MARITIME LOGISTIC HUB IN CONCPET AND PRACTICE

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ABSTRACT

Since the hub-and-spoke concept was introduced to the aviation market after the US airline deregulation in the late 1970s, it becomes a primary distribution model employed by leading international logistics companies such as DHL, UPS and FedEx. This pattern drives the companies to consolidate shipments on the large scale at major terminals (i.e., hub) and to redistribute the smaller scale of shipments to their respective destinations via radial links (i.e., spoke). Container ports, with the application of the same concept to maritime sector, have assumed an important role in global logistics and supply chains and evolved to a global distribution channel node from the traditional loading and discharging function. In the field of maritime logistics and supply chains, however, the hub concept has been often introduced in various terms in accordance with functionality, for example, logistics centre, logistics zone, freight terminal, distribution centre, and warehouse. Such a heterogeneous terminology on the concept of maritime logistics hub seems still in usage by practioners and academics alike. Having recognised this rather ambiguous concept and definition in the literature, this paper attempts to define the hub concept directly applicable to maritime logistics by systematically synthesising the existing studies and to examine the evolutionary pattern of maritime logistics hubs, defined in this paper as container hub ports, in the Far East. When analysing the pattern, this paper utilises the flying geese paradigm as a theoretical framework. As maritime transport (i.e., shipping and ports) plays a significant role in international trade, a flying geese model would be a useful tool to understand the developmental pattern of the maritime industry in the context of maritime logistics hubs. Findings from this analysis will stipulate a platform that a proper definition on maritime logistics hubs be established and their past developments are to be understood so that future developmental direction in the sampled region and elsewhere would be well foreseen.

Keywords: Logistics Hub, Container Hub Port, Flying Geese Model, Northeast Asia.

INTRODUCTION

Continuous growth in international trade and global economic development has significantly increased the demand for container liner shipping and seaports since 1990s. With increasing container vessel sizes, merge and acquisition between shipping lines and strategic shipping alliances, trunk-and-feeder route (i.e. hub-and-spoke) systems and integrated role of ports in global supply chains have become popular in global maritime transport industry. With the effects of economies of scale, recent developments in global maritime industry have led to few port calls, which cause more intensive port competition and the rising importance of transhipment traffic in deciding the competitive position of ports. To cope with these emerging environment, container ports across the world have been trying to improve their physical infrastructures (in particular container terminals and related facilities), and to expand their port hinterland through building various logistics centres (i.e. free trade zones and free economic zones) with a hope of being hub ports in the region. Moving closely to Northeast Asia region (which composed to Japan, Republic of Korea[1] and China), container ports have been dramatic change in recent years due to the globalisation of the world economy and the rise of China as the world's core manufacturing centre.

After economic recession in both Japan and Korea in mid 1990s to late 1990s, China has taken over economic power, and has consequently accelerated enormous investment and development in maritime transport infrastructure. At the end of 2008, seven container ports of China have been ranked among world's top twenty container ports whilst Korea had one port (i.e. Busan) and no port for Japan. However, questions have drawn from recent development in maritime industry (shift from Japan to Korean, and then to China) as to how these phenomena could be explained, whether these movements will be continuous, and why both Korea and Japan to retain competitive market position against China. First two questions could be demonstrated by Japanese economic development theory called the Flying Geese Paradigm (often called as the Flying Geese Model or Catching-Up Model).

The theory originally coined by Akamatsu (1930, 1961 and 1962), intends to explain the catching-up process of countries' economic development and industrialisation process. In summary, the theory explains that Japan was the leader and flying ahead of the whole Asian economies during 1960s. Korea and Taiwan were flying behind Japan, and then members of the Association of South East Asian Nations (ASEAN) and finally China were followed. The theory could demonstrate historical development of container ports in Northeast Asia, and is a particularly useful tool since container ports and shipping play a vital role in nations' economic growth and international trade. The flying geese paradigm, however, has been criticised for its lack of ability in forecasting future. The theory may be limited in explaining how and why ports will take a market position in the region. This is a main reason needed for further investigation of other economics theories which might enable to analyse these questions.

[1] The Republic of Korea is commonly named as South Korea; hereafter it will be referred to as just 'Korea'.

The paper summarises two main aspects of literature review in hub concept from different industrial perspectives with particular reference to container hub ports, and feasibility of catching-up process model into the evolutionary pattern in the development of Northeast Asia's container port. This paper has four main objectives: to review concept of logistics in maritime transports sectors; to provide summary of existing literature of logistics hub concept with particular focus on container hub; to review the flying geese theory and its development; and to look at feasibility of catching-up model into evolutionary pattern of container hub port development in Northeast Asia. First, the context of the definition and components of logistics is addressed. Then, the existing literature on the hub concept and different perspectives from different industries are dealt with. The next section of the paper reviews recent economic and container ports development, and how container hub ports have been developed in the Northeast Asia. Finally, the paper looks at the origin and development of flying geese paradigm, its applicability into the container ports, and future direction of current research.

