

Preliminary draft  
Comments welcome

The Globalisation of Production Networks:  
A View from Asia\*

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## Abstract

International production/distribution networks in East Asia being developed in the 1990s and after have distinctive features in their significance, extensiveness, and sophistication. This paper first lists “18 facts” on production/distribution networks in East Asia that have been found by a number of studies using international trade data, micro data of Japanese multinational enterprises, and casual observations. It then presents a concept of two-dimensional fragmentation as a starting point of theoretically formalizing the phenomena. It lastly discusses the connection with economic effects of the formulation of production/distribution networks and their policy implication.

## 1. Introduction

International production/distribution networks in East Asia<sup>1</sup> are distinctive at this point in time in the following three aspects: their significance for countries in the region, their extensiveness covering a large number of countries in the region, and their sophistication in the combination of intra-firm and arm's-length (inter-firm) transactions (Ando and Kimura (2005a)). Although we observe similar cross-border production sharing in the US-Mexico nexus and in the Western Europe (WE) - Central/Eastern Europe (CEE) corridor, they have not yet reached the level of development that East Asia has accomplished. East Asia has been the region that has realized sustained rapid economic growth for decades, but we should not miss important qualitative changes in economic structure and policy environment in the early 1990s. East Asia is not an "East Asia" anymore stylized by the World Bank's *East Asian Miracle* (World Bank (1993)). Active foreign direct investment (FDI), development of cross-border production sharing or fragmentation, sophisticated disintegration of production activities, and the formation of industrial agglomeration, particularly in machinery industries, have been prime features of the East Asian economy since the early 1990s.

This paper first summarizes what we know about the nature and characteristics of international production/distribution networks in East Asia by listing "Facts" established by a number of empirical studies and observations. Then the analytical framework of two-dimensional fragmentation is presented, and the mechanics of fragmentation and agglomeration in East Asia are discussed. Lastly, possible directions of assessing policy implication of international production/distribution networks are discussed.

## 2. Facts on production/distribution networks in East Asia

We cannot see the world without theory. The lack of proper analytical framework has obviously delayed our understanding on international production/distribution networks in East Asia. We however have accumulated substantial amount of empirical observations and now seem to be ready to develop a new analytical model to provide a view of how to look at the mechanics of international

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<sup>1</sup> In this paper, "East Asia" primarily means ASEAN10 + 3 (Japan, Korea, and China), including Chinese Taipei.

production/distribution networks.

“Facts” that we have confirmed are categorized into three: the ones that are established by international trade data, the ones that are confirmed by micro data of multinational enterprises, and the ones that are being confirmed by case studies and other casual observations. We will list the facts in the following.

#### Facts drawn from international trade data

International trade data have predominant advantages in their international comparability and the complete coverage of traded goods in the detailed commodity classification. Instead, they do not directly describe economic activities inside national borders. We do not detect who is trading with whom, either. International trade data do not present the whole structure of international production/distribution networks but provide a lot of useful information.

The first three facts are related to the overall pattern of international trade in East Asia.

**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.*

Until the 1980s, international trade pattern in East Asia was dominated by a typical North-South trade pattern; i.e., less developed countries (LDCs) exported natural-resource-based products and labor-intensive manufacturing products while Japan exported the whole range of other manufacturing products. The idea of “flying geese” development pattern and pro-trade FDI well fitted the transition of industry-wise comparative advantage in this period (see, for example, Kojima (2000)). In the 1990s, LDCs in East Asia started exporting manufacturing products, particularly machineries. Industry-wise trade pattern has become more and more similar across countries, and intra-industry trade has increasingly been important (Ando (2005)). Figure 1 presents changes in trade composition in Thailand and Malaysia as an illustration.

== Figure 1 ==

**Fact 2:** *Most of the intra-industry trade of the East Asian countries is “vertical” rather than “horizontal.”*

The decomposition exercise of intra-industry trade (IIT) into “vertical” and “horizontal” based on unit prices of exports and imports reveals the fact that most of the IIT of East Asian countries is “vertical” and the proportion of “horizontal” IIT is minimal (Fukao, Ishido, and Ito (2003), Ando (2005)). Figure 2 presents the growth of exports and imports in machinery goods and machinery parts and components in 1990, 1996, and 2000, classified into one-way trade, horizontal IIT, and vertical IIT.

== Figure 2 ==

**Fact 3:** *Vertical intra-industry trade of the East Asian countries does not necessarily follow the pattern suggested by vertical product differentiation models.*

Vertical IIT is often interpreted as the result of vertical product differentiation; i.e., countries with high income export higher-quality, higher-priced products while countries with low income export lower-quality, cheaper products. This “vertical product differentiation model” does not explain the whole picture of vertical IIT in East Asia. Income levels of exporting countries and unit prices of exported products vis-à-vis those of imported products do not necessarily present positive association (Ando (2005)).

The next three facts are particularly on the machinery sector, which has come into the center stage in production/distribution networks in East Asia.

