Port-city relationships in Europe and Asia

César Ducruet

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Ducruet César[1]
Korea Research Institute for Human Settlements (KRIHS)
Northeast Asian Regional Development Center
1591-6 Gwanyang-dong, Dongan-gu, Anyang-si, Gyeonggi-do 431-712 Republic of Korea

Abstract

This paper investigates the nature of port-city relationships in two major port regions of the world, Europe and Asia. Although this issue is well analyzed through either isolated case studies or general models, it proposes a complementary approach based on urban and port indicators available for 121 port cities. In terms of demographic size and container traffic, it shows the decline of port-urban dependence, stemming from changes in global transportation and urban development. However, European and Asian port cities are not identically confronted to the same challenges, notably in terms of their hinterlands. A factor analysis highlights a regional differentiation of port-city relationships according to their insertion in both urban and port systems, with a core-periphery dualism in Europe and a port-city hierarchy in Asia. Thus, the distance to inland markets for European ports and the size of coastal markets for Asian ports are the main factors to explain the nature of port-city relationships in the two areas. It helps to evaluate which European and Asian port cities are comparable beyond their cargo volumes, by putting together micro (local environments) and macro (regional patterns) factors.

Keywords: Asia, Europe, Factor analysis, Port city

[1] Tel. +82 (0)31-380-0183 / Fax +82 (0)31-380-0482 / Email: dcducruet@aol.com

1. Introduction

Port cities are strategic nodes for major trading regions such as Europe and Asia, especially in a world where more than 90% of trade volumes occur by sea (Rodrigue, 2006). However, their roles are different for a number of reasons, such as the history of trade and urban settlements, the geographical layout, and the current level of regional integration. In Europe, the importance of inland cities is reflected in the "central place" paradigm, and port cities have often been disregarded by urban specialists (Bird, 1973). Most European urban comparisons verify the lower economic importance of port cities (Brunet, 1989; Rozenblat & Cicille, 2002; IRSIT, 2004). In Asia, since the colonial period and following the coastal industrialization in Japan, the Dragons and Tigers and China, port cities are vital propellers of development, to the expense of inland cities. They have become the new cores of their national economies (Gipouloux, 2001). Although the different roles have been studied from historical and geographical perspective in Europe (Hoyle and Pinder, 1992; Lawton and Lee, 2002) and Asia (Basu, 1985; Broeze, 1989, 1997; Lee, 2005) through several case studies, few scholars have attempted a direct comparison. According to some of them, Western models of port-city growth are not applicable to Asian countries (Arasaratnam, 1992), but for others, it is fruitful to analyze how port regions adapt differently to a same global phenomena, such as waterfront redevelopment (Hoyle, 2000a). However, the lack of comparable data has limited the quantitative analysis of port-city relationships (Wang & Olivier, 2003), hampering direct international comparisons (Ducruet, 2004). This paper is an attempt to overcome such limitations, arguing that using basic urban and port indicators is sufficient to verify general models. Based on previous works on Asian and European port cities (Ducruet, 2003; Ducruet & Jeong, 2005), it verifies the combinations of port and urban functions through a principal component analysis. This methodology is a means to highlight several key issues such as the importance of ports in local economies, the importance of hinterlands, and the degree of intermodality. It is believed that those issues are differently represented in the two areas.

A first section reviews the major differences between Europe and Asia in terms of hinterland expansion and port competition. Next, the second section proposes an overview of the port-urban dependence in the two areas, based on the evolution of container traffic and urban population from 1970 to 2005. The third section introduces the ten indicators, and proposes a geographical interpretation and typology of port cities from the results of the principal component analysis. Finally, implications are given about the lessons learned in terms of regional integration in the two regions.

1. European and Asian port-city systems

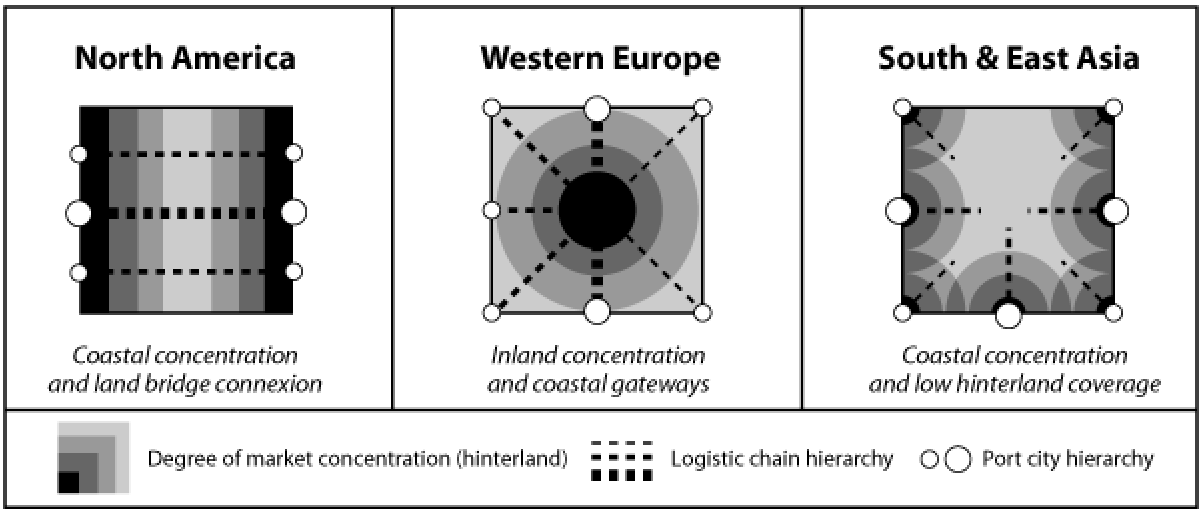
1.1 The role of the hinterland

In Europe, main markets and settlements are located in the "heartland" of the continent; then even major ports are in a peripheral situation to serve their customers. Port authorities in Europe are then engaged, since the spread of containerization, in a reflection on the most efficient way to connect a maximum of inland cities through intermodal services (e.g. river barging, sea-rail, road-rail and even air-sea). In this respect, most coastal cities are suffering from this peripheral location, that has direct effects on their economic structure (e.g. specialization in transport activities), as inland cities tend to retain higher-value activities such as banking, finance and other "metropolitan" functions. Thus, European researchers have been focusing on the way to develop alternative strategies to shipping, to diversify local economies notably since maritime-related business have suffered from employment decline (e.g. shipbuilding, stevedoring) and are no longer benefiting local economies (Benacchio et al., 2001). An acute debate still lingers on, between partisans of port-related urban development based on logistics, and partisans of taking advantage of coastal locations without depending on uneven port activity (e.g. cultural or commercial citizen-oriented strategy). Moreover, the increasing environmental concern tends to accentuate the port-city separation, as waterfront are redeveloped for other uses and modern port functions are locating away from inner cities.

In Asia, as settlement patterns are mostly coastal, port cities are the most important markets for ports. The colonial model in South and South East Asia has had the effect to combine urban and port hierarchies along trading regions, through the establishment of depots and entrepots in strategic locations such as Singapore and Hong Kong. In fact, most primate Asian cities are port cities, and still now keep a high share in the volume of goods transported to and from Europe and North America. The rapid development of North-East Asia gave birth to some of the world's most combined models of port-city relationships, such as free trade zones in Taiwan, Korea, China and the enormous reclamations in Japan in the 1970s and 1980s. As a consequence of physical geography (island states) and historical coastal concentration, inland transportation and markets are still underdeveloped. The lack of inland connections between South and East Asia, and between South Korea, Japan, Taiwan, Philippines and the continent, is preventing ports from connecting other countries' markets. Then in Asia, ports and cities have been developing and improving their functions in a symbiotic way. Intermodal transportations is also a secondary concern, except from some specific cases like air-sea in Hong Kong and Singapore, sea-river in Shanghai.

As showed in Fig.1, such spatial patterns give to transport and urban decision-makers very different stakes to overcome so as to realize their policy, as urban coastal economies are "residual" markets in Europe and "core" markets in Asia (Australia, Africa, South America). Another important difference is coming from the level of regional integration, as European ports compete for a single market whereas Asian ports are still focused on a national economy, but are also developing hub functions for regional competition.

