Port-city evolution in the long run (1880-2020): global and regional trends

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Abstract

Based on untapped data on vessel movements and urban population, this chapter investigates the changing relationship between ports and cities since the late 19th century. We refer to a number of models in maritime geography and history that converge about port-city spatial and functional disconnection. The principal results show that the average distance between ports and cities doubled over the period, from 4.9 km in 1880 to 10.1 km in 2020. While the correlation between vessel traffic and city size grew since 1880, it declined rapidly from 0.66 in 1946 to 0.33 in 2020. In turn, vessel traffic became more and more correlated with the size of city-regions, of which port and non-port. Such trends are differentiated across regions of the world, due to historical legacies and specific patterns of port hinterlands.

Keywords: globalization; hinterlands; port city; maritime transport; regionalization

Introduction

Port-city evolution is a direct outcome of the tension between global trade and local socio-economic development. In the academic literature, ports are seen either as vital or peripheral components of urban growth, giving the floor to acute debates. The central place theory for instance did not consider ports (Christaller, 1933; McKenzie, 1933; Alonso, 1964), because they disturb the regularity of urban systems by their overseas connections or "maritime forelands" (Pearson, 1998). The concept of gateway city was proposed to palliate this lack (Burghardt, 1971), supporting the idea that forelands confer to certain cities a higher status and bigger size than the central place theory would predict (see Bird, 1973, 1975, 1980). As such, numerous major cities of the world are port cities (Short, 1984; Dogan, 1988) or locate along the coast (Wackermann, 1998; Noin, 1999). Further debates concerned the reverse causality of port-city growth (Verlaque, 1979; Boyer and Vigarié, 1982; Vallega, 1983; Brunier, 1993), although the difficulty measuring the economic contribution of ports prevented definitive answers (Vleugels, 1969; Randall, 1988; Suykens, 1989; Gripaios and Gripaios, 1995).

In fact, port-city relationships vary extensively in time and space. The mercantile model of Vance (1970) offered a useful distinction between the colonial port city, with penetration lines towards the interior and coastal primacy (see also Taaffe et al., 1963), and the European port city, situated upstream in a central place system, with a downstream port. In the first case, we find numerous examples in the literature of a shift of population and economic activities from inland to the coast. They include the development of Vancouver (Forward, 1984), Beirut (Ozveren, 1990), and Buenos Aires (Socolow, 1991) at the expense of the interior, the transformation of port cities into major economic nodes in the Pacific (Spoehr, 1963), New Zealand (Taylor, 1974), South Africa (Wiese, 1981), Nigeria (Omiunu, 1989),

the Atlantic (Knight and Liss, 1991), as well as the extraversion of West Africa (Debrie et al., 2003), to name but a few. Elsewhere, large ports were created in existing large cities, together with a series of banks and insurance companies serving external interests (Basu, 1985; Jones, 1990; Higman, 1991; Fau, 1999). Such dynamics often resulted in a relative overlap between port and urban hierarchies, as evoked by Broeze (1985) and Mangazol (1996) in the case of 19th century sugar entrepots in the Caribbean and U.S. Gulf, and Konvitz (1994) for Atlantic port cities. In Europe, Southampton (Bird, 1977) and Bordeaux (Gutmann, 1986) became larger than expected, despite their peripheral situation in the regional urban system.

The long-term synergy between port and urban functions became challenged by numerous examples of port-city separation across the world, provoked by technological change in ocean transportation, the recognition of the waterfront as an urban asset, and the emergence of intermodal transportation systems (Hayuth, 1982, 1988). This motivated scholars to propose spatiotemporal models of port-city separation, with a universal reach. However, there has been a growing recognition that port-city relationships greatly vary across regions of the world, due to distinct spatial features regarding the pattern of hinterlands (Figure 2.1). Europe is specific by the inland centrality of main markets, which are more coastal in North America (Gottmann, 1961) and well-connected through land bridges. The rest of the world, including Asia, has a limited inland penetration of logistics corridors and a coastal urban primacy (McGee, 1967). Several spatial models were proposed about Asia itself, such as the South Asian port metropolis (Eliot, 2003), the consolidation model in East Asia (Lee et al., 2008), the multilayered gateway-hub in China (Wang and Ducruet, 2012), and the global hub port city in the Middle East (Akhavan, 2017).

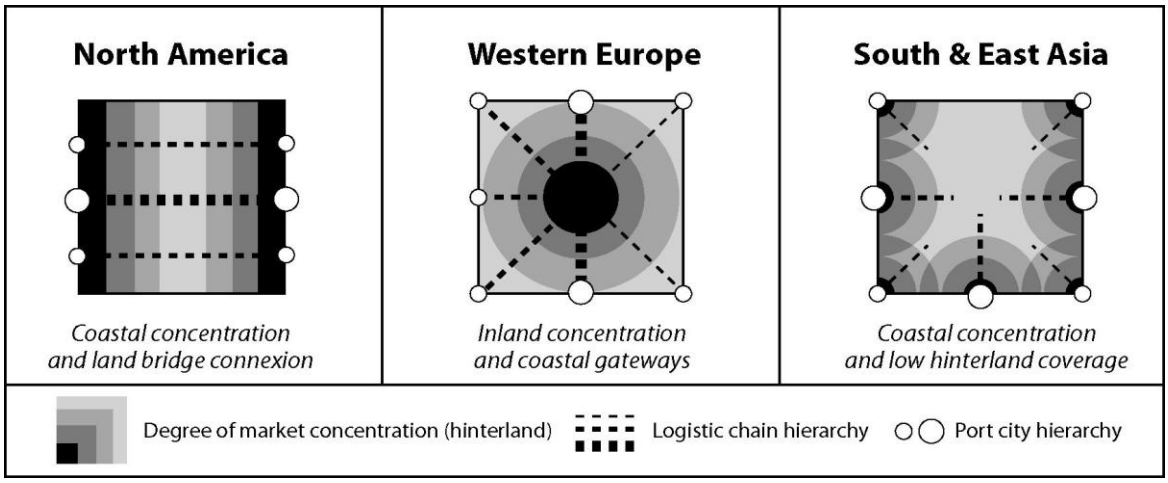


Figure 2.1: Regional patterns of port hinterlands

(source: Lee et al., 2008)

