An Account of Global Factor Trade

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Heckscher-Ohlin and HOV

- H-O theory is a pillar of international economics
- Deep intuition: goods serve as a vehicle to arbitrage factor price differences
- Relatively robust version: Heckscher-Ohlin-Vanek
- Prediction: A country's net factor trade equals the difference between its endowment and the endowment typical in the world for a country that size

Paradoxes and Mysteries

- Efforts to verify this simple intuition on international data have ended disastrously
  - Leontief (1953): "paradox"
  - Maskus (1985): "Leontief commonplace"
  - Bowen, Leamer, and Sveikauskas (1987): "coin flip"
  - Trefler (1993, 1995): "mysteries"
  - DWBS (1997): "production model fails"
  - Gabaix (1997): "dominated by white noise"
- Time to give up?

Strategy in Recent Research

- Clear that the simple HOV framework fails
- Consider amendments to simple model
  - Technological differences
    - Hicks-neutral
    - Factor augmenting
    - Etc.
  - Absorption
    - Home bias in demand

Difficulties

- Key amendments concern
  - Technological differences
  - Absorption
- Yet typically data contains
  - One observation on technology (US)
  - No observations on absorption
- Hence statistical selection of preferred model leaves structural relation unclear

New Strategy

- Examine hypotheses directly on the relevant data
  - Technology matrices
  - Measured absorption
- Having selected the best models of technological differences and absorption
  - Impose these on HOV equations to see if they account for factor trade

What Find

- Consider a few simple and plausible amendments
- Confirm them directly on the relevant data
- When implement these in HOV equations
  - Countries export abundant factors
  - In approximately the right magnitude
- HOV works

Theory (1)

- Technology/production
  - Identical technologies, equal to US (P1)
  - Identical technologies, equal to "average" technology (P2)
  - Hicks-neutral technical differences (P3)
  - Dornbusch-Fischer-Samuelson, approximate FPE & specialization in tradables (P4)
  - Helpman no-FPE

Theory (continued)

- Absorption
  - Preferred production model features specialization in tradables
  - Rationalizes use of gravity model of import demand
  - Accounts for costs of trade, a crucial feature of the real world

Data Sources

- 10 OECD countries (those in IO database): Australia, Canada, Denmark, France, Germany, Italy, Japan, Netherlands, United Kingdom, United States
  - OECD input-output database (production, demand and trade)
  - OECD STAN (capital and labor for manufacturing)
  - International sectoral database (capital and labor for non-manufacturing)
  - 34 sectors total

Data Sources (Continued)

- 20 other countries (those reporting gross output or value added): rest of world (ROW)
  - Capital From Summers and Heston
  - Labor from ILO
  - Gross output From *UN Industrial Statistics Yearbook*
- Bilateral trade flows from Feenstra, Lipsey and Bowen (1997)

Data Issues

- First use of relevant data on technology and absorption to test hypotheses underlying HOV
- OECD data highly consistent, matched
- Construction of technology matrices internally consistent
- Quality of data on ROW consistent with prior work

Choice of Factors

- Previous studies have had many factors; have only capital and aggregate labor here
- Cannot separate high-skilled from low-skilled workers
  - Not available by sector for sample

Does Choice of Factors Bias Results?

- Omit land and mineral factors, which worked best in prior studies
- Factors included exhibit standard pathologies from prior tests
- In later tests, conversion to efficiency units may provide some remedy

Technology Data

- Basis for estimation is set of total factor input matrices constructed for 10 OECD countries
  - Capital derived from GFCF by sector and perpetual inventory method
  - Labor
    - Manufacturing: STAN "number engaged"
    - Non-manufacturing: ISDB "total employment"
  - Input-output matrix from OECD IO

Estimating Technology

- (P1) US matrix
- (P2) "average matrix"
  - $\ln B_{fi}^{c} = \beta_{fi} + \varepsilon_{fi}^{c}$
- (P3) Hicks-neutral technical differences
  - $\ln B_{fi}^{c} = \theta^{c} + \beta_{fi} + \varepsilon_{fi}^{c}$
  - $\mathrm{Exp}(\theta^{c}) = \lambda^{c}$
- Results plausible
  - Measured precisely, US most productive
  - Range of productivities for 10 in 1985 is a factor of two

Estimating Technology (continued)

- (P4) Continuum DFS model with H-N Technology Differences and FPE
  - $\ln B_{fi}^{c} = \theta^{c} + \beta_{fi} + \gamma_{fi} \ln(K_c/L_c) + \varphi_{fi}^{c}$
  - Normalization: $\Sigma_{fi} \gamma_{fi} = 0$ so country's K/L does not affect productivity level
  - Standard H-O model predicts $\gamma_{fi} = 0$
  - Actual elasticity in tradables: 0.8

Estimating Technology (continued)

- (P5) Helpman (1998) No-FPE model
  - Under (P4), input ratios in traded vary with country abundance, but not in non-traded
  - Under (P5) they vary in both
    - In tradables due to specialization
    - In non-tradables due to factor substitution
- Data show elasticity of 0.9 in non-tradables

Which Model of Technology Is Best?

- The tests are nested, so (P5) selected due to statistical and economic significance of
  - Hicks-neutral technical differences
  - Dependence of industry input ratios on country capital abundance in both tradables and nontradables
- Use Schwartz criterion to select among all
- (P5) the preferred model

Caution

- Data on technology for 10 OECD, but NOT for ROW
- Potentially Problematic
  - Projecting to a ROW that is much less capital abundant, different policy setting, etc.
    - UK (lowest K/L) is 2.5 times more K-abundant than ROW
- Potentially Important
  - ROW is largest net trader for each factor
- May need to consider alternatives with ROW

Estimating the Gravity Model

- Gravity model justified by
  - Identical homothetic preferences
  - Specialization in tradables (P5)
  - Fact that trade costs limit integration
- Standard form for bilateral imports
  - $\ln M_i^{cc'} = \alpha_{0i} + \alpha_{1i} \ln(s_i^{Tc} X_i^{c'}) + \delta_i \ln(d^{cc'}) + \ln \zeta_i^{cc'}$
- As many gravity regressions have shown, frictionless model is rejected

Taking Stock

- True statistical work is done
- Preferred model features
  - Hicks-neutral technical differences
  - No FPE
  - Specialization in tradables
  - Gravity absorption model
- But will it reconcile predicted and measured net factor trade?
  - Must move to measures of HOV model fit

Implementing the HOV Model: Measures of Model Fit

- Production tests
  - Production slope test: MFCP = PFCP
  - Median error test
- Trade tests
  - Trade slope test: MFCT = PFCT
  - Sign test: *sign*(MFCT) = *sign*(PFCT)
  - Variance ratio test: *var*(MFCT)/*var*(PFCT) = 1?

Plots and Regressions

- Production
  - Plots (P1) to (P5)
  - Regressions for all Factors
- Trade
  - Plots (T1) to (T7)
  - Regressions for all factors

Conclusions

- Implement a new approach
  - Examine key hypotheses on relevant data on technology and absorption
  - Allows us to have confidence we have identified the structural economic parameters of interest
- Striking confirmation of amended HOV
  - Countries export abundant factors
  - They do so in the right order of magnitude
- In short: HOV works