Figure 1. Models of hinterland organization in the world's main port regions



Source: Lee, Song & Ducruet, 2006

1.2 Integration level and port competition

Within a single market, ports in the European Union are competing for more and more overlapping hinterlands. It is now famous that Le Havre port authority and dock workers blame Antwerpen (Belgium) players for "unfair competition', as Antwerp was catching Paris region market due to Le Havre's incapacity to enlarge its radiance through rail and barge regular services to the East. For example, the whole French production of bottled mineral water, that originates in the Alps, goes through Antwerp and not Marseilles, Le Havre or even Dunkirk, because Antwerp offers better services for storage and lower cost for export. Moreover, the port of Antwerp is now digging a canal towards Paris, that recalls the failure of French projects such as Rhine-Rhone rivers' connection and "Seine-East" canal project, due to environmental and cultural concerns. Thus, despite its fantastic strategic position at the entrance of the English Channel which leads to the North Sea, the world's busiest sea lane, Le Havre's hinterland is considerably diminished due to the lack of efficient national plans for maritime and intermodal strategy. As a consequence, northern ports such as Antwerp, Rotterdam and Hamburg are in leading position in all transport modes (rail, road, sea, river) and can pretend to cover the newly integrated EU members such as Poland and Hungary. As the gravity center of Europe is heading East, western ports such as Le Havre, which already suffer from severe institutional and technical constraints, might see their activity reducing in the near future, despite the planning of new port terminals.

In Asia, the absence of a single market doesn't prevent ports from competing with each other, mostly on "extra" freight such as transshipment[2] flows. In the recent 10 years, a number of ports have emerged to as to offer this type of service (hub) for an efficient distribution of freight to secondary ports. Singapore and Hong Kong, the world's busiest container ports, have been challenged in the throughput ranking by mostly hub ports such as Busan, Kaohsiung, Laem Chabang, Port Klang and Shanghai. In the case of Busan, South Korea, the hinterland function (Seoul region) has been progressively integrated with the hub function, notably after shipping lines moved there due to excessive handling costs in Japanese ports (Frémont & Ducruet, 2005). In fact, port competition is more dramatic for hub functions than for hinterlands. However, increasing integration of East Asian economies, that leads to increasing intra-regional waterborne trade, and the congestion level of the oldest nodes, that implies rising costs (e.g. handling charges), bring out new patterns of port development, like in the Pearl River Delta with the emergence of Shenzhen ports (Wang and Slack, 2000), and the complex network of port terminals arising from public and private operators' global strategies with a particular Asian trend (Slack and Wang, 2002). The risk for Asian ports is to rely heavily on the short-term transshipment opportunities offered by the concentration of shipping lines. The emergence of Tanjung Pelepas in Malaysia, rival of Singapore, of Shenzhen ports, more or less cooperating and competing with Hong Kong, and of Gwangyang, within the Korean "double-hub" strategy with Busan, is a sign that large cities are facing some limits to handle both national and interregional trade, because of their densely populated urban environment (Ness and Tanigawa, 1992). This accentuates the preference for non-marine related urban policies (Okuno, 2000).

[2] Transshipment refers to the handling of containers from one ship to another (e.g. mother vessel to feeder vessel) without using port terminals or inland generated products.

2. Population and traffic evolution in Europe and Asia

By using simple indicators of centrality and intermediacy (Fleming and Hayuth, 1994) such as population and container throughput, some general trends on port-city relationships are highlighted.

2.1 Port-city interdependence

The correlation between metropolitan population and container throughput provides a good indicator of port-city interdependence (Table 1). The interdependence is clearly decreasing for both samples, what gives some evidence on the lesser importance of urban economies for new logistic systems, described in a vast number of works.

Table 1: Correlation between urban population and container throughput by port region, 1980-2005

Region	2005	2000	1995	1990	1985	1980	1975	1970
Northwest Europe	0.408	0.574	0.594	0.594	0.563	0.540	0.519	0.378
Scandinavia Baltic	0.572	0.337	0.162	0.153	0.156	0.234	-	-
West Med. Iberian Peninsular	0.146	0.122	0.232	0.367	0.365	0.193	0.262	0.174
East Med. Black Sea	0.330	0.305	0.510	0.278	0.061	0.752	0.898	1.000
Northeast Asia	0.292	0.349	0.407	0.457	0.584	0.625	0.614	0.636
Southeast Asia	0.308	0.304	0.286	0.336	0.416	0.312	-	-
Indian Subcontinent	-0.149	0.020	0.303	0.461	0.437	-	-	-
Europe	0.179	0.174	0.190	0.162	0.179	0.215	0.222	0.127
Asia	0.264	0.300	0.347	0.429	0.565	0.592	0.634	0.664

Data sources: Moriconi-Ebrard, 1994; Brinkhoff, 2005; Helders, 2005; Lahmeyer, 2005; Containerisation International Yearbooks

In general, European port cities have a lower but stable port-city interdependence index, while Asian port cities had a strong interdependence but this has dramatically decreased. As observed by Kidwai in India (1989), this phenomenon is particularly keen in the Indian subcontinent, while values are more stable in Southeast Asia and more gradually declining in Northeast Asia. Inversely, port-city dependence has increased in Northwest Europe until 1995 and in Scandinavia after 1990, while it has been very irregular in southern Europe. This confirms the relative stability of the north European port system (Frémont and Soppé, 2005).

In fact, southern Europe can be compared to the Indian subcontinent in terms of port concentration, hub strategies, and urban-port separation. This also confirms the high complexity of shipping networks in the Mediterranean and Caribbean basins (Mc Calla et al., 2004). This first step helps to understand the relation between port reorganization and port-city evolution.

2.2 City size and throughput concentration

The evolution of container throughput distribution among different city sizes is another insight in the changing pattern of port-city relationships (Table 2). This phenomena is, of course, influenced by the nature of urban settlements and the pace of urban growth in the two areas.

Table 2: Distribution of container traffics by urban size in Europe and Asia, 1970-2005 (Unit: % TEUs)

Area	Population (000s)	2005	2000	1995	1990	1985	1980	1975	1970
Europe	0 < 200	28.09	30.47	28.21	26.21	25.56	18.89	19.69	22.98
	200 < 499	10.52	10.08	11.39	14.89	15.90	17.43	18.27	18.78
	500 < 999	6.95	16.01	15.31	13.39	12.68	18.95	16.96	21.86
	1,000 < 2,499	33.96	27.14	29.97	39.89	40.94	39.55	43.75	36.37
	2,500 < 4,999	20.09	15.95	14.31	5.10	4.91	5.18	1.32	0.00
	5,000 <	0.40	0.35	0.82	0.52	0.00	0.00	0.00	0.00
	Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Asia	0 < 200	4.78	2.59	2.12	0.91	1.47	0.64	0.00	1.27
	200 < 499	1.22	1.15	1.55	1.01	0.96	1.16	1.23	4.46
	500 < 999	2.60	0.78	1.99	1.02	1.16	0.65	6.00	0.00
	1,000 < 2,499	17.86	6.37	2.72	5.06	17.57	14.71	20.10	2.22
	2,500 < 4,999	19.92	27.75	40.34	36.19	17.95	37.18	24.14	12.88
	5,000 <	53.61	61.35	51.28	55.81	60.90	45.66	48.52	79.17
	Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Data sources: Moriconi-Ebrard, 1994; Brinkhoff, 2005; Helders, 2005; Lahmeyer, 2005; Containerisation International Yearbooks

The most striking difference between Europe and Asia comes from the level of traffic distribution in small cities. In Europe, traffics are equilibrated between small (0 to 199,000) and large cities (1 to 2.5 million) along the period. The share of intermediate cities (200,000 to 999,000) is gradually reducing from 40% to 17%, while the proportion of largest cities (2.5

and over) increases from 0% to 20%. Such trends indicate that in Europe, traffics are kept in large cities, because of important economies of scale and regional radiance, but tend to shift from intermediate cities to smaller cities due to technical inadequacy and lesser centrality.