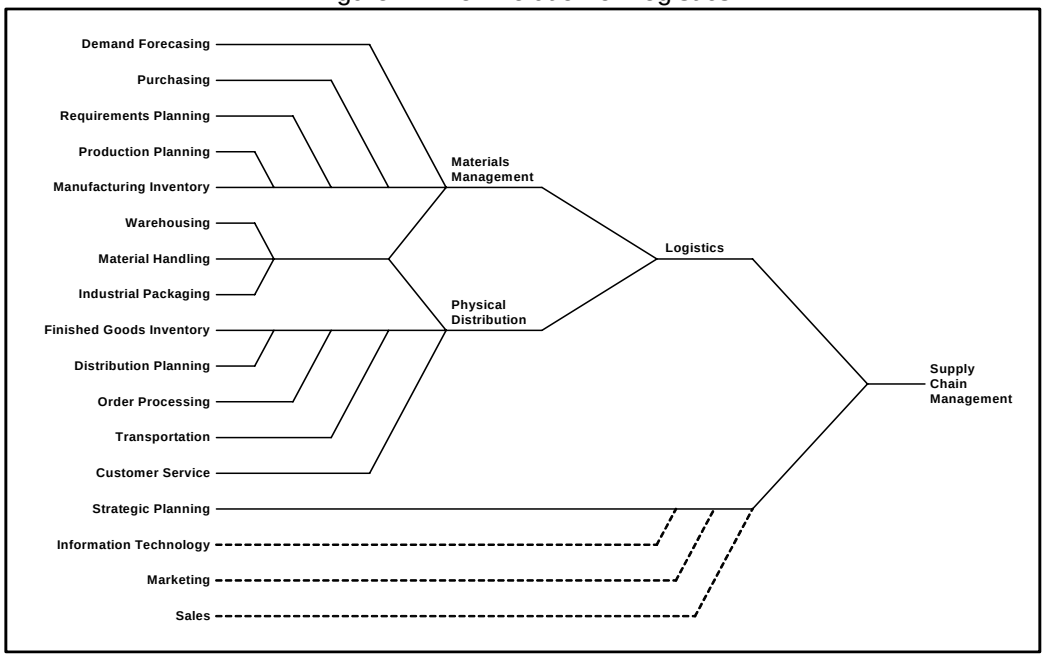
LOGISTICS HUB IN CONCEPT

Hub Concept in the Logistics Context

Since the logistics concept that has been introduced in the early of 1960s, the importance of the role of logistics, as the firm's main cost reduction centre and consequently gaining competitive market position, was a known truth for both practitioners in business and academia. Growing interest in logistics has been mainly due to the fact that it is one of the very few areas that could be utilized to build substantial economies (Baudin, 2004). The term of logistics is often used to mean different aspects such as: physical distribution, materials management, procurement and supply, and supply chain management. The term of logistics has been defined by various authors. Stone (1968) was the first author who defined what is logistics as "…art and science of determining requirement; acquiring them; distributing them and finally, maintaining them in an operational ready condition for their entire life" Grant, Lambert, Ellram and Stock (2006). David and Stewart (2008) viewed logistics as part of the supply chain process that plans, implements, and controls the effective forward and reverse flow and storage of goods, services, and related information…from the point of origin… to the point of consumption. Coyle, Bardi and Langley (1996), however, defined logistics using seven R functions that the Seven *R*s, which stand for "ensuring the availability of the *right* product, in the *righ*t quantity and the *right* condition, at the *right* place, at the *right* time, for the *right* customer, at the *right* cost. Rushton, Oxley and Croucher (2002) state that logistics can be characterised by both "material management and distribution", while Agapio, Clausen, Flanagan, Norman and Notman (1998) claim that "transport and distribution" are cornerstones of logistics and its most visible manifestations. However, widely accepted term of logistics is concerned with *physical* and *information* flows from raw material through to the final distribution of the finished product (Coyle *et al.*, 1996: Burgess, Singh and Koroglu, 2006). From the these logistics definition, Rushton *et al.* (2002) and David *et al.* (2008)

categorise logistics elements, as illustrated in Figure 1, including storage, warehousing and material handling; transport; inventory; information and control; and packaging and utilisation.

Figure 1: The Evolution of Logistics



Source: David and Stewart (2008, p. 21)

Coyle *et al.* (1996) and Rushton *et al.* (2003) provided three major stages of logistics developments. The first stage is 1960s to 1970s where logistics has been viewed as mere physical movement of goods. There has been recognition of relationship between the various functions within logistics, and companies recognised the change in the structure and control over their distribution chain. The large retail chains have developed their own distribution structures which are based on the concept of regional or local distribution depots to supply their store. Moving to late 1980s and 1990s, this stage linked to implementation of information technology concept (Mangan, Lalwani, and Butcher, 2009) and integration of individual logistics function that logistics was viewed as combination of materials management (i.e. the inbound logistics) with physical distribution (i.e. the outbound logistics). The third stage of logistics development was 2000 and beyond. Companies confronted a number of business challenges to maintain or improve market position against their competitors. There has been highlighted a positive value added role of logistics whereas the traditional view of logistics that the various functions within logistics were merely a cost burden that must be minimised regardless of any other implication.

Maritime logistics is often referred to as a process of planning, implementing and managing the movement of goods and information which is involved with ocean carriage. Maritime logistics, in particular, has highlighted the role of maritime transportation in global logistics (Panayides, 2006), and its strategically significant role in the logistics integration system (Lu, 2000). Maritime logistics consists of three key players of maritime transportation; those being shipping, port operation and freight forwarding. Although shipping mainly concerns moving goods from one port to another, it also provides related logistics services in order to support

the shipping and logistics flow, including pickup service, inbound/outbound bills of lading, intermodal services and container tracking. Port operations in modern logistics systems involve not only loading/off-loading cargoes into/from a vessel, but also various value adding services including warehousing, storage and packing and arranging inland transportation modes. Freight forwarding, or a third intermediate party, encapsulates the process of sea transportation in order to arrange the complex process of international trade such as booking vessels on behalf of the shipper, preparing documents for ocean carriage and arranging logistics services for the shipper. Over the last decade, the maritime industry has experienced environmental challenges mainly due to changes in trade patterns (i.e. increase seaborne trade), introduction of larger size vessels, regional competition between shipping lines and ports and intermodality.

Due to cost and capacity advantages, maritime transportation has always remained the primary choice in global trading. As of 2007, seaborne trade accounted for 89.6% of global trade in terms of volume and 70.1% in terms of value (Widodo 2008). The liner shipping industry is the major contributor to this statistic as it accounts for over 70% of total trade value shipped by sea (UNCTAD 2007). A significant volume of containers are delivered every day through its fast, frequent and reliable transport network to almost any destination worldwide. Figure 2 illustrates the distribution of merchandise exports throughout the world in 2007. The development of the liner shipping industry has been accelerated through the process of economic globalization. The total volume of international container trade reached 117.2 million TEUs in 2006, more than twice that of 1999. In order to cope with this increasing demand for container transportation, the total capacity of liner shipping services was increased from 4.7 million TEUs in 1999 to 10.8 million TEUs in 2006, an average annual growth rate of 8.7% (UN 2007).

Having been affected by the growth of containerisation traffic, shipping lines now compete to acquire vessel sizes as large as they can, in order to gain the advantages of economies of scale while also attracting the interest of powerful shippers with a large amount of products to be shipped (Fremont, 2007). This movement redefines the geographical structure of sea transport. Huge vessels now make it possible for only a few ports (e.g. hub ports) to accommodate them, leading to the division of container ports into hub and feeder ports. Under these conditions, an imbalance of power tipped in favour of the shipping lines and the added capability of dealing with huge amount of cargo has posed a new threat to both small-sized shipping lines and port terminal operators.

Most shippers traditionally arrange two or more forms of transport modes in order to ensure that their goods are efficiently delivered to their final destination. Maritime transportation is an inter-mediate mode which connects other modes of transport such as road, rail, air and sea. In order to offer a single transport package service and achieve quick door-to-door delivery, maritime operators are forced to amalgamate all possible transportation modes and to coordinate with other modes of transport (Marlow and Paixao, 2003). Song (2003) points out that ports should ensure that cargoes are smoothly and safely connected to road or rail modes to facilitate delivery to their final destination. Nowadays, it is crucial for maritime

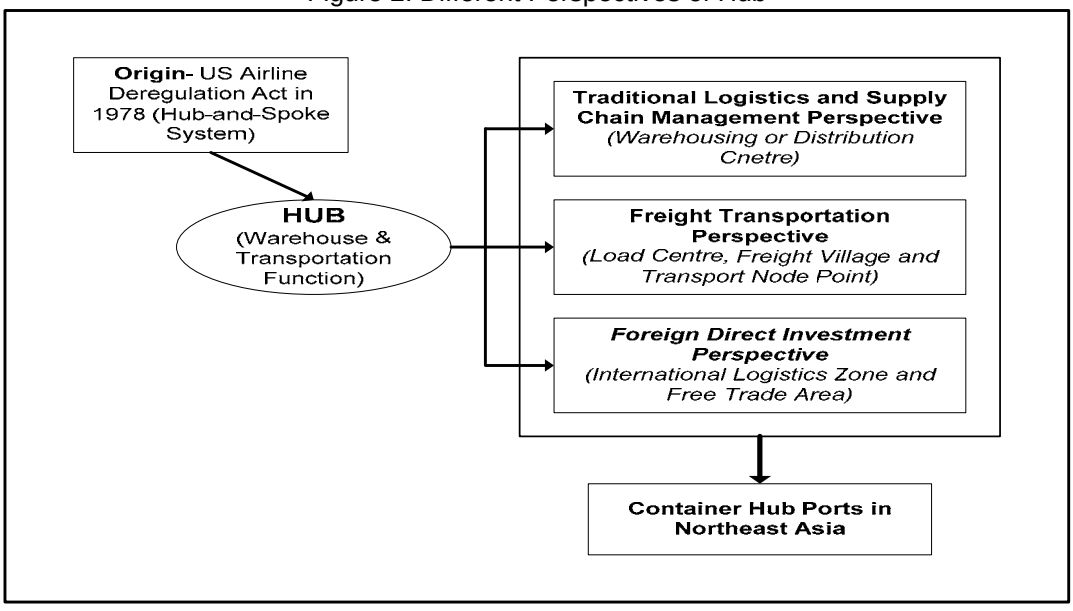
operators to combine the intricately connected intermodal systems in an efficient and reliable manner, since it may affect the performance of logistics integration

