

The Nottingham Lectures in International Economics

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Lecture 1: Interacting Factor Endowments and Trade Costs

Background paper:

Markusen, James R. and Anthony J. Venables (2007), “Interacting trade costs and factor endowments: a multi-country, multi-good approach to trade theory”, under revision for the *Journal of International Economics*.

Interacting factor endowments and trade costs

James Markusen Anthony Venables

- (1) Focus on the interaction of endowments and trade costs with multiple countries, goods, and/or stages of production
- (2) Improve on existing “higher dimensions” literature: inability to solve for world general-equilibrium avoidance of trade costs, difficulties with inequalities
- (3) Provide a multi-country approach: countries can differ in trade costs and endowments countries with average endowments can trade a lot finer patterns of specialization permitted simultaneous horizontal/vertical patterns

Our approach: Countries can differ by factor endowments and trade costs

All goods are shipped to a central market and back out to other countries (alternatively, all trade costs are port costs)

Each country has a “distance” to this market therefore has a country-specific trade costs.

Bilateral trade flows are not determined but “world” prices are well defined

$N = n_1 \times n_2$ countries are arrayed in a matrix.

Countries in a row all have the same trade costs

Countries in a column have the same endowments

Model 1: 3 goods, two factors (L, K), many countries

The world endowment ratio is $K/L = 50/50$

X_1, X_2, X_3 are Cobb-Douglas with symmetric factor intensities

X_1 has shares $K/L = 75/25$

X_2 has shares $K/L = 50/50$ (the central good)

X_3 has shares $K/L = 25/75$

There is an odd number n of country endowment ratios (41 in the simulations), countries endowments are evenly and symmetrically distributed.

Country 1 has endowments $L = 0.10, K = 1 - L = 0.90$

Country n has endowments $L = 0.90, K = 1 - L = 0.10$

Central country has endowments $K = 0.50, L = 0.50$

All countries' preferences are identical, CD, shares all = $1/3$

Full model: non-linear complementarity problem:

31x41 = 1271 countries: 31 trade costs, 41 endowments
29236 weak inequalities in 29236 non-negative
complementary variables

i, j are countries: i gives country ij's trade cost,
j gives its endowment

A_{tij} activity t (production, trade, utility) for country ij
13 activities for each of 1271 countries = 16523

C_{kij} market k (goods, factors, utility) for country ij
9 mkts, 1271 countries, three world mkts = 11442

I_{ij} country ij's aggregate income balance
1 equation for each of 1271 countries = 1271

