

The Leontief Paradox

- Empirical tests of the Heckscher-Ohlin theory

In 1954 and 1956 Leontieff run two tests of Heckscher-Ohlin-Samuelson theory

In the first test (1954) he uses American data from the 1947 input-output tables with 200 industries aggregated in 50 sectors

He computes direct and indirect requirements of labour and capital for the production of 1 million dollars worth of US export and for the production of 1 million dollars worth of competitive imports (import replacement)

Then he computes the capital/labour ratio of US import and export in order to test the H-O-S theory under the hypothesis that the USA is a “Capital Abundant” country

Input-output analysis

	A	M	S	C	
A	a_{aa}	a_{ai}	a_{as}	c_a	x_a
M	a_{ma}	a_{mi}	a_{ms}	c_i	x_i
S	a_{sa}	a_{si}	a_{sc}	c_s	x_s
L	l_a	l_i	l_s	VA	
	x_a	x_i	x_s		X

A=agriculture

M=manufacture

S=services

C=consumption (GDP)

L=labour income

VA=value added (GDP)

X=gross production

Input-output: an example

	A	M	S	C	X
A	50	30	20	50	150
M	25	70	40	60	195
S	20	50	40	50	160
L	55	45	60	160	
X	150	195	160		505

Value added
GDP

Gross production

Expected results:

Assuming that the USA have a relative abundance of capital, the USA

should export capital intensive goods

should import labour intensive goods

Results: just the opposite!

The USA exports labour intensive goods!

Table 13.1 *Leontief's first US study*

	<i>Capital (1947 prices)</i>	<i>Labour (worker years)</i>	<i>Capital/labour ratio</i>
Exports	\$2,550,780	182,313	\$13,991
Import replacements	\$3,091,339	170,004	\$18,184

α -index = $\$18,184 \div \$13,991 = 1.30$

Explanations of the paradox according to Leontieff:

American workers are more efficient so that
American labour is more valuable
(example: 1 hour of American work is worth
2 hours of foreign work)

As a consequence, the USA is actually better endowed
with labour than other countries

Leontieff does not explain why American work
should be more efficient

In 1956 Leontieff repeats his test using the same 1947 input-output tables but taking in account 192 industries and the 1951 US trade composition

The “paradox” shows up again even if it is attenuated

US export appears to be still labour intensive

Table 13.2 *Leontief's second US study*

	<i>Capital (1947 prices)</i>	<i>Labour (worker years)</i>	<i>Capital/labour ratio</i>
Exports	\$2,256,800	173.91	\$12,977
Import replacements	\$3,303,400	167.81	\$13,726

α -index = $\$13,726 \div \$12,977 = 1.06$

Source: Leontief (1956).

The Tatamoto-Ichimura test

Table 13.3 *Factor content result for Japan*

	<i>Capital (1951 prices)</i>	<i>Labour (worker years)</i>	<i>Capital / labour ratio</i>
Exports	¥1,385,780	5.520	¥251,047
Import replacements	¥1,330,926	8.233	¥161,657
$\alpha\text{-index} = ¥161,657 \div ¥251,047 = 0.64$			

Source: Tatamoto and Ichimura (1959).

The case of Japan confirms the Leontieff paradox: in 1951 Japan was “Labour Intensive” but its export was “Capital Intensive”

The paradox disappears when just the bilateral Japanese-USA trade is taken in account ($\alpha\text{-index} > 1$)

As to factors endowment, Japan was in an “intermediate” position among developed and under-developed countries

Test di Bharadwaj

Bharadwaj computes two α -index with US and Indian data

Table 13.4 *Capital-labour ratios of US-Indian trade*

	<i>Exports</i>	<i>Competitive imports</i>	<i>α-index</i>
USA	\$20,741	\$11,405	0.55
India	Rs.860	Rs.662	0.72

Source: Bharadwaj (1962b).

The α -index computed with US data confirms H-O:
the USA exports capital intensive goods to India

On the other side, Indian data generates the paradox:
India sells capital intensive goods to the USA!

The Baldwin test

Baldwin makes a distinction between physical capitale (K)
and human capitale (H)

When just human capital is used, the Leontieff paradox
disappears (α -index < 1)

Table 13.5 *US factor requirements: 1962 trade composition*

	Exports	Competitive imports	α -index
(K/L) All sectors	\$14,200	\$18,000	1.27
(K/L) Excl. Agri.	\$12,800	\$18,100	1.41
(K/L) Excl. NR	\$11,500	\$11,900	1.03
(H/L) All sectors	\$10,500	\$10,300	0.98
(H/L) Excl. Agri.	\$11,900	\$11,000	0.92
(H/L) Excl. NR	\$12,200	\$11,200	0.92
(HK/L) All sectors	\$24,700	\$28,300	1.15
(HK/L) Excl. Agri.	\$24,700	\$29,100	1.18
(HK/L) Excl. NR	\$23,700	\$23,100	0.97

Agri. = agriculture, NR = Natural resource industries

Source: Baldwin (1971).

The Stern-Maskus α test

Using US data for 1958, the Authors obtain results very close to the Baldwin's ones

α -index are < 1 when human capital (H) is taken in account

Table 13.6 *US factor requirements: 1958 trade composition*

	<i>Exports</i>	<i>Imports</i>	<i>α-index</i>
(K/L) All industries	\$9,559	\$10,243	1.07
(K/L) Excl. Agri.	\$9,423	\$9,995	1.06
(K/L) Excl. NR	\$8,992	\$9,270	1.03
(H/L) All industries	\$24,366	\$20,064	0.82
(H/L) Excl. Agri.	\$31,656	\$26,869	0.85
(H/L) Excl. NR	\$31,928	\$27,310	0.86
(HK/L) All industries	\$33,925	\$30,307	0.89
(HK/L) Excl. Agri.	\$41,079	\$36,864	0.90
(HK/L) Excl. NR	\$40,920	\$36,580	0.89

Source: Stern and Maskus (1981).

The Stern-Maskus 2 test

With 1972 US data they find support for the H-O-S theory

The α -indexes are always < 1

Table 13.7 *US factor requirements: 1972 trade composition*

	<i>Exports</i>	<i>Imports</i>	<i>α-index</i>
(K/L) All industries	\$14,989	\$14,218	0.95
(K/L) Excl. Agri.etc.	\$19,329	\$18,569	0.96
(K/L) Excl. NR	\$18,650	\$17,338	0.93
(H/L) All industries	\$53,193	\$52,429	0.99
(H/L) Excl. Agri. etc.	\$59,836	\$53,750	0.90
(H/L) Excl. NR	\$60,721	\$54,153	0.89
(HK/L) All industries	\$68,182	\$66,647	0.98
(HK/L) Excl. Agri.etc.	\$79,165	\$72,319	0.91
(HK/L) Excl. NR	\$79,371	\$71,491	0.90

Source: Stern and Maskus (1981).