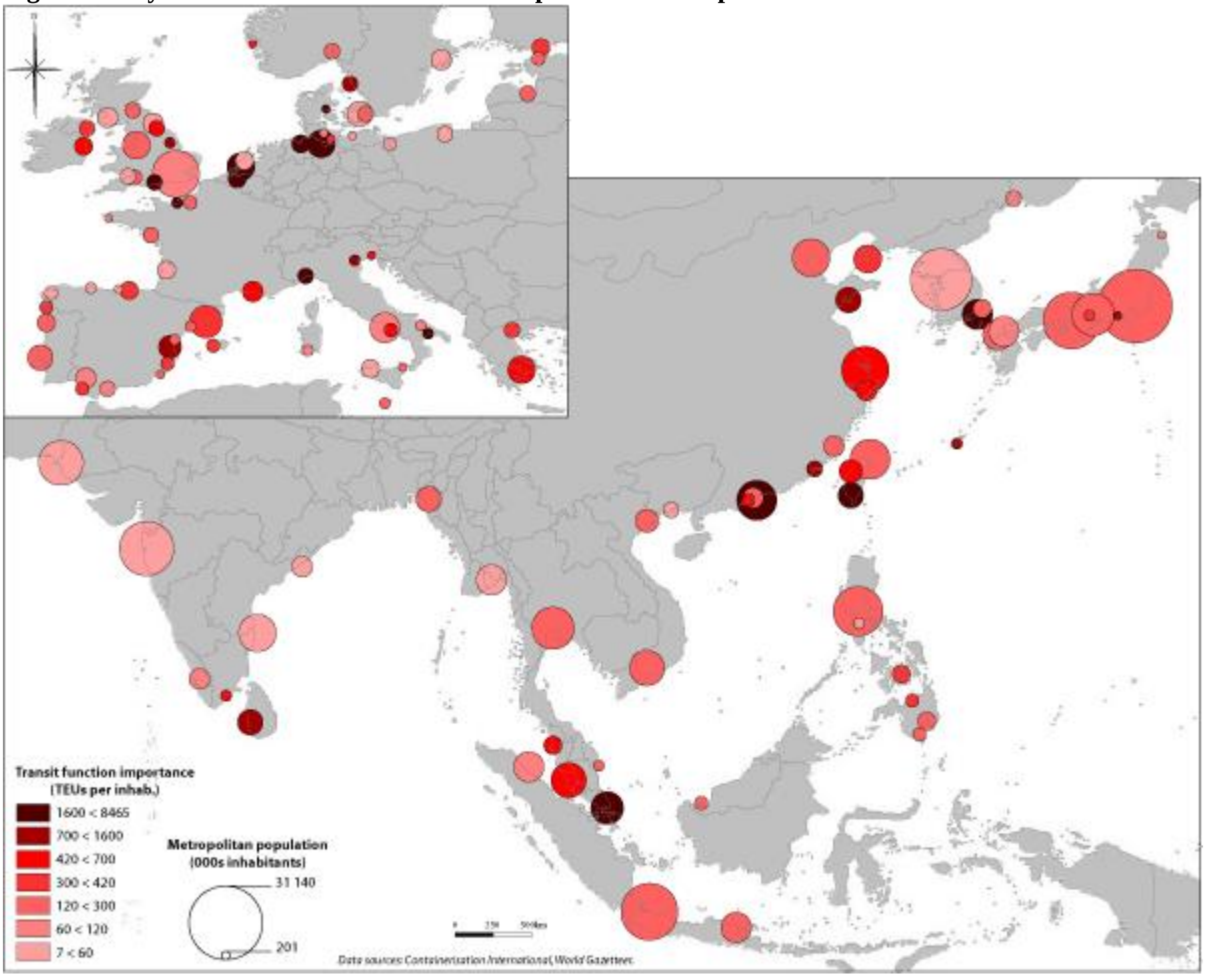
In Asia, most traffics concentrate in the largest cities, and the share of cities under 1 million has only increased from 5% to 8% from 1970 to 2005. Thus, although port reorganization is seen more strikingly in Asia, traffics tend to follow the urban hierarchy. This shows the importance of already established centers such as Tokyo, Shanghai, Hong Kong, Manila, Singapore, Jakarta, and Mumbai, which are dominant economic centers of their national economy.

This analysis partly verifies the hypothesis that the port activity in Asia is dependent on economic factors, of which the concentration of economic activities in major cities, while in Europe, the port activity is more influenced by geographical factors such as the distance to markets and hinterlands.

2.3 Maritime dependence and urban density

The distribution of the "maritime dependence index" proposed by Vigarié (1968) and developed by Kenyon (1974) for US cities is another means to testify the interplay of ports and port cities in Europe and Asia (Figure 2). Unsurprisingly, the level of "transit function" (TEUs per inhabitant) highlights the importance of the main European gateways (i.e., the northern range from Le Havre to Hamburg and the West Mediterranean arc from Valencia to Genoa) and the Asian hubs (i.e., from Colombo to Busan).

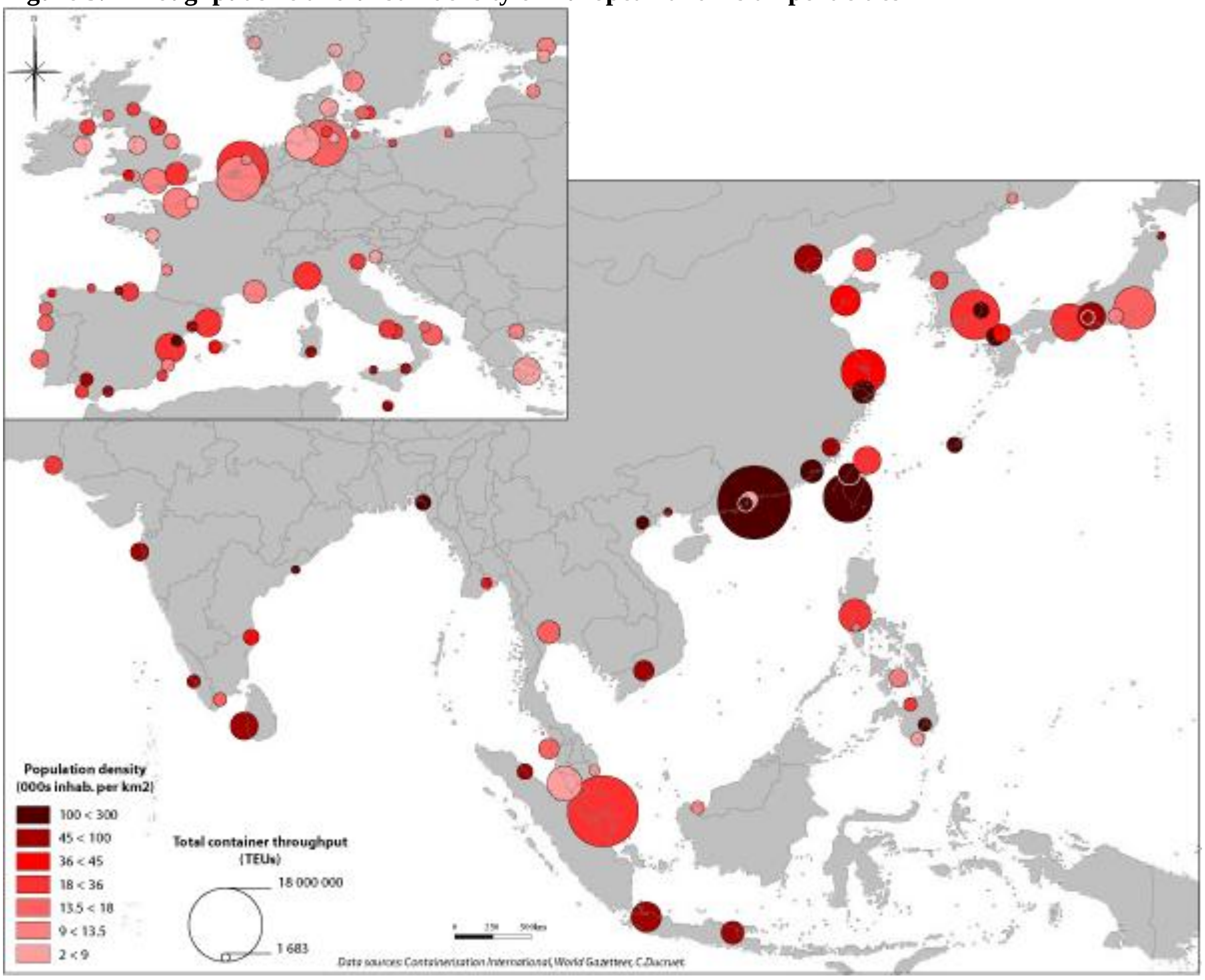
Figure 2. City size and transit function of European and Asian port cities.



According to the density (Figure 3), an interesting difference appears. In Europe, major container flows are not located in higher density nodes, showing the influence of a north-south pattern on port activities. Because Mediterranean port cities are historically more concentrated than northern port cities in terms of urban land use, the concentration of port activity is such cities has been limited. This also explains the urgent need for shipping lines to reorganize their networks through hub and spoke networks in the Mediterranean area, while in Northern Europe this could have been solved by the shift of port facilities to downstream deep-sea locations, as seen in the Anyport model of Bird (1963).