Hub Concept in Logistics and Supply Chain Management Context

Origin and Perspectives of Hub

There has been no clear definition found what a logistics hub is. The Oxford Concise Dictionary (2005) defines the term "hub" as central part of vehicle's wheel and exchangeable with 'centre'. Hub concept is commonly used in the passenger aviation market after the US airline Deregulation Act in 1978, since then this route structure has been adopted by the majority of airlines that operate in deregulated markets. Hubs are strategically located airports that are used as collection–distribution centres for passengers serviced generally by a single carrier (Martin and Roman, 2004). Since the Deregulation Act eliminated routing restrictions, networks based on hub-and-spoke architecture have proliferated in the US freight transportation industry. During 1990s, it became the primary distribution model employed by integrators (such as DHL, TNT, UPS, and Fed-Ex) and leading international carriers that shipments coming from several originating points were consolidated at major terminals (i.e. Hub) and redirected to their respective destinations through radial links (i.e. Spoke) (Lumsden, Dallari and Ruggeri 1999).

Figure 2: Different Perspectives of Hub



Source: Drawn by the authors

In the field of logistics and supply chain management (which covers maritime transport), the concept of container hub port has been referred by various terms in accordance with mainly its functionality of storage and transportation, such as logistics centre, freight terminal, logistics zone, distribution centre, and warehousing. Hub concept could be derived from

three different points of views, as shown in Figure 2, such as *traditional logistics and supply chain management view* (i.e. distribution centre or warehousing), *freight transport view* (i.e. load centre, freight village and transport node point), and *foreign direct investment view* (i.e. international logistics zone). Several authors have defined and highlighted the term of logistics centre (as a hub function) as classified in Table 1.

Table 1: Definitions of Logistics Centres

Definition	Authors	Emphasis on
Logistics Centre as *Freight village* or *Logistics node*	Breitzmann & Wenske (1999); Rushton, Croucher & Baker (2006); Europlatforms (2004); InLoc (2006)	• transport, logistics and goods distribution functionality • geographic coverage • facilities include warehouse and storage area • public service, full territory access • management and ownership issues
Freight Terminal as *Distribution centre*	Pefrum (1963); Holtgen (1996); Ballis & Golias (2002)	• Freight transport modes change • Handling operation • Value-added services
Distribution Centre as *Logistics centre*	Reynaud & Gouvenal (1987); Holtgen (1996); Kia, Shayan & Ghotb (2003); Lu & Yang (2006)	• Consignments grouped or spited • transport organisation centre • freight transport modes change • located as nodal points in the system
Distribution Centre as *Warehouse*	Cavinato (1989); Johnson & Wood (1996); Lu & Yang (2006); Zidonis (2002)	• Product flow in contrast to storage • Value-added services • Rapid delivery
Warehouse	Minalga (2001); Zidonis (2002); Urbonas (2004);	• Place for inventory • Storage • Connecting link between producer and customer

Source: Complied by the authors

Rimiene and Grundey (2007) have summarised definition of logistics centre from existing literature (Refer to Table 1) providing three stages of developments of logistics facilities: 1960s-1970s; 1980s-early 1990s; and mid 1990s-present. At the first stage, logistics facilities were viewed as simple warehouse function that was understood as a place for inventory, and had no direct impact on production (Waters 2003). At the second stage development, logistics facilities have engaged to provide additional outbound transportation function (Rimiene *et al.* 2007) and often called as transport terminal and freight village. The last stage, logistics facilities are developed as supplicated logistics node, which provides value-added service and a point where many route meet traffic (i.e. people, goods, and information) (Lee and Oum, 2003). From the maritime transportation perspective, load centre concept for containerisation port has been noted by several authors including Marti (1988) and Wang (1998). The container revolution has provided a technology that was able to

produce economies of scale in the general cargo segment of maritime transport, which have resulted from the employment of larger and more efficient vessels, a reduction of both time and cost of port operations, and the intermodal integration of ocean shipping with movements by other transport modes (Marti, 1998). Several international logistics hubs have been established at major Asian and European airports and seaports, which have resulted from both multinational firms' global business strategy, and host countries' investment to attract foreign firms. Lu, Liao and Yang (2008) provide a summary of recent trend of logistics zones (as a logistics hub in terms of functionality) which provides not only a place for firms to store or hold their raw materials, semi-finished goods, or finished goods for varying period of time, but also many value-added activities (including manufacturing, warehousing, consolidation, packing, labelling processing, and distribution). Lu (2003) highlighted the function of international distribution centre, which defined as a place which integrates the operations of manufacturing with land, sea, air transportation, storage, port and customs operations in order to achieve the efficient distribution of commodities (International Maritime Organisation 1991), as part of foreign investment. The term distribution centre is virtually synonymous with the warehouse, since most goods in a warehouse are in somebody's distribution system. In distribution channels, warehouses can also represent storage facilities between suppliers and the manufacturer and the manufacturer and industrial customers (Johnson and Wood 1996).

Based on above context, the operational definition of maritime logistics hub adopted in this research would be: "maritime logistics hub is *a nodal point of transhipment or cargo transit* (which assures flawless door-to-door movement of cargo), *central distribution centre* (that functions as temporary storage and place), and *a place creation for its value added*", and could be exchangeable for "container port".

Recent Development of Container Ports

Although the concept of hub was traditionally developed by the passenger airline industry (Martin and Roman 2004), which identifies hub and spoke airports in the international aviation market, there have been a number of studies concerned with building seaport based logistics hub and its integration to the global supply chain network (Mangan, Lalwani, and Fynes, 2008; Min and Guo, 2004; Lee, Song and Ducruel 2008). Botha *et al.* (2008) describe the role of seaports are recognised as main components in determining the competitiveness of a nation's economies, and there is a close relationship between development and expansion of seaport and economic growth. Therefore, in this research, the main context of maritime logistics hub is defined as "*seaport and hinterland*" in terms of spatial boundary where logistics activities are conducted.

Traditionally, ports have been defined as areas made up of infra and superstructures capable of receiving ships and other modes of transport, handling their cargo from ship to shore and vice-versa (Paixo and Marlow 2003). However, the definition has been expanded to encompass the provision of logistics services which create value-added (Paixo *et al* 2003), and ports constituting a critical link in the supply chain and their level of efficiency, and

performance influencing to a large extent, a country's competitiveness (Cullinane and Song 2002). Tongzon (2007) provides overall nine key determinants to be a successful port (and also a logistics hub) such as port operation efficiency level, cargo handling charges, reliability, port selection preferences of carriers and shippers, the depth of the navigation channel, adaptability to the changing market environment, landside accessibility, product differentiation, and government role (including government support, and law/regulation).