Zero- Π inequal

Comp var

Description

$$mc_{tij} \geq p_{tij}$$

activity level A_{tij}

marg cost \geq price

Mkt clear inequal

Comp var

Description

$$SC_{kij} \geq DC_{kij}$$

price of com C_{kij}

supply \geq demand

Income balance

Comp var

Description

$$I_{ij} = w_{ij}L_{ij} + r_{ij}K_{ij}$$

income

income balance

Figure 1: Regions of production specialization in the three-good model

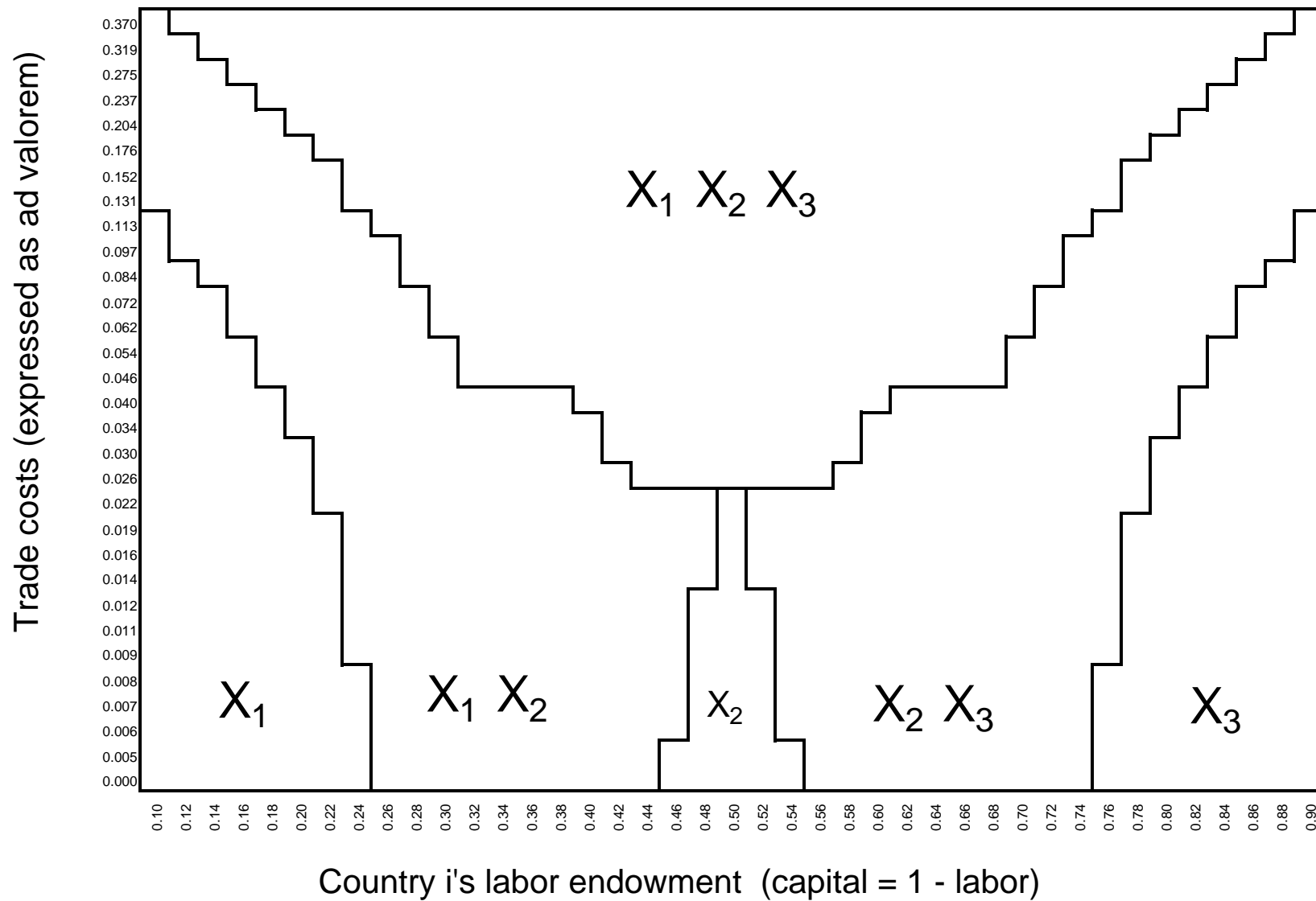


Figure 2: Regions of trade specialization in the three-good model

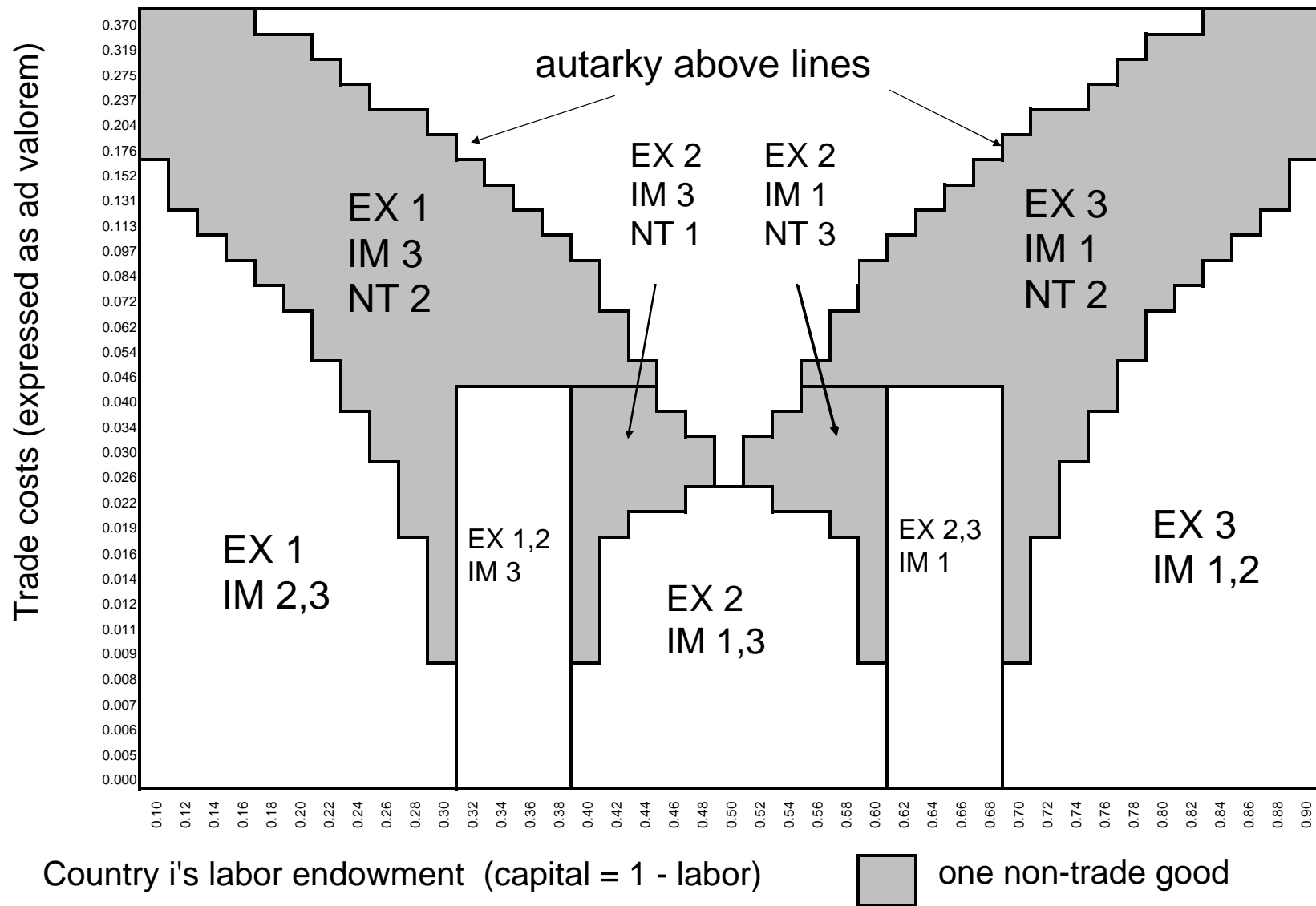
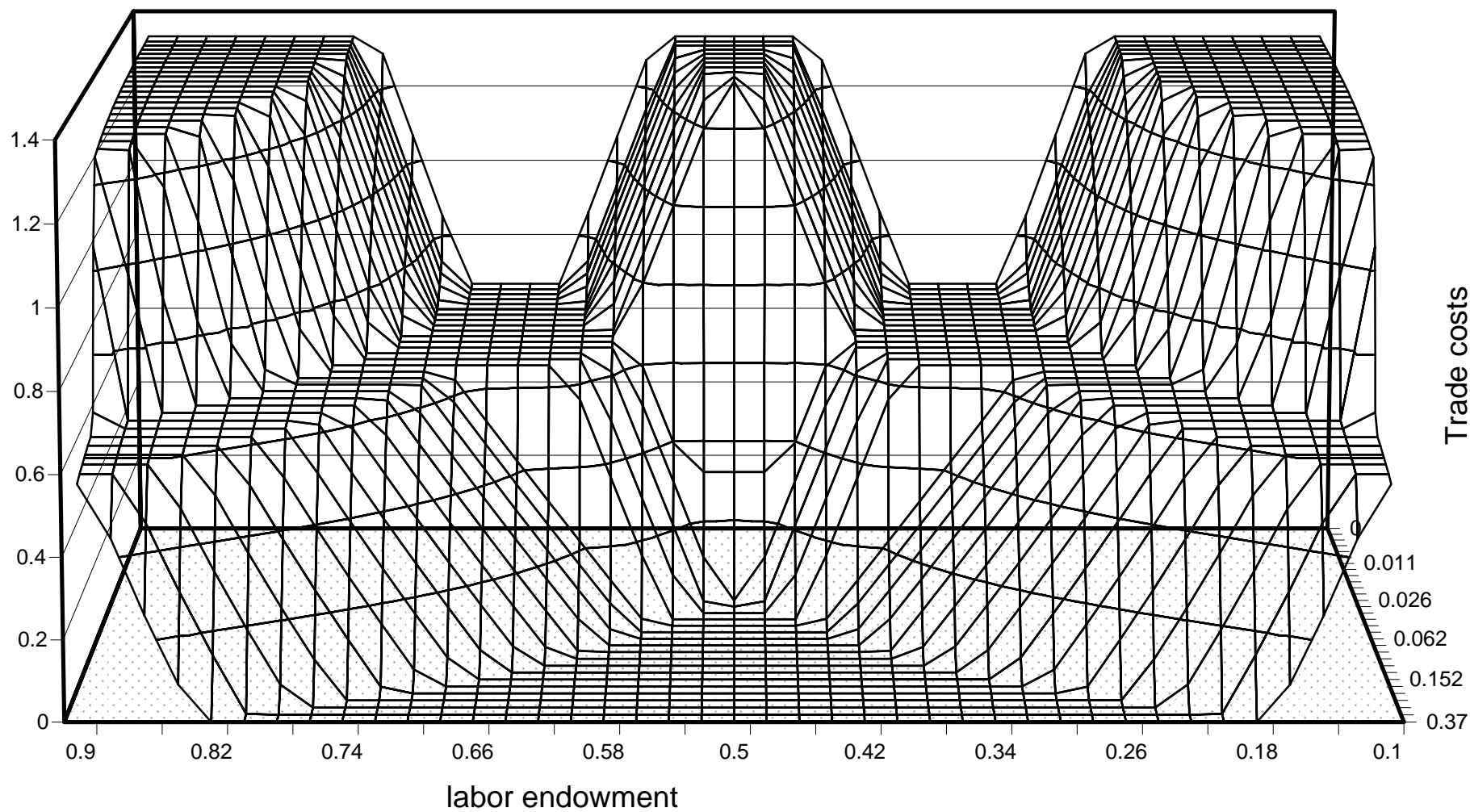


