Multicountry, Multifactor Tests of the Factor Abundance Theory

Harry Bowen, Edward Leamer, and Leo Sveikauskas, *The American Economic Review*, 1987

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Motivation

Paper claims that most tests of the Heckscher-Ohlin Model are lacking on two counts:

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Paper claims that most tests of the Heckscher-Ohlin Model are lacking on two counts:

- The original 2×2 H-O model doesn't generalize in an unambiguous fashion to a multi-factor, multi-good world.
- H-O theorem describes a relationship between three separate phenomena: trade, factor input requirements, and factor endowments. Most tests before BLS only used data on 2 out of these 3 variables.

Leontief's Paradox

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- He finds that factor requirements of U.S. imports are more labor-intensive than U.S. exports.

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- He finds that factor requirements of U.S. imports are more labor-intensive than U.S. exports.
- He only uses capital and labor as factors, which Leamer (1980) shows does not generalize to a multi-factor world.
- Also, he only has data on factor requirements, not factor endowments.

Regression Studies # 1

One strand of literature tries to test the H-O Theorem by regressing trade of various commodities on their factor input requirements for a country.

- Sign of regression coefficient should reveal country's abundance in that factor. (E.g. Baldwin (1971), Branson and Monoyios (1977), Harkness (1978, 1983), Stern and Maskus (1981))

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- Sign of regression coefficient should reveal country's abundance in that factor. (E.g. Baldwin (1971), Branson and Monoyios (1977), Harkness (1978, 1983), Stern and Maskus (1981))
- Problem is that there is no factor endowment data to check predictions against. Bowen and Leamer (1981) show that coefficients might be misleading.

Regression Studies # 2

Another strand regresses net exports for a single commodity on factor endowments for different countries.

- Tests a weakened version of H-O Theorem that says that trade can be explained somehow by factor endowments, but does not make an explicit link with factor requirements. (E.g. Bowen (1983), Chenery and Syrquin (1975), Leamer (1974, 1984))

Purpose of This Paper

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- This paper computes the amount of 12 factors embodied in the net exports of 27 countries in 1967, using a U.S. input-output matrix for 1966.
- Analysis has data on all three elements: trade flows, factor requirements, and factor endowments.
- Results are generally not very supportive of the Heckscher-Ohlin Model.

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Vanek (1967) Model

Vanek (1967) creates an extension of the Heckscher-Ohlin Model (henceforth, HOV Model) for an arbitrarily large number of M factors, N goods, and C countries.

- Start with country i's trade balance:

$$\mathrm{T}^i = \mathrm{Y}^i - \mathrm{D}^i$$

  where each element is an $N \times 1$ vector of goods – T^i is a vector of net exports (each element could be positive or negative), Y^i is a vector of production, and D^i is a vector of consumption.

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  where each element is an $N \times 1$ vector of goods – T^i is a vector of net exports (each element could be positive or negative), Y^i is a vector of production, and D^i is a vector of consumption.

- Pre-multiply both sides by an $M \times N$ input-output matrix A:

$$\mathrm{AT}^i = \mathrm{AY}^i - \mathrm{AD}^i \tag{1}$$

  Note that A does not have a superscript. This is because we assume identical production technologies across all countries.

HOV Model # 2

- Define $\mathrm{F}^i = \mathrm{AT}^i$ as country i's "factor content of trade" – that is, the $M \times 1$ vector of factor inputs embedded in the country's net trade of goods (each element could be either positive or negative).

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- Due to the assumption of full-employment in the H-O model, we can write $\mathrm{A}\mathrm{Y}^i = \mathrm{V}^i$, where V^i is the $M \times 1$ vector of country i's factor endowments.

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- Due to the assumption of full-employment in the H-O model, we can write $\mathrm{AY}^i = \mathrm{V}^i$, where V^i is the $M \times 1$ vector of country i's factor endowments.
- If world supply equals world demand, then $\sum_{i=1}^{C} \mathrm{D}^i = \mathrm{Y}^w$. If utility functions are homothetic across countries (as is assumed in the H-O model), then $\mathrm{D}^i = s^i \mathrm{Y}^w$, where s^i is country i's share of world income.