Nottemboom and Rodrigue (2005) and Lee, Song and Ducruet (2008) have shown the importance of port's hinterland as a new phase of development. Hinterlands are categorised into two types: main and competition margin (UNESCAP, 2005). The fundamental (main) hinterland is the space over which a port has almost the exclusivity for providing its services. The competition margins are the areas where other ports are in competition. The fundamental hinterland is being challenged by intense port competition with a port regionalization mainly composed competition margins and few fundamental hinterlands. Notteboom *et al*. (2005) explain four phases of port development (called as Bird's model) in terms of level of functional integration that setting, expansion, specialisation and regionalisation. The important role of hinterland could be found in the last phase that the hinterland reach of the port through a number of market strategies and policies linking it more closely to inland freight distribution centre. Lee *et al*. (2008) provide three regional patterns of hinterland concentrations by three geographical areas: North America, Western Europe and South & East Asia. According to their research, current Asian ports characterise that ports are concentrated in coastal region and there is relatively low hinterland coverage.

UNCTAD's Report (1995) provided three evolutional patterns of port development. Until 1960, ports played a simple role as the junction between sea and inland transportation systems. At that time, the main activities in the port region were cargo handling and cargo storage, leaving other activities extremely unrepresented. Such a way of thinking severely influenced related persons in the government and local administration. Also, it even influenced persons related with the port industry, so it was considered that it was enough to develop and invest in only port facilities, as the main functions of the port were cargo handling, storage and navigation assistance. It was for these reasons that important changes in transportation technology were neglected.

Moving to the next pattern (ports had build between 1960 and 1980), ports had a system comprising of government and port authority, so the port service providers could understand each other and cooperate for mutual interests. The activities in these ports were expanded ranging from packaging, labelling to physical distribution. A variety of enterprises have also been founded in ports and hinterlands. Compared to first-generation ports, the second generation ports have a characteristic that freight forwarders and cargo owners had a tighter relationship. We can say that the second-generation ports had begun to notice the needs of customers, but when it came to keeping a long-term relationship with customers, they took a passive attitude.

From 1980, container transportation has been developed quickly, and the new intermodal transport system emerged. The activities of production and transportation have linkage to

form an international network. The former services function has been enlarged to include logistics and distribution services. The environment protection facilities are becoming more important, so the ports are developing closer relationships with those in their surrounding neighbourhoods. Compared to the past, today's port authorities are focusing on efficiency rather than effectiveness. In the third-generation ports, the needs of customers were analyzed in detail and port marketing has been actively engaged. The late 1980s saw the emergence of major changes (Nottemboom and Rodrigue 2005). Customers began to ask ports to provide a greater variety of services. Providing value-added services is a powerful way for ports to build a sustainable competitive advantage. Shippers and port customers are becoming increasingly demanding. Customers now tend to look at value-added logistics services as an integral part of their supply chain. As a result, ports must attempt to satisfy these needs by offering differentiated services.

DEVELOPMENT OF CONTAINER PORTS IN NORTHEAST ASIA

Overview on Regional Economies and Maritime Industry

The Northeast Asia is composed of China, Japan and two (North and South) Koreas. During the past two decades, the countries in the Northeast have engaged in a greater degree of economic cooperation. The reform and opening up of the Chinese economy since the 1970s have accelerated an economic cooperation in the region, mainly among China, Japan and Korea. China's accession to WTO in 2001 provided a new momentum for regional economic integration by promoting intra-regional trade and accelerating economic cooperation. The Northeast region is an area occupying one-quarter of the world population, and boasts a total economic size of above US$ 13 trillion (International Monetary Fund 2008), and some of the fastest economic growth rates in the world.

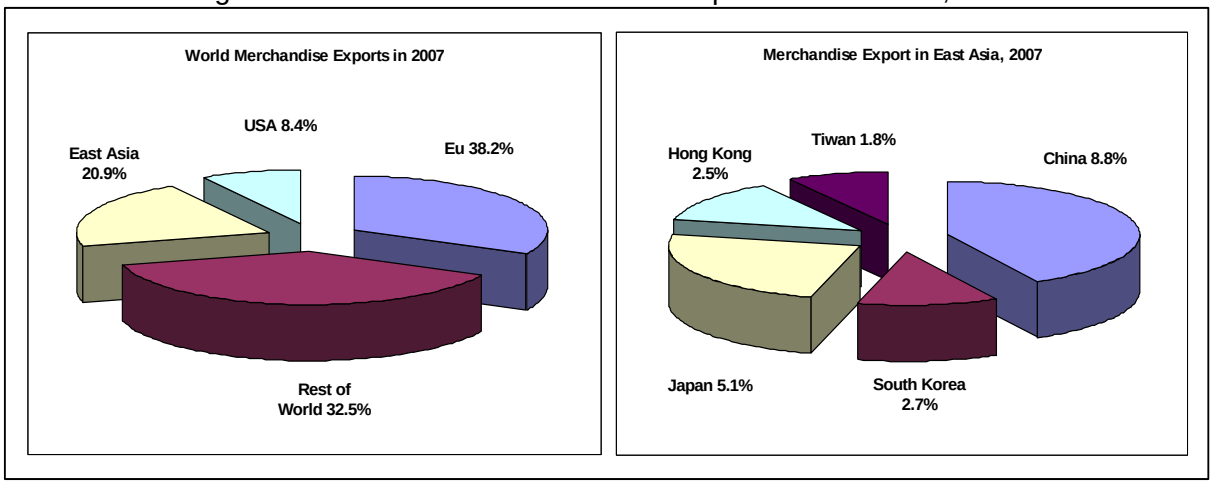
Table 2: Main Trade Partners in Northeast Asia

Country	Main Destination	Percent of Total	Main Origin	Percent of Total
China	USA	21.4	Japan	15.2
	EU	18.9	South Korea	11.6
	Hong Kong S.A.R	16.3	Taiwan	11.3
	Japan	11.0	EU	11.2
	South Korea	4.6	USA	8.9
Japan	USA	22.9	China	21.0
	EU	14.7	USA	12.7
	China	13.5	EU	11.4
	South Korea	7.8	Saudi Arabia	5.6
	Taiwan	7.3	UAE	4.9
South Korea	China	21.6	Japan	25.3
	EU	16.2	China	11.6
	USA	15.1	USA	11.0
	Japan	11.6	EU	9.6
	Hong Kong S.A.R	7.6	Saudi Arabia	7.3

Sources: International Monetary Fund, World Economic Outlook 2008 Database

Table 2 indicates the top five trade origin and destinations of three Northeast Asian countries in 2007. The USA and EU have been the traditional trading markets for three countries. Their market shares account for 31 to 40 percent for in terms of total exports and 20 to 24 percent for total imports. In addition, the significance of intra trade within the Far East region should not be ignored. It is also predicted that these three countries will have approximately 32 percent of the market share in global container movements, accounting for 1,360 million TEUs and reap into the centre of the world economy by year 2010 (Kwak 2004). Figure 3 shows the share of international trade in terms of worldwide and East Asian nations.

