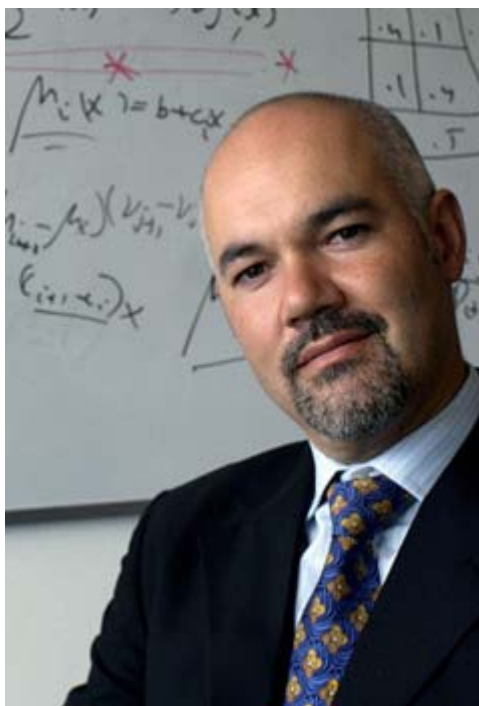


# Factor Proportions and the Structure of Commodity Trade

(AER 2004)

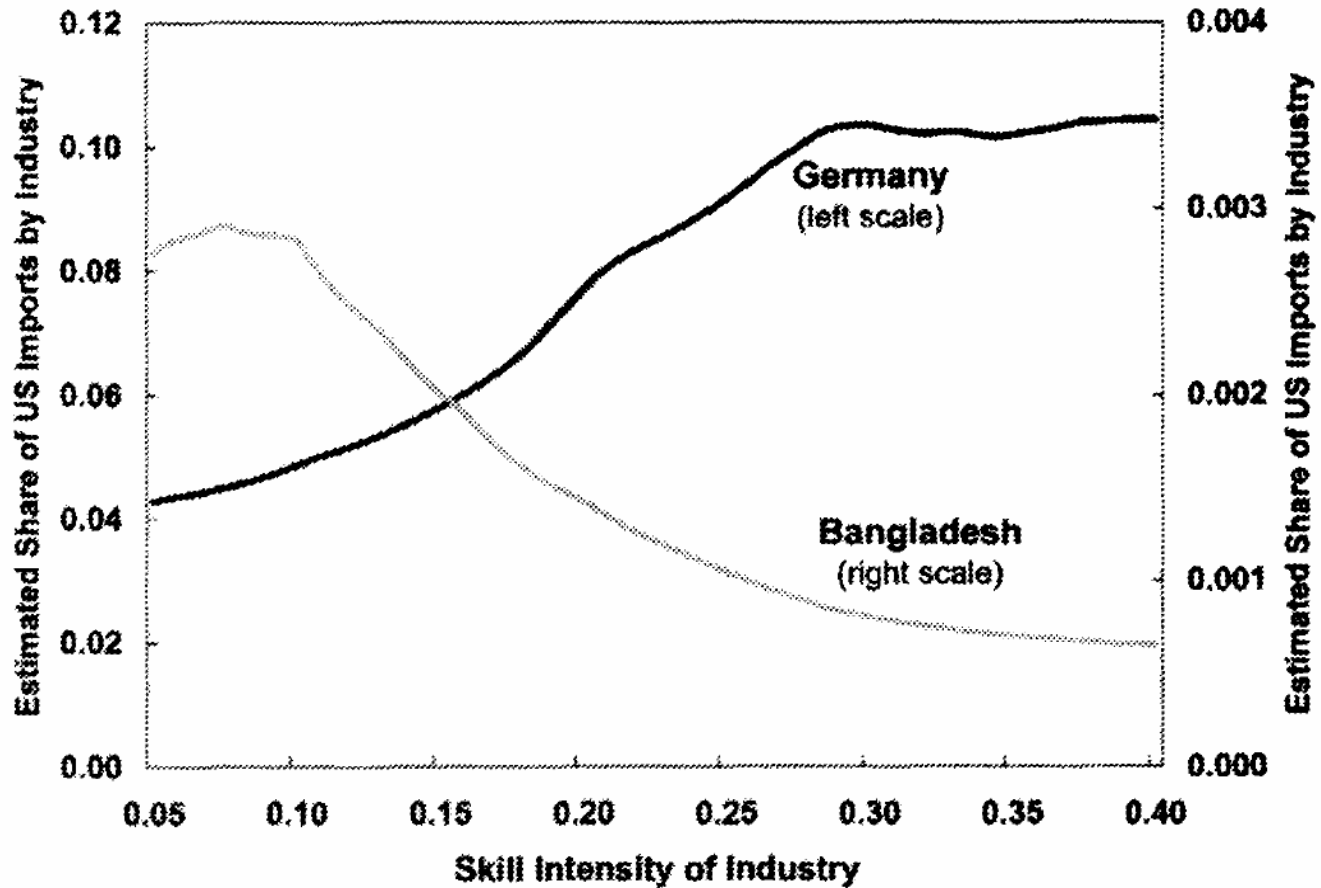
**JOHN ROMALIS**



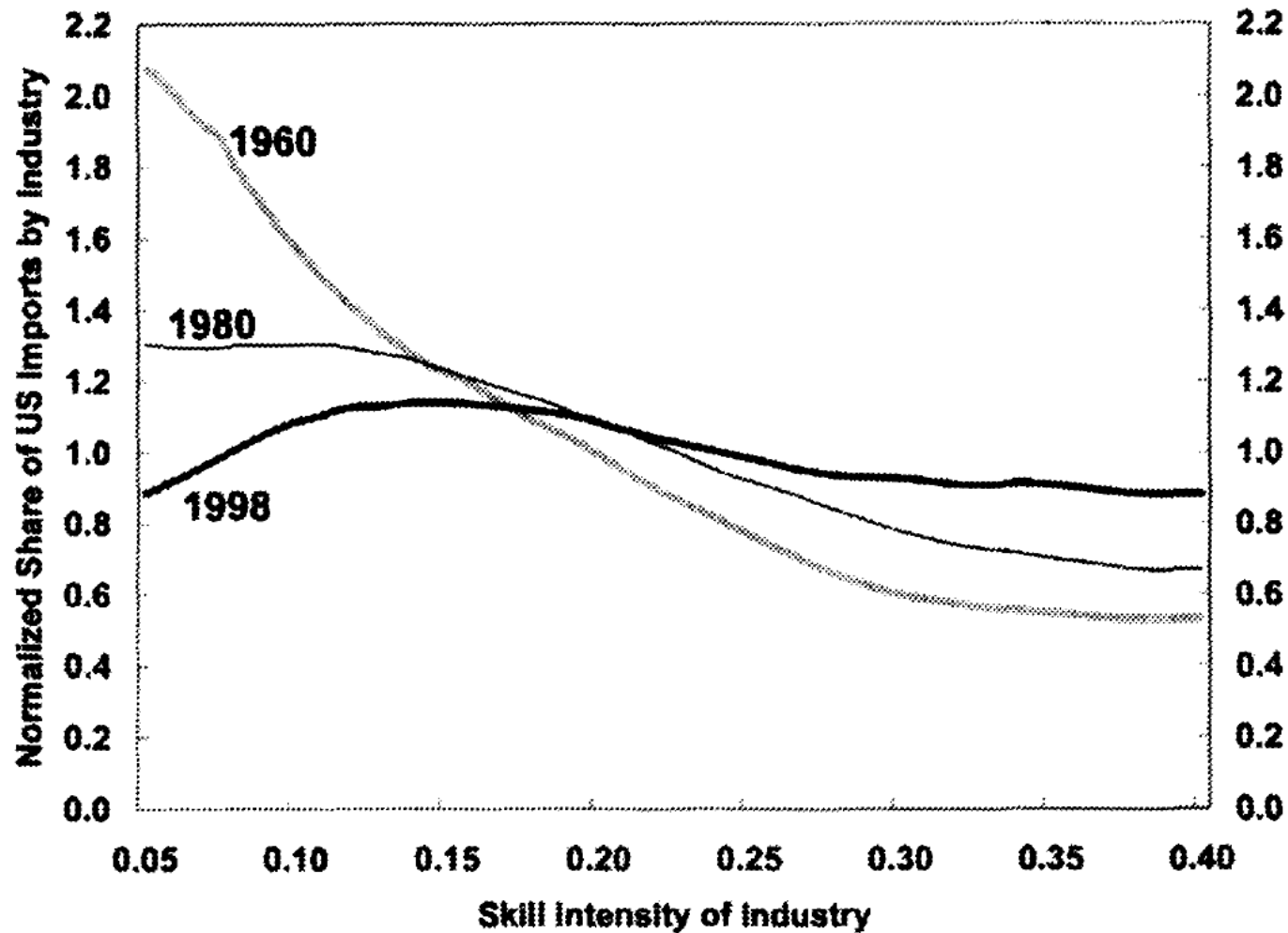
# Introduction

- **Heckscher-Ohlin model with transport costs and monopolistic competition**
- **Model determines the structure of production and trade.**