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- Combining all of the above, we can then rewrite equation (1) as:

$$\mathrm{F}^{\mathrm{i}} = \mathrm{V}^{\mathrm{i}} - s^i \mathrm{V}^{\mathrm{w}} \tag{2}$$

That is, the factor content of country *i*'s trade will be equal to the difference between country *i*'s factor endowment and the world factor endowment multiplied by country *i*'s share of world income.

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  That is, the factor content of country *i*'s trade will be equal to the difference between country *i*'s factor endowment and the world factor endowment multiplied by country *i*'s share of world income.
- This equation forms the basis of the empirical tests in BLS.

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Data

Data come from the 367-element U.S. input-output table for 1967, and factor supply and trade data for 27 countries.

- Factors looked at are: net capital stock, total labor, professional/technical workers, managerial workers, clerical workers, sales workers, service workers, agricultural workers, production workers, arable land, pasture land, and forest land.

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- Factors looked at are: net capital stock, total labor, professional/technical workers, managerial workers, clerical workers, sales workers, service workers, agricultural workers, production workers, arable land, pasture land, and forest land.
- Trade data for each country's trade is obtained at the 4 and 5-digit level of the Standard International Trade Classification (SITC) industry classification, and concorded to the U.S. input-output table.

Sign Test

The first test that BLS try is a sign test:

- The kth element of equation (2) can be written as:

$$\frac{F_k^i/V_k^w}{Y^i/Y^w} = \left[\frac{V_k^i/V_k^w}{Y^i/Y^w}\right] - 1$$

(i.e. if the term in brackets on the right is greater than 1, then the country is abundant in the factor, and scarce if it is less than 1).

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  (i.e. if the term in brackets on the right is greater than 1, then the country is abundant in the factor, and scarce if it is less than 1).

- The sign test checks to see if the sign on the left-hand side of the equation is the same as the sign on the right-hand side of the equation – i.e. if the country has a positive factor-content of trade for factor k, then the country should be abundant in factor k, and conversely if the signs are negative.

Rank Test

The other type of qualitative test used by BLS is a rank test:

- The rank test checks if the relative factor content of trade reveals the relative abundance of resources, that is, if we have two factors k and l, then:

$$\frac{F_k^i / V_k^w}{Y^i / Y^w} > \frac{F_l^i / V_l^w}{Y^i / Y^w} \Leftrightarrow \frac{V_k^i / V_k^w}{Y^i / Y^w} > \frac{V_l^i / V_l^w}{Y^i / Y^w}$$

  that is, if a country has a relatively higher factor content of trade for factor k than factor l, then it should have a relatively higher factor endowment for factor k than factor l, and vice versa.

Sign and Rank Test Results #1

Table 1 shows $F_{k,i}/V_{k,w}$ for a number of countries and factors of production in 1966-67. Note that, contrary to Leontief Paradox, U.S. seems to export capital services and import labor services.

