Seminar at Doshisha University

International Production and Distribution Networks in East Asia

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1. Introduction

- The nature and characteristics of international prod./dist. networks must be analyzed more carefully.
- Mainly (but not limited to) machinery industries.
- International prod./dist. networks in East Asia are distinctive in (i) their significance, (ii) their extensiveness, and (iii) their sophistication.
- Comparison with the US-Mexico nexus and the WE-CEE corridor would be useful.

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2. "18 facts" on prod./dist. networks in East Asia

- "18 Facts"
  - Facts 1-8: from international trade statistics
    - Process-wise international division of labor among countries at different development stages
  - Facts 9-11: from microdata of Jap. MNEs
    - Prod./dist. networks; intra-firm vs. arm's length
  - Facts 12-18: from case studies/casual obs.
    - Location advantages; agglomeration; service link cost; outsourcing (disintegration); local firms


- Facts drawn from international trade statistics
  - **Fact 1:** *International trade pattern of the East Asian countries has rapidly shifted from one-way trade to intra-industry trade since the beginning of the 1990s.*
    - Ando (2005).
  - **Fact 2:** *Most of the intra-industry trade of the East Asian countries is "vertical" rather than "horizontal.*
    - Fukao, Ishido, and Ito (2003), Ando (2005).
  - **Fact 3:** *Vertical intra-industry trade of the East Asian countries does not necessarily follow the pattern suggested by vertical product differentiation models.*
    - Ando (2005).

Figure 1 Commodity composition of exports and imports

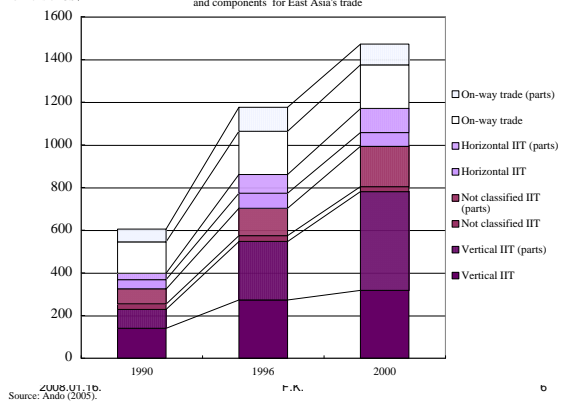Source: Ando (2005).
Note: "EX" and "IM" stand for exports and imports.
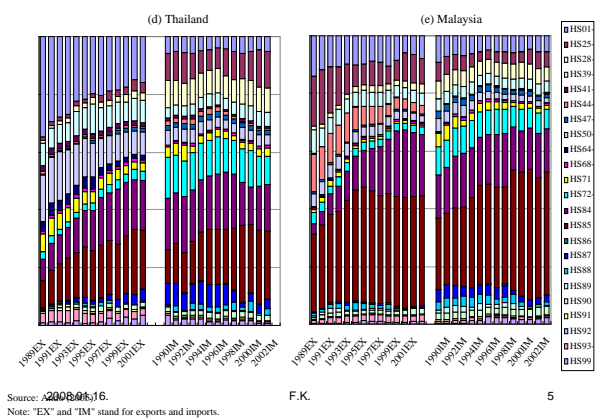
Figure 2 5 Rapid expansion of vertical IIT in machinery goods and machinery parts and components for East Asia's trade

Source: Ando (2005).
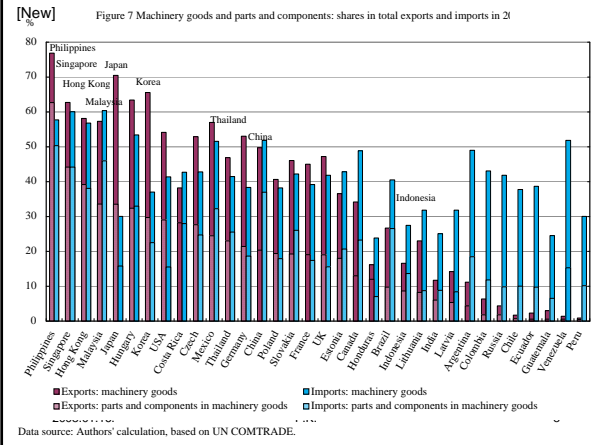
Slide 1 (top-left):

