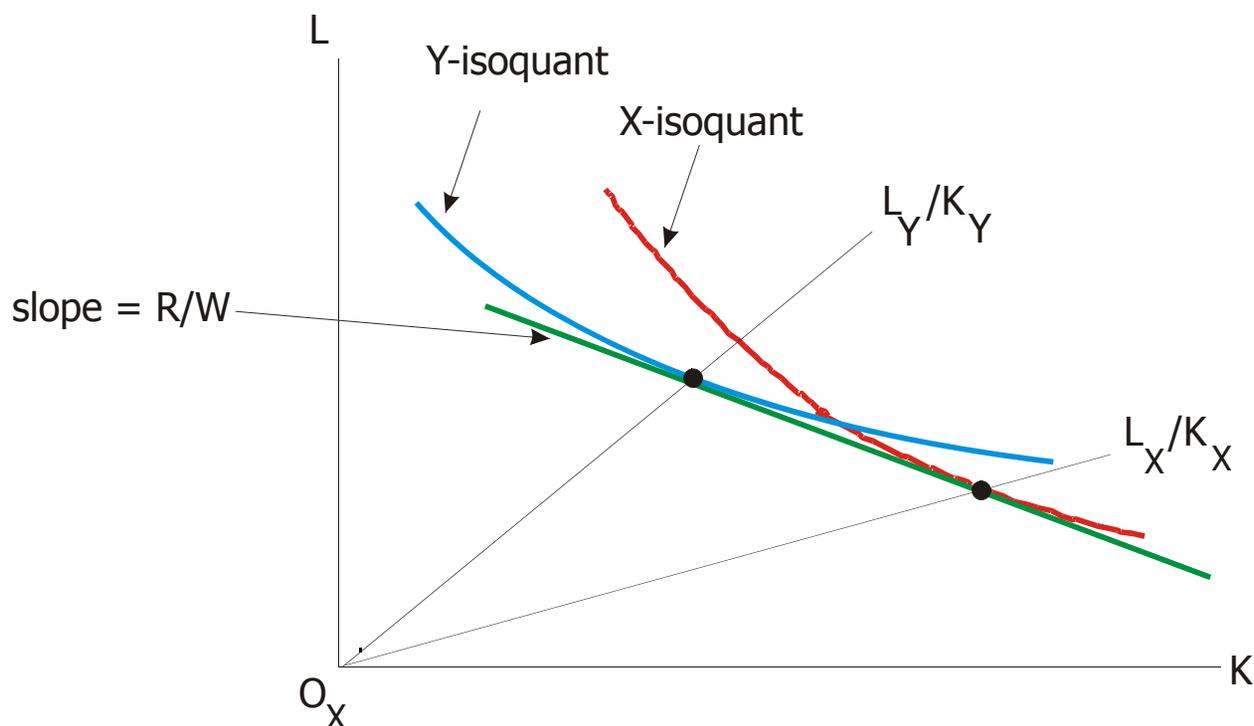
Call the Y-good relatively L-intensive (and the X-good relatively K-intensive)

if the resulting ratio L_Y / K_Y is always $> L_X / K_X$ (equivalently, $K_X / L_X > K_Y / L_Y$)

[1] Always means for any R/W held the same for X and Y

[2] So Y-isoquant flatter than X- at intersection.

[3] If this is true for one pair of isoquants, it is true for any pair, because constant returns to scale.



EFFICIENT ALLOCATION OF FACTORS ACROSS SECTORS

Efficiency requires equal MRTS in the two sectors.
Tangency in the factor allocation Edgeworth Box diagram.