Figure 3: Volume of trade as a share of income



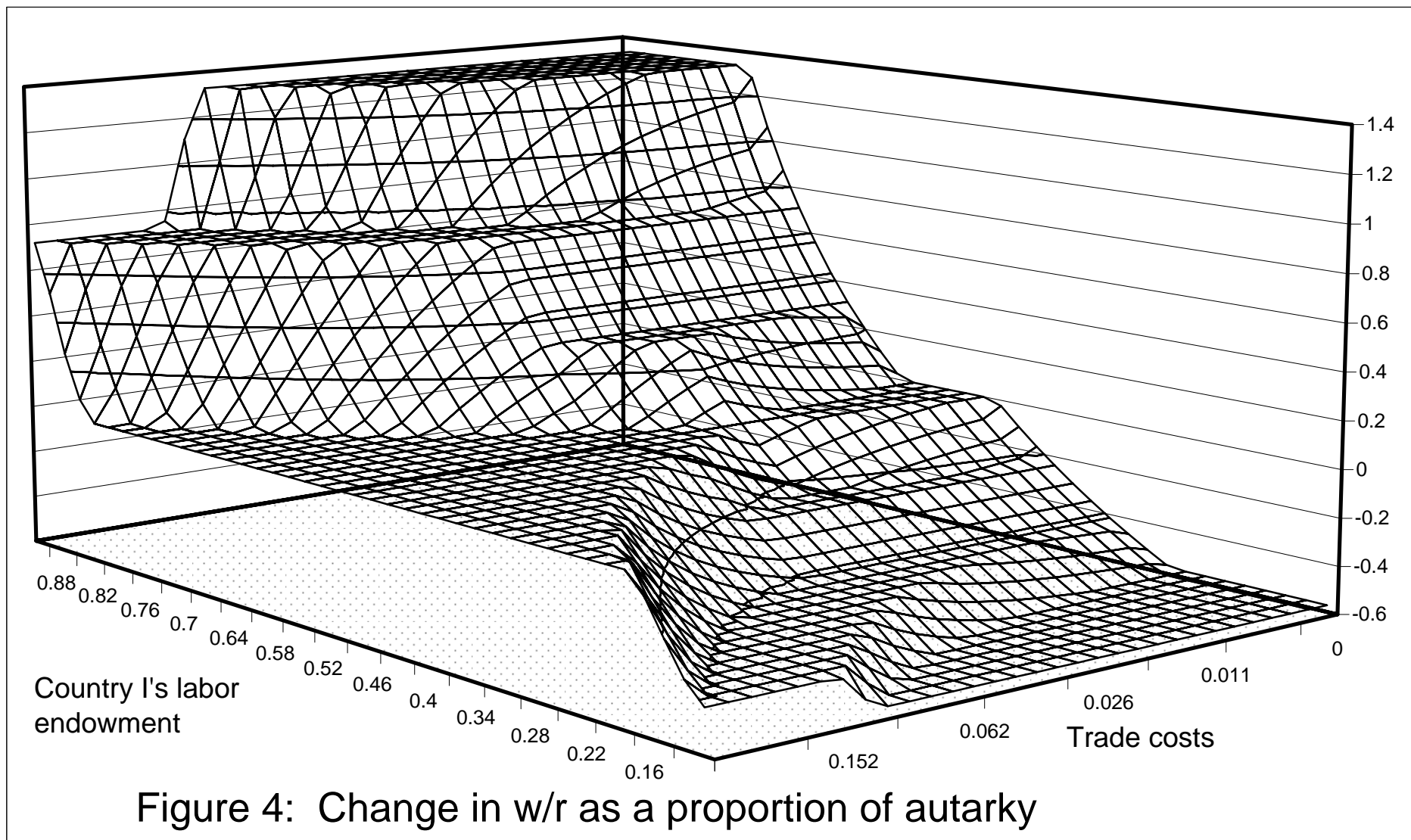
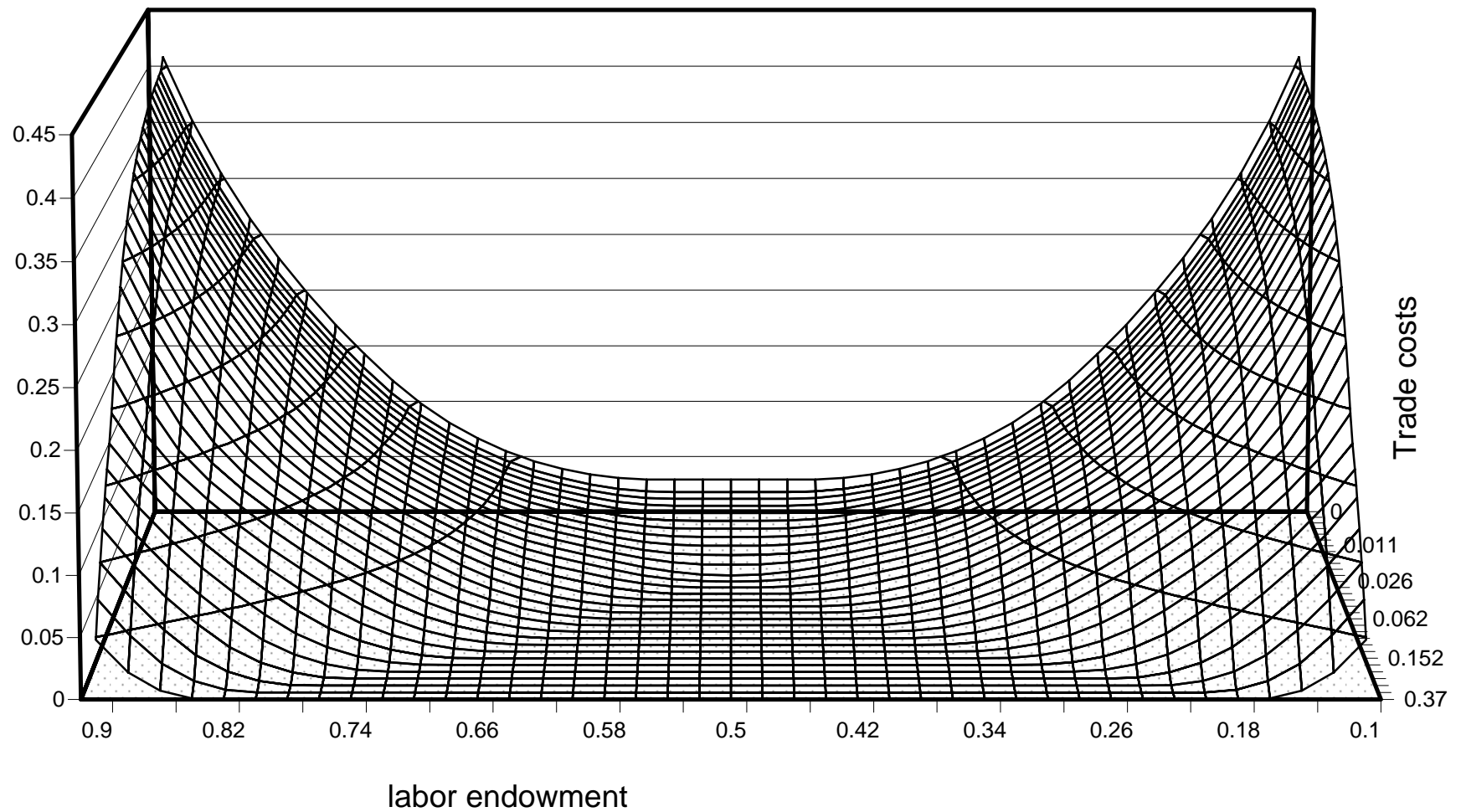