**Fact 4:** *Shares of machinery and machinery parts & components in both total exports and imports have become notably large in East Asian countries.*

Figure 3 presents shares of machinery products and machinery parts & components in total exports and imports in major countries in the world in 2003. Notable significance in trade in machinery goods, particularly machinery parts & components, is observed in a number of the East Asia countries. The importance of international production/distribution networks in the industrialization of these economies is strongly

suggested.

== Figure 3 ==

**Fact 5:** *Explosive increases in intra-East-Asia trade, particularly in machinery parts & components have been observed since the 1990s.*

In the period of 1990-2003, exports of East Asian countries to other East Asian countries grew by 191%. The intra-East-Asia exports of machinery parts & components grew by 452%, which occupies about the half of intra-regional export growth (Ando and Kimura (2005b)). Strong “magnification effect” on trade volume suggested by Yi (2003) is observed in East Asia.

**Fact 6:** *Active back-and-forth transactions of machinery parts & components are observed among countries with different income levels.*

International production/distribution networks in East Asia cover a number of countries at different development stages and income levels. This presents a sharp contrast with horizontal IIT among core EU countries that are at similar development stages and income levels. Diversity in East Asia is much larger than the US-Mexico nexus or the WE-CEE corridor. We also observe that transactions among LDCS are also active in East Asia while those among CEE countries are minimal at least at this point in time (Ando and Kimura (2005c)).

The next two facts report major results in gravity equation exercise with bilateral trade data in machinery goods and machinery parts & components.

**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.*

This suggests that service link cost connecting remotely located production blocks is lower in East Asia than in Europe and/or that location advantages for fragmented

production blocks are so attractive that geographical distance does not matter very much (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.*

In our intuition based on horizontal IIT, IIT is found mainly between DCs. However, it does not hold in East Asia. In the exercise of gravity equation with income gaps between exporting and importing countries as additional explanatory variable, we find that income gaps have positive association with trade values in East Asia. On the contrary, they have negative, though not statistically significant, association in Europe. This suggests that differences in location advantages, including wage levels, are important in international production/distribution networks in East Asia (Kimura, Takahashi, and Hayakawa (2005)).

#### Facts drawn from microdata of MNEs

Because transactions in international production/distribution networks are often relation-specific, we would like to know individual firms' activities and relationship with other firms in order to analyse the mechanics of the networks. However, it is extremely difficult to capture firm-wise information. A partial remedy is to analyse the micro data of foreign affiliates of Japanese firms. Empirical studies with the *Kikatsu Chosa* data and the *Kaiji Chosa* data provide the following three facts:<sup>2</sup>

**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.*

Compared with Japanese FDI in North America and Europe, FDI in East Asia presents

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<sup>2</sup> The Ministry of Economy, Trade, and Industry (METI), Government of Japan annually conducts the *Kikatsu Chosa* or *Basic Survey of Business Structure and Activity* and The *Kaiji Chosa* or *Survey of Overseas Business Activities of Japanese Companies*. For details of the data sets, see Ando and Kimura (2005a).

notable concentration on manufacturing activities. A notable fact is that a lot of SMEs invest in East Asia, which is supposed to work as essential players in international production networks and agglomeration (Kimura and Ando (2005)).

**Fact 10:** *Affiliates of Japanese firms in East Asia have actively traded with countries in East Asia other than Japan.*

Manufacturing affiliates of Japanese firms in East Asia actively trade with other East Asian countries. The proportion of their sales to East Asian countries (other than the host country and Japan) and the proportion of their purchases from East Asian countries both amount to 19% in 2001. These figures are much larger than those for manufacturing affiliates of Japanese firms in Mexico or 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.*

As for manufacturing affiliates of Japanese firms in East Asia in 2001, intra-firm transaction ratios are 77%/66% in sales to / purchases from Japan, 44%/43% in sales to / purchases from other East Asian countries, and 11%/10% in sales to / purchases from local markets. The shorter the distance of transactions, the more likely they conduct arm's-length transactions.

#### Facts drawn from case studies and casual observations

Official statistics unfortunately reveal the whole picture of international production/distribution networks. The following lists important facts derived from case studies and casual observations. The generalization requires a lot of care, but the importance of these facts is evident.

The following three are related to location advantages:

**Fact 12:** *Low wage level is still an important motivation for MNEs to invest in developing East Asia, but many other elements of location advantages seem to be important in direct investment decisions.*

A series of studies on investment climate by the World Bank (<http://rru.worldbank.org/InvestmentClimate/>), questionnaire surveys by Japan External Trade Organization (JETRO) (<http://www.jetro.go.jp>), Japan Bank for International Cooperation (JBIC) (<http://www.jbic.go.jp/english/research/report/review/index.php>), Japan Business Council for Trade and Investment Facilitation (JBCTIF) (<http://www.jmcti.org/mondai/top.html>) and others strongly suggest that MNEs use a list of a number of elements of location advantages when they make investment decisions.