- **He wants to show that skill abundant countries export skill intensive products to the US.**

# Hecksher-Ohlin effect



# Rybczynski effect for the Asian Miracle economies

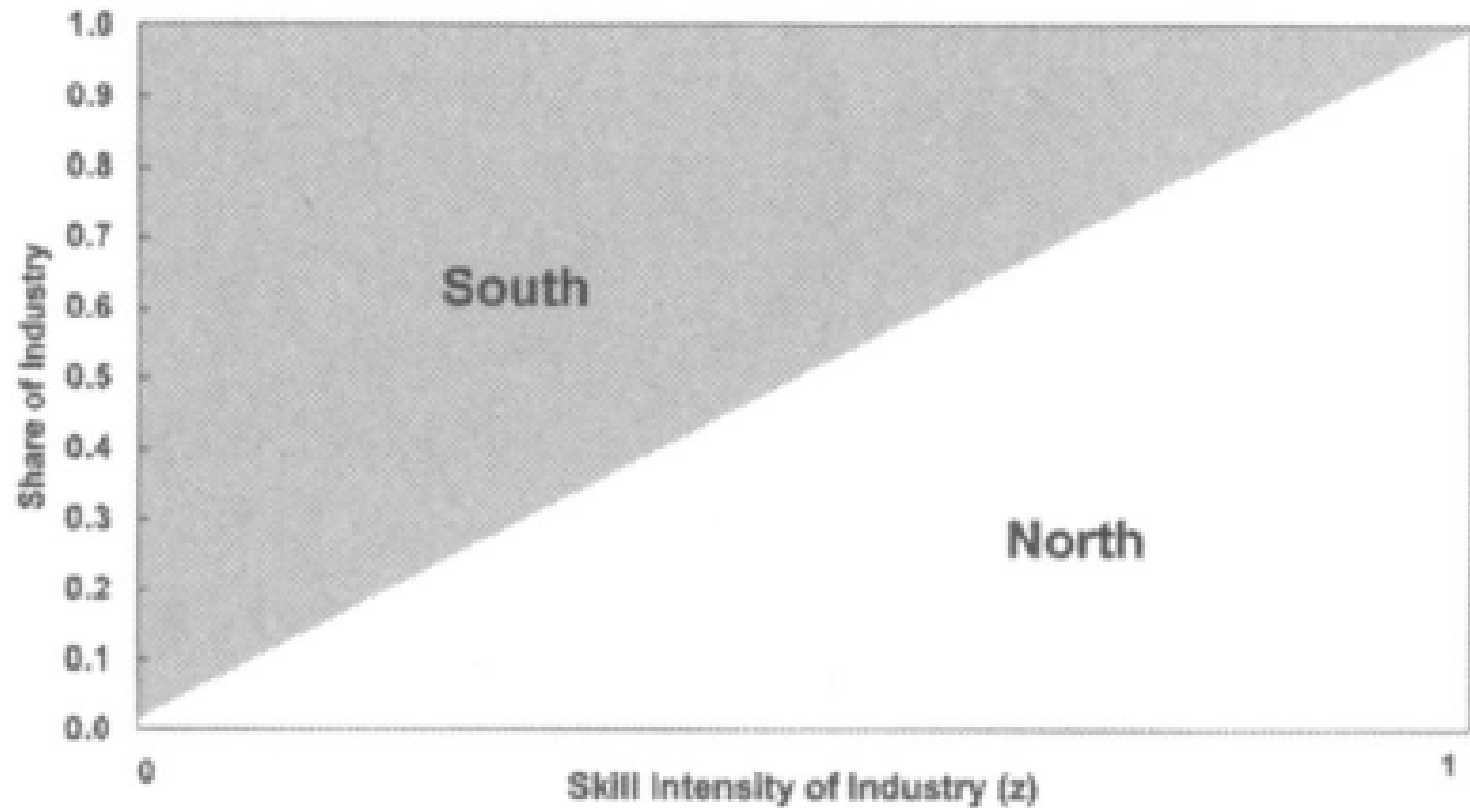


# Theoretical model

- H-O model with a continuum of goods
- Monopolistic competition
- Economies of scale
- Transport costs