Figure 5: Gains from trade as a proportion of autarky welfare



Results for Model 1: Low trade-cost countries: results relatively complex

exhibit multiple cones of production diversification

complex trade patterns as a function of endowment ratios
(number of imported, exported, and non-traded goods)

central countries trade a lot, but gain little: trade volume not
monotonic in endowment remoteness (from world
average)

factor-price changes, autarky to free trade follow Stolper-Samuelson (high-cost countries as well).

Results for Model 1: High trade-cost countries: results relatively straightforward and intuitive.

degree of production specialization monotonically related to a country's endowment remoteness (from world average)

tend to be specialized exporters (one good). number of imports increasing in endowment remoteness (number of non-trade decreasing in endowment remoteness)

trade volume and welfare gains monotonically increasing in endowment remoteness, falling in trade costs.

Model 2: two goods (X, Y), X can fragment into two production activities;

N competitive, constant-returns economies

Two factor of production: K, L

Two final goods, three production activities:

Y - labor intensive

X - capital intensive

X - can fragment into C (components) and A (assembly)

C - more capital intensive than X

A - more labor intensive than Y

C and X are traded, assembly “services” cannot be trade (X, a “bundle” of C and A can be exported, but not A alone)

Experiments

- (1) geographic wandering: cross-section comparison of countries differing in endowments and trade costs.
- (2) fragmentation: comparison of world with fragmentation allowed versus ruled out.

“with fragmentation” means a country can trade C at its country-specific trade cost
- (3) globalization: trade costs for the ($n_1 \times n_2$) countries are all scaled up and down by a common multiple