– **Fact 4:** *Shares of machinery and machinery parts & components in both total exports and imports have become notably large in East Asian countries.*
  • Ando and Kimura (2005b).
– **Fast 5:** *Explosive increases in intra-East-Asia trade, particularly in machinery parts & components, have been observed since the 1990s.*
  • Ando and Kimura (2005b).
– **Fact 6:** *Active back-and-forth transactions of machinery parts & components are observed among countries with different income levels.*
  • cf. core EU
  • cf. WE-CEE in Ando and Kimura (2005c).

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Slide 2 (top-right):

[New]   Figure 7 Machinery goods and parts and components: shares in total exports and imports in 20...

(Bar chart with country labels: Philippines, Singapore, Japan, Hong Kong, Korea, Malaysia, Hungary, USA, Costa Rica, Czech, Mexico, Thailand, China, Poland, Germany, Slovakia, France, UK, Estonia, Canada, Honduras, Brazil, Indonesia, Lithuania, India, Latvia, Argentina, Colombia, Russia, Chile, Ecuador, Guatemala, Venezuela, Peru)

Legend:
- Exports: machinery goods
- Imports: machinery goods
- Exports: parts and components in machinery goods
- Imports: parts and components in machinery goods

Data source: Authors' calculation, based on UN COMTRADE.

Slide 3 (middle-left):

[New]   Figure 3 Machinery goods and machinery parts and components: shares in total exports and imports in 1990-1994

(Bar chart with country labels: Japan90, U.S.A.91, U.K.93, Malaysia90, Singapore90, France94, Germany91, Hong Kong93, Canada93, Korea90, Thailand90, Hungary92, Czech93, Mexico90, Slovakia94, Brazil90, Poland94, Lithuania94, China92, Argentina93, India94, Latvia94, Colombia91, Venezuela92, Indonesia90, Peru92, Chile90, Honduras94, Guatemala93, Ecuador91)

Legend:
- Exports: machinery goods
- Imports: machinery goods
- Exports: parts and components in machinery goods
- Imports: parts and components in machinery goods

Slide 4 (middle-right):

Table 2 Development of intra-regional exports in East Asia (excerpt)

(Millions US$, %)

	1990 Value	Share	2003 Value	Share
Machinery goods: parts and components				
Intra-East Asia	54,336	39.6	300,137	57.5
Others	82,915	60.4	221,637	42.5
(U.S.)	(39,624)	(28.9)	(82,543)	(15.8)
Total	137,251	100.0	521,774	100.0
Machinery goods: final goods				
Intra-East Asia	50,932	23.2	144,368	28.8
Others	168,597	76.8	356,732	71.2
(U.S.)	(70,183)	(32.0)	(143,634)	(28.7)
Total	219,529	100.0	501,100	100.0
Machinery goods: total				
Intra-East Asia	105,268	29.5	444,505	43.5
Others	251,512	70.5	578,369	56.5
(U.S.)	(109,807)	(30.8)	(226,177)	(22.1)
Total	356,780	100.0	1,022,875	100.0
All products				
Intra-East Asia	270,465	38.5	786,197	44.7
Others	432,736	61.5	973,074	55.3
(U.S.)	(174,978)	(24.9)	(355,643)	(20.2)
Total	703,201	100.0	1,759,271	100.0

Factors of growth in intra-East Asian exports

(i) Growth in intra-East Asian exports (1990-2003)
  All products   191%
  Machinery goods (total)   322%
  - Machinery final goods   183%
  - Machinery parts and components   452%
(ii) Contribution to growth in intra-East Asian exports
  Machinery goods (total)   66%
  - Machinery final goods   18%
  - Machinery parts and components   48%