TABLE 1—RATIO OF ADJUSTED NET TRADE IN FACTOR TO NATIONAL ENDOWMENT

Country	Capital	Labor	Prof/Tech	Manager	Clerical	Sales	Service	Agriculture	Production	Arable	Forest	Pasture
Argentina	1.32	−0.30	−1.64	−2.60	−1.07	−0.62	−0.83	4.30	−1.46	21.24	−6.94	2.40
Australia	−3.77	−0.41	−2.95	−1.79	−1.68	0.21	−0.11	18.10	−3.65	17.15	−13.68	0.80
Austria	−2.03	3.01	2.74	5.64	2.91	3.81	3.20	3.12	2.59	−80.74	13.52	24.35
Bene-Lux	−2.36	1.81	0.88	1.82	1.90	1.36	2.39	−4.26	2.76	−364.25	−922.53	53.27
Brazil	−5.54	−0.27	−0.85	−0.49	−0.82	−0.32	−0.23	−0.04	−0.61	2.10	−0.04	−0.02
Canada	1.82	−3.49	−3.40	−2.23	−4.00	−2.73	−1.88	4.00	−6.84	12.13	6.16	2.84
Denmark	−4.89	5.82	2.37	8.70	4.25	5.08	4.51	24.56	1.21	33.57	803.73	1763.42
Finland	4.69	2.14	0.49	4.22	1.78	1.94	1.89	1.26	3.21	−24.44	30.48	434.70
France	−4.07	0.82	0.70	1.17	1.02	0.90	1.06	0.16	1.04	−21.33	−198.68	1.79
Germany	−1.05	−0.43	1.01	1.34	0.51	−1.08	−1.05	−11.86	2.07	−323.61	−377.64	−124.77
Greece	−5.50	2.93	4.48	14.95	5.37	4.49	4.68	2.20	2.02	46.92	−61.16	1.08
Hong Kong	−46.06	4.52	5.24	3.68	8.10	3.48	3.03	−14.19	6.46	−21568	−30532	−91627216
Ireland	−1.93	6.73	4.49	13.84	7.19	6.10	8.07	10.59	2.67	17.31	−129.98	72.68
Italy	−7.03	0.74	1.25	4.67	1.42	0.39	1.27	−1.73	1.87	−39.91	−431.67	−131.90
Japan	−5.47	0.10	0.44	0.48	0.33	−0.05	−0.03	−1.54	1.18	−341.42	−268.58	−1998.58
Korea	−30.51	0.61	1.53	2.85	1.81	0.76	1.73	0.27	0.85	−42.34	−29.42	1206.60
Mexico	−0.78	0.57	0.19	0.47	0.51	0.80	0.70	0.87	−0.21	12.40	5.69	0.97
Netherlands	−4.56	4.61	3.49	6.36	3.65	4.72	5.53	22.78	1.41	82.74	−719.88	330.86
Norway	−5.54	5.57	3.75	6.15	7.98	10.22	10.58	14.59	−0.06	−125.48	105.96	660.35
Philippines	−13.94	−0.10	−0.59	−0.36	−0.81	0.03	0.06	0.14	−0.81	10.47	−8.43	−17.03
Portugal	−10.31	1.92	3.92	10.85	3.75	2.83	2.72	0.63	2.49	−28.46	24.79	12.03
Spain	−6.19	3.04	4.56	13.88	4.36	4.13	3.89	2.45	2.23	−2.74	−12.00	4.92
Sweden	0.79	1.36	0.59	2.26	1.05	1.09	1.44	−0.66	2.18	−67.23	30.93	48.00
Switzerland	−5.72	3.42	4.46	11.57	3.52	5.42	4.13	−0.79	3.04	−862.95	−352.36	−12.18
UK	−12.86	0.63	1.77	2.04	1.37	1.30	1.32	−18.57	1.11	−313.42	−2573.99	−91.89
US	0.08	−0.25	0.23	−0.11	−0.19	−1.10	−0.68	1.54	−0.34	19.45	−23.82	−1.63
Yugoslavia	−3.15	0.68	0.39	1.59	1.12	2.05	1.15	0.46	0.76	−0.08	2.81	14.24

Note: Numbers in percent. Factor content data are for 1967; endowment data are for 1966.

Sign and Rank Test Results #2

Table 2 shows in the first column the proportion of "correct" matches for signs by different factors across countries and the rank test in the second and third columns.

TABLE 2—SIGN AND RANK TESTS, FACTOR BY FACTOR

Factor	Sign Test[a]	Rank Tests[b]	
Capital	.52	0.140	.45
Labor	.67	0.185	.46
Prof/Tech	.78	0.123	.33
Managerial	.22	−0.254	.34
Clerical	.59	0.134	.48
Sales	.67	0.225	.47
Service	.67	0.282[c]	.44
Agricultural	.63	0.202	.47
Production	.70	0.345[c]	.48
Arable	.70	0.561[c]	.73
Pasture	.52	0.197	.61
Forest	.70	0.356[c]	.65

Sign and Rank Test Results #3

- Sign test exceeds 50% for 11 of the 12 factors. However, only 4 of the 12 are 70% or higher, and only one, Arable Land, is significant at the 5% level.