In parallel, there were initiatives to quantify port-city relationships at the global level. Ducruet and Lee (2006) confirmed port-city separation as seen by the declining correlation between port city population and container throughput volume globally (1970-2005). On a longer-term (1890-2010), Ducruet et al. (2018) also observed a fading correlation between urban population and vessel traffic,

especially for upstream port cities. Ducruet et al. (2023) studied patterns of port migration worldwide since the 1950s, concluding that bulk terminals, West Asia, and upstream cities had been the most affected. Ducruet et al. (2024a) used econometric methods to quantify the impact of containerization on urban growth on the period 1950-1990. They concluded to a zero-sum game, due to the opposite forces of direct market access making port cities attractive to firms and workers, and port migration outside port cities because of congestion and lack of space.

Despite these advances, we still lack of a global picture that would highlight regional differences. Economies of scale in shipping and ports, as well as fierce port competition, are common features of the nineteenth century's steam development and post-WWII containerization (Marnot, 2025), thereby motivating a long-term approach of port-city dynamics. This chapter aims to innovate by offering a comparative perspective of port-city evolution at the global and regional levels over the period 1880-2020. It makes use of untapped shipping data extracted from the Lloyd's Shipping Index, a daily publication of the insurer Lloyd's List, and urban data derived from no less than eight different statistical sources. The correlation analysis is complemented by an investigation into the average land transport distance between ports and the city-center of their host agglomeration.

The remainder of this chapter is organized as follows. Next section offers a literature review of the spatial and functional models of port-city evolution. Then, we present the data and methods to construct a global database of port cities as well as the selected analytical tools. This is followed by the analysis of port-city distance and correlation at different geographic scales. Finally, we discuss the contribution of the results to the literature on port cities, and conclude about the importance of this research for the fields of urban/transport geography and economics.

Models of port-city spatial and functional evolution

The existing models of port-city evolution can be classified according to the geographic scale of analysis, namely local (intra-urban) and regional (interurban), as well as spatial and functional. Spatial aspects refer to the changing location of port infrastructures, often shifting from the inner city to deep-sea and suburban locations. The functional dimension is more about the changing socio-economic structure of the port city, with a tendency for port cities to evolve towards a profile of "general city" as the port function is gradually loosening. Such dynamics strongly depend on the design of the urban and port systems, in which the port city is more or less attractive to firms, workers, and traffic. Port-city evolution has also been modeled over long time periods, notably with reference to port system evolution. Although they do not explicitly discuss urban issues, many port system evolutionary models depict a growing concentration of maritime traffic at the dominant (or primate) port city of the region, especially in developing economies (Ducruet and Notteboom, 2023).

Table 2.1 provides a synthesis of the models of port-city evolution. Most models appeared between the 1960s and 1980s, a period marked by the unprecedented growth of ship size and the spread of containerization. Large vessels, should they carry bulks or containers, could not anymore be accommodated in traditional port cities, due to narrow navigation channels at port entrances and limited water depth at the terminals. This often necessitated the creation of new deep-sea ports and terminals at the fringe of port cities and at greenfield sites. Upstream port cities were particularly impacted by such dynamics, with few exceptions like Antwerp and Hamburg thanks to massive

investment in dredging (Notteboom, 2016). Deep-sea locations could be either downstream (Pounds, 1947; Bird, 1963; Brocard, 1995) or coastal (Hayuth, 1988), in the latter case representing the "challenge of the periphery", through the transformation of a secondary port into a new gateway or transshipment hub (Notteboom and Rodrigue, 2005).

Scale	Entity	Spatial	Functional
Local	City	Waterfront & interface redevelopment (Hoyle, 1989)	Transformation into a general city (Murphey, 1989)
	Port	Congestion & dereliction of inner port areas (Hayuth, 1982), downstream shift of modern terminals (Pounds, 1947; Bird, 1963)	Heavy industries and containerization / ro-ro experiment (Hoyle, 1989)
Regional	City	Eccentric situation of gateways in the urban system (Bird, 1973; Fujita and Mori, 1996)	Concentration of economic activities in central places (Stern and Hayuth, 1984; Brocard et al., 1995)
	Port	Load center development (Hayuth, 1981), challenge of the periphery & new port development (Hayuth, 1988)	Port regionalization & offshore hub development (Notteboom and Rodrigue, 2005)

Table 2.1: Models of port-city evolution in the literature

In functional terms, on the one hand, the loosening of the port function gradually transformed port cities into general cities, reaching a comparable socio-economic structure than non-port cities (Murphey, 1989). Port cities remained, however, slightly specialized in the transport sector compared with other cities (Brocard et al., 1995), given their eccentric situation in the urban system, serving inland regions through transshipment (Stern and Hayuth, 1984; Bird, 1973). This situation has two important consequences. First, new ports and terminals, of which container hubs, did not foster urban growth (Slack and Gouvernal, 2016), due to the lock-in and self-agglomeration effects of pre-existing cities (Fujita and Mori, 1996) and the volatile character of transshipment flows. In European estuaries for instance, the upstream city kept being a central place, overshadowing the development of the downstream port city (Brocard, 1988; Brocard et al., 1995), which often remained a pure gateway. Second, such gateways bear the costs of transshipment (Mc Calla, 1999), while the benefits may go as spillovers towards larger cities, coastal or inland (OECD, 2014). This explains why Ducruet et al. (2024a) concluded to a zero-sum game about the impact of ports on urban growth, due to the contradiction between the benefits of market access and the costs of congestion. Empirical studies demonstrated that higher-order activities concentrate in larger cities, port or non-port, while routine activities concentrate in large ports (Slack, 1989; O'Connor, 1989; Jacobs et al., 2011).