The contract curve is
everywhere below
the diagonal of box:

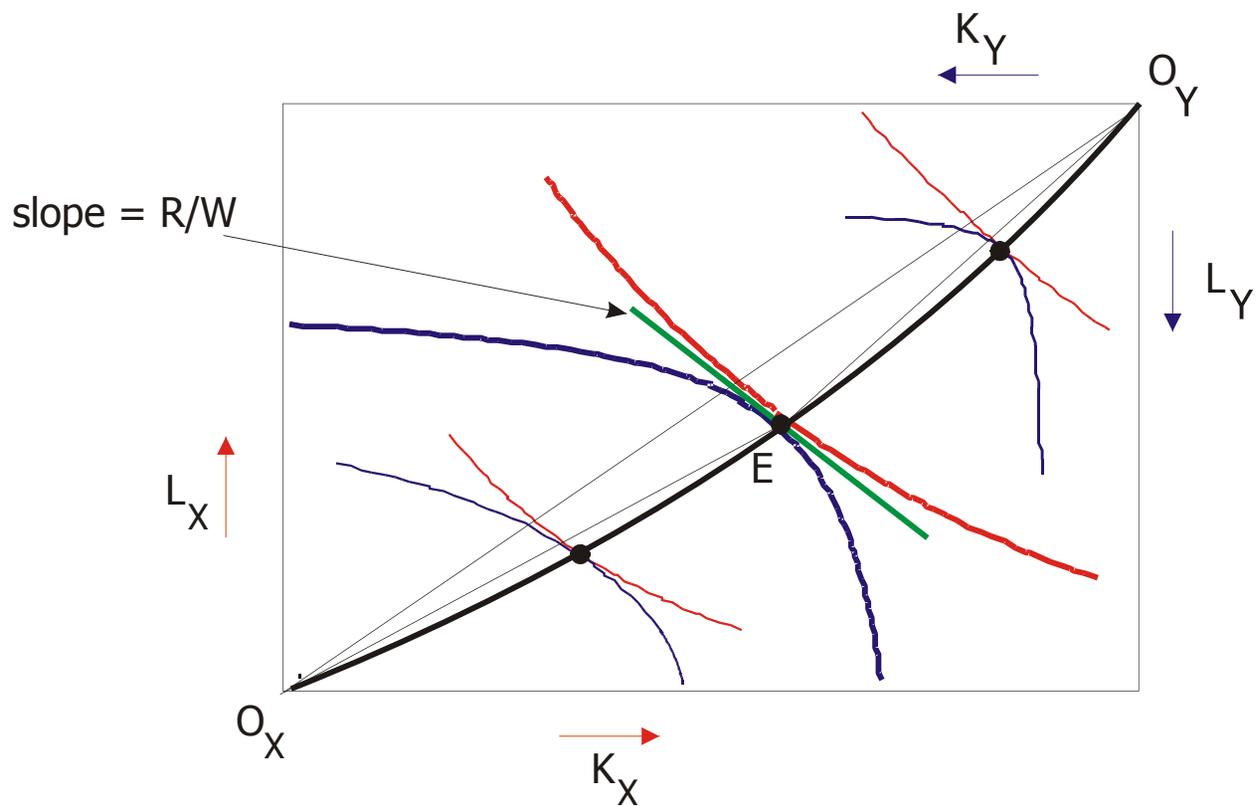
Slope of $O_X E$

< slope of $O_Y E$

$L_X / K_X < L_Y / K_Y$

(Y is rel. L-int.
X is rel. K-int.)

Can then plot the
efficient (X,Y)
combinations
to get the PPF.