Factors of growth in inter-regional exports

(i) Growth in inter-regional exports (1990-2003)
  All products   125%
  Machinery goods (total)   130%
  - Machinery final goods   112%
  - Machinery parts and components   167%
(ii) Contribution to growth in inter-regional exports
  Machinery goods (total)   60%
  - Machinery final goods   35%
  - Machinery parts and components   26%

Factors of growth in East Asian exports

(i) Growth in East Asian exports (1990-2003)
  All products   150%
  Machinery goods (total)   187%
  - Machinery final goods   128%
  - Machinery parts and components   280%
(ii) Contribution to growth in East Asian exports
  Machinery goods (total)   63%
  - Machinery final goods   27%
  - Machinery parts and components   36%

Data source: Authors' calculation, based on UN COMTRADE.
Drawn from Ando and Kimura (2005b).

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Slide 5 (bottom-left):

– **Fact 7:** *In the standard gravity equation estimation for machinery parts & components trade, notably low coefficients in absolute values for geographical distance are estimated in the case of intra-East-Asia trade, compared with intra-Europe trade.*
  • Kimura, Takahashi, and Hayakawa (2005).
– **Fact 8:** *In the gravity equation exercise with a modified version, positive coefficients are estimated for income gap between exporting and importing countries in the case of intra-East-Asia trade.*
  • Kimura, Takahashi, and Hayakawa (2005).

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Slide 6 (bottom-right):

Table 1 Results of gravity equation estimation for machinery parts & components trade

	The whole sample 1995 (1)	2003 (2)	Intra-East-Asia only 1995 (3)	2003 (4)	Intra-Europe only 1995 (5)	2003 (6)
Distance	-1.64**	-1.36**	-0.70**	-0.64**	-1.15**	-1.27**
	(0.11)	(0.10)	(0.15)	(0.17)	(0.10)	(0.10)
Exporter_GDP	2.03**	1.86**	0.68**	0.69**	1.07**	1.07**
	(0.05)	(0.05)	(0.09)	(0.09)	(0.05)	(0.05)
Importer_GDP	1.18**	1.19**	0.18	0.42**	0.89**	0.92**
	(0.05)	(0.05)	(0.10)	(0.11)	(0.05)	(0.06)
Exporter_per capita GDP	0.87**	0.72**	0.56**	0.10	0.44**	-0.22*
	(0.06)	(0.05)	(0.07)	(0.08)	(0.07)	(0.10)
Importer_per capita GDP	0.59**	0.37**	0.57**	0.24*	-0.04	-0.27*
	(0.06)	(0.06)	(0.07)	(0.09)	(0.09)	(0.10)
Intra-East-Asia Dummy	3.04**	3.11**				
	(0.29)	(0.21)				
Intra-Europe Dummy	-1.42**	-1.05**				
	(0.25)	(0.24)				
Language	2.00**	1.58**	1.16**	1.63**	-0.36	-0.36
	(0.21)	(0.19)	(0.29)	(0.25)	(0.20)	(0.20)
constant	-67.44**	-62.35**	-6.86	-6.73	-28.94**	-19.54**
	(1.91)	(1.75)	(3.99)	(3.75)	(2.13)	(2.47)
observations	3,080	3,080	72	72	306	306
Adj. R-squared	0.635	0.637	0.743	0.553	0.802	0.720

Notes: The dependent variable is trade values of machinery parts & components. Heteroskedasticiy-consistent standard errors (White) are in parentheses. ** and * show 1% and 5% significance, respectively.

Source: Kimura, Takahashi, and Hayakawa (2005).