Figure 3: Distribution of Merchandise Exports in the World, 2007



Sources: UNCTAD (2007), Handbook of Statistics On-Line, www.stats.unctad.org/handbook

Along with rapid trade expansion, manufacturing dominant economies in Northeast Asia created tremendous demand for maritime transport. Because container transportation has been the most appropriate method for facilitating the efficient movement of manufactured goods to export and markets, there has been a surge in demand for inter/intra regional shipping capacity and strong container handling performance. Meanwhile, on the supply side, the environment of container transportation has largely changed. Port authorities and terminal operators have invested heavily in both infrastructure and other facilities to meet the demands that have been placed upon them. The liner shipping industry has adopted a range of strategies for enhancing its global service network, such as the deployment of ultra-large container ships and the promotion of global alliances of liner shipping companies. Undoubtedly, container transportation in the Far East region has entered a new era, which provided both challenges and competition.

Until the late 1990s when both Japan and Korea suffered their respective financial and economic crisis, maritime transport has played a key role in promoting trade between the nations. Based on its competitive labour cost and market size, China has been enjoying 8-11 percent of economic growth rates every year since the early 1990s (International Monetary Fund 2008). China's economic growth has accompanied with development of nation's maritime infrastructure and seaports (such as Shanghai and Shenzhen) and China's cargo

throughputs was approximately 3.5 times more than Busan port, the main seaport in Korea, in 2006 (Khalid 2008). Rapid growth of Asia's container seaports and their market position in the 2000s can be seen in Table 3.

Table 3: Container Throughputs in Japan, Korea and China since 1970

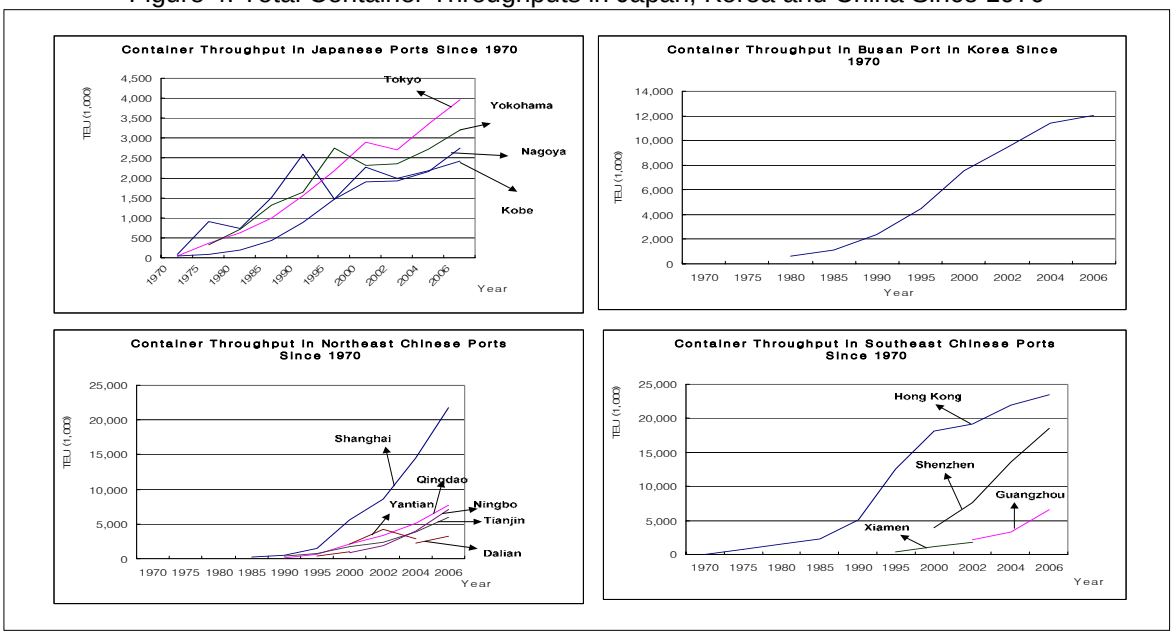
Region	Country	Port	1970		1975		1980		1985		1990		1995		2000		2002		2004		2006	
			Ranking	TEU	Ranking	TEU	Ranking	TEU	Ranking	TEU	Ranking	TEU	Ranking	TEU	Ranking	TEU	Ranking	TEU	Ranking	TEU	Ranking	TEU
Northeast Asia	Japan	Kobe	19	90	3	904	9	727	4	1,518	5	2,595	23	1,463	22	2,265	29	1,992	35	2,176	38	2,413
		Tokyo	25	54	11	358	17	631	12	1,004	13	1,555	12	2,177	15	2,899	20	2,712	22	3,358	23	3,969
		Nagoya	29	44	41	95	45	205	33	422	26	897	22	1,477	28	1,911	31	1,927	36	2,155	33	2,752
		Yokohama			13	328	11	722	6	1,327	11	1,647	7	2,756	21	2,317	26	2,364	27	2,717	28	3,200
	Korea	Busan					15	632	9	1,148	7	2,348	5	4,502	3	7,540	3	9,436	5	11,430	5	12,039
	North China	Shanghai							56	206	40	456	19	1,527	6	5,613	4	8,620	3	14,557	3	21,710
		Qingdao									99	135	54	600	25	2,120	16	3,410	14	5,139	11	7,702
		Tianjin									56	320	44	702	32	1,708	25	2,410	18	3,814	17	5,950
		Yantian													24	2,148	14	4,181	26	2,871		
		Ningbo													66	902	33	1,860	17	4,005	13	7,068
		Dalian											77	370	61	1,011			34	2,211	27	3,212
Sotheast Asia	South China	Hong Kong	31	35	4	802	3	1,464	3	2,288	2	5,100	1	12,549	1	18,100	1	19,144	1	21,984	2	23,539
		Guangzhou															28	2,180	23	3,308	16	6,600
		Shenzhen													11	3,993	6	7,613	4	13,615	4	18,469
		Xiamen											84	329	50	1,084	36	1,750			22	4,019

Note: Unit in 1,000 TEUs for the World Ranking.

Sources: Containerisation International, www.people.hofstra.edu and http://www.bts.gov.

In addition, total container throughput of major container ports in Northeast Asia since 1970s is illustrated in Figure 4. As noted in UNESCAP (2005), the region's economic opportunity is optimised if an appropriate transport and logistics system is carried out, including adequate port and shipping services in place to facilitate the efficient and effective flow of sea-based trade within the region as well as to and form overseas markets.

Figure 4: Total Container Throughputs in Japan, Korea and China Since 1970



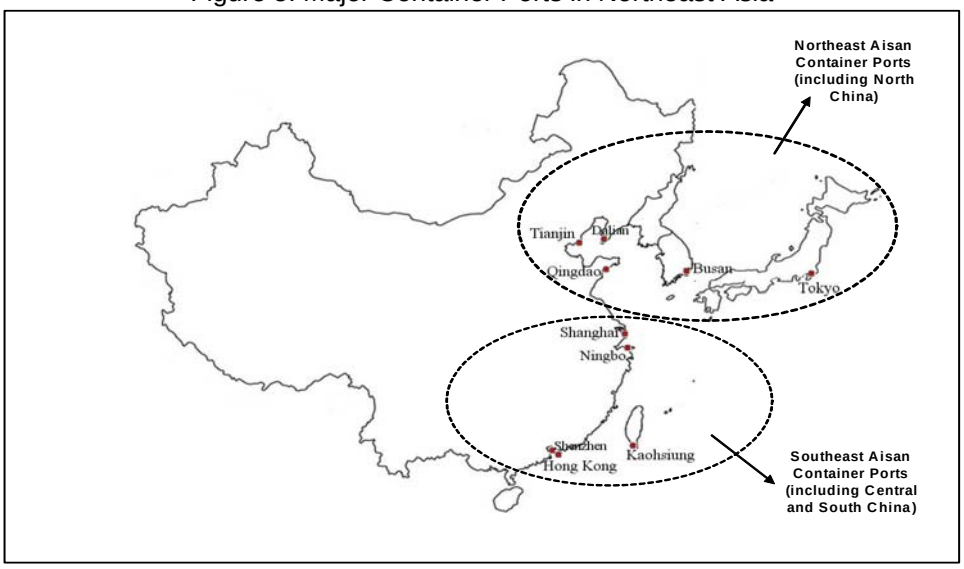
Sources: Containerisation International, www.people.hofstra.edu and http://www.bts.gov