**Fact 13:** *We have observed explosive proliferation of industrial estates or industrial parks in East Asia, run by central/local governments or private developers including general trading companies, where substantial investment facilitation and basic infrastructure services are realized.*

Investment facilitation has substantially advanced as industrial park services have developed. Competition over inviting investment among industrial estates has been extremely harsh, which has improved services. Intimate services of park offices, stable procurement of infrastructure services, facilitation of customs clearance and logistics, rental factory/floor, and others are features that competitive industrial estates have pursued.

**Fact 14:** *Agglomeration or industrial clusters has begun to be formulated in East Asia. Agglomeration has typically started with the accumulation of manufacturing plants of MNEs and has then developed as a mixture of MNEs and local firms.*

Partially supported by the host country's development strategies, substantial agglomeration or industrial clusters have been developed in East Asia; the Shanghai-Jiangsu corridor and Guangzhou and its vicinity in China, Samut Prakan and the Eastern Seaboard in Thailand, Penang and Shah Alam in Malaysia, and others are the examples. In well-developed agglomeration, not only factories run by MNEs but also a substantial number of local firms gather together.

The next two facts are on service link cost.

**Fact 15:** *Although rigorous empirical proof is difficult, “service link cost” for connecting remotely located production blocks seems to be lowered over time in East Asia.*

Increasingly large volume of cargos has been transported in 40-foot containers. Substantial increases in air cargo have been observed for the transportation of electronic parts and components. Trade facilitation including customs clearance has astoundingly improved. Explosive development of logistic industry has been observed.

**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.*

Inspired by the Toyota production system and Dell Computer SCM, studying and introducing JIT and other ideas are in boom among firms in East Asia. Firm managers are now acutely conscious of time cost, slim inventories, efficient management of the whole value chain, and others.

The last two facts are related to disintegration or outsourcing of activities and the development of local firms.

**Fact 17:** *Disintegration or detachment of activities beyond the boundary of firm has increasingly been observed in East Asia. Various forms of outsourcing have been developed including original equipment manufacturing (OEM) contract, electronics manufacturing system (EMS) firms, internet auction, and others.*

Consideration on the nature of activities to be disintegrated, the capability and credibility of business partners, and legal/economic environment affects the decision of outsourcing. Geographical distance also matters a lot. Designing of the whole network considering “modulation versus total integration” choice is also a big issue for downstream firms.

**Fact 18:** *Particularly in China, Malaysia, and Thailand, we have recently observed notable penetration of local firms into production networks.*

Particularly for product lines under harsh price competition, local vendors start penetrating into production networks initially constructed by MNEs. Semiconductor-related supporting services in Penang and ink-jet printer manufacturing in Thailand are the examples.

### 3. Mechanics of two-dimensional fragmentation and agglomeration

The trade and investment pattern of East Asia after the 1990s obviously requires a novel analytical framework. The traditional international trade theories based on industry-wise comparative advantage do not seem to capture the essence of international production/distribution networks in East Asia. The horizontal product differentiation model and the agglomeration theory, which have primarily been developed in the context of core EU, cannot directly be applied to East Asia. The starting point to investigate the mechanics of international production/distribution networks must be the fragmentation theory.

The fragmentation theory started from a seminal work by Jones and Kierzkowski (1990), and both theoretical and empirical studies using the concept of fragmentation have been accumulated.<sup>3</sup> The traditional international trade theory primarily explains location patterns across industries. However, in the currently observed production/distribution networks, location patterns are extensively determined at the production process level. Suppose that a large factory producing electronic products initially exists in a developed country and covers a long value chain from upstream to downstream (see Figure 4). A closer look at the detailed nature of production processes may suggest that some operations require intensive watching by technicians while other may simply be labor-intensive. Fragmentation, i.e., locating fragmented production blocks in different location, becomes cost-saving when the production cost *per se* drastically reduces and the cost of service links connecting production blocks is low enough. This is the original idea of fragmentation.

== Figure 4 ==

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<sup>3</sup> For fragmentation theories, see Arndt and Kierzkowski (2001), Cheng and Kierzkowski (2001), and Deardorff (2001).

To analyse the East Asian economy, we need some modification of the analytical framework. In contrast with the current fragmentation form in the US-Mexico nexus and the WE-CEE corridor, international production/distribution networks in East Asia include sophisticated combination of intra-firm and arm's-length transactions. Kimura and Ando (2005a) claim that the concept of fragmentation must be expanded to two dimensions (see Figure 5). The horizontal axis denotes geographical distance. From the original position, a production block can be detached and placed in geographical distance. A dotted line in the middle is a national border, which distinguishes cross-border fragmentation from domestic fragmentation. On the other hand, the vertical axis represents the organization (integration and disintegration) of corporate activities. A fragmented production may be conducted by either intra-firm establishments or unrelated firms. The dotted line is a boundary of firm, distinguishing arm's-length (inter-firm) fragmentation or outsourcing from intra-firm fragmentation.<sup>4</sup>

== Figure 5 ==

A firm's decision on whether to fragment or not again depends on cost saving in production *per se* in production blocks and the height of service link cost. Both are now two-dimensional. Cost saving in production *per se* comes from differences in location advantages along the horizontal axis and "de-internalization" advantages or counterpart's ownership advantages along the vertical axis. Service link cost is a cost due to geographical distance along the horizontal axis and due to weaker controllability or "transaction cost" in the Oliver Williamson's sense along the vertical axis. These are the tradeoffs that each firm faces in the fragmentation decision.