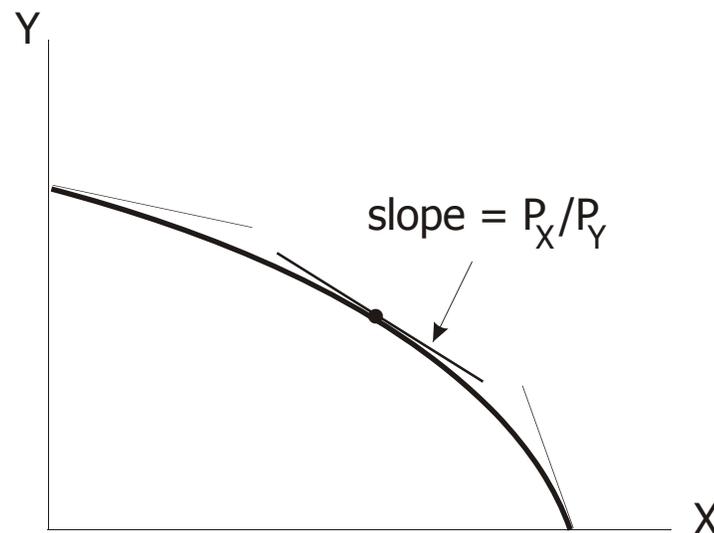
PRODUCTION POSSIBILITY FRONTIER

The PPF is bowed out.

Starting where $X = 0$ and all K and L go into producing Y , suppose we want to produce the first unit of X . For this, L , K should be moved to X in the ratio that the contract curve starts from O_X in the Edgeworth box.

For successive further units of X , we must withdraw a larger ratio L/K , and that reduces the output of Y (which is relatively L -intensive) by more and more.

If the goods were equally K (or L) intensive, the contract curve would coincide with the diagonal $O_X O_Y$. The rate at which Y is reduced for each unit increase in X would be constant, and the PPF would be a straight line.

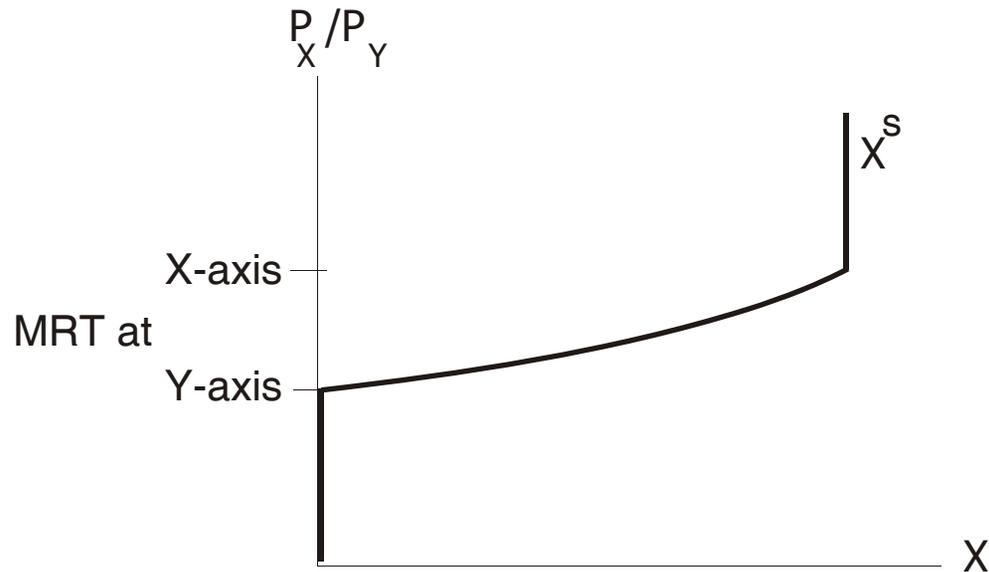
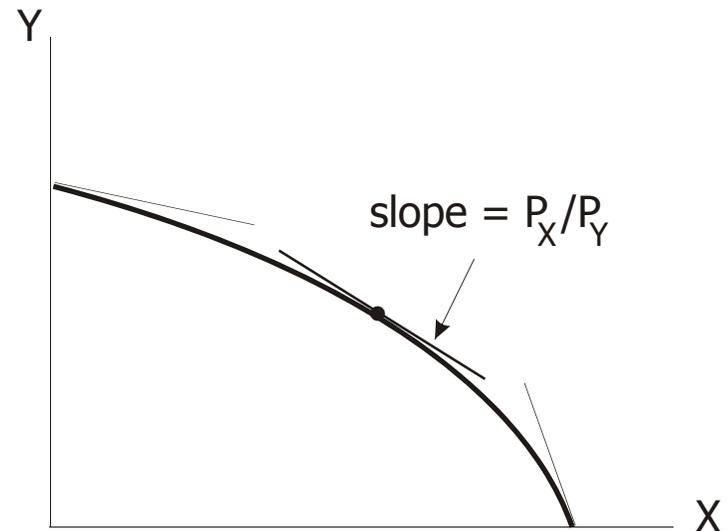