However, there is an increasing concern that inadequate infrastructure and a lack of harmonised policies among the Northeast countries may cause serious bottlenecks in the transport and logistics system, and ultimately hinder the potential of trade and economic developments of the region. Multilateral maritime cooperation among the three countries seems essential to the establishment of a common shipping and port system. It will also help the maritime transport network evolve into other modes of transport throughout cross-boarder of different countries such as the projected Trans-Asian Railway by UNESCAP. It is well recognised that seaports are the focal point of global distribution and logistics systems and therefore a priority should be given to the balanced development of the ports in the Northeast. The demand for container ports, and competition and cooperation within the Northeast region will further increase in the future. This trend will heighten competitive pressures on these major ports in Northeast Asia.

Development of Container Ports in Northeast Asia

Looking back the past 10 years, the development of Northeast countries' port can be summarised as tremendous investment on ports in China, while Korea and Japan have entered economic recession since the late 20th century. Two main container ports in mainland China (such as Shanghai and Shenzhen) ranked world third and fourth highest cargo throughputs which accounted for approximately 40 million TEUs in 2006 (The figure is 3.5 times more than Busan port in Korea) (Containerisation International Yearbook 2007). Even massive port construction both in China and Korea have often been unable to keep pace with the dramatic increase in their maritime traffic. Faced with these problems, countries in Northeast have implemented new approaches to port developments and management, which were typically funded and managed by government. These new ways include deregulation, improvement of FDI and private sector involvement in ports (UNESCAP 2006).

Figure 5: Major Container Ports in Northeast Asia



Source: Drawn by the authors

Figure 5 illustrates major container ports in East Asian region. These new ways include deregulation, improvement of FDI and private sector involvement in ports (UNESCAP, 2006). Chang (2007) and UNESCAP (2006) provide Northeast countries' current problems of container ports:

1. *China* (classified as rapidly developing shipping and port industry) - Port operations in China face shortage of skilled labour, inadequate water depths, constraints in access to the hinterland and congestion in the port storage areas. Unnecessary delays are often occurred by inefficient and slow customs
2. *Japan* (classified as advanced shipping and port industry) – Japanese ports are normally considered expensive and port users are charged much higher than those in Asian neighbours. However, the biggest problem is Japanese container market is less attractive to shipping lines due to increasing container traffic from/to China and comparatively moderate traffic growth
3. *Korea* (classified as advanced shipping and port industry) – The main problem of container ports in Korea is shortage of port facilities, and port capacity lags behind demand in several ports largely because past investment in the port facilities were not enough to meet increase in trade and transport demand

Theory for the Evolution of Container Hub Ports

This research is particularly aimed at investigating factors which influence development of container hub ports, and will test research hypotheses (or research questions) using economic theories and econometrics model(s). As Woodldridge (2008) noted, economics theories and econometrics models are useful tool, which based upon the development of statistical methods for estimating economic relationships, and evaluating and implementing government and business policy. These methods are commonly used when we forecast the future trend, which are based on past historical data. A number of existing econometrics models has been reviewed to find out whether these are applicable to the research. Econometrics models are often used in the field of transportation logistics particularly airport network for passenger aviation, seaport competition, and consideration of MNCs' facility location. Three notable econometrics models which might relate to current research are summarised as:

1. *Traditional hub-and-spoke model*: Marianov *et al.* (1999) use hub-and-spoke model to find the best location of hub airport in a competitive aviation environment, and show the relationship between cost of fair, captured traffic flow and airport location. Their research addresses customer capture from competitor hubs is sought, which happens whenever the location of a new hub results in a reduction of the time or distance needed by the traffic generated by the traveller to go from origin to destination. Their model is useful when an airline wishes to relocate hubs when there are also several competitor hubs. The model used by Martine *et al*. (2004) could apply maritime transport when liner shipping chooses calling port at the neighbouring countries.

2. *Foreign Direct Investment (FDI) model*: Bhutta, Huq, Frazier and Mohamed (2003) provide FDI's investment model for distribution centres and production facilities using number of variables such as capacity requirement, capacity changing costs, inventory holding costs, shipping costs, exchange rate factor at the market place, and government policy (in terms of tariffs and custom duties). The model provides a cost effective way to study the impact of global factors on the operations of firm and provides to help with facilities configuration decisions.
3. *Time series data analysis method*: Time series data analysis method is useful for forecasting based on past historical data. Different stationary and trend stationary models of economic and financial time series often imply different predictions, therefore deciding which model to use is vital important for applied forecasters. Diebold and Kilian (2000) suggest three important choices for forecasters: always difference the data, never difference, or use a unit root pre-test. The time series data analysis model consists of three stages of data analysis: Stationarity Test (or Unit Root Test), Cointegration Test, and the Granger Causality Test (or Error Correction Model). Yap and Lam (2006) provide theoretical framework for competition dynamics between 10 major container ports (5 in China, 1 in Korea, and 3 in Japan) in East Asian region. Using time series data of container throughput in terms of TEUs, the study adopts 2 models: cointegration test (which are employed to determine the existence of long run relationship between various port pairs) and error correction models (which are constructed to determine short run inter-port dynamics). Although the study has been limited to a single variable, authors conclude that the study could be complemented with other information sources and perspectives which include information on container throughput handled by trade route, financial data, operational data and general economic impact.

Apart from above three econometrics models, the author is keen on Japanese economic development theory called Flying Geese Paradigm as this theory explains economic and industrial development in East Asian region, and maritime transport sector that are mainly influenced by nation's economic growth and industrial development. The term 'flying geese pattern of development' was originally created by Akamatsu's (1935) publication in Japanese, and later its English versions (1961) were presented three decades later. Flying geese model intends to explain the "*catching-up process*" of industrialisation of late-coming economies. Japan was flying at the head of the Asian economies, leading the formation of other flying geese. Korea and Taiwan were flying closely behind Japan, followed by the member countries of the Association of South East Asian Nations (ASEAN), again followed by China in some distance. The original Akamatsu's model has been developed by Kojima and Ozawa, students of Akamatsu, and flying geese model is well established to explain economic and industrial development, and trade pattern in East Asia. There is close relationship between economic and industrial development and maritime industry, as maritime industry (mainly development of shipping, seaports and containerisation) plays a key role during the nations' growth. Therefore, the model can be adapted to prove how and why Northeast Asia's maritime container ports has been developed.