Figure 6: Production Regimes with no fragmentation, two-good model

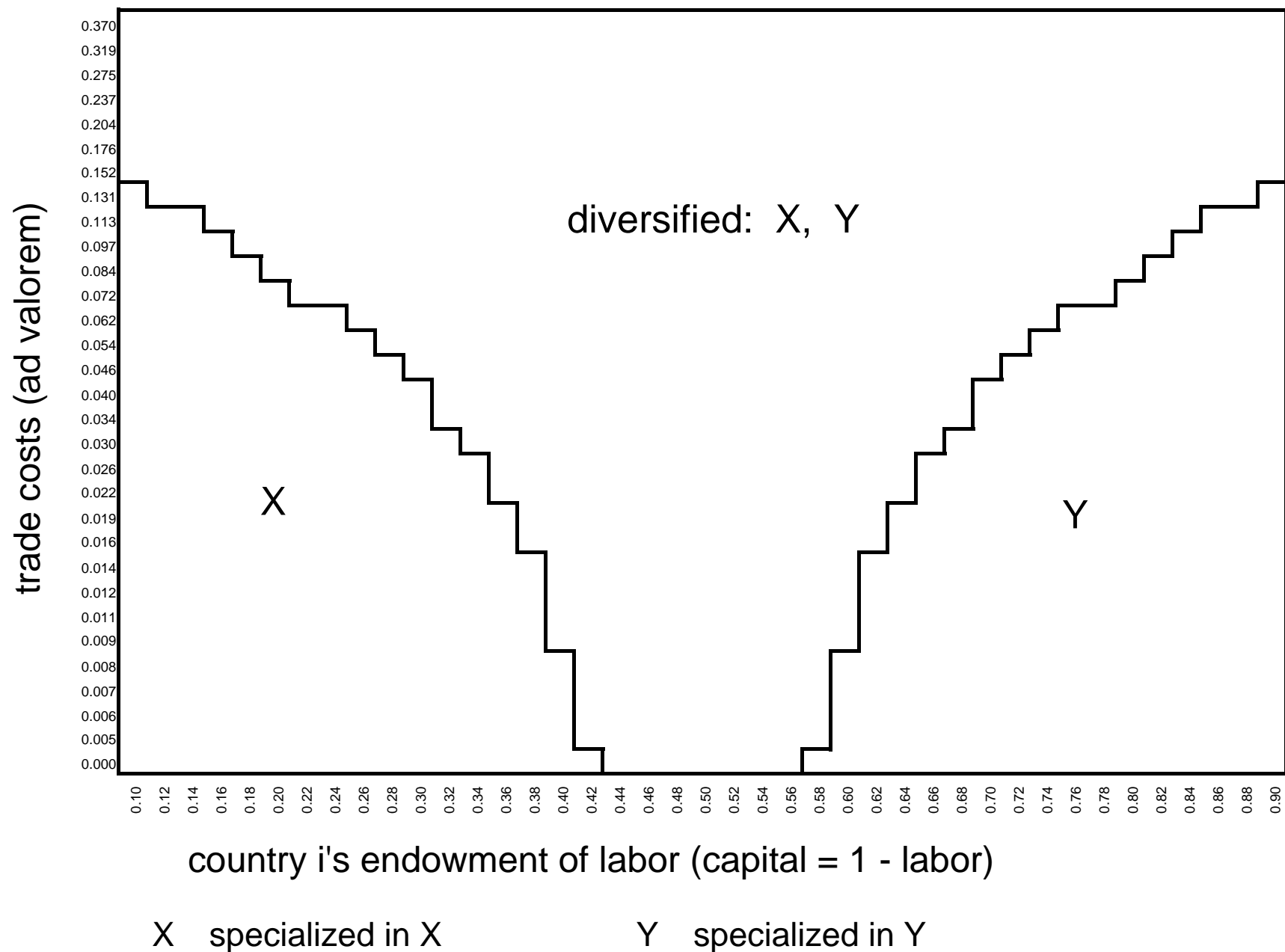
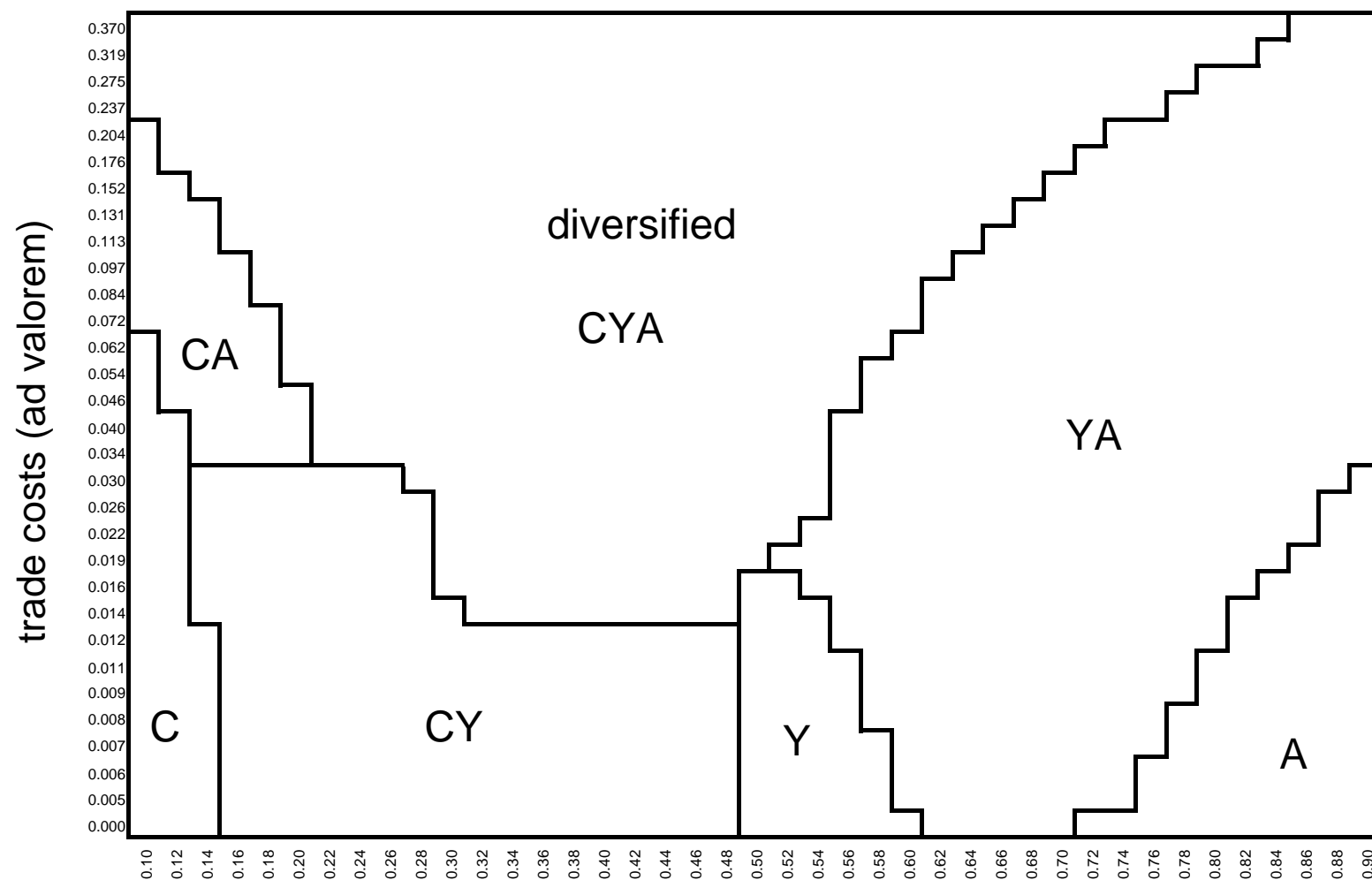