# Theoretical model

The location of production



# The Separate Contributions of Transport Costs and Monopolistic Competition

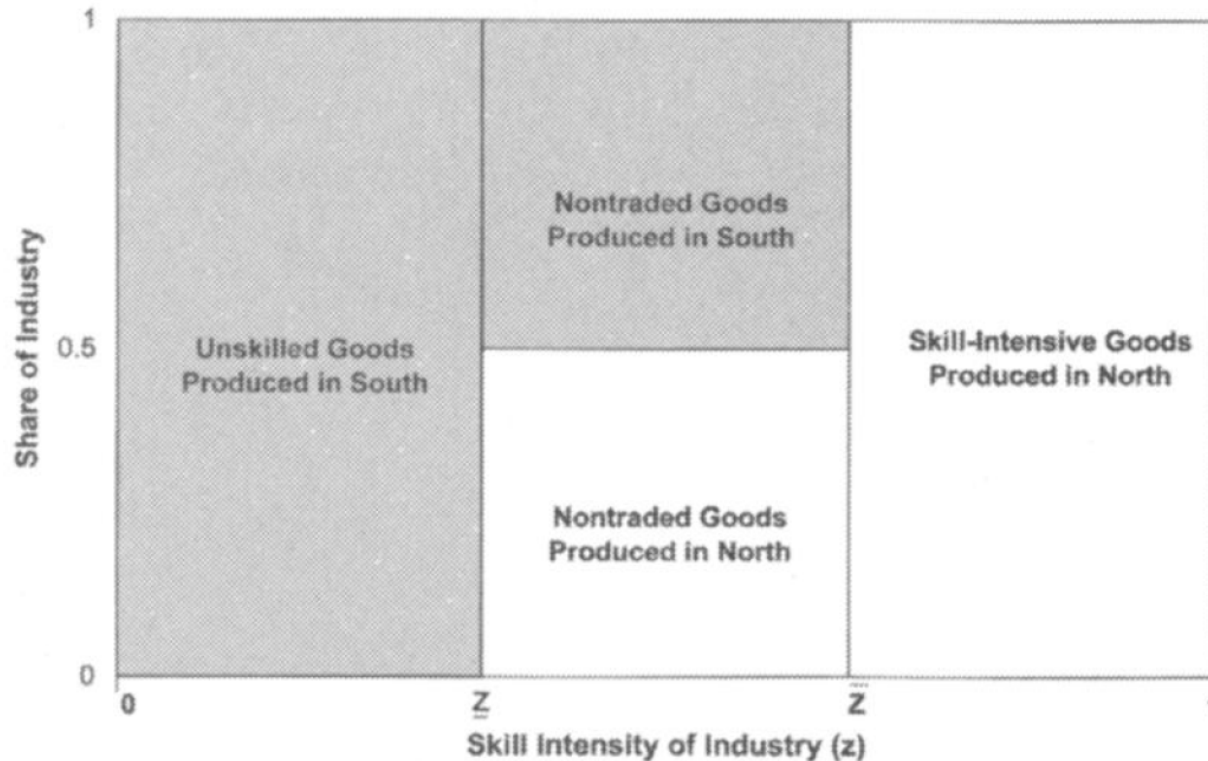


FIGURE 4. LOCATION OF PRODUCTION IN DFS MODEL WITH TRANSPORT COSTS

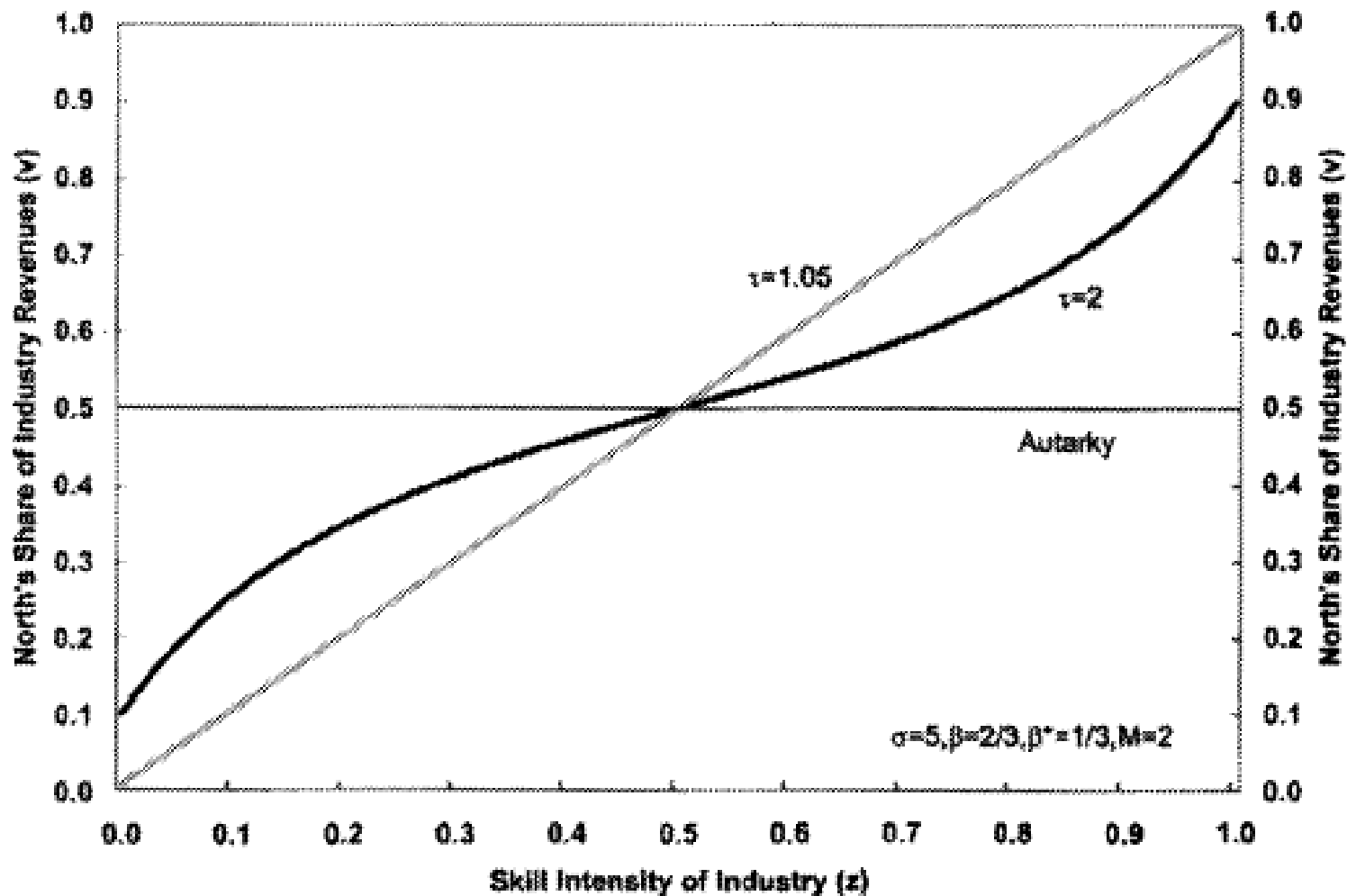


FIGURE 5. EFFECT OF TRANSPORT COSTS ON THE LOCATION OF PRODUCTION



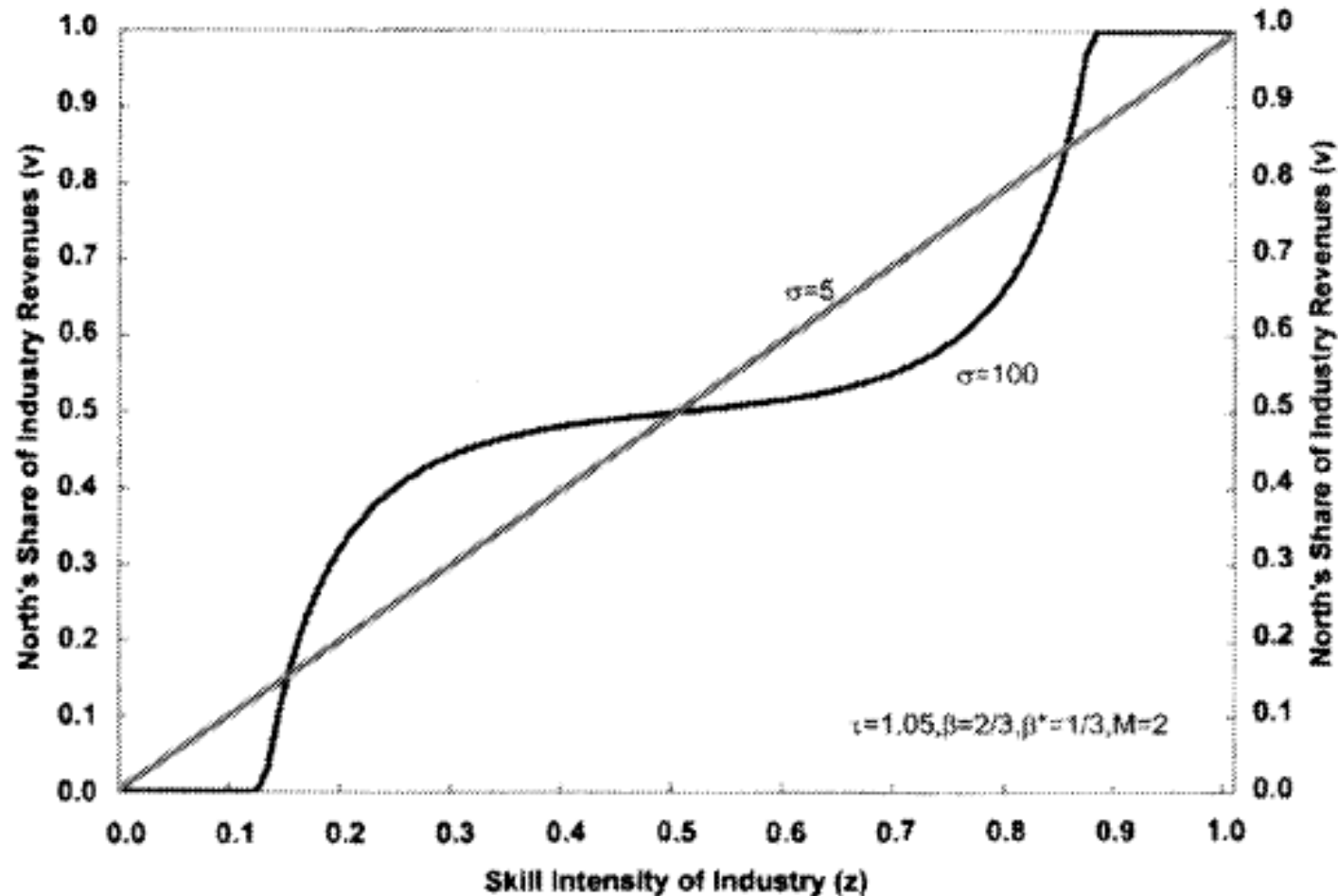