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[New]

Table 4 Gravity model estimation of intra-East Asian exports (excerpt)

Variable	Machinery parts and components	Machinery final goods	All products
	Dependent variables (exports (log)):		
(a) Year:1990	(1)	(2)	(3)
Constant	-5.018	-14.440 ***	-5.358 *
Distance (log)	-0.724 **	-0.623 **	-0.429 **
GDPi (log)	0.378 ***	0.703 ***	0.424 ***
GDPj (log)	-0.155	0.043	0.292 ***
Income gap (log)	1.051 ***	0.823 ***	0.500 ***
(b) Year: 2005	(1)'	(2)'	(3)'
Constant	1.974	-6.774	-1.162
Distance (log)	-0.823 ***	-0.792 ***	-0.690 ***
GDPi (log)	0.351 ***	0.712 ***	0.495 ***
GDPj (log)	0.329 ***	0.438 ***	0.456 ***
Income gap (log)	0.341 ***	0.138	0.171 ***
Number of observations	72	72	72

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- Facts drawn from micro data of Jap. MNEs
  - **Fact 9:** *FDI in East Asia by Japanese firms has concentrated on manufacturing. In addition, small and medium enterprises (SMEs) have also been major players of FDI in East Asia.*
    - Kimura and Ando (2005).
  - **Fact 10:** *Affiliates of Japanese firms in East Asia have actively traded with countries in East Asia other than Japan.*
    - Cf. AJF in LA and CEE (Ando and Kimura (2005b, 2005c)).
  - **Fact 11:** *Intra-firm transactions are relatively large in sales to and purchases from Japan while arm's-length (inter-firm) transactions are relatively large in local sales and purchases.*
    - Ando and Kimura (2005b).

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[New]

Table 3 Sales and purchases by Japanese machinery affiliates in East Asia (excerpt)

	Japan	(Intra-firm)	Local	(Intra-firm)	Third countries (total)	(Intra-firm)	East Asia	(Intra-firm)
Sales								
1992	17	(91)	66	(8)	17	(58)	9	(54)
1995	21	(91)	57	(20)	23	(55)	13	(60)
1998	44	(81)	39	(16)	17	(50)	15	(48)
2001	29	(79)	40	(14)	31	(53)	20	(52)
Purchases								
1992	46	(84)	43	(2)	10	(59)	8	(81)
1995	29	(76)	43	(9)	28	(54)	19	(54)
1998	37	(62)	41	(7)	22	(49)	20	(50)
2001	38	(70)	40	(10)	22	(46)	20	(45)

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[New]

Table 4 Intra-firm and arm's length transactions by Japanese electric machinery affiliates in East Asia

	Japanese affiliates in East Asia				Japanese affiliates in China			
	1992	1995	1998	2001	1992	1995	1998	2001
Sales: share (%)								
(i) Japan	27	29	33	34	81	30	23	32
-intra-firm	24	26	24	27	81	28	16	26
-arm's length	3	3	9	8	0	1	7	6
(ii) Local	46	38	32	31	13	34	41	37
-intra-firm	4	3	5	5	0	3	5	6
-arm's length	42	35	28	26	13	32	36	32
(iii) Other East Asia					5	31	32	22
-intra-firm	9	12	14	12	5	28	27	17
-arm's length	8	8	11	10	0	3	4	5
(i+ii+iii) East Asia (total)	91	86	90	88	100	95	95	91
-intra-firm	38	41	43	44	86	59	47	49
-arm's length	53	46	47	44	14	36	48	42
Purchases: share (%)								
(i) Japan	47	39	37	35	84	53	33	38
-intra-firm	39	33	24	26	78	45	19	25
-arm's length	7	5	13	9	5	8	14	13
(ii) Local	37	34	36	35	16	19	34	37
-intra-firm	1	5	2	3	6	2	3	4
-arm's length	36	29	34	32	10	17	31	33
(iii) Other East Asia					0	27	32	24
-intra-firm	9	11	13	12	0	22	27	16
-arm's length	6	13	13	16	0	5	5	8
(i+ii+iii) East Asia (total)	98	98	99	99	100	99	99	99
-intra-firm					85	69	49	45
-arm's length					15	30	50	54

Data source: authors' calculation, based on METI database.