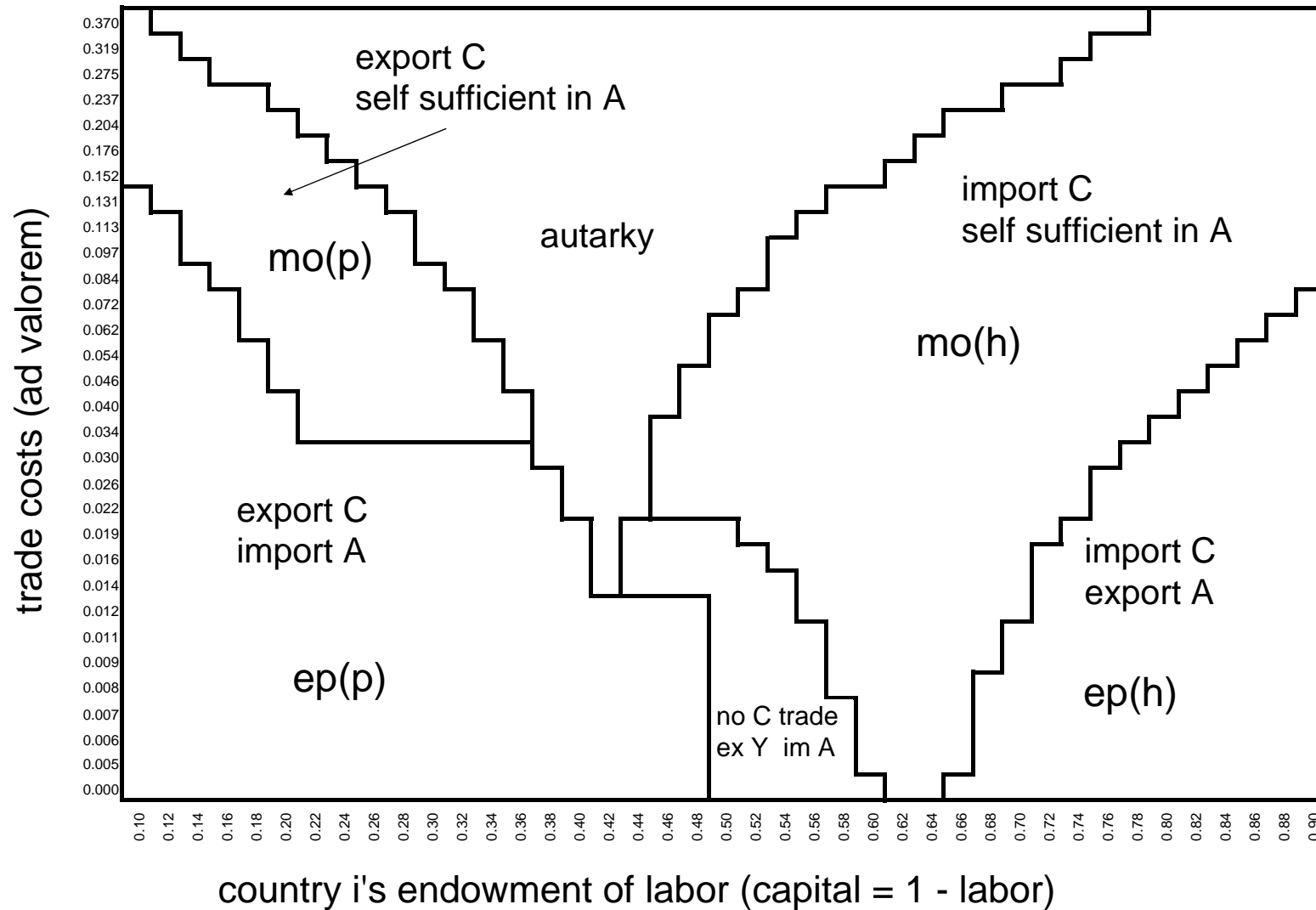
Figure 7: Production Regimes with fragmentation



country i's endowment of labor (capital = 1 - labor)

C	specialized in C	CA	partial specialization in C and A
Y	specialized in Y	CY	partial specialization in C and Y
A	specialized in A	YA	partial specialization in Y and A