In East Asia, geographical fragmentation and agglomeration go hand in hand. In contrast with market-oriented agglomeration in Europe, agglomeration in East Asia is often motivated by the production-side logic. The forces of fragmentation and agglomeration are countervailing at the firm level. However, at the industry/aggregate

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<sup>4</sup> Disintegration and accompanied transaction cost have been long analysed in the industrial organization literature of vertical integration. We have recently observed a renewed interest on this issue in the literature of international trade literature. See, for example, Grossman and Helpman (2002, 2003, 2004, 2005) and Grossman, Helpman, and Szeidl (2004, 2005).

level, fragmentation and agglomeration may go together.

The concentration of fragmented production blocks occurs at least through the following two channels: first, local minimal points of service link cost tend to attract a large number of production blocks. Moreover, service link is often accompanied with strong economies of scale. Therefore, when a country successfully reduces two kinds of service link cost by proper policies, fragmented production blocks may rush in, and service link cost may be pushed down further.

Second, the concentration of production blocks may also happen due to the close relationship between the service link cost along the disintegration axis and geographical proximity. The service link cost in arm's-length fragmentation is extremely sensitive to geographical distance. The closer the distance with business partners, the smaller the service link cost in searching potential business partners, consulting detailed specs of products, managing product quality and delivery timing, solving disputes over contracts, monitoring, and others. The concentration of production blocks would reduce the service link cost, and the low service link cost would further attract production blocks; the arrows of causality would go in both directions.

These are the concise explanation of two-dimensional fragmentation framework. This of course primarily deals with an individual firm's decision on fragmentation and is not directly applied to discussion at the industry or aggregated levels. We need more theoretical sophistication in order to analyse overall economic effects of international production/distribution networks.

#### 4. Economic effects and policy implication

Economic effects of the formation of international production/distribution networks in East Asia and their policy implication have not yet been discussed in the organized manner. However, our understanding of the mechanics and characteristics of production/distribution networks at least provides a good starting point for normative discussion. The following is a list of preliminary thought on various issues.

##### Productivity and employment

Fragmentation means detachment of some of the production processes, and thus the direct effect on employment would be negative at the original position (origin country or origin firm). Location and firms that receive activities would have positive

effects on employment.

Therefore, from the viewpoint of DCs, as frequently claimed, there is an undeniable possibility that employment would be negatively affected by the formation of international production/distribution networks. However, we must note that fragmentation is conducted based on firms' decisions so as to enhance their competitiveness and thus is likely to push up the overall efficiency and productivity. Losing benefits from economics of scale and positive agglomeration effects would hurt DCs, but at the same time, more efficient resource allocation, static and dynamic, would be realized. In the case of Japanese manufacturing sector, Fukao and Amano (2004, pp. 80-87) provide a literature survey on the effect of outward FDI on domestic employment and conclude the existence of mild negative effect. At the same time, we observe that Japanese firms globalizing their activities perform better than those staying in Japan (Kimura and Kiyota (2004)).

From the viewpoint of LDCs, fragmentation has generated new channels of introducing capital and technology, and thus at the first place, strong positive effects on employment as well as productivity growth would be expected. Some would express concern about possible negative effects of inward FDI on the development of local firms/industries. Overall evaluation must be made based on rigorous empirical studies, but we observe that international production/distribution networks in East Asia have positively worked for fostering local firms/industries at least in some sectors.

### Investment climate

Competition over location advantages and service link cost has become harsh among countries in East Asia. In the emergence of production/distribution networks, elements of location advantages has changed, and the importance of service link cost has strongly been recognized. Competition forces seem to bear clear-cut winners and losers, which generates concern about ASEAN latecomers as well as regional disparities. Yet, we must at the same time recognize that substantial trickle-down effects are observed.

### Industrial promotion and development strategies

Infant industry protection argument is passé. Industrialization strategies with using import-substituting FDI are also regarded as out-of-date and are to be largely restructured.

However, East Asian developing countries have not yet very much been successful in establishing new development strategies. International production/distribution networks require further improvement of policy environment in East Asia, but countries do not take any strategic action yet. The whole set of new policy package is needed with recognizing the importance of network-forming FDI and agglomeration in order to foster local firms/industries.

### Regionalism

Regionalism has recently proliferated all over the world, but in order to further activate the benefits of production/distribution networks, novel contents are called for in designing free trade agreements (FTAs). In particular, competitive restructuring of import-substituting industries and enhancing production/distribution networks should be major targets.