In Asia, the biggest cargo volumes are handled in high density nodes (e.g. Hong Kong, Kaohsiung). It highlights a specific trend of port concentration in developing countries (Hoyle, 2000b), which forces Asian ports to overcome the constraints of their urban environments by favouring higher productivity at the terminals. If in Europe, ports may "survive" from the disconnection with the local economy by expanding their hinterlands, this is not the case in Asia, where the coastal concentration of markets allows only a limited range of options in terms of port relocation. In Asia, ports are "forced" to follow the urban hierarchy, resulting in high congestion at the port-city interface, as seen in the Asian consolidation model of Lee (2005). Despite the trend of new port construction outside large port cities (e.g., Port Mohammad Bin Qasim from Karachi, Jawaharlal Nehru from Mumbai, Laem Chabang from Bangkok, Tanjung Pelepas from Singapore, Gwangyang and Busan New Port from Busan), inner ports in Asia keep a substantial amount of trade activity.

Figure 3. Throughput size and urban density of European and Asian port cities



3. A typology of European and Asian port cities

3.1 Data and sample selection

The sample of European and Asian port cities is based on two criteria: a minimum size of 200,000 inhabitants, that is used for usual international urban comparison (Brunet, 1989; Rozenblat & Cicille, 2002) and a regular containerised trade activity, resulting in a total of 121 places (Table 3). So as to enlarge the measure of port-city relationships, container traffics and urban population are complemented with other key indicators such as transport activities (container-related businesses and freight forwarders), port infrastructures and maritime networks (number of direct calls, total length and maximum depth of container terminals), and physical characteristics of the metropolitan area (urbanized area, number of highway and railway connections). In particular, some of them have been used for benchmarking European ports' infrastructures, but without looking at urban functions (Joly & Martell, 2003).

Table 3: Comparison of combined indicators of the two areas' samples*

	Europe	Asia
Urban population		
- total (no inhab.)	77,427,000	264,310,000
- % all cities > 200,000	40	26
- urbanized areas (km²)	6,029	9,444
Containerisation		
- total throughput (TEUs)	47,884,473	97,208,910
- direct calls (no)	3,054	6,363
- businesses (no)	2,977	3,549
- terminals' length (m)	121,568	127,087
Inland networks		
- highway connections (no)	216	102
- railway connections (no)	299	152
- freight forwarders (no)	681	499

* See Appendixes for original data.

1. *Population of the metropolitan area*: the number of inhabitants in the whole urbanised area expresses the scale of the immediate market served by the port;
2. *Surface of the metropolitan area*: the size of the perimeter covered by continuous urbanisation shows in which type of settlement does the port functions develop. This has been calculated manually (Ducruet, 2004) from online geographical atlas;
3. *Number of highways connecting the port city*: the total highway connections serving the port city gives an idea of the potential for port hinterland coverage from the terminals through road transport (trucks);
4. *Number of railways connecting the port city*: the total railway connections serving the port city is a good indicator of insertion within land systems and might reflect a potential of intermodality between sea and

land for containers, although this does not prove the real connection between port and rail tracks for the handling of goods;

5. *Length of container terminals*: the total amount of container terminal frontage is an indicator of modernity, as containers developed since the 1970s, for the handling of manufactured goods;
6. *Maximum depth of the container terminals*: given the increase in vessel size, the maximum depth for container terminals gives the nautical accessibility level of port infrastructures in a competitive context;
7. *Container throughput*: the total amount of TEUs (Twenty-Foot Equivalent Units) reflects the level of a port's activity and insertion within the transport chain. The difficulty comes from distinguishing real trade coming from the port's hinterland (sea-land) and redistribution from one ship to another (sea-sea), as this information is strategic and usually lacks;
8. *Total number of containerised direct calls*: the total amount of regular services calling at port (mother vessels) from shipping lines (service offered by shipowners) is an indicator of foreland wideness and stability for the port activity;
9. *Number of container-related services*: the total amount of such activities (shipowners, repair, distribution, inspection, clearance, warehousing…) give an idea of the level of transport functions around a port;
10. *Number of international forwarding agents*: the total amount of forwarding and logistics agents (e.g. DHL, Panalpina, Kuehne & Nagel, ABX, Damco…) show the degree of attractiveness of a place for its insertion within sea and land networks.

The interaction between those indicators is different in the two areas (Table 4). From the two separated correlation matrixes, the difference is calculated between Asia and Europe. Values higher than 0.1 and lower than -0.1 are interpreted as European or Asian specificities. In Asia, urban population has a higher correlation than Europe with other indicators. In Europe, transport connections, which are used as a surrogate for the importance of hinterlands, have a higher correlation than Asia with other indicators. Another European specificity is the higher correlation between freight forwarders and port infrastructures and maritime connections. Although it again confirms the role of cities in Asia and of hinterlands in Europe, an analysis of the distribution of those trends throughout the two areas is needed.

Table 4: Correlation difference between European and Asian data*

	Metropolitan population	Freight forwarders	Container related activities	Container throughput	Direct calls	Container terminals	Maximum depth	Urbanized area	Highway connections
Freight forwarders	-0.012								
Container related activities	**-0.154**	-0.097							
Container throughput	**-0.142**	-0.003	-0.029						
Direct calls	**-0.136**	*0.117*	0.004	-0.046					
Container terminals	**-0.318**	*0.128*	-0.045	-0.063	0.005				
Maximum depth	**-0.136**	*0.228*	0.064	**-0.148**	0.007	0.051			
Urbanized area	**-0.101**	0.080	-0.023	0.019	-0.086	**-0.283**	-0.067		
Highway connections	*0.294*	*0.428*	*0.274*	*0.161*	0.053	-0.090	**-0.242**	*0.342*	
Railway connections	*0.112*	*0.143*	0.002	-0.031	**-0.162**	**-0.156**	-0.099	*0.177*	**-0.142**

* bold = Asian preference (< -0.1); italic = European preference (> 0.1); other = similar correlation

3.2 Interpretation of principal components

The analysis is operated for the entire database of 121 cities, allowing to highlight how the common trends of port-city relationships are diversely distributed among the two areas. The 4 main principal components concentrate almost 85% of the original information, each one showing a specific trend (Table 5):

- a hierarchy of the port activity (direct calls, port throughput, container-related businesses, and container terminals): “logistic hierarchy”
- an opposition between transport connections (railways, highways) and port activity (throughput, calls, depth, terminals, companies): “hinterland / foreland”
- an opposition between urban functions (city size and logistic activities) and port infrastructures (depth and length of terminals): “urban magnitude / accessibility”
- an opposition between transport functions (logistic activities and transport connections) and urban functions (city size): “logistic specialization / port-city combination”