The slopes of the PPF at the points where it meets the axes are finite
 Slope at the Y-axis flatter, but > 0 ;
 at the X-axis, steeper, but $< \infty$

If P_X and P_Y is outside the range of the finite slopes at the endpoints, corner solution (specialization), production of only one good.

So absolute supply curve for X is:
 compare / contrast with both Ricardo and Ricardo-Viner.

We will mostly ignore complete specialization in Heckscher-Ohlin.
 It arises if one country's K/L ratio is too high or too low.



PRICES OF GOODS AND FACTORS

So long as both goods are being produced, factor rewards R , W depend only on goods prices P_X and P_Y , not on factor endowments K , L .

To see this, remember that the four input coefficients

A_{LX} = amount of labor used per unit of output of X etc.

are found by equality of MRTS and R/W , so they depend only on the ratio R/W .

Then the zero pure profit conditions for equilibrium are

$$A_{KX}(R/W) R + A_{LX}(R/W) W = P_X, \quad A_{KY}(R/W) R + A_{LY}(R/W) W = P_Y,$$

Subject to some technical mathematical conditions, these have a unique solution for R , W given P_X and P_Y (see the fixed coefficient beer-cheese example).

This also means that when free trade equalizes goods prices across the countries, it will also equalize factor prices across them!

Intuition: exporting a labor-intensive good is an indirect way to export labor.

In Heckscher-Ohlin, this goes to full extent, as if just one labor market.

Possible cause for concern for US labor?

SUPPLY AND TRADE

How does the PPF shift in response to changes in factor endowments?

Equivalently: how does it differ across countries with different factor endowments?

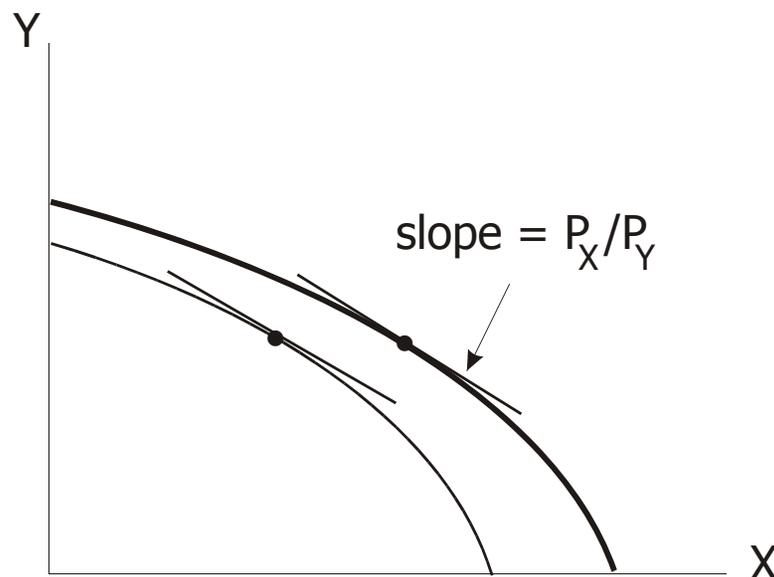
If both K and L doubled, all production possibilities and the PPF would shift radially out in the same proportion because of constant returns to scale.

If one factor say K increases relative to the other, the shift of the PPF is

“biased” in favor of the good that uses K more intensively, here X.