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- Rank test is mixed. 11 of 12 Kendall rank correlation coefficients are positive, but only 4 of 12 are significant at the 5% level.

Sign and Rank Test Results #4

Table 3 repeats the sign and rank test across factors by country.

TABLE 3—SIGN AND RANK TESTS, COUNTRY BY COUNTRY

Country	Sign Tests[a]	Rank Tests[b]	
Argentina	.33	0.164	.58
Australia	.33	−0.127	.44
Austria	.67	0.091	.56
Belgium-Luxembourg	.50	0.273	.64
Brazil	.17	0.673[c]	.86
Canada	.75	0.236	.64
Denmark	.42	−0.418	.29
Finland	.67	0.164	.60
France	.25	0.418	.71
Germany	.67	0.527[c]	.76
Greece	.92	0.564[c]	.80
Hong Kong	1.00	0.745[c]	.89
Ireland	.92	0.491[c]	.76
Italy	.58	0.345	.69
Japan	.67	0.382	.71
Korea	.75	0.345	.69
Mexico	.92	0.673[c]	.86
Netherlands	.58	−0.236	.38
Norway	.25	−0.236	.38
Philippines	.50	0.527[c]	.78
Portugal	.67	0.091	.56
Spain	.67	0.200	.62
Sweden	.42	0.200	.62
Switzerland	.67	0.382	.69
United Kingdom	.92	0.527[c]	.78
United States	.58	0.309	.67
Yugoslavia	.83	−0.055	.49

[a] Proportion of 12 factors for which the sign of net trade in factor matched the sign of the corresponding excess supply of factor.

[b] The first column is the Kendall rank correlation among 11 factors (total labor excluded); the second column is the proportion of correct rankings out of 55 possible pairwise comparisons.

[c] Statistically significant at the 5 percent level.

Sign and Rank Test Results #5

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- For rank correlation, 5 of 27 countries have the wrong sign, only 8 countries have correct sign and significantly different from zero at the 5% level. Pairwise comparisons are greater than 50% for 22 countries.
- Qualitative tests are generally not very supportive of the HOV model, but it is difficult to tell the reason why.

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Alternative Hypothesis: Homothetic Preferences

H-O-V Model assumes homothetic (proportional) consumer preferences. Relaxing all assumptions about consumption preferences would make the relation between trade and factor endowments completely indeterminate, but we can test a specific alternative.

- Alternate Hypothesis (A2): All individuals have identical preferences with linear Engel curves; and within each country, income is equally distributed. Consumption of good j is:

$$C_{i,j} = \lambda_j L_i + \psi_j \left((Y_i - B_i) - L_i y^0 \right) \tag{3}$$

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- Equation (3) implies that equation (2) can be rewritten as:

$$\mathrm{F_i} = \mathrm{V_i} - \theta L_i - \beta \left(Y_i - B_i \right)$$

  where our original assumption is nested within this specification if we restrict $\theta = 0$ and $\beta_k = V_{k,w} / Y_w /$

Alternative Hypothesis: Measurement Error #1

We also assume that trade vectors and factor endowment vectors, which may be tricky to measure in practice, are not measured with error:

- Alternative Hypothesis (M1): The measurement of net trade vectors are measured with error, where the measured net trade differs from the true value by a constant plus a random error:

$$\mathsf{T}_i^m = \omega + \mathsf{T}_i + \mathsf{T}_i^e$$

which, in turn, implies that the factor content of trade is:

$$\begin{aligned} \mathsf{F}_i^m = \mathsf{A}\mathsf{T}_i^m &= \mathsf{A}\omega + \mathsf{A}\mathsf{T}_i + \mathsf{A}\mathsf{T}_i^e \\ &= \alpha + \mathsf{F}_i + \mathsf{F}_i^e \end{aligned}$$

and our original assumption is nested in this specification by assuming that $\alpha = 0$.