FIGURE 6. THE EFFECT OF  $\sigma$  ON THE LOCATION OF PRODUCTION

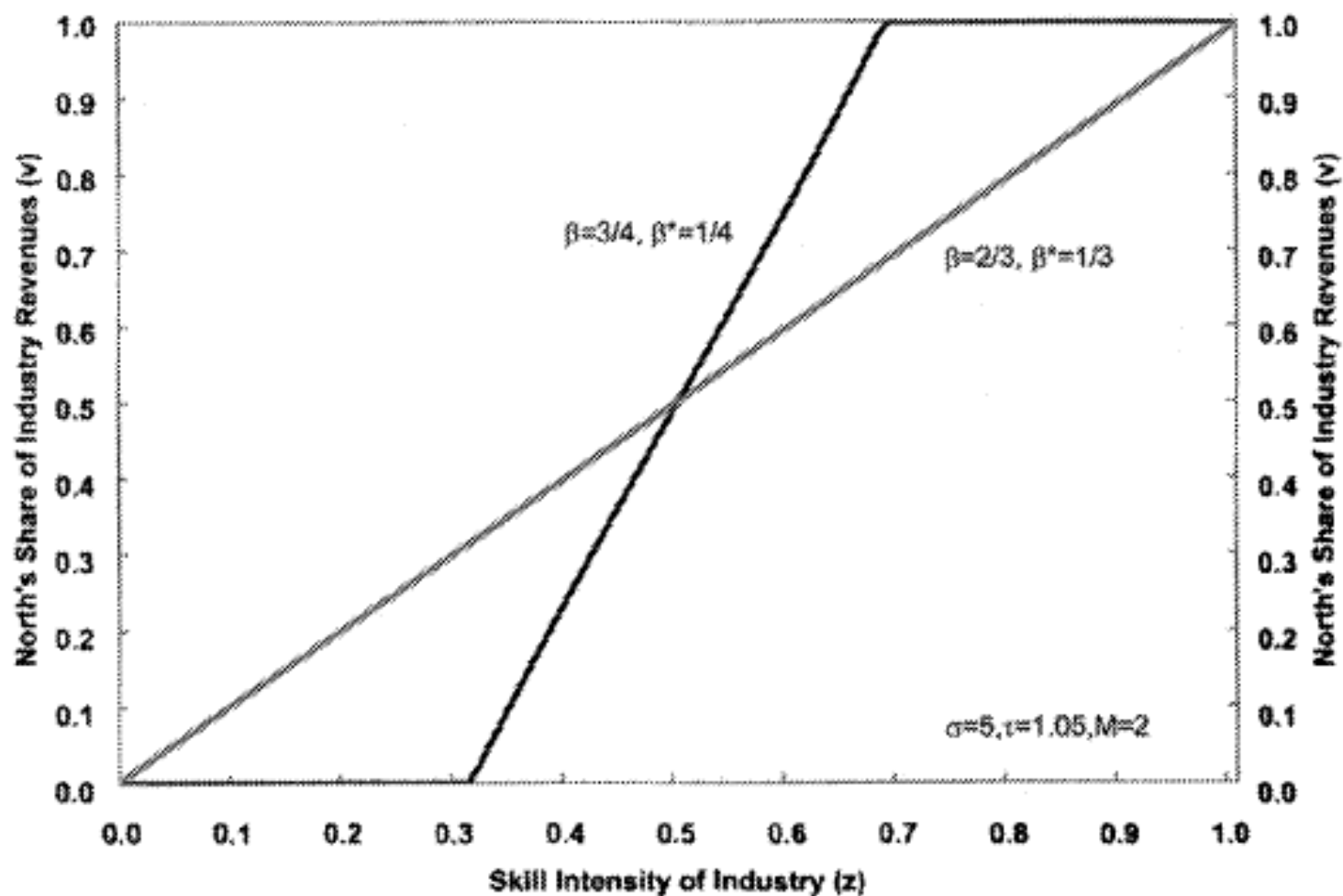


FIGURE 7. THE EFFECT OF FACTOR ABUNDANCE ON THE LOCATION OF PRODUCTION

# Empirics

- Heckscher-Ohlin prediction:
  - North's market share ( $x$ ) increases with skill intensity of the good ( $z$ )
- Cross-commodity regression of  $x$  on  $z$
- $z$ : skill intensity
- $k$ : capital intensity
- $m$ : raw material intensity