Until the industrial revolution, the "primitive port city" had been functioning through synergy, both spatially and functionally, according to the model of Hoyle (1989). Rapid trade and industrial growth in the late nineteenth and early twentieth centuries forced the port to develop outside the city's

territory. After WWII, as said above, the race for naval gigantism and port expansion caused port-city physical separation. Heavy industries migrated toward deep-sea locations in the 1960s-1980s, namely Maritime Industrial Development Areas (MIDAs), while inner city's port areas became derelict and were redeveloped for new urban uses in the 1970s-1990s. Yet, Charlier and Malézieux (1997) argued in favor of the redevelopment of old port areas for new port uses, to maintain the port function near the urban core. Such a strategy, in some way, had been realized recently in a few places through the "return of the port in the city" (El Hosni, 2017). The development of Dubai Ports World's London Gateway terminal at an upstream location near London city is one example of the kind, echoed by Taipei New Port in Taiwan. Interestingly, the objective of the Taiwanese government had been to limit the environmental impacts of trucking flows between Kaohsiung port in the south and the capital city in the north, whereas for London, the strategy of DP World was better explained by its competition with Hutchinson Whampoa, located further away in Felixstowe.

Data and methodology

Quantifying port activity between 1880 and 2020 was made possible thanks to vessel movement data from the historical archives of the maritime insurer Lloyd's List up to 1975, complemented up to 2020 by digital data. The limitations of the Optical Character Recognition (OCR) software prevented us from extracting vessel tonnage, so that port traffic is only measured by the number of vessel calls. The total number of vessel calls by port corresponds to the last known vessel voyage between two or more ports at the date of the publication. One weekly issue of the Lloyd's Shipping Index was extracted every five years around early April. We are aware that the number of vessel calls, especially in the recent period, may not fully reflect the importance of port activity, given the trend of naval gigantism since the 1960s for bulks and 1990s for containers. Yet, the number of vessel calls is a good indicator of the frequency of ship visits.

The attribution of ports to cities followed a specific methodology, based on the Global Port-City Database that assigns ports to cities of the world (Ducruet, 2025). Each port was assigned to a host municipality (administrative definition of the city), a host agglomeration (morphological definition of the built-up area), and a well-connected city-region (largest city of the region within a 200 km radius around the port) (Figure 2.2). Urban population data, used as a proxy of cities' economic size (Kenyon, 1974; Vallega, 1979), was collected for these three levels from multiple sources (Table 2.2). In addition, we used satellite images from Google Maps to obtain the coordinates of ports and cities, in order to evaluate the distance between them using QGIS. It was not possible to track historically the situation of port sites, since the Lloyd's database is not at the terminal level but at the port level. However, it is believed that our methodology can estimate whether ports and cities have grown apart over time. Whenever possible, for some cases, we zoomed at the intra-port level when the information was available. Although Lloyd's data points at "Rotterdam" as a whole, it is sometimes more precise when indicating "Europoort" for instance. Therefore, should it be across estuaries, deltas or along the coast, witnessing a changing geographic distance between port and city is only possible when new terminals and ports have a different name than the eponym city. Examples include Yangshan for Shanghai, Thilawa for Yangon, Port Muhammad Bin Qasim for Karachi, Nava Sheva for Mumbai, etc.

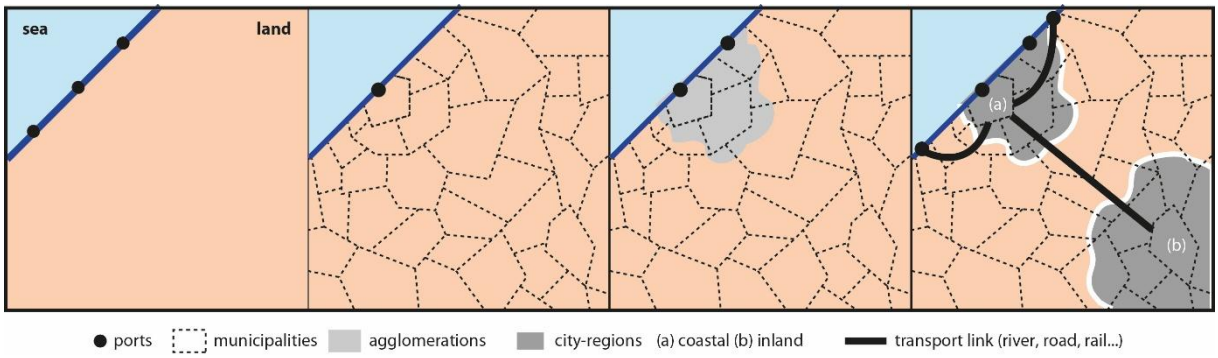


Figure 2.2: Methodology for port-city matching

Source	Cities	Period	Link
Africapolis	Agglomerations	1950-2015	https://africapolis.org/fr
Citypopulation	Agglomerations & municipalities	1970s-2020s	http://citypopulation.de/en/
Geopolis	Agglomerations	1950-1990	Moriconi-Ebrard (1994)
Macrotrends	Agglomerations	1950-2020	https://www.macrotrends.net/
Population Statistics (Populstat)	Agglomerations & municipalities	1875-2010	http://populstat.info/about.html
UN World Urbanization Prospects	Agglomerations	1950-2020	https://population.un.org/wup/
World Gazetteer	Agglomerations & municipalities	2010	discontinued
ZhujiWorld	Not specified	1950-2020	https://zhujiworld.com