### 5. Concluding remarks

This paper provides an overall picture of international production/distribution networks in East Asia. Although our understanding on the mechanics of networks has substantially improved these days, we still need to formalize our theoretical thought as well as accumulating empirical facts. By doing so, we could provide some important lessons for developing countries in the rest of the world.

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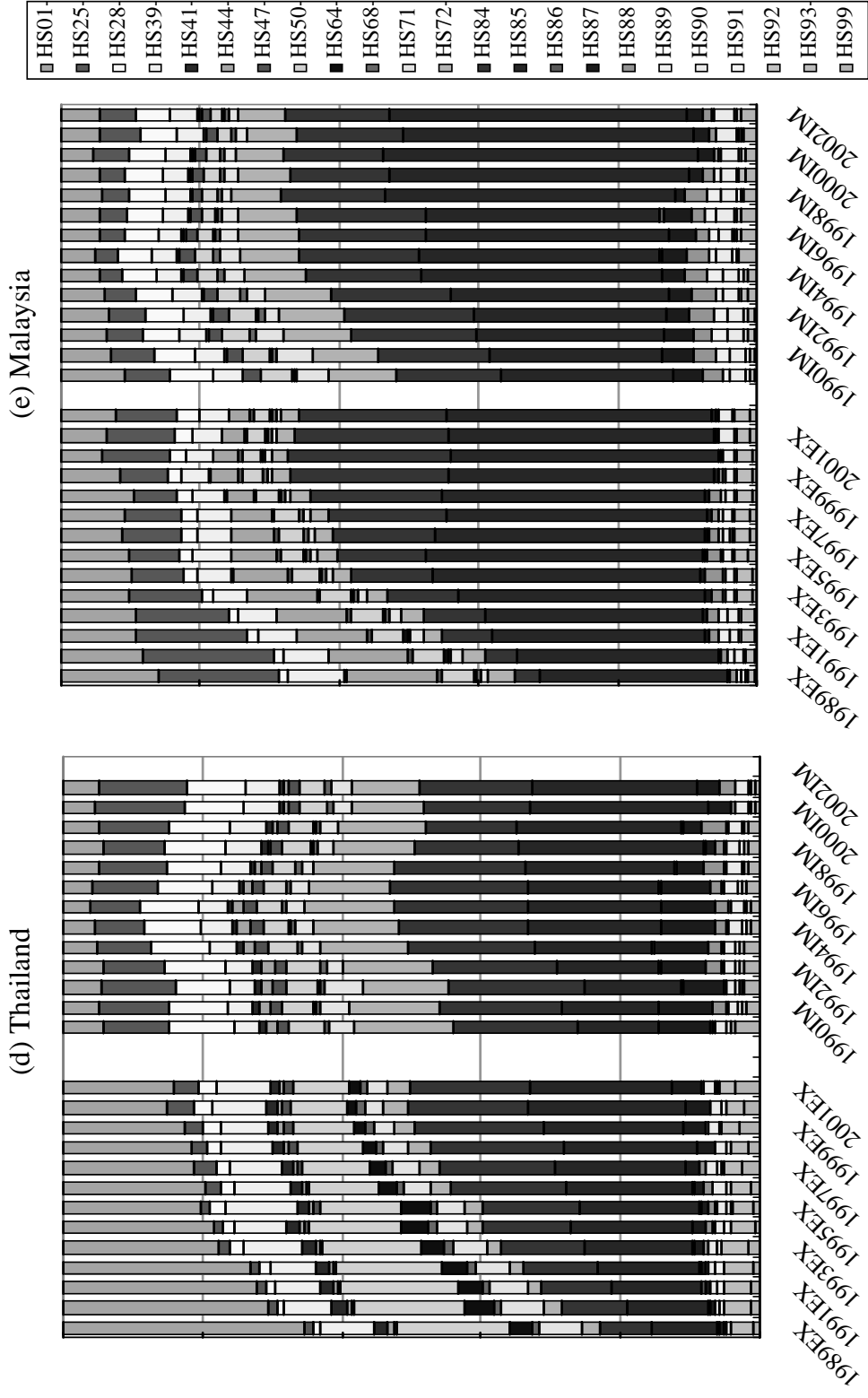
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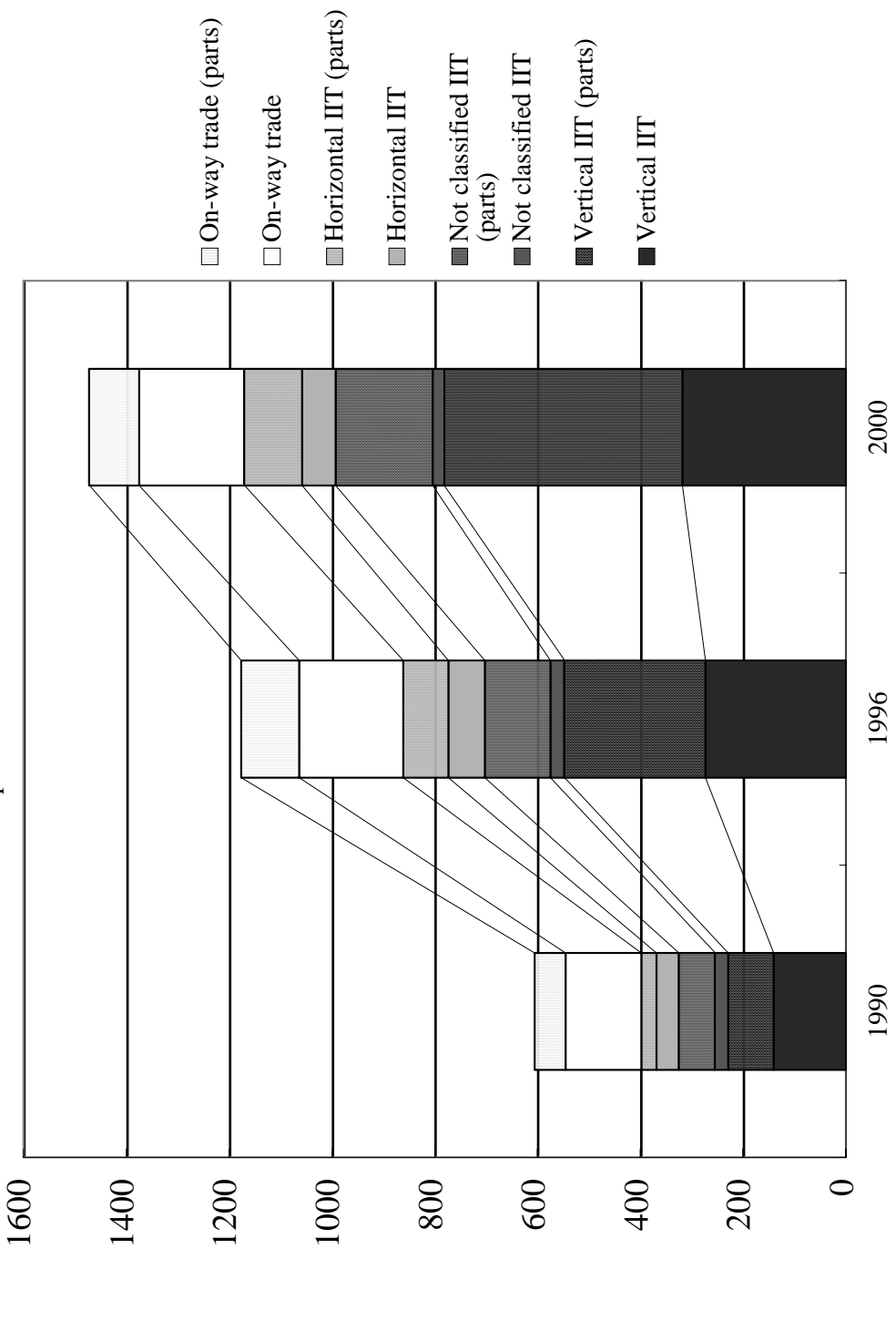
Figure 1 Commodity composition of exports and imports