# Skill intensity

- $z_2$ : skill intensity: 
$$\frac{\text{nonproduction workers}}{\text{employment}}$$

# Intensities (1992 US)

- **Capital intensity**
- $k_3 = 1 -$  (total compensation / value added)
- **Skill intensity**
- $z_3 = z_2(1 - k_3)$ 
  - (skill intensity \* labor intensity)
- **Raw material intensity**
- $m_4 =$  raw material input / (VA+ raw material input)

TABLE 1—INDUSTRIES WITH EXTREME FACTOR INTENSITIES

<b>10 Most Skill-Intensive Industries</b>	<b>10 Most Capital-Intensive Industries</b>	<b>10 Most Unskilled Labor-Intensive Industries</b>
3764 Space propulsion units and parts	2111 Cigarettes	3321 Gray iron foundries
3826 Analytical instruments	2087 Flavoring extracts and syrups	3543 Industrial patterns
3769 Space vehicle equipment	2043 Cereal breakfast foods	2299 Textile goods
3812 Search and navigation equipment	2046 Wet corn milling	2397 Schiffli machine embroideries
3547 Rolling mill machinery	2047 Dog and cat food	3149 Footwear, except rubber
2711 Newspapers	2879 Agricultural chemicals	3151 Leather gloves and mittens
3721 Aircraft	2095 Roasted coffee	2517 Wood TV and radio cabinets
3699 Electrical equipment and supplies	2085 Distilled liquor, except brandy	2393 Textile bags
3827 Optical instruments and lenses	2834 Pharmaceutical preparations	3544 Special dyes, tools, jigs and fixtures
3541 Machine tools, metal cutting types	2813 Industrial gases	3731 Ship building and repairing
<b>10 Least Skill-Intensive Industries</b>	<b>10 Least Capital-Intensive Industries</b>	<b>10 Least Unskilled Labor-Intensive Industries</b>
2111 Cigarettes	2299 Textile goods	2087 Flavoring extracts and syrups
2043 Cereal breakfast foods	3534 Elevators and moving stairways	2111 Cigarettes
2087 Flavoring extracts and syrups	3321 Gray iron foundries	2721 Periodicals
2032 Canned specialties	3543 Industrial patterns	2731 Book publishing
2047 Dog and cat food	3547 Rolling mill machinery	2834 Pharmaceutical preparations
2322 Men's and boys' underwear	3731 Ship building and repairing	2879 Agricultural chemicals
2284 Thread mills	3542 Machine tools, metal forming types	2813 Industrial gases
2035 Pickles, sauces and salad dressings	3544 Special dyes, tools, jigs and fixtures	2046 Wet corn milling
2676 Sanitary paper products	2397 Schiffli machine embroideries	2095 Roasted coffee
2085 Distilled liquor, except brandy	3671 Electronic computers	3571 Electronic computers

# Abundance relative to the US

- Skill labor abundance = human capital (educated) / labor
- Capital abundance = capital / labor (investment)
- Also, GDP per capita is used as proxy for both
- Raw material abundance = land area / labor

# The aggregate North

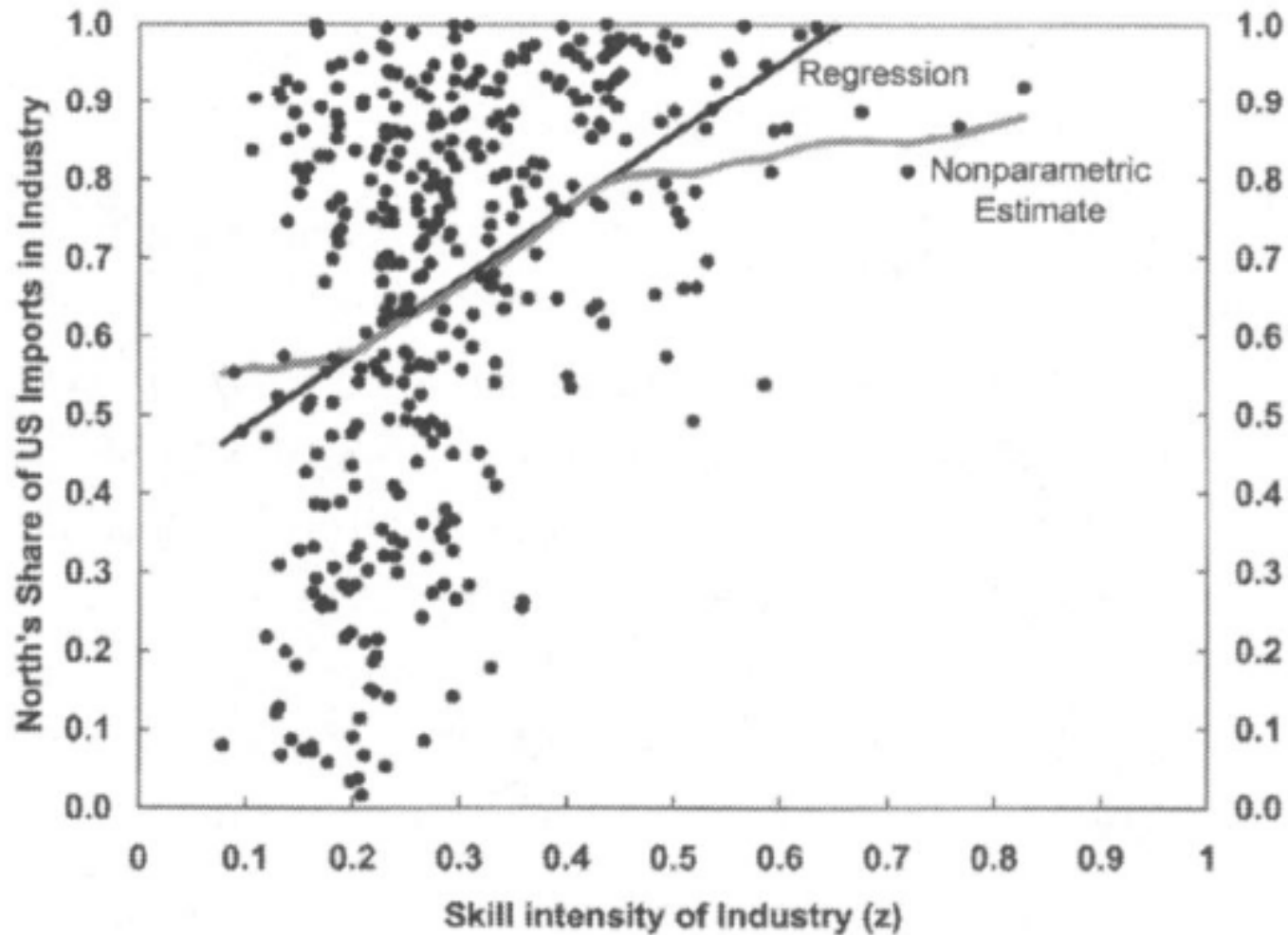


FIGURE 8. FACTOR INTENSITY AND THE NORTH'S MARKET SHARE



TABLE 8—REGRESSION FOR THE AGGREGATE NORTH  
(Dependent Variable:  $x_{nz}$ )