Table 2.2: List of urban population data sources

In all cases, the method has been to measure the latitude and longitude of the agglomeration's city center and the centroid of the port(s). Municipalities hosting port that are adjacent to an agglomeration were considered to be part of this agglomeration. This is the case for instance of Incheon (Seoul), Callao (Lima) and Piraeus (Athens). We are aware that port and urban locations dramatically changed over history. Some ports and terminals may have vanished or expanded, while cities have grown spatially. Thus, calculating port-city distances based on the *current* layout of agglomerations may mislead past patterns. For city-regions, the method has been to calculate the (orthodromic) distance between ports and such cities, following several criteria. The city-region should be demographically larger than the port city, within a radius of about 200 kilometers, well accessible by road transport to/from the port, and located in the same country. Examples include Santos (Sao Paulo), Le Havre (Rouen), and Tianjin (Beijing). Like in the spatial models at regional level, such as those on estuaries, this method implies that the port (city) has the advantage of good nautical accessibility, while the city-region is stronger by its land-based centrality. As such, the city-region constitutes the most likely "immediate hinterland" of the port city, being the principal consumption and production center of the outlying region. This corresponds to numerous national and regional capitals being near the coast but non-port cities, accessing maritime trade via a neighbor gateway (Ducruet and Guerrero, 2022).

Main results

The changing distance between ports and cities

The methodology employed to measure the physical distance between ports and cities is found to be quite successful, given the results obtained in Figure 2.3. At the world level, the average distance between ports and the city center of their respective agglomerations doubled over the whole period, from 4.9 kilometers in 1880 to 10.1 kilometers in 2020. While there has been a continuous increase of distance over time, a marked acceleration of this phenomenon is observed from 1960 onwards. This evolution corresponds to an exponential curve, with a determination coefficient of no less than 0.946. Such a result confirms the model of Hoyle (1989) about the development of modern port areas beyond city confines in the 19th and early 20th centuries. This phase entitled "expanding port city" corresponds to rapid commercial and industrial growth, forcing the development of linear quays and break-bulk industries. Port-city separation really occurs during the third phase of Hoyle's model (modern industrial port/city, mid-20th century), with the growth of heavy industries, especially oil refining, and the introduction of containers and roll-on/roll-off traffic that require more space. This is in line with the Anyport model of Bird (1963) where the phases of "expansion" and "specialization" depict the downstream shift of modern port terminals, but which are still within the reach of the upstream agglomeration.

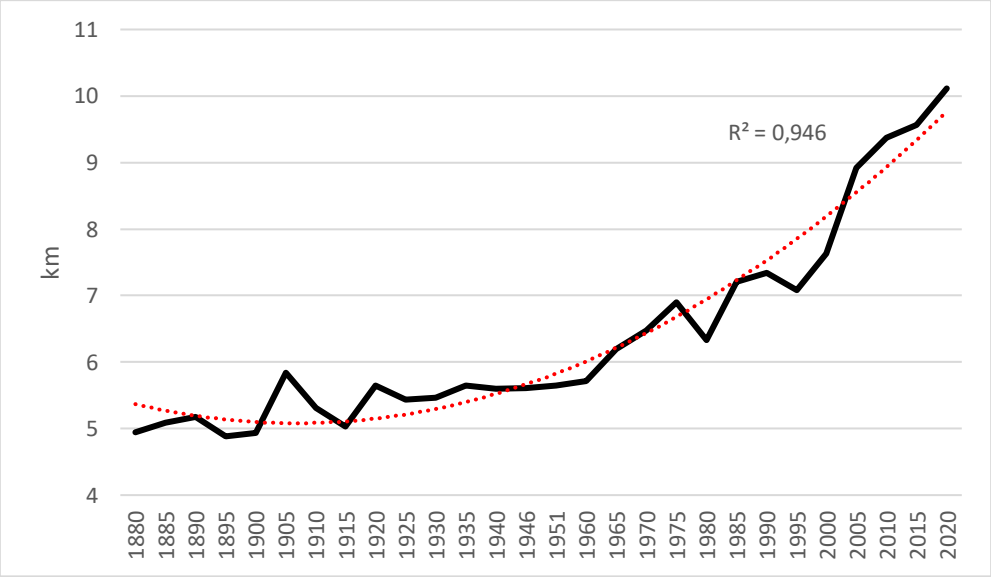


Figure 2.3: Average distance between ports and cities, 1880-2020

The distribution of vessel traffic by classes of port-city distance was calculated based on quintiles (Figure 2.4). As a matter of fact, traffic increased the most at the farthest ports (13.7 to 167.5km). Their proportion in total vessel calls increased from 5.5% in 1880 to 17.1% in 1951 and 31.9% in 2020, the maximum value. The combined proportion of the nearest ports (0 to 6.26km) went through a drastic decline, from 83.7% in 1880 to 70.1% in 1951 and 52.0% in 2020. There is no doubt that the inclusion

of vessel tonnage capacity, in further research, shall accentuate this trend, given that the biggest ships increasingly called at more distant terminals, benefiting from better nautical accessibility. It must be noted that the observed tendencies are not only explained by port expansion and migration. Cities have expanded as well, some of them growing into large agglomerations that progressively integrated neighboring municipalities hosting ports. Our results thus combine both port and urban dynamics.