Figure 8: Trade in C and A: analogy to affiliate production



MO - market oriented
EP - export platform

(p) - parent's point of view
(h) - host's point of view

Figure 9: Change in the volume of trade following fragmentation

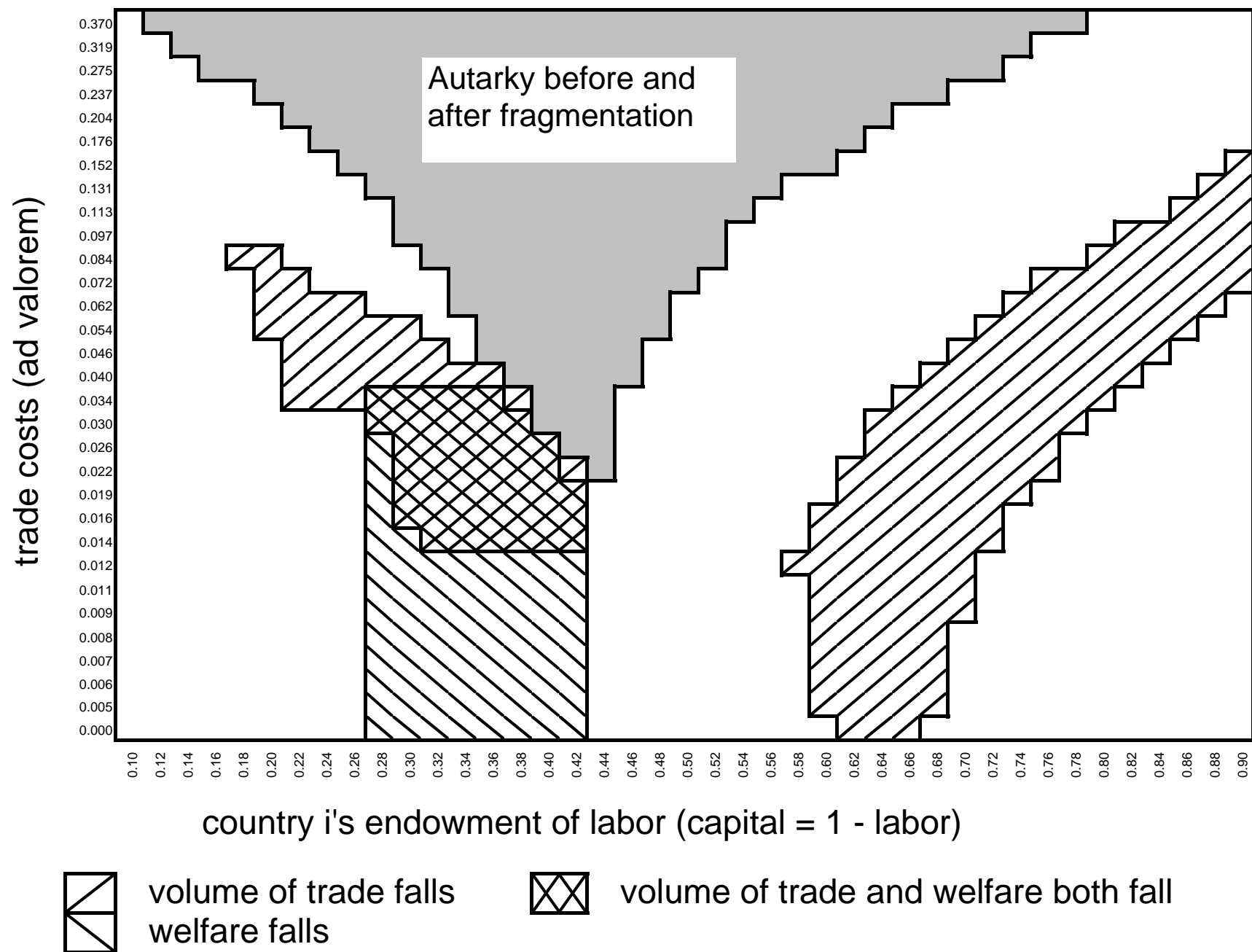


Figure 11: World VOT/GDP with and without fragmentation (vary trade costs for all countries)

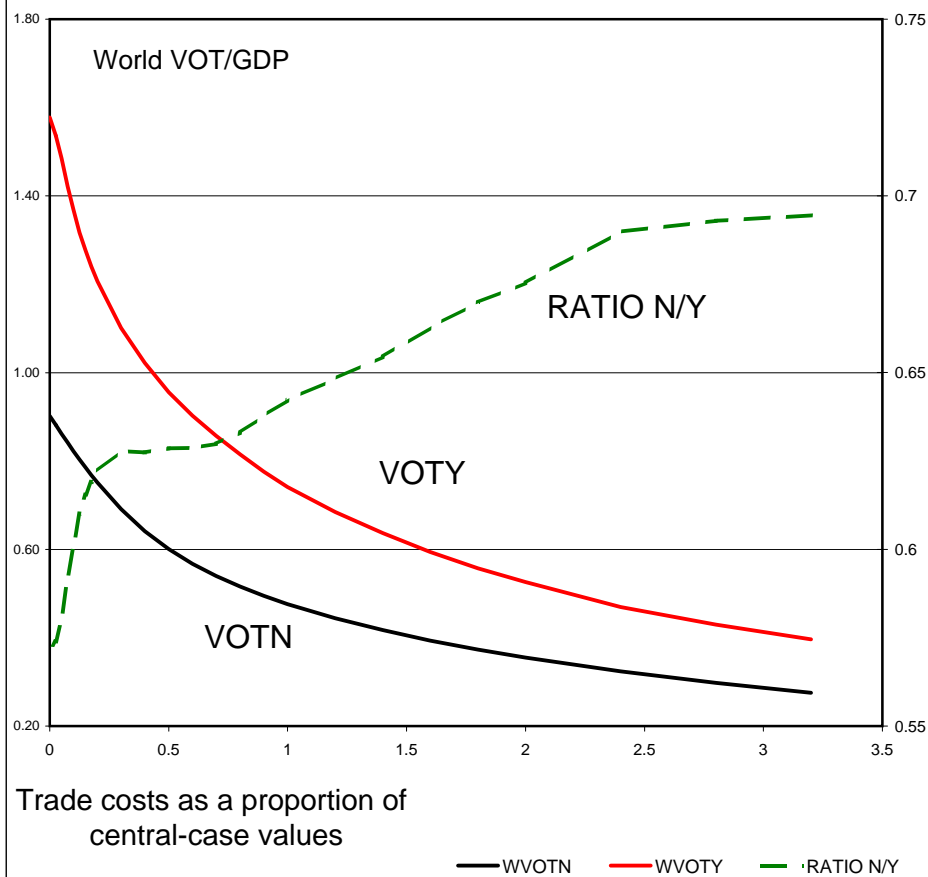
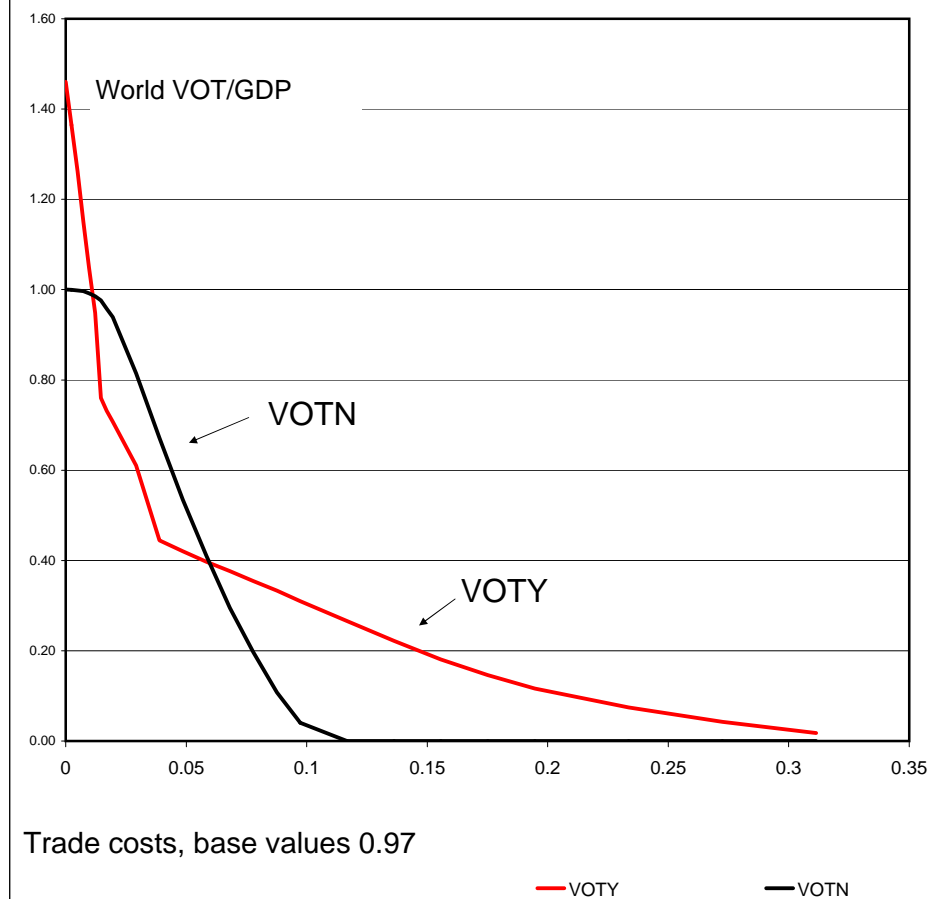