	Two factors	Three factors	Four factors
Constant	0.39*** (0.04)	0.12 (0.08)	0.05 (0.08)
$z_2$	0.93*** (0.10)		
$z_3$		1.90*** (0.22)	
$k_3$		0.54*** (0.11)	
$z_4$			2.00*** (0.22)
$k_4$			0.64*** (0.11)
$m_4$			0.60*** (0.12)
Observations	370	370	370
$R^2$	0.19	0.18	0.19

# Country by country regression

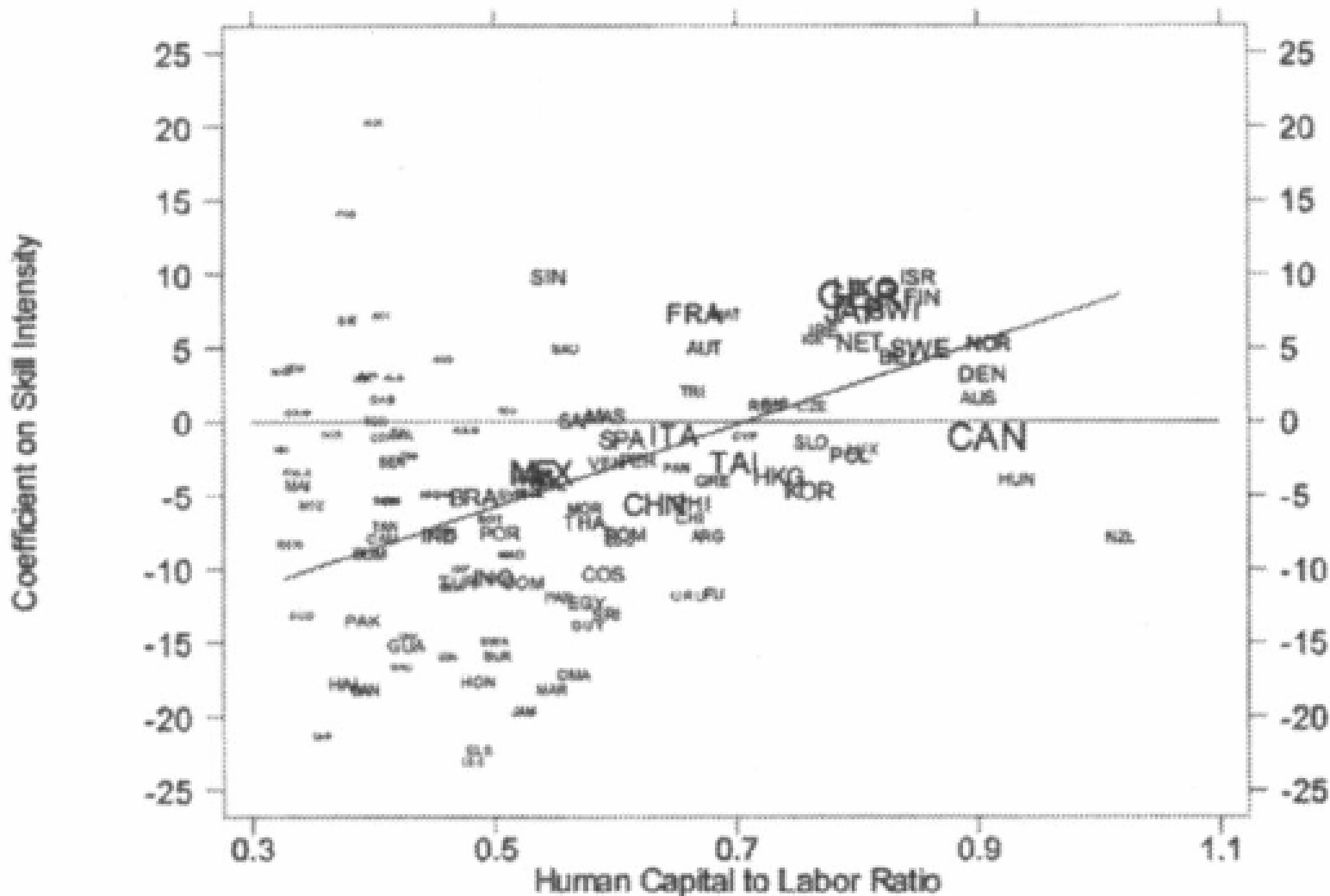


FIGURE 9. SKILL INTENSITY, THREE-FACTOR MODEL

# Country by country regression

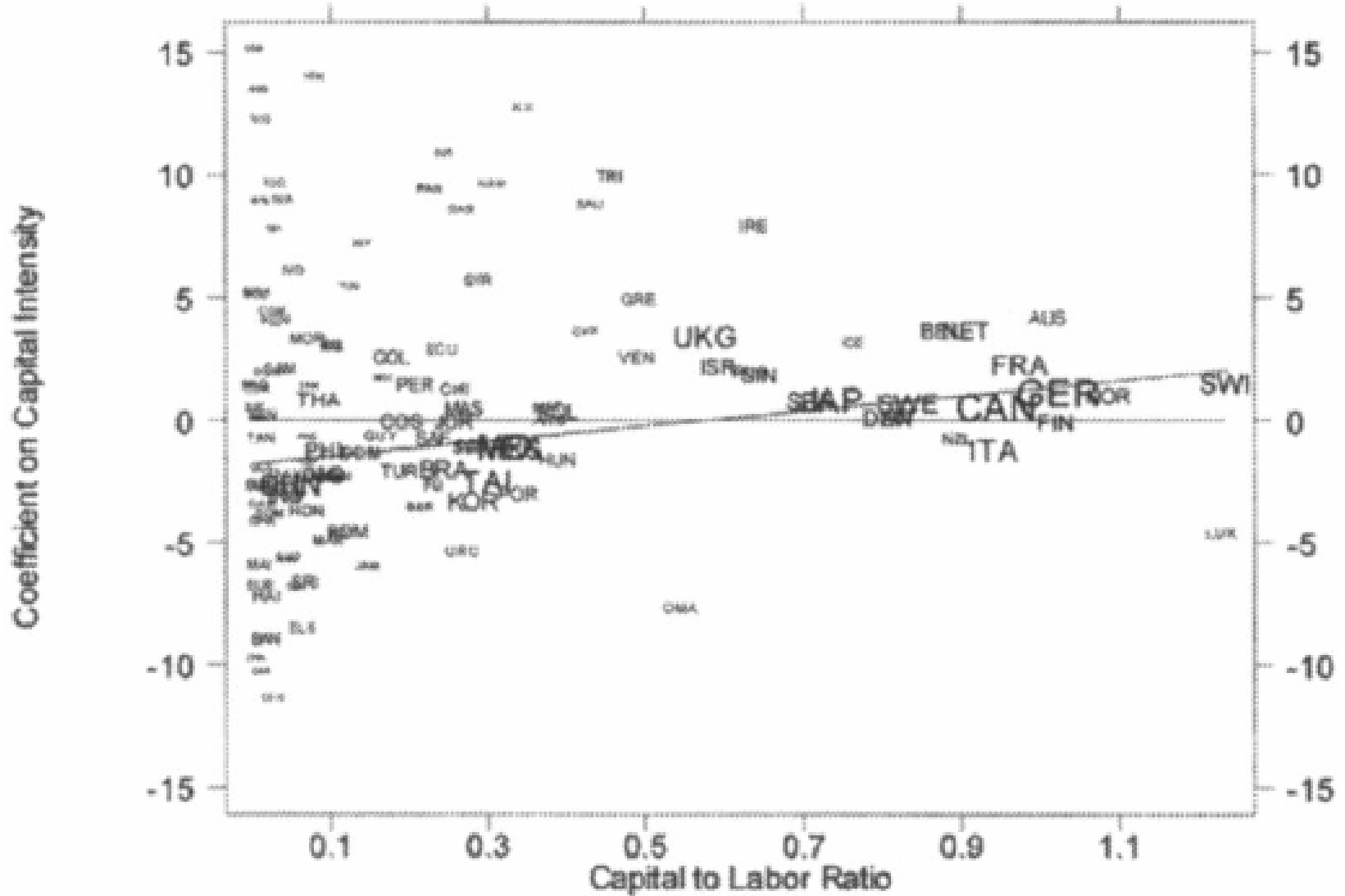


FIGURE 11. CAPITAL INTENSITY, THREE-FACTOR MODEL

TABLE 9—POOLED REGRESSION OF IMPORT SHARE ON FACTOR INTENSITIES  
(Dependent Variable:  $X_{cz}$ )

Variable	(1)	(2)	(3)	(4)
$z$	-16.66*** (1.32)	-9.52*** (0.62)	-17.18*** (1.17)	-8.07*** (0.54)
$Skill \times z$	23.26*** (1.83)		24.32*** (1.60)	
$GDPPC \times z$		17.87*** (1.05)		15.52*** (0.84)
$k$	-0.77*** (0.26)	-1.91*** (0.31)	-1.37*** (0.27)	-2.03*** (0.29)
$Capital \times k$	1.30*** (0.37)		2.26*** (0.35)	
$GDPPC \times k$		3.66*** (0.53)		3.83*** (0.45)
$m$			-0.28 (0.17)	-0.25 (0.17)
$Raw \times m$			0.40*** (0.04)	0.38*** (0.04)
Country dummies	Yes	Yes	Yes	Yes
Countries	124	123	120	120
Observations	45,880	45,510	44,400	44,400

# Rybczynski prediction

TABLE 10—PER CAPITA REAL INCOME RELATIVE  
TO THE U.S.

	1960	1970	1980	1990	1998
Japan	0.30	0.56	0.66	0.79	0.79
Singapore	0.17	0.23	0.46	0.65	0.82
Hong Kong	0.23	0.35	0.57	0.82	0.70
Taiwan	0.13	0.17	0.29	0.45	0.54
Korea	0.09	0.11	0.20	0.37	0.46
Ireland	0.33	0.39	0.45	0.51	0.73
Spain	0.32	0.45	0.48	0.53	0.55
Israel	0.35	0.46	0.52	0.51	0.58

TABLE 11—REGRESSION COEFFICIENTS OF MARKET SHARE ON FACTOR INTENSITIES  