Source: Ando (2005).

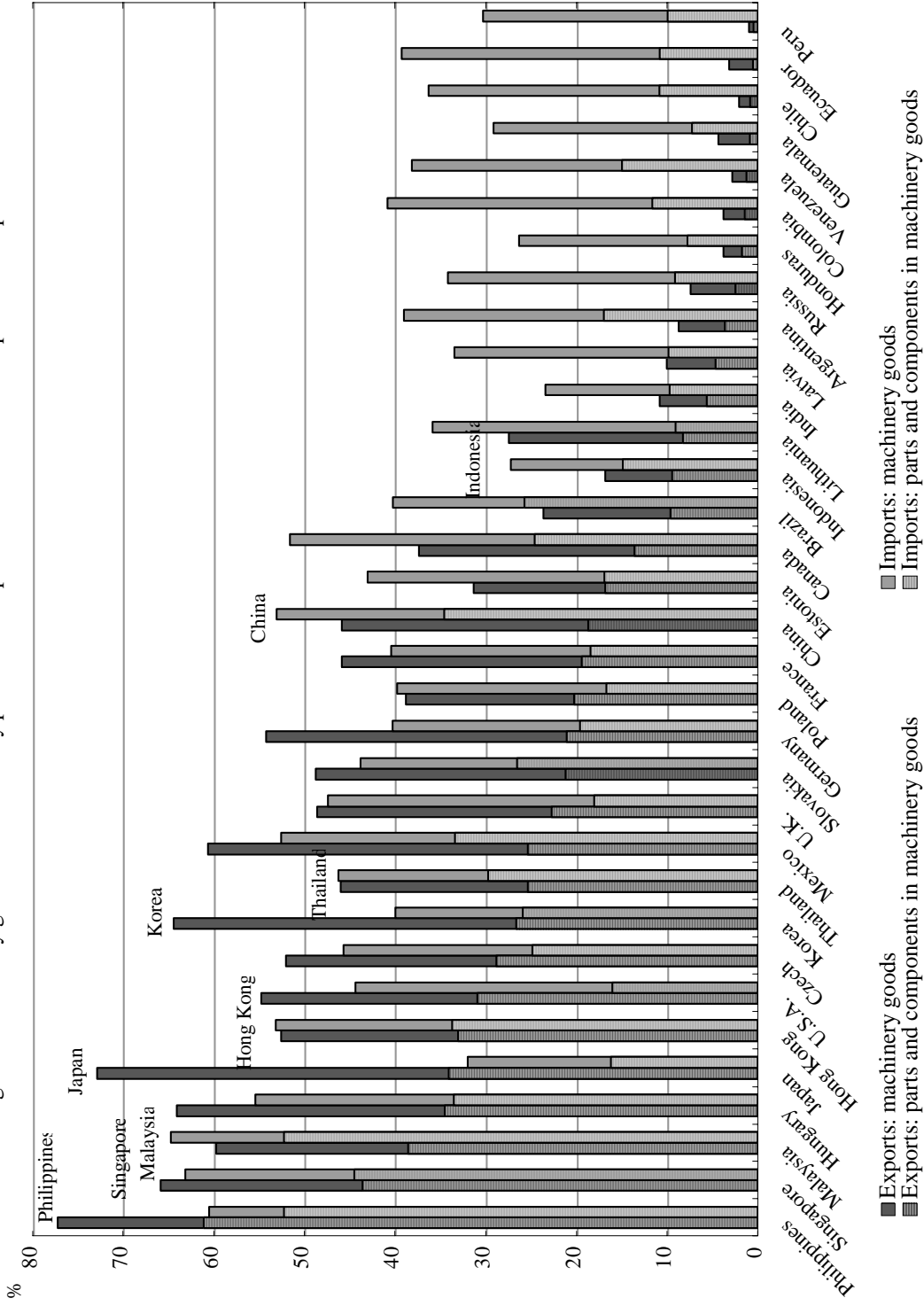
Note: "EX" and "IM" stand for exports and imports.

Figure 2 5 Rapid expansion of vertical IIT in machinery goods and machinery parts and components for East Asia's trade



Source: Ando (2005).

Figure 3 Machinery goods and machinery parts and components: shares in total exports and import



Source: Ando and Kimura (2005b).