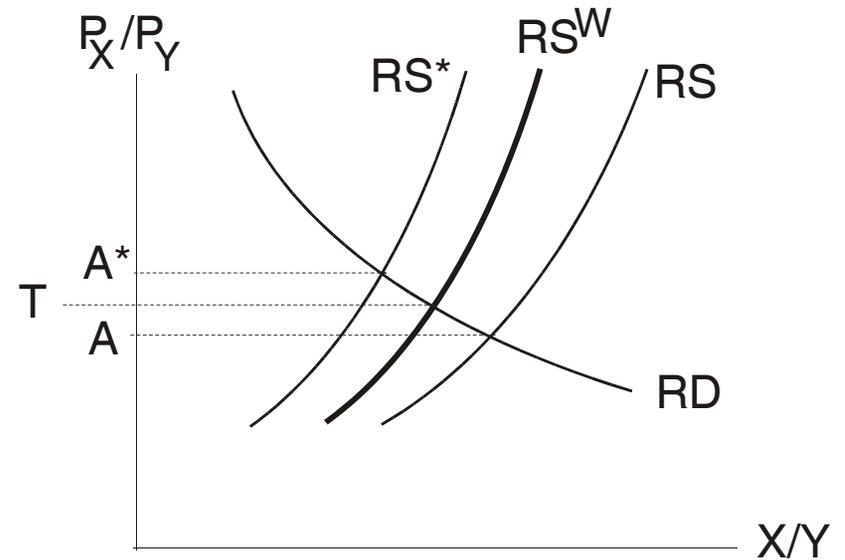
This is intuitive, and illustrated for fixed coefficient case in the beer-cheese example.

The figure illustrates this for an increase in K alone. It raises possible outputs of both X and Y (intercepts of the PPF on the axes) but that of X by more. This biased shift raises the optimal X for any given P_X / P_Y , and actually lowers the optimal Y (only slightly so in the figure) by the Rybczynski effect.



Therefore the country that has the relatively larger K/L (say home) has its relative supply curve (X/Y) function of P_X / P_Y to the right of that for the other country.

Therefore it has comparative advantage in the X good, with the same reasoning as that for earlier models.



DISTRIBUTIVE CONFLICT

Who gains and who loses from trade? In home country, trade raises P_X / P_Y
This raises R (reward to factor more intensively used in X production), lowers W .
Show this for the fixed coefficient case:

$$A_{KX} R + A_{LX} W = P_X, \quad A_{KY} R + A_{LY} W = P_Y$$

imply

$$\frac{R}{P_X} = \frac{A_{LY} - A_{LX} (P_Y / P_X)}{A_{KX} A_{LY} - A_{LX} A_{KY}}, \quad \frac{W}{P_Y} = \frac{A_{KX} - A_{KY} (P_X / P_Y)}{A_{KX} A_{LY} - A_{LX} A_{KY}}$$

The denominator is positive because of the relative factor intensity condition.

As P_X / P_Y increases, the numerator for R/P_X increases, that for W/P_Y goes down.

So R/P_X increases, and then R/P_Y also increases;

W/P_Y decreases, then W/P_X also decreases.

Distributive conflict by class (type of factor), not occupational (type of sector).

Contrast with pure exchange (all factors specific), Ricardo-Viner (some specific)

Evidence on distributive conflict:
 Magee examined the positions (pro-free-trade or protection) in testimony by business and labor groups to Congress in hearings on the 1973 trade bill.

Theories predict:

- [1] Both factors specific: entries along diagonal. Export sectors pro-trade, import-competing ones protectionist.
- [2] Ricardo-Viner: Entries in one vertical column.
- [3] Heckscher-Ohlin: Entries only in top right (if US is capital abundant).

Clear victory for specificity!

	Labor pro-trade	Labor Protectionist
Capital pro-trade	Paper Machinery Tractors Trucks Aircraft	Petroleum
Capital protectionist	Tobacco	Chemicals Distilling Textiles Apparel Plastics Leather Shoes Iron and Steel Bearings Hardware Cutlery Watches