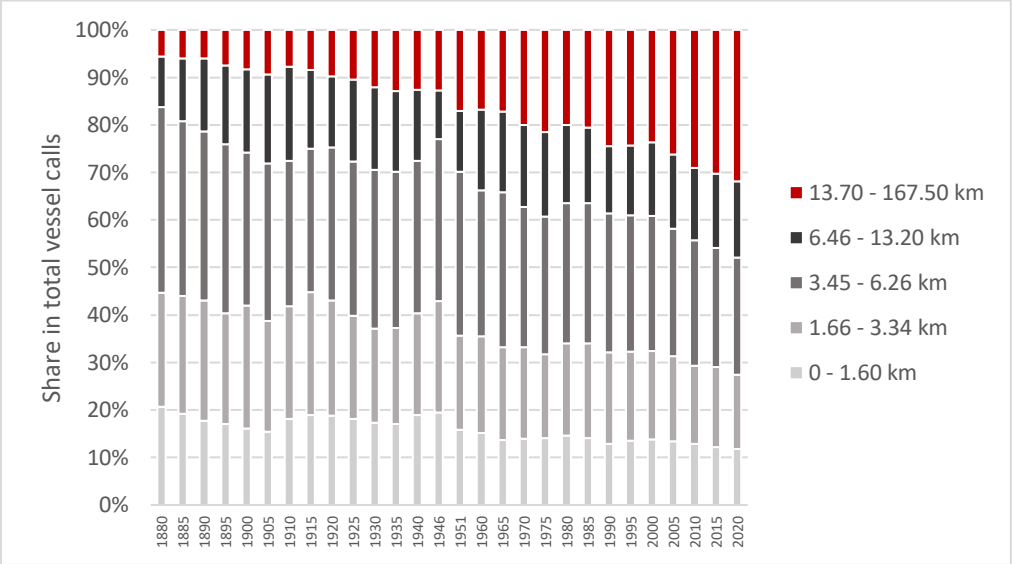


Figure 2.4: Vessel traffic share and port-city distance

The regional breakdown of port-city distance offers an interesting differentiation of world trends (Figure 2.5). North America and Asia share two commonalities. First, they possess relatively larger cities than other regions, both in terms of land area and population, so that their average port-city distance is the highest. Ports and terminals are thus scattered across such vast agglomerations. Second, they went through a rapid increase of port-city distance since the middle of the period. The increase of distance has been more regular and higher for Asia, however. Like for the global trend, Asia's port-city distance had more than doubled, from 7.32 km in 1880 to 16.30 km in 2020. This particular trend for Asia is a direct reflection of the global manufacturing shift that occurred in the "Asian Tigers" and China since the 1960s and 1970s as well as in Southeast Asia and the Indian subcontinent. Already established port cities, previously colonial or not, became export centers of manufacturing goods as well as large container hubs and consumers of large quantities of raw materials and energy, forcing port terminals to locate at the fringe of agglomerations.

In comparison, other world regions experienced a much less pronounced physical separation. Latin America and Africa have a comparable profile, with a take-off of port-city distance after WWII, but which stabilized around 6-7 km for the first and 5-6 km for the former. In those two regions, ports thus remained relatively "urban", near the inner city core. Oceania has the lowest port-city distance in 2020 (3.8 km), while Europe barely surpasses 4 km. For Europe, this is because its (port) cities cover a much smaller land surface than in other regions, so that ports did not need to migrate very far to escape from inner city density and congestion. Still, port-city distance increased regularly in Europe, from 3.46

km in 1880 to 3.88 km in 1960 and 4.31 km in 2020, with the whole trend following an exponential determination of no less than 0.69. In Oceania, the main ports and terminals have remained relatively unchanged over the period, or traffic was shifted at very close locations (e.g., Botany Bay for Sydney, Fremantle for Perth).