Figure 4 Fragmentation and service link costs

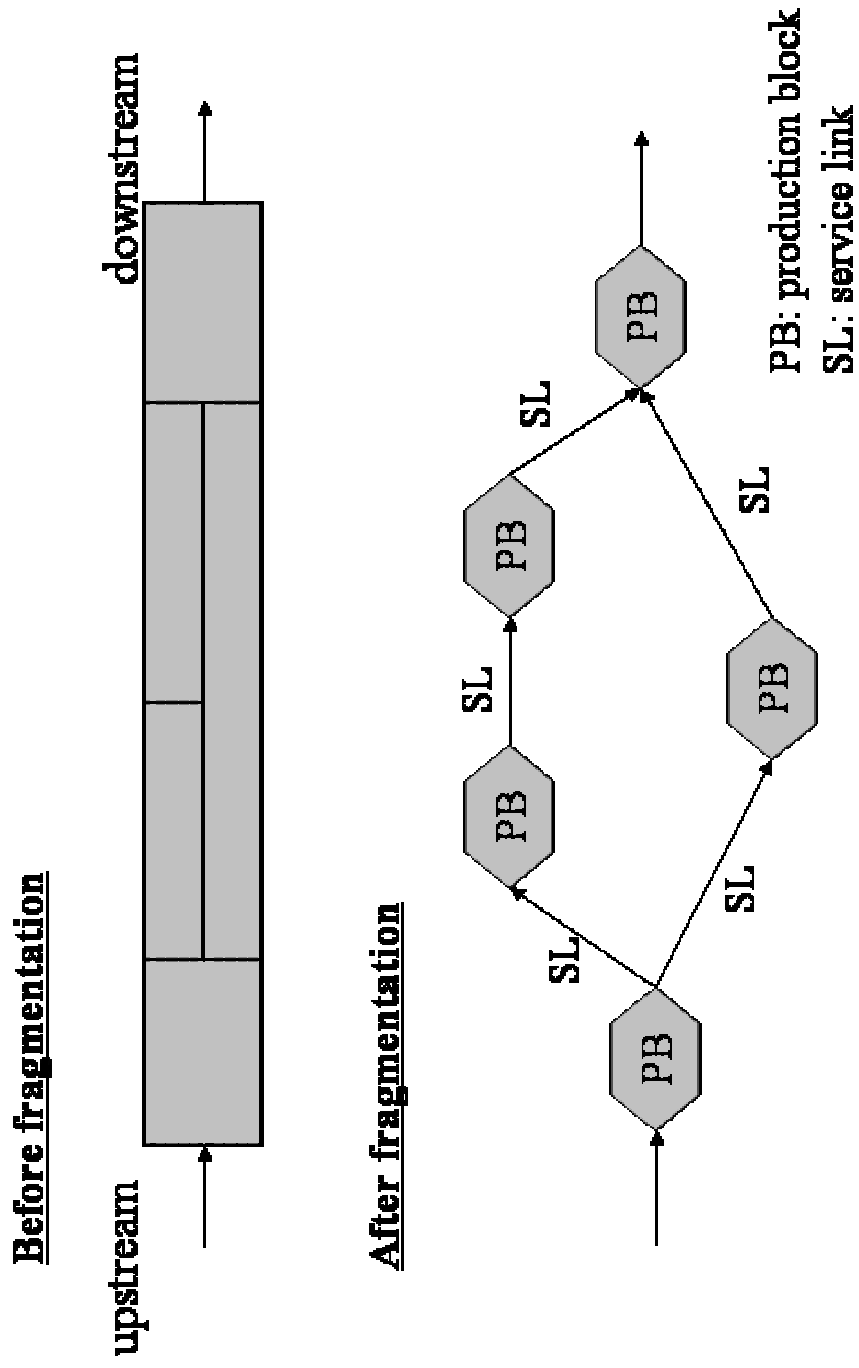
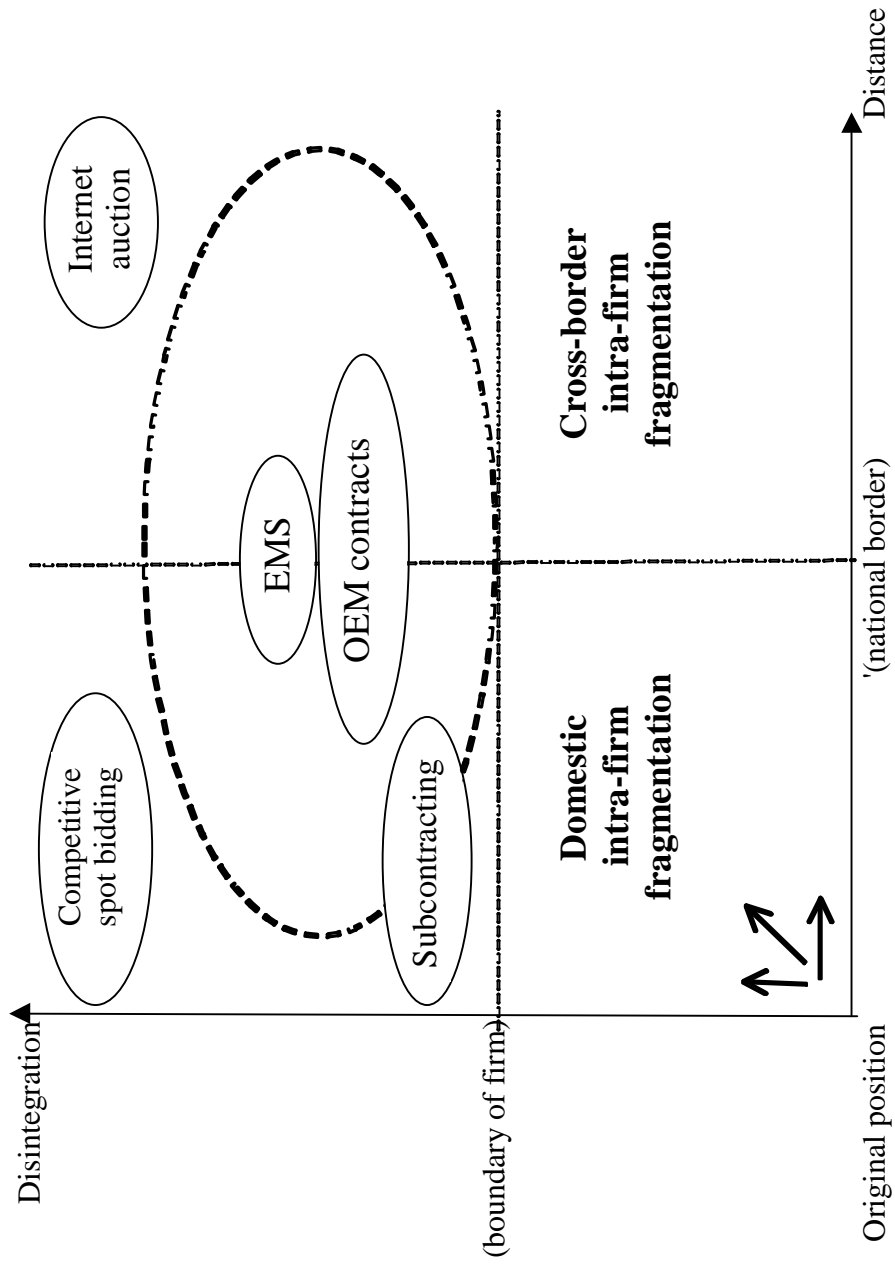


Figure 5 Fragmentation in a two-dimensional space



Source: Kimura and Ando (2005).