Alternative Hypothesis: Measurement Error #2

- Alternative Hypothesis (M2): The measurements of factor endowments are also imperfect, but in the following manner:

$$V_{k,i} = \gamma_k V^m_{k,i}$$

where the original assumption is nested by assuming that $\gamma_k = 1$ for all k.

Alternative Hypothesis: Measurement Error #3

Measurement error may also affect the total world endowments, especially because we have incomplete coverage of countries. This isn't a big problem if the sum of endowments in our sample is roughly proportional to the world endowment, but we don't know that it is.

- Alternative Hypothesis (M3): Assume that the calculated totals from the sample do not accurately represent the world totals so that:

$$V_{k,w} = \sigma_{k,S} V_{k,S}$$

$$Y_w = \phi_S Y_S$$

where S is the total of the countries in the sample, and ϕ and σ are unknown elements. The original assumption is nested by assuming that $\sigma = 1$ and $\phi = 1$ for all k.

Modified Regression Equation

If we combine all of the alternative assumptions above, we can write a regression equation of the following form:

$$F_{k,i} = \alpha_k + \gamma_k V_{k,i} - \theta_k L_i - \beta_k (Y_i - B_i) + F^e_{i,k} \tag{4}$$

where all of the variables are the measured amounts.

Technological Heterogeneity

We have assumed (along with the H-O-V Model) that all countries use the same technology as the U.S.. Relax this assumption slightly by allowing a proportional deviation from the U.S. input-output matrix.

- Alternative Hypothesis (A3): We measure other countries' input-output matrix as proportional to the U.S. matrix:

$$\mathrm{A}_{\mathrm{US}} = \delta_i \mathrm{A}_{\mathrm{i}}$$

  where $\delta_i > 0$ and $\delta_{US} = 1$.

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  where $\delta_i > 0$ and $\delta_{US} = 1$.
- Under hypothesis (A3), θ_k becomes θ_k/δ_i, β_k becomes β_k/δ_i, and $F_{k,i}$ becomes $F_{k,i}^{US}/\delta_i$ where $F_{k,i}^{US}$ is country i's factor content of trade for factor k using the U.S. input-output matrix.

Regression Equation

If we substitute the values generated by hypothesis (A3) into equation (4), we get:

$$\frac{F_{k,i}^{US}}{\delta_i} = \frac{\alpha_k}{\delta_i} + \gamma_k V_{k,i} - \frac{\theta_k}{\delta_i} L_i - \frac{\beta_k}{\delta_i} (Y_i - B_i) + \frac{F_{k,i}^{e}}{\delta_i}$$

And multiplying through by δ_i, we get:

$$F_{k,i}^{US} = \alpha_k + (\delta_i \gamma_k) V_{k,i} - \theta_k L_i - \beta_k (Y_i - B_i) + F_{k,i}^{e} \tag{5}$$

Parameter Restrictions

We can turn different assumptions on and off via parameter restrictions, which are noted in Table 4:

TABLE 4—ALTERNATIVE ASSUMPTIONS AND PARAMETER RESTRICTIONS

	Assumptions[a]						Parameter Restrictions				
Hypothesis	A1	A2	A3	M1	M2	M3	θ_k	δ_i	α_k	γ_k	β_k
HG	*										
H1	*	*	*			*	0	1			E_{ks}/Y_s
H2	*	*		*	*	*	0		0	1	E_{ks}/Y_s
H3	*	*				*	0				E_{ks}/Y_s
H4	*	*	*	*	*		0	1	0	1	
H5	*	*	*				0	1			
H6	*	*		*	*		0		0	1	
H7	*	*					0				
H8	*		*	*	*			1	0	1	
H9	*		*					1			
H10	*			*	*				0	1	

[a]Absence of an asterisk indicates selection of the alternative $\tilde{A}_i$ or $\tilde{M}_i$. Each parameter restriction is listed in the same order as the corresponding assumptions A2–M3.