CATCHING-UP THEORY: FLYING GEESE PARIDGM

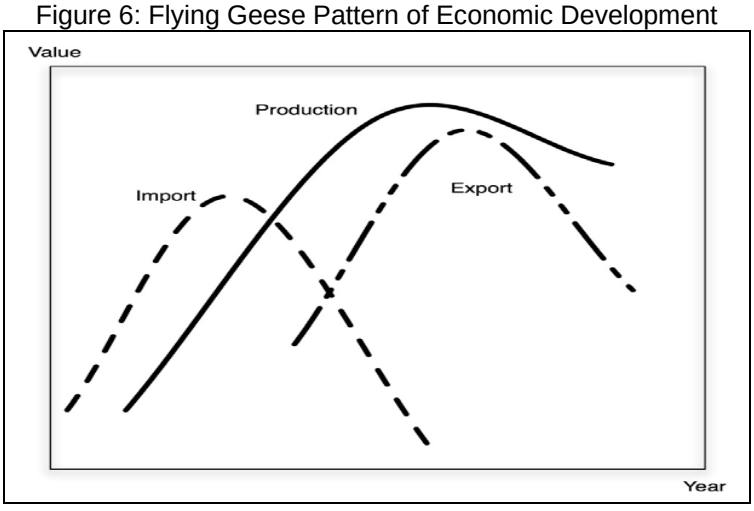
The Origin of Flying Geese Model (FGM)

> "Wild geese fly in orderly ranks forming an inverse V, just as airplanes fly in formation. This flying pattern of wild geese is metaphorically applied to the below-figured three time-series curves each denoting import, domestic production, and export of the manufactured goods in less advanced countries" (Akamatsu, 1962, p.11).

Akamatsu (1896-1974) used the lyrical name "*Ganko-Keitai*" (means Flying Geese) in his 1935 and 1937 articles (Japanese version). It was later translated as "Flying Geese Pattern" in his 1961 and 1962 papers. His theory explains a sequential development of the few modern industries in Japan before the Second World War. Kojima (2000) indicates the essence of the FGM may be summarised by directly citing key observations from Akamatsu's English articles, as "the wild-geese-flying pattern of industrial development denotes the development after the less-advanced country's economy enters into an international economic relationship with the advanced countries" (Akamatsu, 1962, p 11). This means that the FGM aims to address the catching-up process of industrialisation in developing open economies.

The origin of FGM is similar to that of the "Product Cycle Theory" developed by Vernon in 1966 (Kojima, 2000; Kwan, 2002). The key difference between the two theories is the prospective of country taken. Product cycle theory takes the prospective of the developed countries. It describes how a new product is invented and developed from its infant stage to exporting stage and finally to its declining stage. On the other hand, the FGM takes the prospective of a developing country. It describes how a new product is introduced to the less developed countries via imports, and how the less developed countries acquire the necessary production technique and become exporters.

Figure 6: Flying Geese Pattern of Economic Development



Source: Kwan (2002, p. 4)

Akamatsu's original model (called the fundamental wild-gees-flying pattern) is illustrated in Figure 6. Akamatsu (1962) explained the "fundamental pattern" of the Flying Geese Model in the following four stages:

Stage 1: Import of manufactured consumer goods begins.
Stage 2: Domestic industry begins production of previously imported manufactured consumer goods while importing capital goods to manufacture those consumer goods.
Stage 3: Domestic industry begins exporting manufactured consumer goods.
Stage 4: The consumer goods industry catches up with similar industries in developed countries. Export of the consumer goods begins to decline, and capital goods used in production of the consumer goods are exported.

Akamatsu's "fundamental" model is based on the case of Japan's industrial development, specifically industries involving cotton yarn and wool. He provides statistical evidence to support the Flying Geese pattern and completes a picture of import, production, and export in Japan's cotton yarn and wool industries from the 1860's to the 1930's (Dowling and Cheang, 2000).

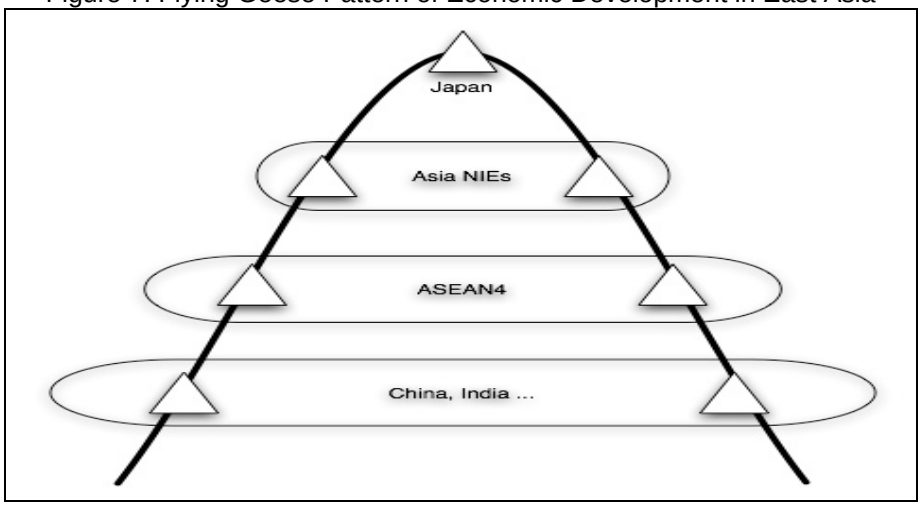
Model Developments

There were several attempts to develop Akamatus's original model including Kojima (2000), Rowthorn and Kozul-Wright (1998), Kasahara (2004) and Okita (1985). Kasahara (2004) states new paradigm of development of original FGM is incorporation of Flying Geese into regional development and integration with particular reference to the various overseas activities of "Transnational Corporations" (through sub-contracting, licensing arrangement, joint ventures, and FDI) in East Asia. As Kojima (2000) and Okita (1985) note Akamatsu's Flying Geese model shows the development of East Asian region, which can be divided into three groups of countries according to their relative state of economic development status. Japan is the lead country, followed by the NIEs as the newly rising countries, and lastly the four ASEAN as the follower countries. This regional hierarchy allows industrial development to trickle down from Japan first to the NIEs and then to the ASEAN, which is illustrated Figure 7.

Based on the original Flying Geese model, Okita (1985) explains the five stages of Japanese Transnational Corporations' process, which starts with the introduction of some new product via imports from the lead country, and ends when domestic production losses comparative advantage and relocates to other less developed countries. The main features in the various stages of the development are described as follows. (The modern Flying Geese Paradigm is illustrated in Figure 8). The first stage of development transforms a previously unconnected country by introducing different new products via imports from industrialised countries. Consumer demand gradually picks up and demand induces domestic production starts. However, the domestic imitations cannot compete with foreign imports because of inferior

quality and high production costs. Hence, imports remain high and a run on the country's foreign exchange may occur.

