INTERNATIONAL TRADE - ECON 245

FABIAN ECKERT

HECKSCHER-OHLIN

HECKSCHER-OHLIN MODEL

- Assumptions:
  - Identical technologies across countries
  - Identical and homothetic tastes across countries
  - Free trade in goods; no trade in factors
  - Different relative factor endowments across countries
  - No FIRs and hence FPE, if countries within cone of diversification

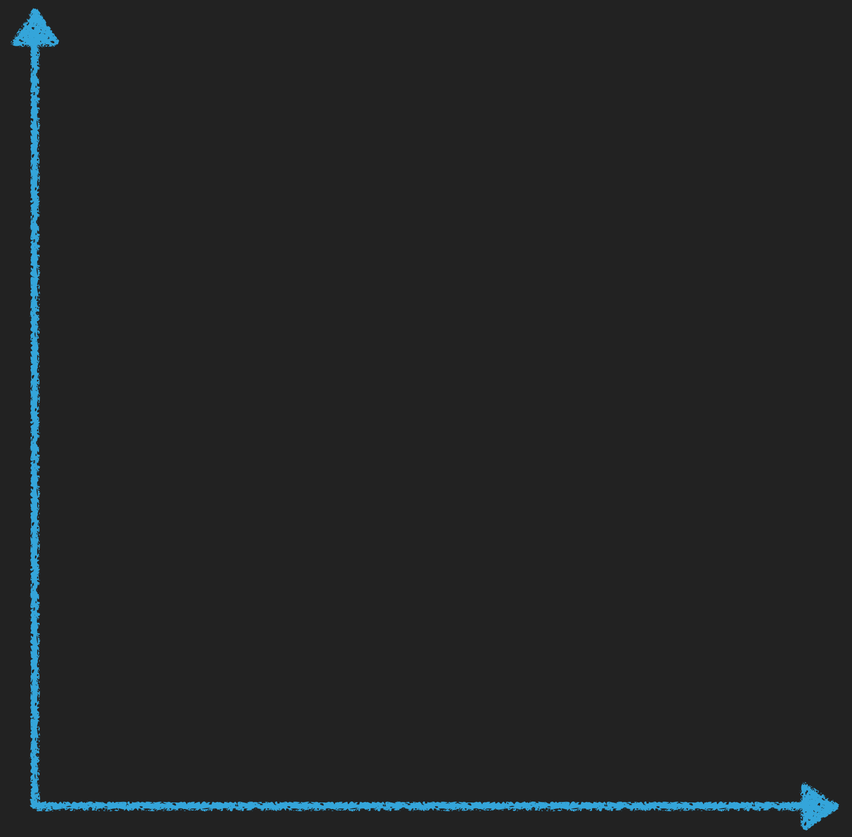
HECKSCHER-OHLIN-SAMUELSON (HOS) MODEL: 2 BY 2 BY 2 VERSION

- We assume WLOG:
  - Assume $L/K > L^\star/K^\star$ and identical labor endowments $L = L^\star$
  - Sector 2 is capital intensive
  - Trade is balanced (value of imports = value of exports)
- Question: What is the pattern of trades in goods between countries?

Theorem (Heckscher-Ohlin): Each country will export the good that uses its abundant factor intensively.

HECKSCHER-OHLIN-SAMUELSON (HOS) MODEL: 2 BY 2 BY 2 VERSION

- Can both countries have the same autarky price?
  - *Rybczynski* tells us no! y_1/y_2 must be higher lower in foreign in equilibrium.
  - Define excess demand function for good 1, $z(\,.\,)$.
  - But then $z(p^a) = 0$ and $z^\star(p^a) > 0$, likewise $z(p^{a\star}) < 0$ and $z^\star(p^{a\star}) = 0$
  - But then by continuity of $z(\,.\,)$, $\exists p,$ s.t. $p^a < p < p^{a\star}, z(p) + z^\star(p) = 0$
    - Equilibrium price lies between autarky prices



HECKSCHER-OHLIN-SAMUELSON (HOS) MODEL: 2 BY 2 BY 2 VERSION

- The *Law of Comparative Advantage* then tell us that home is exporting good 1!
- The *Stolper-Samuelson Theorem* tell us what factors win and lose in each country in *real terms* (!):
  - Recall for an exogenous price increase in the good using labor intensively: $\hat{r} < 0 < \hat{p} < \hat{w}$
  - By implication wages rise in home and fall in foreign when trade is liberalized!
- Factor content implications: export abundant factor, import scarce factor