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- Facts drawn from case studies and casual observations
  - **Fact 12:** *Many other elements of location advantages than low wages seem to be increasingly important in direct investment decisions in East Asia.*
    - e.g., WB investment climate study, JETRO, JBIC, JBCTIF.
  - **Fact 13:** *We have observed explosive proliferation of industrial estates in East Asia where substantial investment facilitation and basic infrastructure services are realized.*
    - e.g., intimate services, customs clearance, rental factory/floor.
  - **Fact 14:** *Agglomeration has begun to be formulated in East Asia, as a mixture of MNEs and local firms.*
    - e.g. Shanghai-Jiangsu, Guangzhou, Samut Prakan, Eastern Seaboard, Penang, Shah Alam.

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- **Fact 15:** *"Service link cost" for connecting remotely located production blocks seems to be lowered, or at least stable with quantitative increase, over time in East Asia.*
  - e.g., duty-drawback, AFTA, 40-foot containers, air cargo, customs clearance.
- **Fact 16:** *We have recently observed notable dissemination of ideas related to efficient production/distribution networks such as just-in-time (JIT) production system, supply chain management (SCM) or value chain management (VCM), lead time, vendor managed inventory (VMI), milk run, and others in East Asia.*
  - e.g., Toyota production system, Dell model.

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- **Fact 17:** *Disintegration or detachment of activities beyond the boundary of firm has increasingly been observed in East Asia.*
  - e.g. OEM, EMS firms, internet auction.
  - Modular versus total integration, fixed cost versus proximity.
- **Fact 18:** *Particularly in China, Malaysia, and Thailand, we have recently observed notable penetration of local firms into production networks.*
  - e.g., Automobiles and ink-jet printers in Thailand.

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[New]

- Spatial structure of production networks (in the case of machinery industries)
  - 1st layer (local): lead time < 2.5 hours mainly by trucks
    - Arm's length, tight JIT, high frequency
  - 2nd layer (sub-regional): lead time = 1-7 days by sea, air, and others
    - Arm's length + intra-firm, modular, between agglomeration/hubs
  - 3rd layer (regional): lead time = 1-2 weeks mainly by sea
    - Mainly intra-firm, Japan-ASEAN, Bangkok-Hanoi, …
  - 4th layer (world): lead time = 2 weeks - 2 months mainly by sea (containers)

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3. Mechanics of two-dimensional fragmentation and agglomeration

- Seminal work: Jones and Kierzkowski (1990)
- Adding "disintegration" to "geographical distance" as another dimension of fragmentation (particularly important in East Asia)
  - cf. vertical integration, Antras and Helpman (2004), …
- Reduction in production cost per se vs. service link cost in two dimensions
- Link with agglomeration at the industry/macro level
  - Location advantages (including policy environment); economies of scale in service link
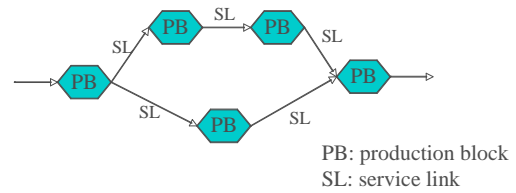 - Proximity to facilitate arm's-length transactions

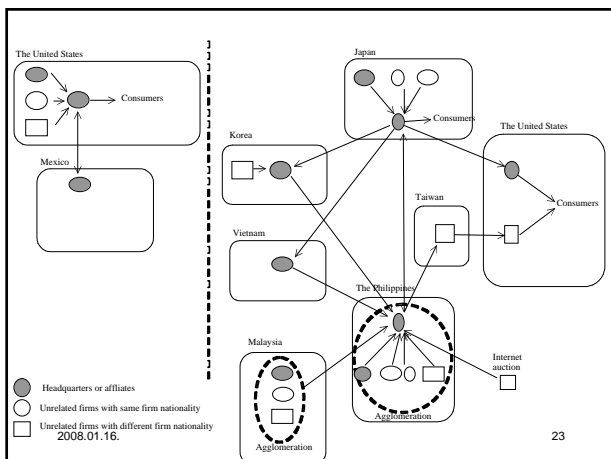2008.01.16.   F.K.   21
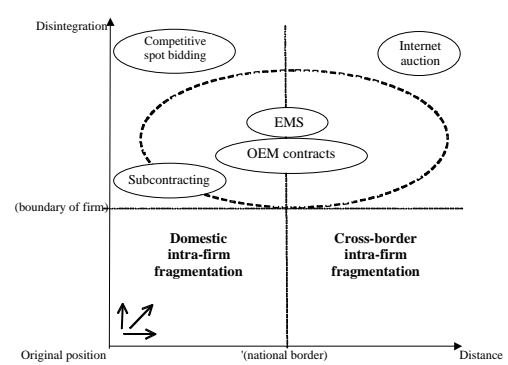