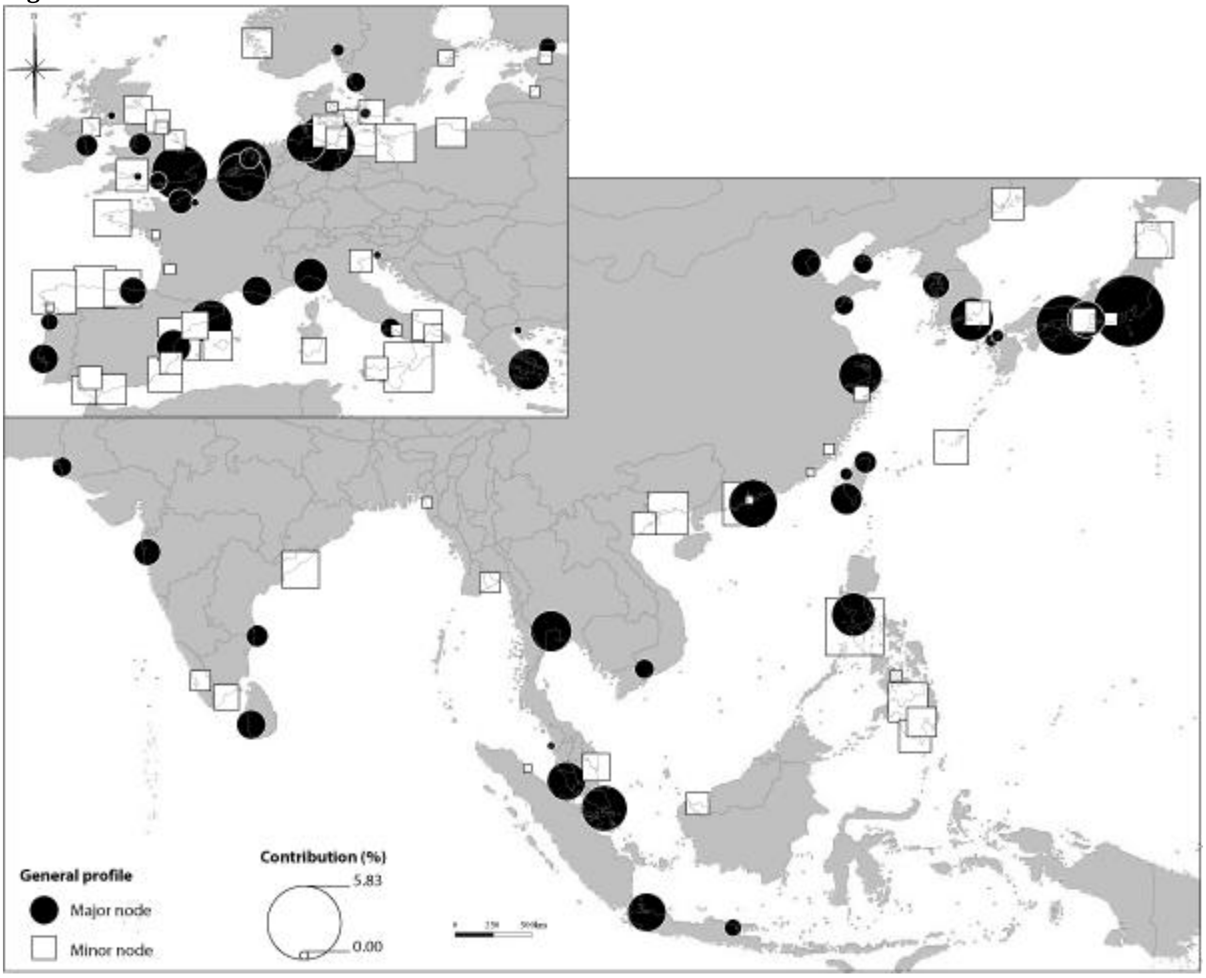
Table 5: Presentation of the factors

	F1 (54.70%)	**F2** (15.03%)	**F3** (9.51%)	**F4** (5.47%)
	Container hierarchy	***Inland connections***	***Sea-land accessibility***	***Logistic specialisation***
> 0	**Direct calls (13.65%)** Container throughput (13.59%) Container companies (13.20%) Terminals' length (12.42%) Freight forwarders (11.31%)	**Railways (42.54%)** Highways (38.80%) Urban area (2.65%)	**Maximal depth (41.90%)** Terminals' length (9.29%) Railways (3.33%) Highways (2.15%) Direct calls (1.44%)	**Forwarders (38.72%)** Container companies (20.39%) Railways (1.04%) Highways (0.06%)
< 0	-	Container companies (0.62%) Terminals' length (0.97%) Maximal depth (2.78%) Direct calls (5.45%) **Container throughput (5.57%)**	Container companies (3.93%) Forwarders (5.00%) Urban area (15.69%) **Population (16.94%)**	Maximal depth (0.45%) Direct calls (1.44%) Terminals' length (9.29%) Urban area (11.59%) **Population (22.12%)**
		Shipping connections	***City size and logistic activities***	***Port-city combination***

3.3 Geographical distribution of port-city relationships

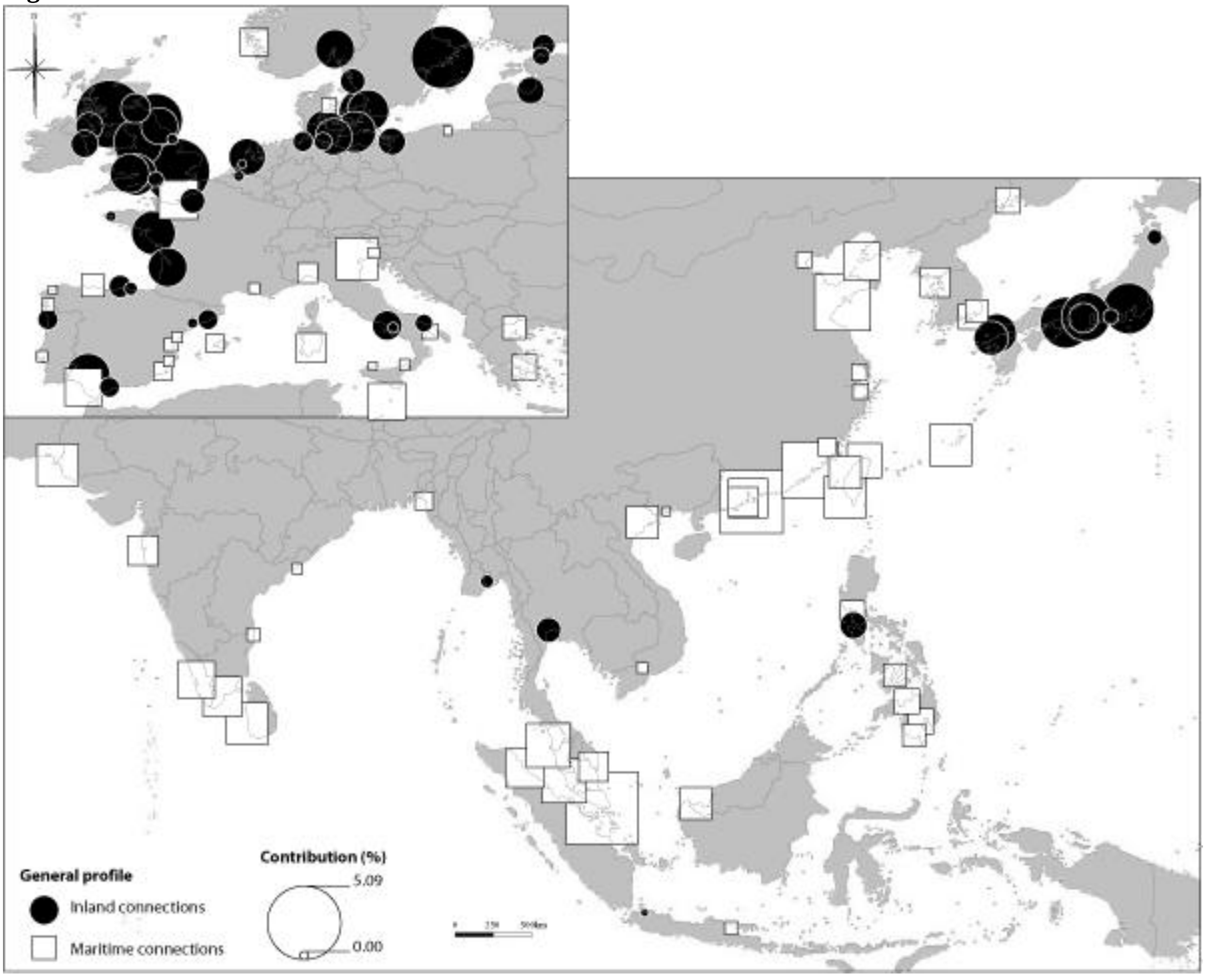
The first distribution (Figure 4) confirms the importance of the European "ring", located around the heartland (Le Havre-Hamburg and Valencia-Genoa), and followed by a few peripheral metropolises such as Lisbon, Leixoes (Porto), Bilbao, Naples and Piraeus (Athens) in the south; Dublin, Liverpool, Gothenburg and Helsinki in the north. In Asia, the major port cities also appear, from Tokyo-Yokohama to Karachi. We can notice that any Asian port city which is not on the major sea route is a minor node, like in the Philippines, with the concentration in Manila disfavouring other ports.