HECKER-OHLIN-VANEK (HOV) MODEL: N BY N BY N VERSION

- Many factors and goods and countries.
- Do not keep track of the trade patterns in individual goods
  - Instead keep track of which factors a country imports and exports
  - Lot of tests of this factor content idea
- Assume away FIRs. Provided countries have endowments within cone of diversification this implies equalized factor prices.
- Bottom line of much of the empirical work: HOV model performs quite poorly unless we dispense with assumption of identical technologies which brings us back to Ricardo

HECKSCHER-OHLIN-VANEK MODEL

- Many country, many industry, many factor version
- Countries $i = 1 \ldots C$, industries $j = 1 \ldots N$ and factors k or $l = 1 \ldots M$
- $M \times N$ matrix $A = [a_{jk}]'$ factors needed for one unit of output
- Y^i, D^i are vector of output and demand for country i, $T^i = Y^i - D^i$ equals the vector of net exports for country i
  - "Factor content of trade" is $F^i \equiv AT^i$

HECKSCHER-OHLIN-VANEK MODEL

- The HOV model relates a country's endowments to the factor content of trade.
- The endowments of a country are denoted: $AY^i = V^i$
- Homothetic preferences+free trade implies $D^i = s^i D^w$
  - s^i share of country i in world consumption
- World consumption = world production: $AD^i = s^i AD^W = s^i AY^W = s^i V^W$
  - It follows: $F^i \equiv AT^i = V^i - s^i V^W$
    - Statement of the *Heckscher-Ohlin-Vanek Theorem*

LEONTIEFS PARADOX

- Leontief (1953) was the first to confront HO model with data.

USA	Exports	Imports
K ($million)	2.5	3.1
L (person-years)	182	170
K/L ($/person)	13700	18200

- Under assumption hat US was capital abundant at odds with HO prediction

LEONTIEF PARADOX

- Potenital Explanations:
  - U.S. and foreign technologies are not the same
  - Ignore factors such as land
  - Need to disaggregate labor by skill
  - Data for 1947 unusual due to WWII
  - Trade was not free but costly
- Leamer (1980): Leontief has performed the wrong test!

HECKSCHER-OHLIN-VANEK MODEL

- Leamer (1980) defines capital abundance of i as $K^i/K^W > L^i/L^W$

Theorem (Leamer 1980): If capital is abundant relative to labor in country i, then the HOV theorem implies that the capital-labor ratio embodied in production for country i exceeds the capital-labor ratio embodied in consumption:

$$K^i/L^i > (K^i - F^i_k)/(L^i - F^i_l)$$

- Turns out reformulating the Leontief Paradox in these terms resolves it!
  - Key: can show Leontief's test depends on trade balance and Leamer's did not, and trade was unbalanced in 1947

LEONTIEFS PARADOX REVISITED

- Leamer instead computed the following table:

USA	Production	Consumption
K ($billion)	327	305
L (person-years)	47 million	45 million
K/L ($/person)	6949	6737

- Production is indeed more capital intensive than consumption

EMPIRICAL TESTS OF THE HOV MODEL

- *Leontief 1953*
- Baldwin 1971
- *Leamer 1980*
- Leamer 1984
- Bowen Leamer Sveikaukas 1987
- Tefler 1995
- Tefler 1993a
- Trefler and Zhu 2010
- Bernhofen and Brown 2004a

BALDWIN 1971

- If the number of goods equals the number of factors, A is square so that:

$$T^i = A^{-1}(V^i - s^i V^W)$$

- Baldwin (1971) tests this equation treating T^i and A as data
  - Run across industries for the United States in 1960
- BUT makes mistake and regresses T^i on A, not its inverse!
- Regresses adjusted net exports on labor/capital requirements for one unit of production.

LEAMER 1984

- Uses the same equation but takes endowments not technologies as data.
- Run across different countries j, written as:

$$T_j^i = \sum_{k=1}^{M} \beta_{jK}(V_k^i - s^i V_k^W),\ i = 1,\ldots, C$$

- "Rybczynski" coefficients can be positive or negative
- The theory implies a linear fit so look at R^2 as "test" of the theory
  - Range from .13 to almost 1.
  - R^2 is a weak measure of validity of a theory

BOWEN LEAMER SVEIKAUKAS 1987

- First “full” test of the HOV theorem.
- Two tests of central equation: a sign test and a rank test:

$$\text{sign}(F_k^i) = \text{sign}(V_k^i - s^i V_k^W), i = 1,\ldots, C; k = 1,\ldots, M$$

$$F_k^i > F_l^i \Leftrightarrow (V_k^i - s^i V_k^W) > (V_l^i - s^i V_k^W), i = 1,\ldots, C; k = 1,\ldots, M$$

- What fraction of these relationships is as predicted by the model
  - Sign test 50% of cases, rank test 60% of cases - not much better than random!