Before fragmentation

After fragmentation

PB: production block
SL: service link

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The United States
Japan
Korea
The United States
Mexico
Taiwan
Vietnam
The Philippines
Malaysia
Internet auction
Agglomeration
Consumers

- Headquarters or affiliates
- Unrelated firms with same firm nationality
- Unrelated firms with different firm nationality

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Figure 5 Fragmentation in a two-dimensional space

Disintegration

Competitive spot bidding
Internet auction
EMS
OEM contracts
Subcontracting

(boundary of firm)

Domestic intra-firm fragmentation   **Cross-border intra-firm fragmentation**

Original position   '(national border)   Distance

Source: Kimura and Ando (2005).

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4. Policy environment for int'l prod./dist. networks

- Policy background for network development
  - Policy reform of East Asian countries in the late 1980s and early 1990s.
- Policy agenda for developing EA
  - Clean up inefficient import-substituting industries
  - Further activate prod./dist. networks

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[New]

Table 8 Two-dimensional fragmentation and improvement in investment climate

	Reduction in fixed costs to develop production/distribution networks	Reduction in service link costs connecting production blocks	Further cost reduction in production cost per se in production blocks
Fragmention along the distance axis	Various policies to reduce investment costs	Various policies to overcome geographical distance and border effects	Various policies to strengthen location advantages
	Examples : (i) improvement in stability, transparency, and predictability of investment-related policies, (ii) investment facilitation in FDI-hosting agencies and industrial estates, (iii) liberalization and development in financial services related to capital investment	Examples : (i) reduction/removal of trade barriers such as tariffs, (ii) trade facilitation including simplification and improved efficiency in custom clearance/procedures, (iii) development of transport infrastracture and improved efficiency in transport and distibution services, (iv) development of telecommunication infrastructure, (v) improved efficiency in financial services related to operation and capital movements, (vi) reduction in costs of coordination between remote places by facilitation of the movement of natural persons	Examples: (i) establishment of educational/occupational institutions for personnel training to secure various types of human resources, (ii) establishment of stable and elastic labor-related laws and institutions, (iii) establishment of efficient international and domestic financial services, (iv) reduction in costs of infrastructure services such as electricity and other energy, industrial estates services, (v) development of agglomeration to facilitate vertical production chains, (vi) establishment of economic institutions such as investment rule and intellectual property rights, (vii) various trade and investment faciliation
Fragmentation along the disintegration axis	Establishment of economic environment to reduce set-up costs of arm's length transactions	Development of institutional environment to reduce the cost of implementing arm's length transactions	Various policies to strengthen competitiveness of potential business partners
	Examples : (i) establishmemt of economic system to allow co-existance of various business partners as well as making various types of contracts, (ii) various policies to reduce costs of information gathering on potencial business partners, (iii) securing fairness, stability, and efficiency in contracts, (iv) establishment of stable and effective institutions to secure intellectual property rights	Examples: (i) policies to reduce monitoring cost of business partners, (ii) improvement in legal system and economic institutions to activate dispute settlement mechanism, (iii) policies to promote technical innovations in modulation to further facilitate outsourcing	Examples : (i) hosting and fostering various types of business partners including foreign and indiginous firms, (ii) strengthening supporting industries, (iii) various policies to promote the formation of agglomeration