Figure 7: Flying Geese Pattern of Economic Development in East Asia



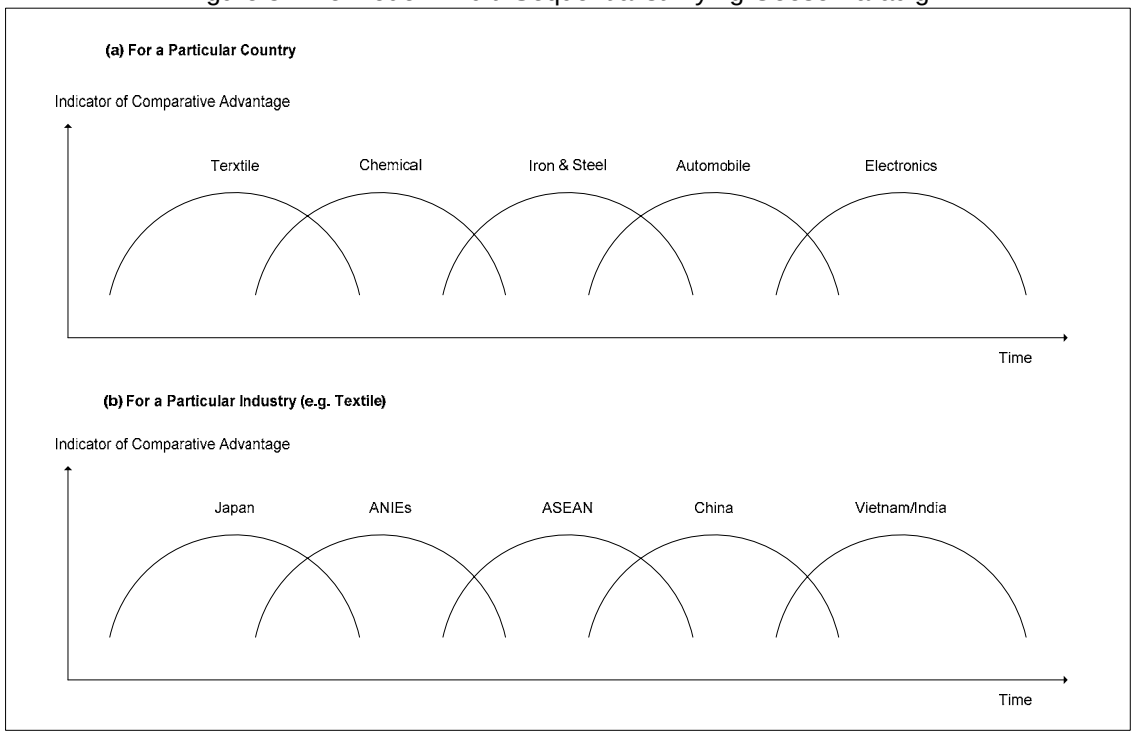
Source: Furuoka (2005, p. 27)

The next stage of development is often to substitute foreign imports with domestic products in the hope of correcting the current account deficits, which result from increasing domestic demand. In order for this to happen, it is necessary for the state to implement certain level of tariffs and other import restrictions to protect the domestic industry from foreign competition, as happened in the ASEAN in the 1970s. The advantageous position of having an established and often protected domestic market, coupled with the acquisition of standardized production technology, makes large-scale production possible. Hence, domestic products gradually replace foreign imports as product quality improves and price becomes competitive. Foreign investors will start investing, but in small amounts. This may be because the domestic market is relatively small because the income per capita is still low, or because of an undeveloped or inappropriate commercial and legal framework, inadequate transport and communication facilities, and the lack of an educated workforce (Dunning, 1981).

By the third stage, the growth of domestic demand has slowed down and exports of the product have begun. Production is kept at a high level through additional production for export. Imports diminish in absolute terms. The strong exports enable the country to import capital goods for continued expansion of production. Inward FDI becomes significant as the same industry in the advanced countries has lost its comparative advantage and has started to relocate to developing countries. In addition, as the economy develops, both the commercial and legal framework and transport and communication facilities will be better developed. The workforce will also be better educated. As the industry gets into its mature stage (stage four), production slows down in face of increasing costs and intensified competition from late-starting countries. Consequently, exports will increase less slowly if not decrease; and domestic demand is sluggish. FDI also falls as foreign investors are attracted to the late-starting countries. Finally, in stage five, when wages and other costs of production become so high that even the best-practice domestic firms lose comparative edge, the

industry will have to relocate in order to survive. Reverse importation of the product from either foreign affiliate will start.

Figure 8: The Modern Multi-Sequentialist Flying Geese Paradigm



Source: Kwan (1996, p. 162)

Application of FGM to Container Hub Port Development in Northeast Asia

Based on literature review, two research objectives have been put forward: firstly, *to examine the historical development of container hub ports in Northeast Asia*; and secondly, *to diagnose future implications for Japan, China and Korea individually as well as collectively*. It has been identified that flying geese paradigm would be a useful tool to understand the developmental pattern of maritime transport sector (i.e. shipping and ports) in the context of container hub ports since maritime transport plays a significant role in economic development and international trade. As discussed above, FGM is a useful tool that could be used to explain the catching-up process of countries' economic development and industrialisation, and can be applicable in several different industries. There have been few attempts of application of catching-up theory into maritime industry. Han and Song (2005) have found "westbound movement" of maritime industry in Northeast Asia (i.e. Japan to Korea, then to China) using both inter and intra regional port networks based on FGM, whilst Thanopoulou (2009) brought out the Product Life cycle to show the trend of different type of cargoes (i.e. break-bulk, pallet friendly and container friendly). Based on the economic catching-up model concept, the model is applicable for the following two areas:

- *Evolutionary pattern of container port development in Northeast Asia*- Since the original FGM intends to explain the catching-up process of countries' economic development and industrialisation in Asia, the model can be used to provide evolutionary pattern of container ports in Northeast Asia as containerisation and building container ports are closely relate to countries' economic development and growing international trade.
- *Competition and co-operation of container hub ports in Northeast Asia*- Based on historical data (including economic growth of countries in the region, international trade volume both intra and inter region, total TEUs handling in ports, etc.), major ports and popular routes in the region can be identified. FGM can be useful in explaining the relationship between competition and co-operation among ports in the region, and changing economic growth and industrialisation process.

However, FG paradigm is a rather deterministic model in which every set of variable state is uniquely determined by parameters in the model and by set of previous states of these variables (Krugman, 1998). Therefore, deterministic models tend to perform the same way for a given set of initial conditions. Current research is the first attempt which applies flying geese paradigm into maritime transport sector, and will provide evolutionary development pattern of container hub ports from the past to date. The main barrier of current research is its limitation to anticipate future direction as flying geese paradigm is a main theoretical framework. The research, therefore, would be more valuable if further stochastic models (from economic geography theories and industrial location theories) are brought out to provide past/current competition and cooperation between hub ports in Northeast Asia region, and forecast future direction. Therefore, the research enables to suggest how container hub ports can take an advantage against competitors. For example, Yap and Lam (2006) provide empirical results of competitive dynamics between container ports in East Asia using co-integration test and error correction model. In addition, Min and Guo's (2004) paper is another example, which provide the location of hub-seaports in the global supply chain network using a static equilibrium model.

CONCLUDING REMARK

As a part of an ongoing research, this paper attempts to define the concept of hub inspired by the existing literature. In the field of logistics and supply chain management, a variety of terms; logistics centre, distribution centre, warehousing, freight village, transport node point, international distribution centre, are used interchangeably to mean the term 'hub'. All these terms highlight the imperative role of value-added logistics service and hinterland function as a competitiveness source. Furthermore, the catching-up process models (mainly FGM) have been examined for the possible application to the evolution of container hub ports in Northeast Asia. There have been a few attempts made to apply the catching-up process model into maritime industry. As the original FGM was initially intended to analysis the evolutionary pattern of international trade and foreign direct investment in Asia, the model is certainly an applicable framework by which the historical developments of container hub

ports being taken place in Northeast Asia or even broadly the whole Asian region can be explained. Having examined what happened in the past with such an analytical framework would provide stakeholders in the shipping and port industry a useful insight into a future policy and strategic movement. It is, however, acknowledged that this line of research is in the early stage and further fine tuning efforts are still necessary to make a meaningful research contribution to the literature in maritime transport and logistics.

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