Figure 4. Distribution of F1 scores



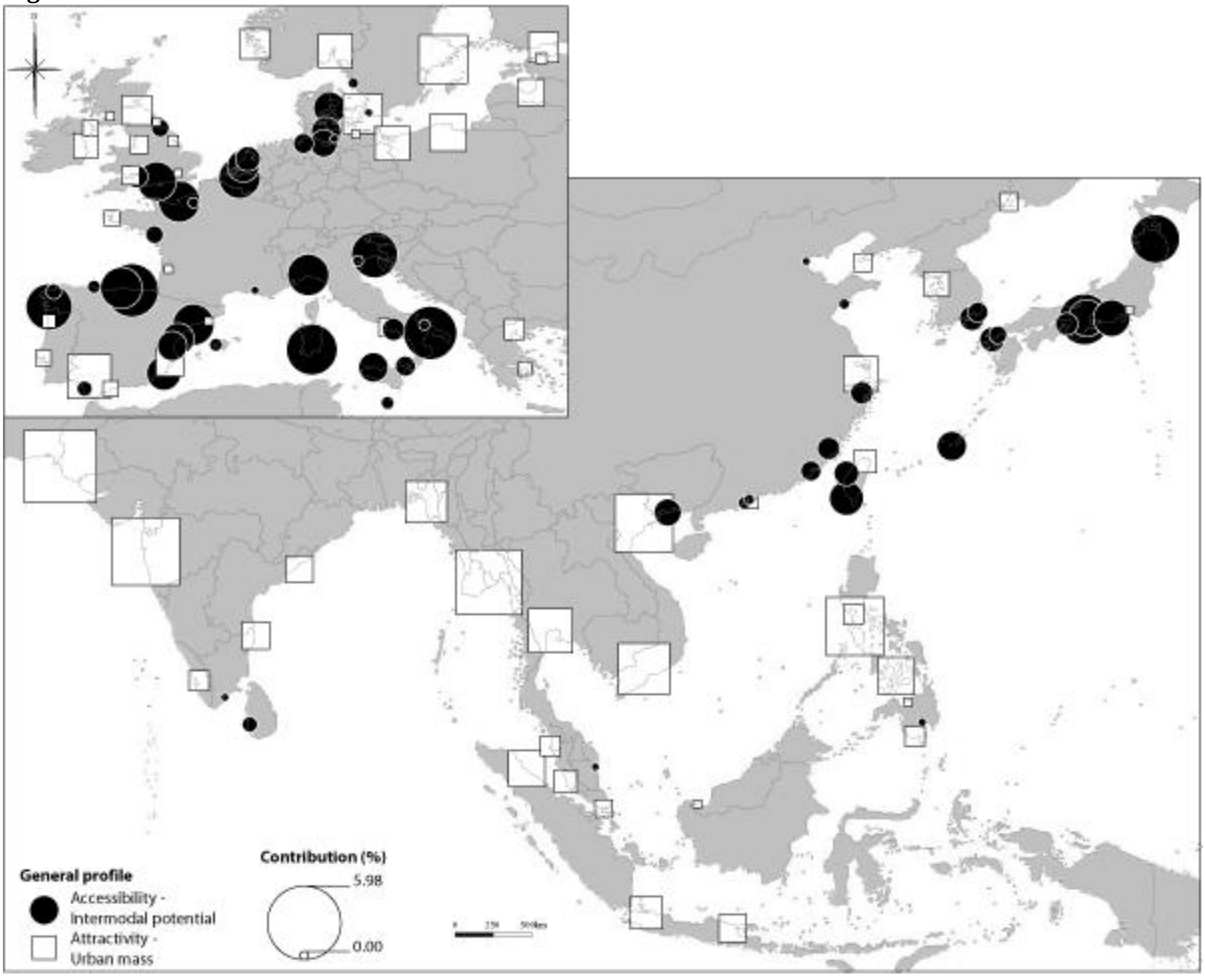
The second distribution (Figure 5) is much more contrasted than the previous one. There is a radical opposition between south and north Europe, and between Japan and the rest of Asia, apart few exceptions. Northern European port cities are fundamentally central places at the crossroads of land transport modes and at the head of large hinterlands (estuaries), while southern European port cities have limited inland radiance, due to physical (Alps, Pyrenees) and historical factors. Only Le Havre, Aarhus and Bergen show a "maritime" profile, as they have in common that their shipping activity surpasses the size of the local economy and the degree of hinterland penetration. Although some southern cities have a lower maritime activity (e.g., Sevilla, Santander, Bilbao, Naples, and Bari), the case of Barcelona is better explained by its strategic situation close to the French border, that strengthens its inland radiance. Thus, Barcelona has been defined as a "*northern city located in the south*" (Garcia, 1992), as its port function has "*a lower importance than for other port* *cities*" (Sagarra Y Trias, 1992). In Asia, few port cities have developed their hinterland connections.

Figure 5. Distribution of F2 scores



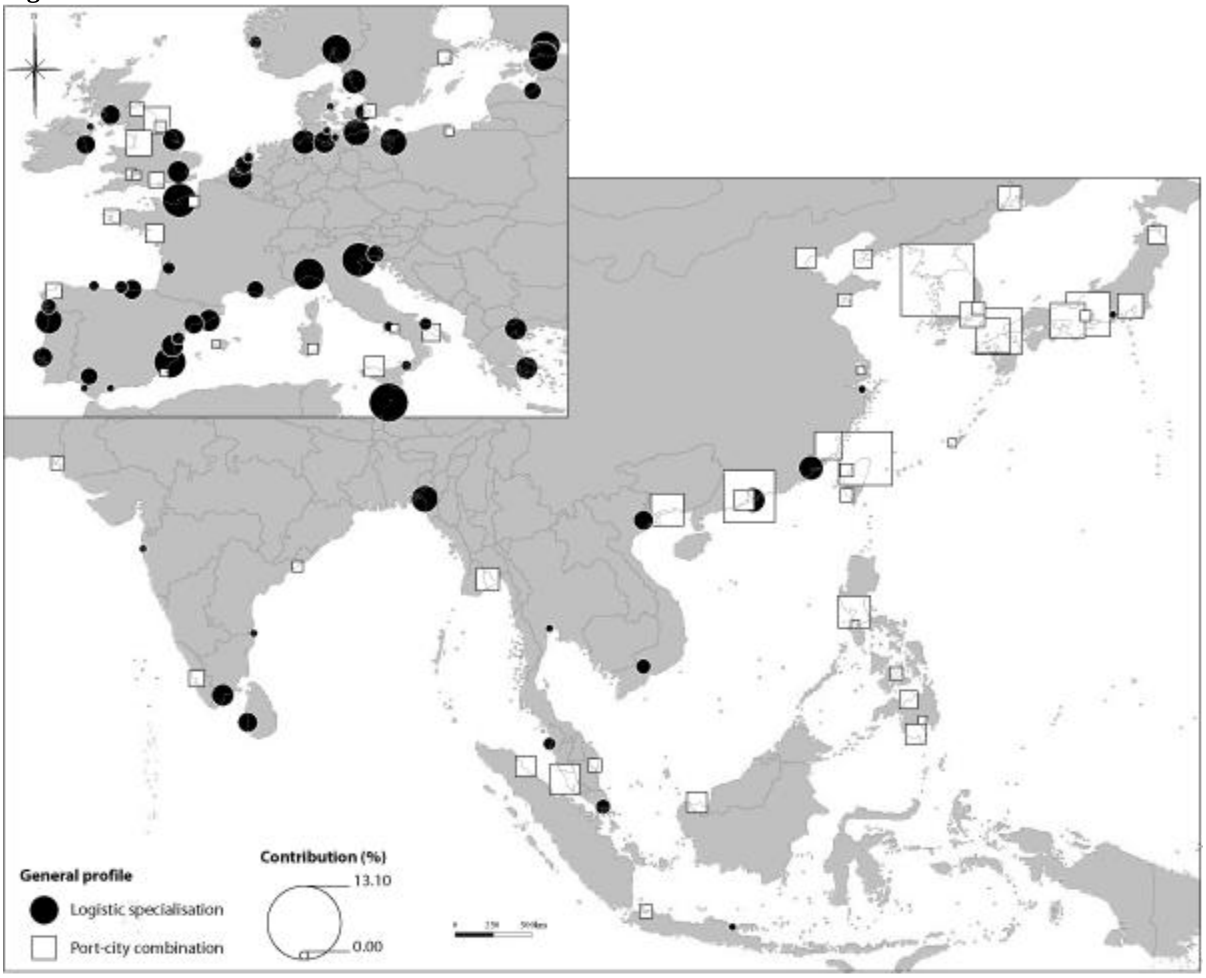
The third distribution (Figure 6) shows a clear sub-regional differentiation in both areas. The trend of sea-land accessibility is concentrated in Northeast Asia, while in Europe, it is mostly distributed around the heartland. Inversely, the trend of city size is confined in South and Southeast Asia, while in Europe it is mainly in the north with the British Isles and the Scandinavia / Baltic region. This reflects the fact that the accessibility of ports has been improved around the major markets. The city size is in fact more important where port modernization has been less efficient, and where urban policies have accompanied the shift of port functions from physical handling to broader services (e.g., Singapore, Mumbai, London, Stockholm, and Oslo).

Figure 6. Distribution of F3 scores



The fourth distribution (Figure 7) appears, this time, to oppose a majority of European and Asian nodes. In spite of its lower statistical significance, F4 has a meaningful geographical logic. European port cities are much more specialised in the logistic function (i.e. distribution, storage, transfer) because they are the gateways between core regions and the outside world (cf. Figure 1). For this reason, it is quite rare to find a logic of port-city combination in Europe, where port-related functions have, comparatively with other areas of the world, a stronger importance for the local economy. It has been argued elsewhere (Ducruet, 2005) that this specificity of European port cities has led to a number of contradicting opinions about the role of ports in enhancing local economic development, as it is a hard task in Europe but a natural process in many other areas. This also verifies the "lock-in effect" of urban systems (Fujita and Mori, 1996), based on the idea that port cities in centralised urban systems are “blocked” and remain specialised when they are dependent and well connected to core regions. It also shows that in Asia, the distribution of goods needs less logistic agents due to closer markets and a simpler transport chain. Thus, Asian port cities have a better port-urban combination than in Europe, where the transport chain is more complex and forces ports to compete inland through intermodal services and hinterland expansion.