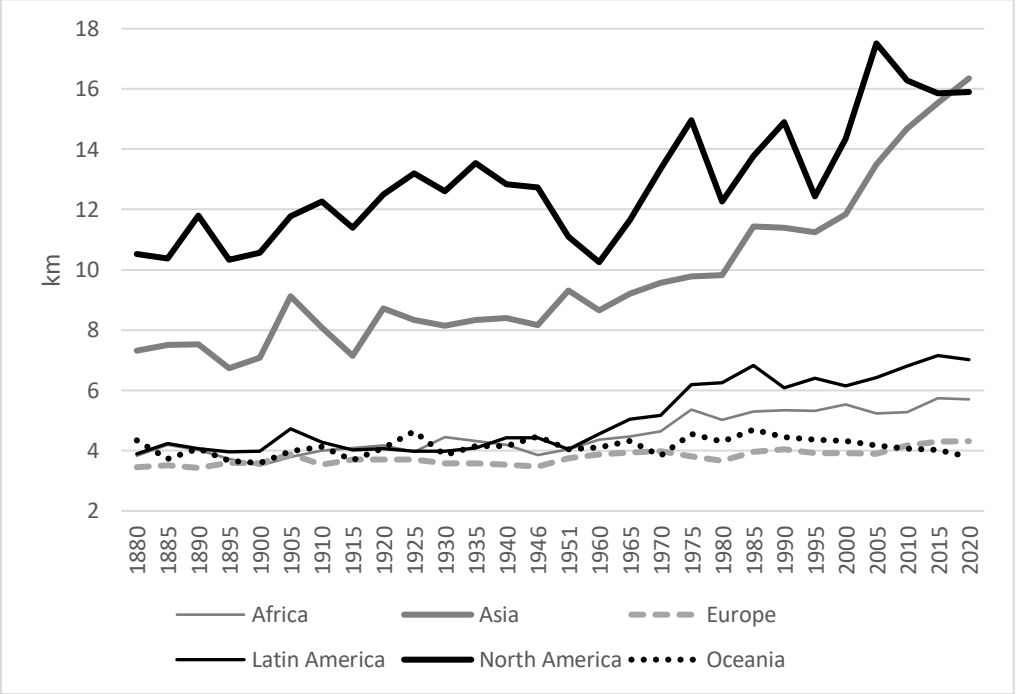


Figure 2.5: Average port-city distance by world region

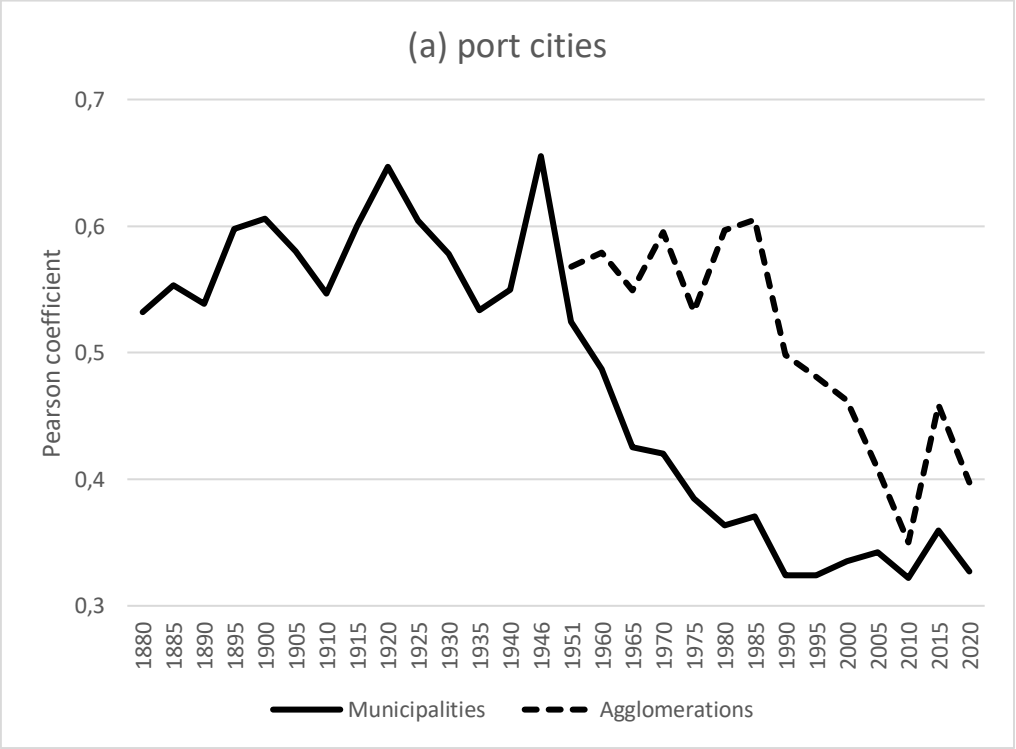
The correlation between port activity and city size

At the global level, we measure the correlation between urban population and vessel traffic based on different configurations of cities (Figure 2.6). It is important to note that the population of agglomerations is only available from 1950. In the recent period, agglomerations are more in line with port activities than municipalities, which cover a smaller land area. The correlation for agglomerations dropped only after 1985, compared with 1951 for municipalities. Being larger market areas, agglomerations resisted port-city separation more durably, until the emergence of container hubs and the acceleration of naval gigantism in the 1990s.

Municipalities witnessed a rapid drop of correlation after WWII, from 0.65 in 1946 to 0.33 in 2020, namely a 50% loss of traffic generation power. Such a result is definitely an empirical verification of the fact that “the amount of cargo handled by the port was strictly proportional to the number of clients in the area surrounding it” (Todd, 1993), while “major ports now serve producers and consumers in widely dispersed hinterlands” (Hall, 2009). Port migration outside inner cities, with the advent of containerization and large tankers, had a reverse effect on the port-city hierarchy, with large cities handling small traffic and small cities having large traffic, a phenomenon coined by Norcliffe et al. (1996) the emergence of “placeless ports”. This well-known phenomenon does not appear to be a

cycle, however, because new port locations did not entice further urban growth locally (Slack and Gouvernal, 2016; Ducruet et al., 2024a). In general, port economic impacts spread as spillovers towards farther regions, often situated inland (OECD, 2014). Such results confirm the findings of Ducruet and Lee (2006) on the fading port-city correlation since the 1970s based on container throughput, and of Kidwai (1989) about the case of India, where port-city correlation declined from 1.0 in 1911 to 0.4 in 1981, due to the rise of new bulky ports outside traditional port cities. Other factors include changing market conditions and the shift of major trade lanes, depriving port cities from their maritime centrality despite having modern port infrastructure (Thayer and Whelan, 1989).