Definitions: A1 = identical commodity prices; A2 = identical and homothetic tastes; A3 = identical input intensities; M1 = unbiased measurement of factor contents; M2 = perfect measurement of endowments; and M3 = complete coverage of countries.

Likelihood Functions

- In order to compare the performance of alternative models, we estimate the likelihood function associated with (5):
$$L = (ESS)^{-NK/2}$$
where ESS is the error sum of squares summed across countries and factors and NK is the total number of observations.

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  where ESS is the error sum of squares summed across countries and factors and NK is the total number of observations.
- Because L necessarily increases as we add more parameters, we adjust using the asymptotic Bayes' formula proposed in Leamer (1978) and Schwarz (1978):

$$L^* = L\,(NK)^{-p/2}$$

  where p is the number of parameters estimated under a given hypothesis.

Likelihood Ratios

- Given an alternative hypothesis j and a null hypothesis i, calculate the likelihood ratio:

$$\Lambda = L_j^* / L_i^* = \left(\frac{ESS_i}{ESS_j} \right)^{(NK/2)} (NK)^{(p_i - p_j)/2}$$

The evidence favors hypothesis j if $\Lambda > 1$.

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$$\Lambda = L_j^*/L_i^* = \left(\frac{ESS_i}{ESS_j}\right)^{(NK/2)}(NK)^{(p_i - p_j)/2}$$

  The evidence favors hypothesis j if $\Lambda > 1$.

- In order to eliminate heteroskedasticity and scale the variables so that the error terms can be assumed to have the same variance, we scale all variables by the "world" endowment level $V_{k,s}$ and the country consumption level $(Y_i - B_i)$ so that the regression becomes:

$$F_{k,i}^{US} S_{k,i} = \alpha_k S_{k,i} + (\delta_i \gamma_k)(V_{k,i} S_{k,i}) - \theta_k (L_i S_{k,i}) - \frac{\beta_k}{V_{k,S}} + F_{k,i}^{e^*} \tag{6}$$

  where $S_{k,i} = [(Y_i - B_i) V_{k,S}]^{-1}$ and $F_{k,i}^{e^*}$ is assumed to be a normally distributed error term.

Estimation

Equation (6) is estimated iteratively.

- First δ_i (the country fixed effect) is given a seed-value of 1, and the parameters α_k, γ_k, θ_k, and β_k (all factor-specific parameters) are estimated.

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- These estimates are then plugged back in to equation (6), and δ_i is estimated.
- The estimation procedure continues until the likelihood function converges to a stable value.

Likelihood Ratio Results

Table 5 shows the performance of each hypothesis.

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- The 2nd best is (H7), which is the same as (H3) except allowing for sample selection in country coverage.
- The 3rd best is (HG), the least restrictive sample. The others are essentially "impossible" given the data evidence.

Table 5

TABLE 5—PERFORMANCE STATISTICS FOR ALTERNATIVE HYPOTHESES

Hypothesis	ESS[a]	ln(L)	Number of Parameters	Adjusted[b] ln(L)	Odds of Hypothesis[c] Relative to H3
HG	1.32	−41.1	71	808.1	3.15E-15
H1	6.63	−280.9	22	707.8	nil
H2	14.56	−397.7	27	576.8	nil
H3	1.61	−70.4	49	841.5	1.0
H4	961.80	−1020.0	11	0.0	nil
H5	6.35	−274.6	33	682.8	nil
H6	11.85	−367.2	38	576.0	nil
H7	1.51	−60.9	60	819.6	32.20E-10
H8	492.39	−920.6	22	68.1	nil
H9	6.25	−272.1	44	653.9	nil
H10	11.58	−363.7	49	548.1	nil

[a] In millions.

[b] Adjusted $\ln(L) = \ln(L) - (p/2)\ln(297) + 1051$, where p = number of parameters and 1051 is the value of equation (16) under hypothesis H4.

[c] Odds = exp[adjusted $\ln(L) - 841.5$]. "Nil" entries indicate a value less than 10^{-50}.