Figure 7. Distribution of F4 scores

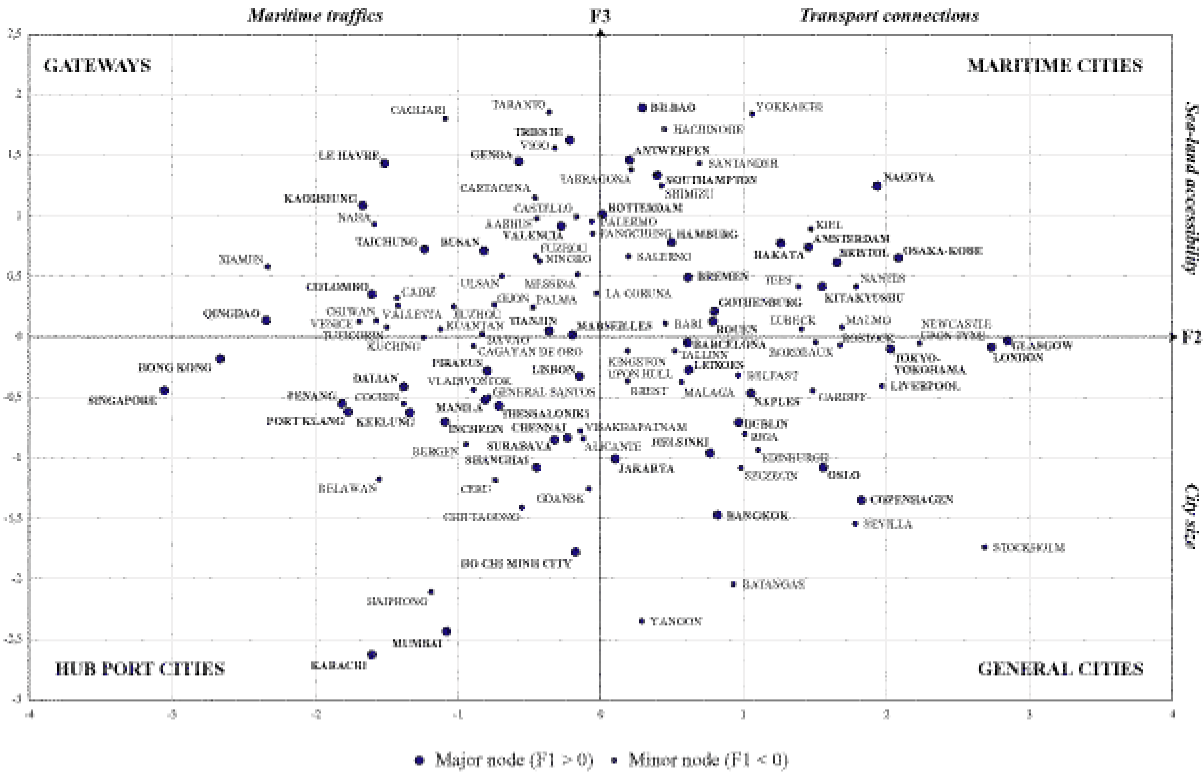


3.4 Are European and Asian port cities comparable?

So as to synthesize the results of the factor analysis, we propose a typology of the cities studied (Figure 8). This allows to verify which port cities are comparable and why. As F4 factor strongly opposed the two areas, we keep only F1, F2 and F3 to build the typology. According to those factors, four different types can be distinguished:

- General port cities: a reduced importance of port functions in the local economy, favouring central place functions but lowering port competitiveness. Major urban centres dominate this category, with financial poles (Tokyo, London), national and regional capitals (Bangkok, Helsinki, Copenhagen, Oslo, Dublin, Barcelona, Glasgow, Naples and Leixoes). It also shows the remotely located port cities of the Atlantic Arc and the Scandinavia Baltic areas;
- Hub port cities: port functions dominate the local economy, through efficient port concentration but limited hinterland penetration. The only European major nodes to be compared to Asian ones are located in southern Europe: Lisbon, Piraeus (Athens), Thessaloniki. Asian port cities dominate this category due to the limitation of their hinterlands;
- Hinterland port cities: port functions are important for a local economy specialized in industrial and logistic activities which serve large hinterlands. This is seen in Europe with port cities facing the lock-in effect of core regions (e.g., Le Havre, Marseilles with Paris; Genoa, Trieste with Milan, Turin; Valencia with Madrid). This is similar to the Asian cases of Busan, Kaohsiung, Taichung and Tianjin, which are also dependent on their close centralized markets (Seoul, Taipei, and Beijing);
- Maritime port cities: port functions are limited compared to other urban functions but port activity is kept despite the pressure from the urban environment. Those port cities are found mostly in Japan, where the risk of congestion has been overcome by gigantic reclamation projects, and in northern Europe thanks to the downstream shift of port functions along estuaries (Maas delta for Antwerp and Rotterdam, Severn river for Bristol, Solent river for Southampton, Seine river for Rouen, Weser river for Bremen and Elbe river for Hamburg). Without such geographical advantage and territorial strategies, these port cities would have become without any doubt “general cities”, gradually losing their port function due to congestion.

Figure 8: Typology of European and Asian port cities



4. Conclusion

This research has proposed an international comparison of port-city relationships in Europe and Asia. It has showed the decreasing interdependence of port and urban systems in the two areas, although major cities keep a major share of container traffics. The analysis of port-city relationships, although it uses very basic indicators of urban and port functions, helps revealing the importance of macro factors. In Europe, the distance to inland markets and the extension of hinterlands is a main factor to explain the relative importance of urban and port functions, while in Asia, there is more a combined port-city hierarchy due to the lack of hinterlands. While such trends are suggested in the literature, this paper could, at least, verify them by putting separately studied areas on a common ground. Of course, more efforts should be given to the improvement of statistical measures, notably of urban economic activities, so as to better consider the respective role of industrial and tertiary activities when dealing with ports. Despite such limitations, the study indicates the fundamental differences between European and Asian port cities. It provides a base upon which further research shall be done for the comparison of case studies. The main message is that port cities shall be compared based on objective profiles rather than only port throughputs, that are the usual – and sometimes the only – reference to justify a comparison. Although any typology is not an end in itself, it clearly shows that the main ports in Europe and Asia are not directly comparable. The volume of throughputs is generated in very contrasting environments, but those environments are often ignored by port specialists. Further comparison of port cities should consider the urban dimension and degree of hinterland expansion of ports before putting "global ports" in a same category.

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Appendix 1: Database on European port cities