This is exemplified by the opposite evolution of city-regions along the period. Increased land-based transport connectivity by roads, highways (trucking), rail and waterways allowed ports to widen their hinterland coverage (Amato, 1999), so that their overall activity is more and more explained by the size of distant cities (of which non-port and inland). In turn, such cities exert a "shadow effect" on port locations, which remain specialized in logistics and cargo transshipment (Fujita and Mori, 1996). In developed countries, industrial port regions witness lower growth rates of container throughput (Ducruet, 2009), while port regions in general perform less than other regions due to their lower value-added (Lever, 1994), higher unemployment levels (Grobar, 2008), limited wage advantages (Hall, 2009; de Langen, 2009), and higher emissions of greenhouse gases (Ducruet et al., 2024b).



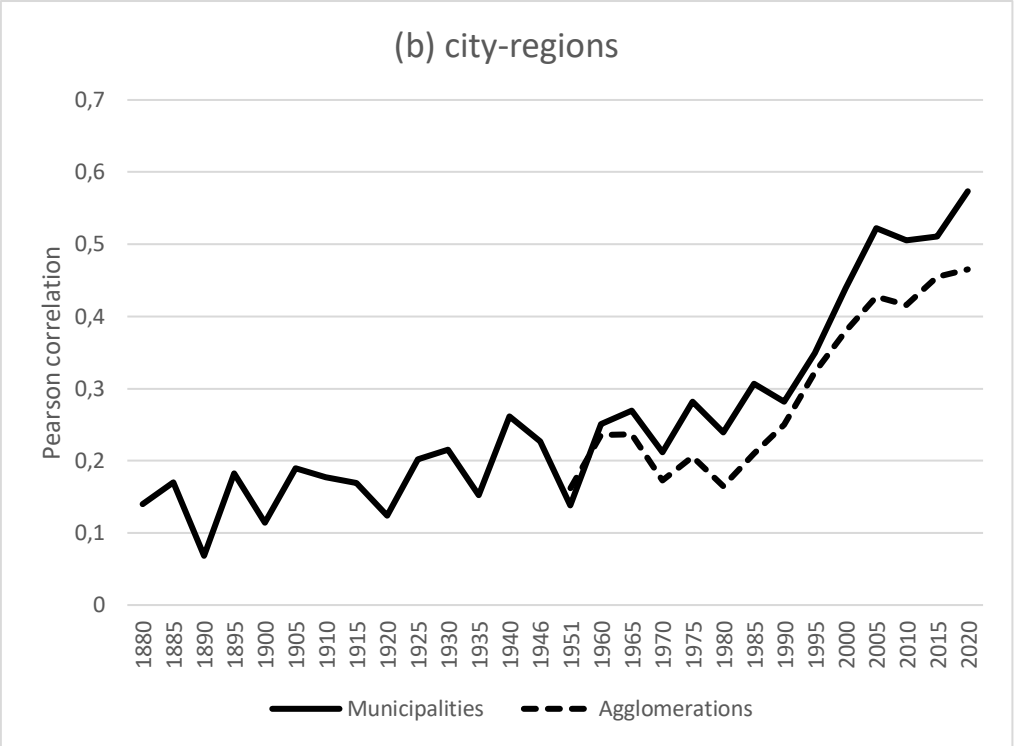


Figure 2.6: Correlation between urban population and vessel traffic, 1880-2020

The global trend happens to be much differentiated at the regional level (Figure 2.7). Certain similarities can be found however. Asia, Europe, and Latin America witnessed an inverse evolution between port cities (decrease) and city-regions (increase). North America and Oceania have the highest correlation at port city level, as their major cities are dominantly coastal (e.g., New York, Los Angeles, Sydney, Melbourne), but a low or negative correlation for city-regions. The case of Africa is peculiar, being the only region with a higher correlation for city-regions than for port cities, both being highly significant and stable over the period. African city-regions include non-port coastal cities served by nearby ports, such as Rabat, Accra, and Porto Novo, as well as inland/upstream ones like Cairo. Europe experienced a relatively late port-city separation, around the 1970s, compared with other regions, from a correlation coefficient of 0.61 in 1970 to 0.22 in 2020. In Europe as well, the growth of correlation at city-region level started earlier than in other regions, around the 1920s, with a peak in the 1940s-1960s. The latter trend confirms the observations of Pounds (1947) and Bird (1963) on port migration from upstream city cores towards deep-sea locations across estuaries. The decline of port-city correlation in the 1970s corresponds to a wave of waterfront redevelopment and port migration as well in Europe. An exemplary case is London, with the spread of new port terminals along the River Thames (e.g., Thamesport, Sheerness, and Felixstowe to some extent) and the transformation of inner port areas into new urban districts (e.g. Canary Wharf). In addition, the trend of European integration caused a massive concentration of port activity around the megalopolis. Largest ports increasingly located in cities of moderate size, like Antwerp, Rotterdam, and Genoa, compared with larger cities such as Lisbon and Stockholm, which handle limited traffic.