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- Possible uneven developments in EA
  - Link with new economic geography
    - Mobility of human capital and technology
    - Economies of scale in service link
    - Economies of scale in agglomeration
  - Possibly generate winners and losers
  - Also, congestion effect => possibly trickle down to latecomers; policy matters
- Issues for developed countries
  - "Hollowing-out"; employment and productivity
    - Cf. micro data analysis of Japanese firms: firms extending operation in EA seem to generate domestic employment at the firm level (Ando and Kimura (new)).
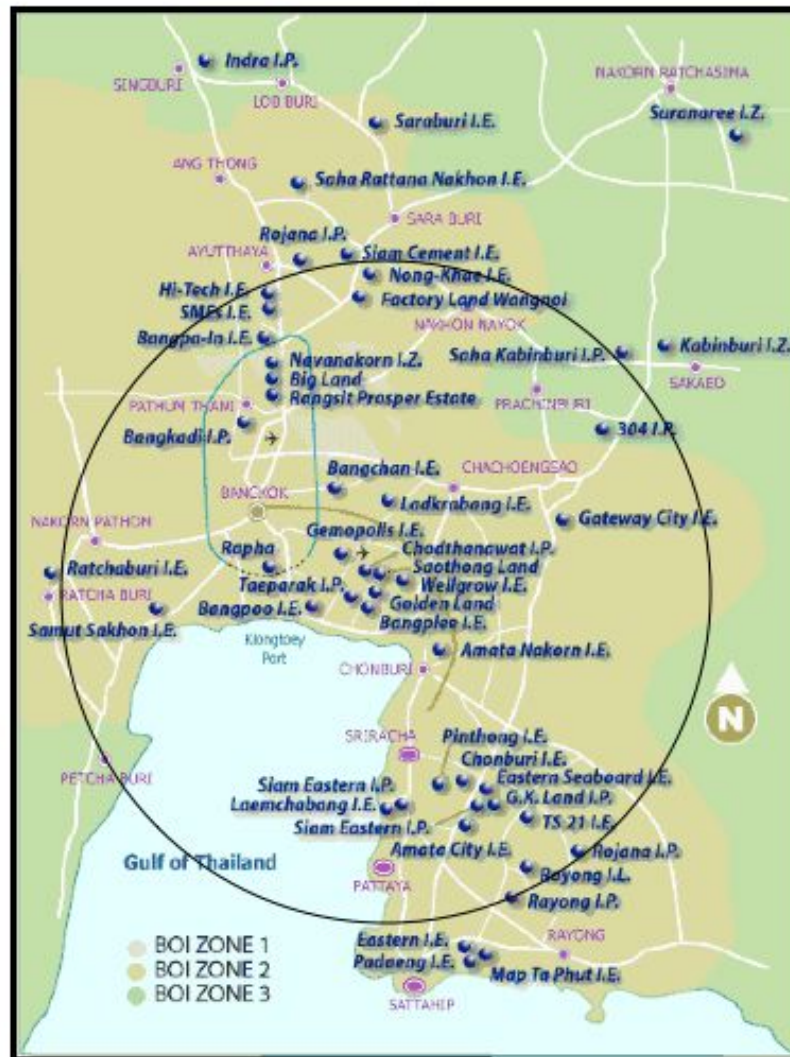 - Cf. US, EU

[Map1]

[New]

The large portion of the industrial estates in Thailand are within 100km diameter circle, which is within 2.5 hours by trucks.
Tight JIT system is operated.
About the same size as Pearl River Delta, extended Tokyo, extended Nagoya area, and others.

[Map2]

The distance between Bangkok and Singapore is about 1,500km; the lead time is 1-7 days.
Both arm's length and intra-firm trade exist.
Active trade in modules and large lots of parts.

Annual Average Daily Traffic of the ASIAN Highway

[Map3]

[New]

1,500km are also the distance within which agglomerations/hubs are connected.