(Dependent Variable:  $X_{cz}$ )

Country	Factor	1960	1972	1980	1990	1998
Japan	Skill	-5.42*** (1.08)	-1.62*** (0.57)	1.22* (0.71)	3.10*** (0.78)	5.66*** (0.95)
Japan	Capital	-2.71*** (0.48)	-1.59*** (0.31)	-0.95*** (0.36)	-0.40 (0.42)	0.47 (0.49)
Singapore	Skill	1.25 (2.62)	3.04 (4.94)	-0.01 (2.11)	1.75 (2.48)	8.30*** (2.42)
Singapore	Capital	-7.50 (9.75)	-1.48 (1.08)	-0.91 (0.74)	0.54 (0.81)	0.36 (2.10)
Hong Kong	Skill	-14.18*** (4.13)	-6.64*** (1.63)	-5.77*** (1.24)	-5.68*** (1.52)	-2.54 (1.92)
Hong Kong	Capital	-4.14*** (1.52)	-3.05*** (0.71)	-2.00*** (0.63)	-2.56*** (0.82)	-1.44 (1.18)
Taiwan	Skill	-12.38*** (3.93)	-7.12*** (1.70)	-5.48*** (0.82)	-4.07*** (0.70)	-1.97** (0.85)
Taiwan	Capital	-1.72 (2.07)	-3.71** (0.74)	-3.07*** (0.47)	-3.12*** (0.45)	-2.54*** (0.54)
Korea	Skill	-1.83 (5.27)	-10.53*** (2.67)	-6.70*** (1.23)	-5.39*** (1.19)	-3.52** (1.66)
Korea	Capital	-5.43 (5.40)	-4.65*** (1.10)	-2.20*** (0.63)	-3.06*** (0.56)	-3.26** (1.49)
Ireland	Skill	-9.82 (6.93)	1.35 (2.87)	-0.39 (1.97)	3.04*** (1.15)	4.80*** (1.39)
Ireland	Capital	8.72 (8.41)	3.06 (2.15)	5.70* (2.95)	6.25* (3.41)	6.58** (3.07)
Spain	Skill	-5.12** (2.58)	-3.35** (1.48)	-1.23 (1.56)	-0.78 (1.69)	-1.2 (1.60)
Spain	Capital	0.59 (1.62)	1.13 (0.92)	2.60* (1.33)	1.24 (0.81)	0.62 (0.92)
Israel	Skill	-0.27 (4.18)	-2.06 (1.75)	0.61 (4.25)	4.25*** (1.61)	7.46*** (2.66)
Israel	Capital	-0.76 (1.98)	-0.31 (0.76)	-1.50 (1.82)	0.03 (0.65)	1.41 (0.96)
Average skill coefficient		-5.97	-3.37	-2.22	-0.47	2.12
Average capital coefficient		-1.62	-1.33	-0.29	-0.14	0.28
Number of industries		296	376	376	366	370