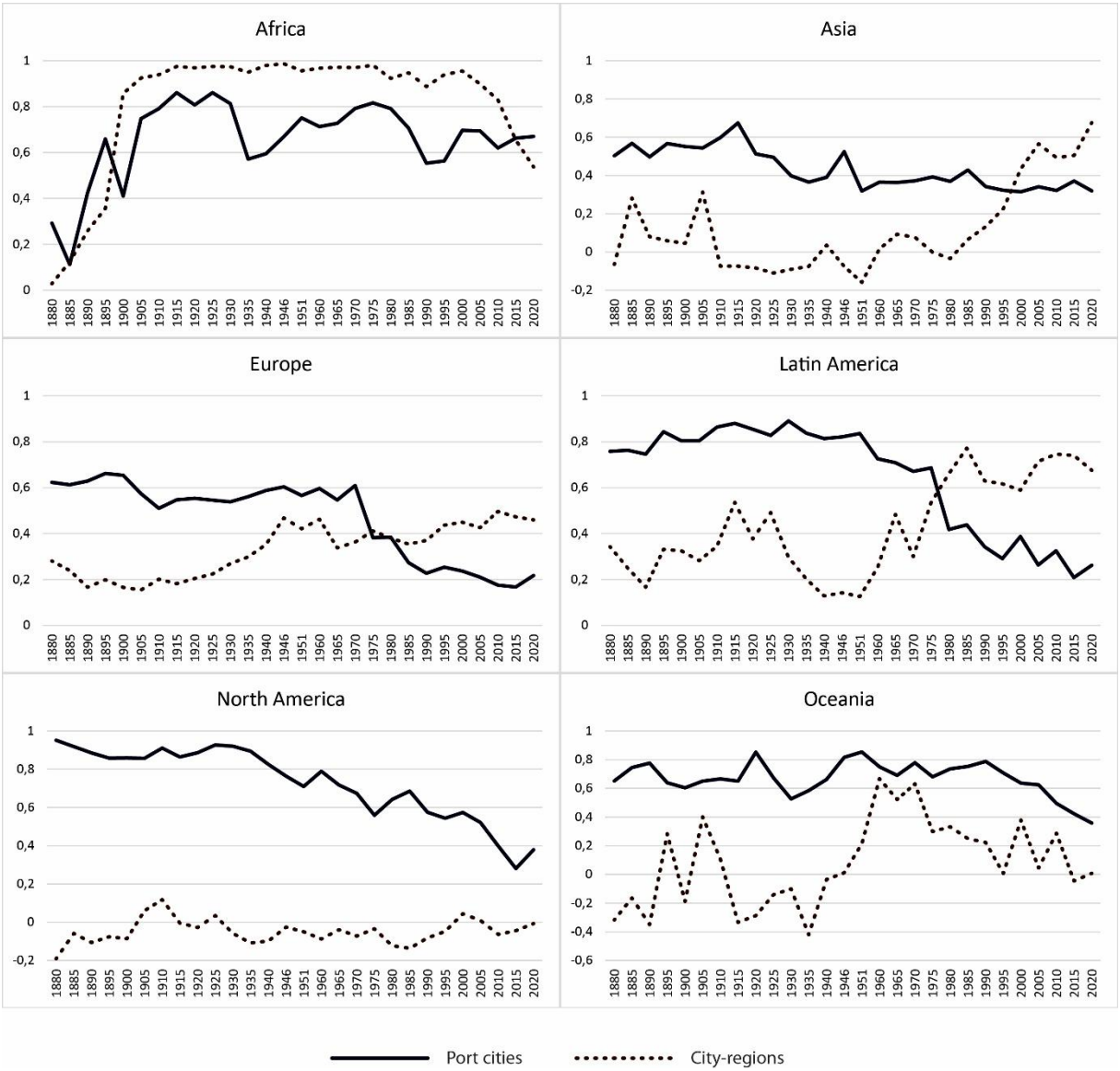


Figure 2.7: Correlation between urban population and vessel traffic by world region, 1880-2020

For Latin America, the correlation decrease for port cities and increase for city-regions occurred in parallel since WWII, with an inversion of the curves like for Europe around 1975-1980. One important difference with Europe, however, is the higher correlation for port cities between 1880 and 1951 (around 0.8 compared with 0.6). Latin America includes a number of very large port cities like Buenos Aires and Rio de Janeiro, which are also among the largest ports. Oceania is a region with a stable and highly significant correlation for port cities, but city-regions do not play a particular role. Its port-city hierarchy has remained more or less the same since the late 19th century, and the decline of correlation occurred relatively late, from 0.79 in 1990 to 0.36 in 2020. North America had the highest correlation at port city level at the beginning of the period, but it went through regular decline from 0.95 in 1880 to 0.38 in 2020. Like for Oceania, city-regions do not play a strong role in the distribution of vessel traffic, as the correlation oscillated around zero. Asia and Latin America have in common the widest gap between port cities and city-regions in the second half of the period, and the highest correlation for city-regions in 2020 (0.68). The rise of city-regions as relevant market centers started earlier,

however, in Latin America (1951) than in Asia (1980). Latin America has the peculiarity to possess an important number of large inland capital cities, such as Santiago, Lima, Bogota, Caracas, but also Sao Paulo, Managua, Tegucigalpa, San Salvador, Guatemala City, so that the activity of coastal ports has become more and more in line with the development of these urban centers.

Conclusion

This research investigated the changing geography of port-city relationships between 1880 and 2020 at the global and world region levels, both within port cities and across the port city hierarchy. Global trends do confirm existing spatial models, which converge about the growing separation between ports and cities. First, the average distance between ports and the city center of their host agglomeration doubled over the period. Second, the correlation between urban population and vessel traffic declined abruptly after WWII for port cities. An inverse trend was observed for city-regions, confirming that port activity is more and more in line with the market size of distant cities, should they be coastal or inland, thanks to the improvement of land-based network connectivity. When zooming on world regions, we first demonstrate their coevolution, since port-city distance increased everywhere (except from Oceania) and port-city correlation declined in all cases. Important differences are observed however, in terms of the timing and extent of port-city separation.

Further research shall explore such phenomenon based on cumulated vessel tonnage rather than call frequency, to better capture the trend of growing ship size. Another avenue of research is to investigate port-city linkages at a thinner regional level, such as the principal maritime ranges (e.g. West Africa, Northeast Asia, Caribbean, etc.). Last but not least, the analysis would gain in relevance by focusing on general cargo ships and later containerships, which traffic is by essence more in line with city size than bulk ships.

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