PORT CITY	TEUTRA	DIRCAL	TERLEN	MAXDEP	POPMET	METARE	HIGHWA	RAILWA	FORBUS	CONBUS
AARHUS	500 000	15	1 500	14	226	79	1	4	1	48
ALICANTE	146 477	4	354	10	428	36	0	3	12	14
AMSTERDAM	44 511	28	5 360	14	1 188	107	5	7	13	26
ANTWERPEN	6 063 746	374	16 190	16	933	96	8	5	26	189
BARCELONA	1 882 878	136	4 370	14	4 973	141	5	7	79	81
BARI	35 000	6	990	10	303	20	1	5	3	5
BELFAST	229 000	11	747	9	585	30	3	4	1	26
BERGEN	110 359	8	310	10	213	59	1	1	1	33
BILBAO	468 960	43	2 118	21	1 120	52	3	7	15	43
BORDEAUX	46 385	10	690	12	971	88	3	7	9	9
BREMEN	3 469 104	54	4 040	15	1 001	221	5	6	26	105
BREST	19 917	1	400	11	213	87	2	1	1	6
BRISTOL	100 493	10	1 050	14	616	156	5	6	5	10
CADIZ	150 909	11	580	12	407	11	0	1	1	22
CAGLIARI	28 432	60	1 520	14	292	5	0	2	0	8
CARDIFF	41 461	3	250	9	720	17	3	4	1	6
CARTAGENA	27 523	3	1 280	13	201	10	0	2	0	6
CASTELLO	35 041	8	167	12	290	3	0	3	1	3
CATANIA	0	7	290	12	852	14	2	3	0	3
COPENHAGEN	135 000	10	375	10	2 366	150	5	6	5	77
DUBLIN	540 779	37	1 087	11	1 024	247	5	4	14	53
EDINBURGH	169 300	6	320	8	696	32	3	3	1	7
GDANSK	24 074	6	275	10	867	60	1	2	3	9
GENOA	1 628 594	143	9 993	15	692	24	3	4	20	126
GIJON	3 172	5	326	12	285	10	1	0	1	10
GLASGOW	34 200	5	376	13	1 379	86	9	10	7	23
GOTENBURGH	731 000	26	1 603	12	786	65	3	7	6	90
HAMBURG	7 003 479	318	9 553	17	3 278	231	9	6	42	296
HELSINKI	500 000	31	415	11	1 215	108	8	2	15	76
KIEL	27 454	4	1 070	10	235	9	4	4	0	5
KINGSTON UPON HULL	292 345	17	300	10	302	26	2	3	2	27
LA CORUNA	8 000	3	400	11	387	10	1	2	0	2
LE HAVRE	2 150 000	242	6 075	15	254	24	2	2	19	67
LEIXOES	331 741	51	900	12	1 218	77	4	4	27	27
LISBON	514 679	72	1 883	14	2 613	170	3	3	30	75
LIVERPOOL	578 000	21	707	13	3 562	473	5	10	2	38
LONDON	1 132 700	138	2 100	16	11 327	408	15	24	60	213
LUBECK	78 778	10	647	10	213	63	3	5	1	12
MALAGA	70 000	8	236	9	843	10	2	3	1	10
MALMO	135 000	2	1 050	9	598	21	5	4	1	8
MARSEILLES	916 000	60	2 750	14	1 573	174	3	3	20	68
MESSINA	61 449	0	165	11	237	4	1	2	0	2
NANTES	119 385	2	1 593	13	765	226	5	5	8	3
NAPLES	430 000	49	374	14	3 770	155	3	8	10	35
NEWCASTLE UPON TYNE	44 937	3	514	11	1 428	54	5	6	0	4
OSLO	177 019	11	563	10	808	175	5	5	9	92
PALERMO	20 000	11	700	15	987	20	2	2	1	11
PALMA	183 300	1	1 070	11	475	11	0	2	0	15
PIRAEUS	1 605 135	64	3 100	17	3 231	370	2	3	50	209
RIGA	150 000	10	450	10	843	84	2	6	4	37
ROSTOCK	1 683	2	143	9	205	8	2	5	0	11
ROTTERDAM	8 281 000	462	10 250	17	3 328	118	7	5	30	211
ROUEN	126 468	25	2 040	12	535	171	3	4	4	16
SALERNO	329 760	47	1 654	11	533	21	3	3	3	9
SANTANDER	10 007	1	839	13	229	5	2	3	1	6
SEVILLA	102 854	4	760	7	1 312	17	5	4	6	10
SOUTHAMPTON	1 441 012	83	1 350	15	764	61	3	6	1	42
STOCKHOLM	33 550	3	240	9	1 692	441	6	6	2	27
SZCZECIN	14 008	1	125	9	505	15	1	5	2	18
TALLINN	111 599	7	400	13	394	67	2	4	6	47
TARANTO	763 318	15	1 500	14	255	17	1	5	1	5
TARRAGONA	53 086	3	489	14	357	5	2	3	2	11
TEES	318 587	13	660	11	675	31	4	6	0	17
THESSALONIKI	336 096	31	600	12	829	68	3	1	18	25
TRIESTE	131 200	21	1 420	18	201	86	2	3	6	22
VALENCIA	2 145 236	120	4 039	16	1 740	67	2	7	28	63

VALLETTA	51 666	7	352	12	258	4	0	0	5	30
VENICE	283 667	21	510	12	259	9	0	1	8	19
VIGO	161 952	30	1 021	17	419	27	2	3	4	18

Appendix 2: Database on Asian port cities

PORT CITY	TEUTRA	DIRCAL	TERLEN	MAXDEP	POPMET	METARE	HIGHWA	RAILWA	FORBUS	CONBUS
BANGKOK	1 073 517	85	3 417	11	8 838	595	6	4	37	107
BATANGAS	2 566	1	342	5	247	20	0	2	0	2
BELAWAN (MEDAN)	273 704	46	850	11	3 800	70	0	1	4	24
BUSAN	7 540 387	547	11 040	15	4 298	156	5	2	9	52
CAGAYAN DE ORO	148 482	2	300	11	461	16	0	0	0	3
CEBU	404 116	21	1 141	9	1 223	98	0	2	4	21
CHENNAI	321 960	40	600	15	6 677	177	2	3	18	55
CHIBA	57 535	7	240	12	31 139	879	6	5	0	302
CHITTAGONG	324 147	19	450	9	2 592	16	0	3	14	33
CHIWAN (SHENZHEN)	400 000	75	1 270	15	1 500	0	0	0	0	6
COCHIN	133 178	20	680	11	1 408	20	0	0	1	32
COLOMBO	1 732 855	193	2 546	15	2 436	38	0	3	21	71
DALIAN	1 011 000	91	1 173	14	3 221	157	0	2	7	31
DAVAO	145 372	17	250	11	1 195	4	2	0	1	12
FANGCHENG	5 000	2	500	14	744	11	2	0	0	1
FUZHOU	400 200	18	1 050	14	1 546	32	2	2	1	15
GENERAL SANTOS	115 363	2	588	11	411	63	0	0	0	7
HACHINOHE	25 673	7	530	13	241	5	3	2	0	1
HAIPHONG	219 000	16	342	8	1 820	16	0	1	7	22
HAKATA (FUKUOKA)	510 721	85	840	13	4 200	29	5	7	1	9
HO CHI MINH CITY	733 236	80	486	10	5 894	108	2	3	24	44
HONG KONG	18 100 000	716	6 791	15	8 190	44	0	2	83	274
INCHEON (SEOUL)	611 261	43	9 585	14	21 738	28	2	1	2	14
JIUZHOU (ZHUHAI)	235 000	3	700	9	371	4	0	0	0	0
KAOHSIUNG	7 425 832	297	6 047	15	2 557	21	2	2	6	56
KARACHI	615 024	69	600	11	10 537	428	1	1	23	61
KAWASAKI	43 707	14	431	14	31 139	1 895	5	6	0	302
KEELUNG (TAIPEI)	1 954 573	178	3 192	12	8 030	2	1	2	0	24
KITAKYUSHU	412 043	38	1 895	12	4 193	98	5	7	0	6
KOBE	2 265 992	285	11 205	15	17 621	531	3	5	0	113
KUANTAN	62 783	12	620	12	289	38	0	0	1	12
KUCHING	110 474	14	1 248	11	423	41	0	0	1	13
MANILA	2 867 836	167	8 278	15	13 790	584	2	3	12	82
MUMBAI	429 448	31	1 388	11	16 368	240	2	1	31	145
NAGOYA	1 911 920	312	3 555	15	8 610	115	10	14	1	31
NAHA	303 337	17	540	11	302	2	1	0	0	4
NINGBO	902 000	2	900	14	1 399	11	2	2	3	16
OSAKA	1 474 201	234	3 765	14	17 621	531	13	18	6	113
PENANG	635 780	46	931	12	1 033	59	0	0	8	31
PORT KLANG	3 206 753	367	4 379	15	6 139	44	0	2	14	57
QINGDAO	2 120 000	162	1 000	16	2 536	67	0	1	7	34
SHANGHAI	5 613 000	322	2 281	13	12 039	286	2	5	27	111
SHIMIZU	361 700	40	1 160	12	236	19	4	3	0	18
SINGAPORE	17 040 000	612	5 919	15	4 591	153	1	1	42	278
TAICHUNG	1 130 357	55	2 437	14	2 131	18	0	3	4	22
TANJUNG PERAK	949 029	54	1 450	11	3 788	49	2	3	11	34
TANJUNG PRIOK	2 222 496	24	2 338	14	17 891	283	3	4	24	103
TIANJIN	1 708 423	54	2 450	15	6 809	135	2	4	10	35
TOKYO	2 899 452	234	4 321	15	31 139	1 895	12	20	18	302
TUTICORIN	136 612	30	283	12	252	16	0	1	2	28
ULSAN	236 296	53	240	12	1 155	5	1	3	1	8
VISAKHAPATNAM	20 427	4	168	10	1 381	12	0	2	1	11
VLADIVOSTOK	70 000	5	303	12	646	49	1	1	0	7
XIAMEN	1 084 700	112	972	13	738	6	0	1	8	30
YANGON	49 453	9	500	8	4 344	109	0	3	2	19
YOKKAICHI	103 500	30	550	13	291	6	4	5	0	3
YOKOHAMA	2 317 489	344	6 030	16	31 139	1 895	6	6	2	302