# Rybczynski effect

Trade structure shift from 1960 to 1998

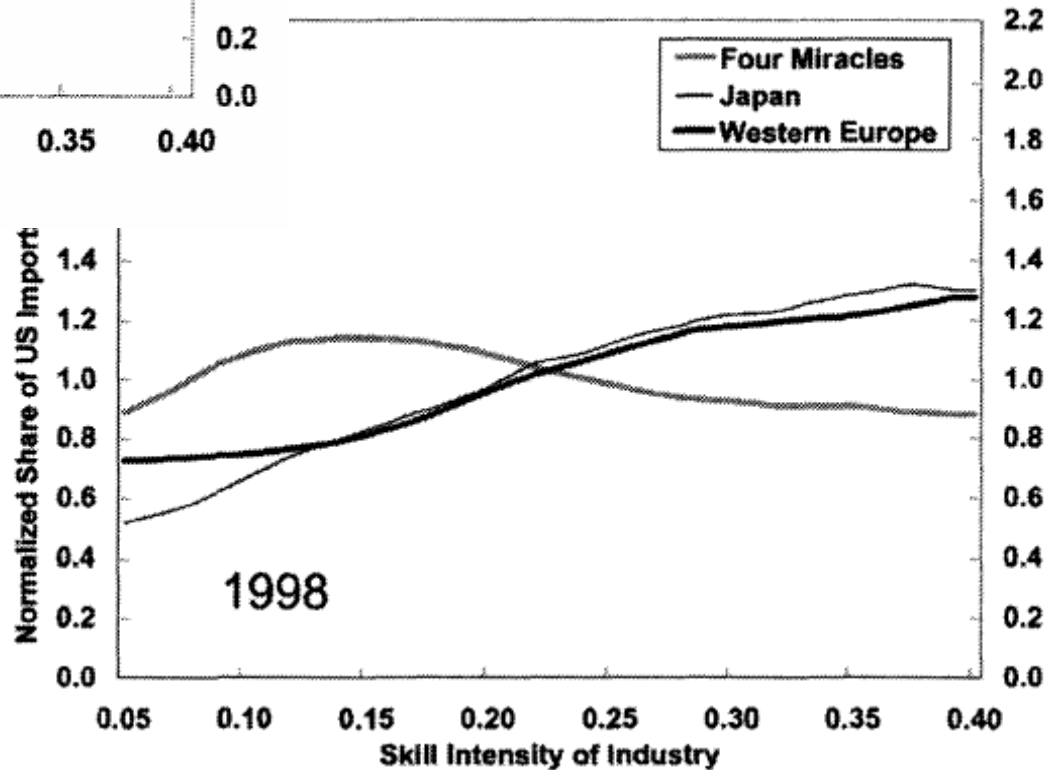
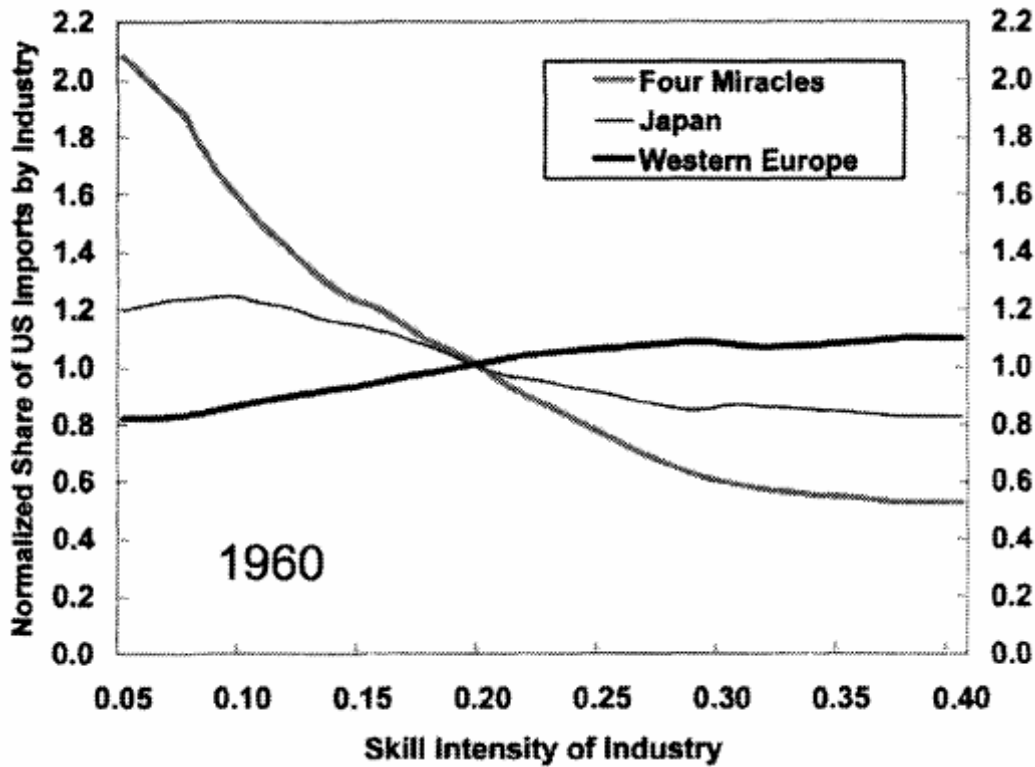


TABLE 12—POOLED RYBCZYNSKI REGRESSIONS  
(Dependent Variable:  $\Delta X_{cz}$ )

Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
<i>z</i>	2.48*** (0.52)	2.37*** (0.46)	0.99** (0.46)	-19.41** (6.89)	-17.34** (7.07)	-7.83*** (2.37)	-11.15*** (2.62)	-3.59 (2.45)	-4.44* (2.44)
$\Delta College \times z$	0.17 (3.43)			-0.73 (3.51)		-1.42 (3.45)		1.95 (3.50)	
$\Delta Education \times z$		4.01 (3.99)			5.61 (5.07)		12.89*** (4.33)		7.11* (4.13)
<i>TestScores</i> $\times z$				22.44*** (6.91)	20.21*** (7.07)				
<i>EdnQual1</i> $\times z$						0.20*** (0.05)	0.26*** (0.05)		
<i>EdnQual2</i> $\times z$								0.11** (0.04)	0.12*** (0.04)
$\Delta GDPPC \times z$			16.31*** (3.32)						
<i>k</i>	0.53** (0.24)	0.53** (0.24)	-0.05 (0.23)	0.77*** (0.26)	0.78*** (0.26)	0.49** (0.24)	0.50** (0.24)	0.47** (0.24)	0.46* (0.24)
$\Delta Capital \times k$	1.35* (0.70)	1.33* (0.70)		1.68** (0.78)	1.61** (0.77)	1.70** (0.71)	1.65** (0.70)	1.82** (0.73)	1.88*** (0.73)
$\Delta GDPPC \times k$			6.70*** (1.62)						
Country dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Countries	49	49	103	25	25	47	47	47	47
Observations	15,533	15,533	32,651	7,925	7,925	14,899	14,899	14,899	14,899



# Conclusions

- **Two reasonable modifications of the traditional Heckscher-Ohlin model. Introduction of transport costs and monopolistic competition**
- Two quasi predictions find support in data