Figure 12: World VOT/GDP for a subset of 22 countries (vary trade costs for all countries)



Results for model 2:

- (1) Fragmentation produces a logical progression of specialization moving across factor-endowment space.
- (2) Similarly with moving across trade costs: higher trade costs, less specialization for a given endowment ratio.
- (3) Moderate trade costs produce something that resembles market-oriented affiliate production and low trade costs lead to export-platform affiliate production.
- (4) Fragmentation increases welfare for fringe-endowment countries and may lower welfare of “near-middle” countries.

- (4) Fragmentation, with otherwise free trade, increases trade volumes for fringe countries but also for central countries.
- (5) Fragmentation decreases trade volumes for countries with moderate trade costs and moderate endowment ratios: they can trade only for the part of X they need.
- (6) Over all countries, lowering trade costs larger trade volumes and world production specialization when fragmentation is permitted than when not.
- (7) However, this is not true for a substantial set of countries, which trade less and specialize less with fragmentation allowed.

*THREEG.GMS MANY GOODS MODEL

*countries have double index ij: trade cost i, endowment j

*two factors, set F

*nine goods, set G

*41 endowment ratios, 31 trade costs, 3 goods

SETS	I	countries	/1*31/,
	J	countries	/1*41/,
	F	factors of production	/L,K /,
	G	goods	/1*3/;

PARAMETERS

TC(I) trade cost of country i,

ENDOW(I,J,F) country ij's endowment of factor F,

FX(F,G) factor f's share (intensity) in sector G;

\$ONTEXT

\$MODEL: MULTI

\$SECTORS:

X(I,J,G)	! production activity for good G
EX(I,J,G)	! export activity for good G
IX(I,J,G)	! import activity for good G
XX(I,J,G)	! supply of domestically produced G to home
W(I,J)	! welfare of country ij

\$COMMODITIES:

PW(I,J)	! utility price index for country j
PX(I,J,G)	! domestic producer price (mc) of good G
PCX(I,J,G)	! domestic consumer price of good G
PF(I,J,F)	! price of factor F in country ij
PFX(G)	! world (central market) price of good G

\$CONSUMERS:

CONS(I,J)	! income of representative consumer in ij
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\$PROD:X(I,J,G) s:1

O:PX(I,J,G)

Q:100

I:PF(I,J,F)

Q:FX(F,G)

\$PROD:EX(I,J,G)

O:PFX(G)

Q:100

I:PX(I,J,G)

Q:(100*TC(I))

\$PROD:IX(I,J,G)

O:PCX(I,J,G)

Q:100

I:PFX(G)

Q:(100*TC(I))

\$PROD:XX(I,J,G)

O:PCX(I,J,G)

Q:100

I:PX(I,J,G)

Q:100

\$PROD:W(I,J) s:1

O:PW(I,J)

Q:(300*2/3)

I:PCX(I,J,G)

Q:(100*2/3)

\$DEMAND:CONS(I,J)

D:PW(I,J)

Q:(SUM(F, ENDOW(I,J,F)))

E:PF(I,J,F)

Q:ENDOW(I,J,F)

\$OFFTEXT

\$SYSINCLUDE mpsgeset MULTI

OPTION MCP=PATH;

OPTION LIMROW=0;

OPTION LIMCOL=0;

\$OFFSYMLIST OFFSYMREF OFFUELLIST OFFUELXREF

* choose world price of central good G = 2 as numeraire

PFX.FX("2") = 1;

*here is the loop that sets the endowment of country j

*and the trade costs of country i

LOOP(I,

LOOP(J,

ENDOW(I,J,"K") = (180+(160/40) - (160/40)*ORD(J));

ENDOW(I,J,"L") = (20-(160/40) + (160/40)*ORD(J));

```
TC("31") = 1.00025;  
TC(I)$ (ORD(I) LT 31) = 1 + (1.16**(30 - ORD(I)))*0.005;  
  
);  
);
```

*set the factor shares (intensities) of sector G

```
FX("L", "1") = 30;  
FX("K", "1") = 70;  
FX("L", "2") = 50;  
FX("K", "2") = 50;  
FX("L", "3") = 70;  
FX("K", "3") = 30;
```

```
MULTI.workspace = 25;
```

```
MULTI.ITERLIM = 20000;  
$INCLUDE MULTI.GEN  
SOLVE MULTI USING MCP;
```