TREFLER 1993A

- Diagnostic tests suggests “equal technologies“ assumption is worst.
- Trefler (1993a) *all factors in every country can differ in productivities*
  - π_k^i productivity of factor k in country i relative to the United States
- HOV equation in terms of effective endowments $\pi_k^i V_k^i$:

$$F_k^i = \pi_k^i V_k^i - s^i \sum_{j=1}^{C} \pi_k^j V_k^j, i = 1,\ldots, C; k = 1,\ldots, M$$

- Can fit data exactly (in most cases): test by studying “reasonableness“ of π_k^i

TREFLER 1993A

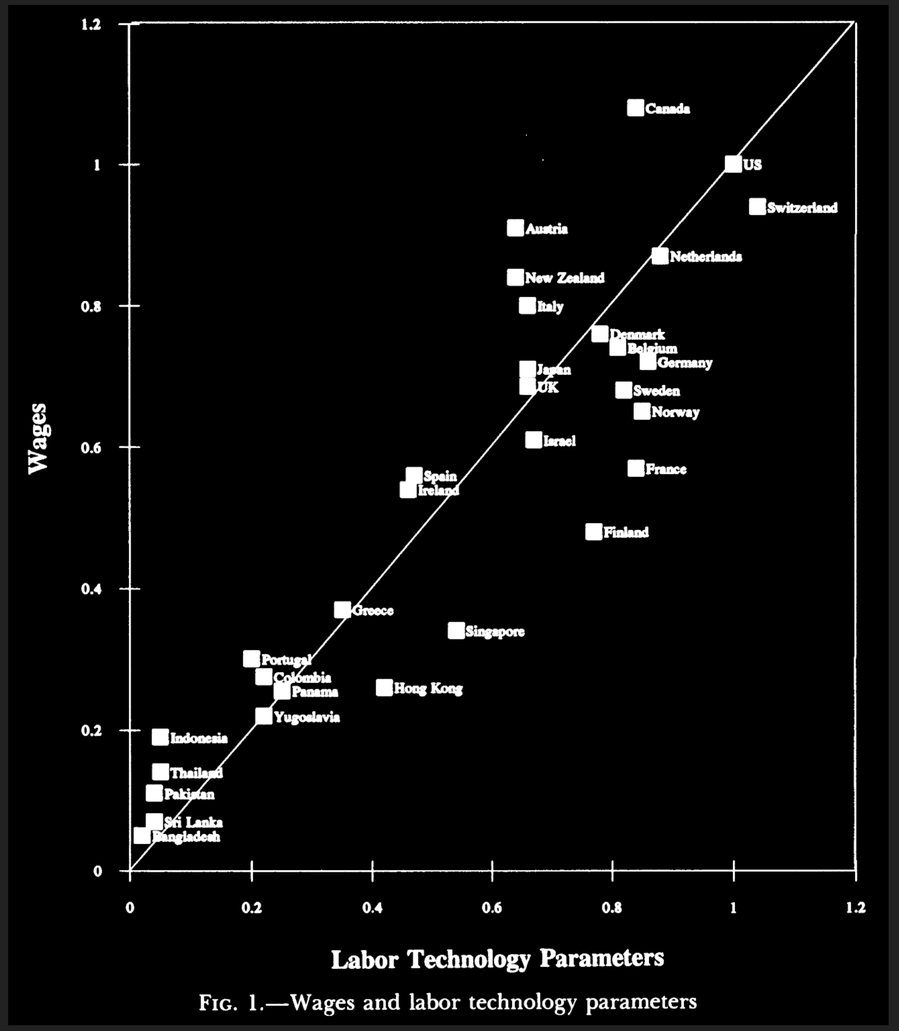


FIG. 1.—Wages and labor technology parameters

TREFLER 1995

- Second method of introducing technology differences
  - Make factor requirements matrix differ across countries:

$$\delta^i A^i = A^{US}$$

- HOV equation with such differences:

$$F^{iUS} \equiv A^{US} T^i = \delta^i V^i - \left(s^i \sum_{j=1}^{C} \delta^j V^j \right)$$

- Introduce additive error and choose δ^i to minimize it.
  - Correlation of δ^i with GDP is .89!

TREFLER AND ZHU 2010

- Suppose we used actual technology data for each country
- Trefler and Zhu show:

$$V^i - s^i \sum_j V^j = (\sum_{j \neq i} F^{ij}) - (\sum_{j \neq i} F^{ji})$$

with actual technologies and if output of every good is exported to each country in proportion to countries GDP.

- Warning about using actual technology data and being careful about what is testable versus what is accounting equation.