Estimates of δ_i

Even though (H3) is the most plausible model, some of its estimates produce implausible values. Table 6 reports estimates of δ_i. 8 of 26 countries have impossible negative values, and 15 of 26 have values that are significantly greater than 1, which is unlikely.

TABLE 6—H-O-V REGRESSIONS AND COUNTRY COEFFICIENTS UNDER HYPOTHESIS H3

Country	δ_i[a]	Standard Error	t-Statistics[b]
Argentina	1.5769	0.0941	6.129
Australia	1.1315	0.0751	1.751
Austria	3.9479	0.8720	3.380
Belgium-Luxembourg	−7.1774	2.7668	−2.955
Brazil	0.1327	0.0474	−18.281
Canada	0.9431	0.1225	−0.463
Denmark	7.2536	0.6196	10.092
Finland	4.4885	0.2966	11.758
France	−0.7803	0.7591	−2.345
Germany	−16.9248	2.0573	−8.712
Greece	6.1582	0.2809	18.357
Hong Kong	−174.4016	24.7673	−7.081
Ireland	13.4523	0.4147	30.024
Italy	−1.5930	0.7419	−3.494
Japan	−21.3424	2.2211	−10.059
Korea	3.0928	0.2646	7.906
Mexico	1.1999	0.1121	1.782
Netherlands	18.5644	3.2888	5.340
Norway	13.0655	0.8802	13.706
Philippines	2.2965	0.1057	12.258
Portugal	1.9940	0.1640	6.060
Spain	0.3709	0.2131	−2.950
Sweden	2.9687	0.7193	2.736
Switzerland	−16.2249	5.0798	−3.390
United Kingdom	−17.4481	2.0614	−8.949
United States	1.0000	NA	NA
Yugoslavia	1.7798	0.1524	5.115

Note: Number of observations = 297.
[a] Values are divided by U.S. estimate ($\delta_{us} = 1.0012$).
[b] Asymptotic t-values for testing δ_i is unity. The critical t-value based on equation (17) is 2.19.

Estimates of α_k and γ_k

Table 7 reports the estimates for the measurement error parameter estimates. We have no hypotheses about the value of α_k, but 4 of the γ_k coefficient estimates are negative, implying that the observed factor endowments are negatively correlated with the true factor endowments.

TABLE 7—H-O-V REGRESSIONS AND FACTOR COEFFICIENTS UNDER HYPOTHESIS H3

Resource	Parameters α_k[a]	γ_k[b]
Capital	−990620794	13.431
	(−6.665)	(2.142)
Labor		
Agricultural	−7853	13.631
	(−1.376)	(2.721)
Clerical	−4628	−1.111
	(−1.426)	(−0.386)
Prof/Tech	−4376	−0.360
	(−1.866)	(−0.128)
Managerial	−1815	−0.528
	(−1.587)	(−0.370)
Production	−19608	−2.671
	(−1.997)	(−2.152)
Sales	−1214	0.216
	(−0.515)	(0.175)
Service	−1302	0.053
	(−0.498)	(0.052)
Land		
Arable	−2570651	1718.648
	(−62.891)	(52.545)
Forest	−2454843	833.206
	(−21.263)	(20.427)
Pasture	−202638	199.930
	(−2.275)	(9.163)

[a]Asymptotic t-values in parentheses. The critical t-value based on equation (17) is 2.19.
[b]Values of γ_k scaled by 10^3.

Table of Contents

Conclusions #1

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- At a minimum, the assumptions of identical technology, and precisely measured factor contents need to be relaxed.
- Homothetic tastes are supported by the evidence, but the weird parameter estimates cast even this result into question.

Conclusions #2

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Conclusions #2

- Qualitative tests linking trade flows, factor requirements, and factor endowments do not lend much support for the HOV Model.
- Further empirical tests suggest that there are errors in the observed factor content of trade, and that there are technological differences across countries. However, regression estimates which relax these assumptions yield some implausible empirical results.
- Overall, "The Heckscher-Ohlin model does poorly, but we do not have anything that does better."