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Regional Disintegration in South Asia: Evidence from the End of the British Empire on Maritime Networks

Cesar Ducruet* and Kenmei Tsubota**
March, 2018

Abstract

In the early 20th century, the British Empire primarily governed South Asia, and these regions shared similar administrations, institutions and commercial practices. After the Second World War, decolonization in South Asia became evident through the partition of India and countries gaining independence. These subsequent events can be seen as regional disintegration, and they offer a potential scope for examining the impacts of such institutional changes on maritime transport networks. By examining a new database detailing vessel movement between South Asian ports and the rest of the world from 1890 to 2000, we explore how maritime transport networks evolved in South Asia. Specifically, we compare the trends of shipping routes among ports before and after 1947. Applying the methodology developed by Redding, Sturm, and Wolf (2011) and Xu and Itoh (2017), we show that regional disintegration clearly lowered vessel movements for the routes that became international after 1947. Additionally, we examine two points; relationship with UK, and the independence of Bangladesh. For most of the cases, we find significantly negative impacts on vessel movements directly affected by regional disintegration.

Keywords: Maritime Transport Networks, South Asia, Colonialism,
JEL Classification: F15, N75, F54

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1. Introduction

The economic geography models following Krugman (1991) show multiple steady states in spatial distribution of activities. This calls for empirical enquiry, particularly when at certain changes in trade costs, a possible shift from one steady state to another occurs. While there have been several studies, beginning with Davis and Weinstein (2001), that have attempted to answer such line of questioning, empirical answers to understanding the impact of certain shocks on spatial distributions of activities are not conclusive. This paper provides new evidence on this enquiry by treating the end of the British Raj as a source of an exogenous shock. During the British Raj (1858–1947), South Asia experienced a period of regional integration. This era was coined as the region's first globalization, where steamers helped further South Asia's international connectivity (Bronze 1996, Jacks et al 2008, and Pascali 2017). Most of the existing geographical literature on Indian ports and port cities provided monographs or comparative studies of individual places such as Kolkata (Suylichem, 1968; Kosambi and Brush, 1988). These studies primarily looked at urban port morphology and regional impacts through spatial models to illustrate the evolution of the port (Eliot, 2003). Other studies documented the fading correlation between city size and port throughput in India from the 1960s to present, attributing the declining correlation to the creation of new bulk ports outside urban areas (Kidwai, 1989). Indian ports remain the most studied ports in the region today. Studies have examined governance restructuring and port reforms from the early 1990s (Haralambides and Behrens, 2002), productivity, efficiency and technological change (De and Ghosh, 2002), the effects of globalization (Ghosh and De, 2001), dry port development in relation to seaports (Ng and Cetin, 2012), among others, and numerous quantitative analyses of Indian port traffic in subsequent years. In addition, Ducruet (2015) detailed a historical evolution of port traffic in Asia as a whole over the last century. While there have been a wealth of South Asian transport studies, excluding Ducruet (2015), there is a gap in the literature; a systematic historical analysis of South Asia through the lens of a relational or network perspective is necessary to understand the region as a whole.

Just after the World War II, the Indian subcontinent experienced independence from the British Empire and separated into several countries as a result of the *Partition and Independence*. Until that time, Indian regions were governed directly or indirectly by the British, which created similar institutions across the different regions, namely, bureaucracy, jurisdictions, business associations, and common language. It was due to these similar institutions and control under British colonial policies, that these regions became an integrated colony. Despite this, once the power of governance transferred to each region after 1947, international borders emerged within the Indian

subcontinent and the coastal line was divided into four parts: West Pakistan, India, East Pakistan, and Myanmar. Subsequently, East Pakistan became Bangladesh after the war of independence in 1971. These historical events can be observed as a case of regional disintegration and can offer a potential scope for an empirical study, and so this paper examines these events as a natural experiment to explore the evolution in maritime networks.[1]

As some routes became international from domestic trade, called coasting trade, their shipments required customs declarations as well as other necessary documents and tax duties. This change inevitably increased trade costs for any shipments using the routes affected by regional disintegration. In this paper, we ask how regional disintegration affected the maritime transport networks by comparing networks before and after 1947 and comparing affected and non-affected routes.

Empirical literature focusing on the interplay between maritime network dynamics and border-related or wider political changes remains rather scarce. Yet, it is possible to take inspiration from recent works on inter-Korean trade dynamics over the period 1977-2016 (Ducruet et al., 2017); on the USSR collapse between 1987 and 1994 (Zreik et al., 2017); and on the North African (Mohamed-Chérif and Ducruet, 2016) and Northwest African (Castillo and Ducruet, 2017) maritime ranges. The first demonstrates the changing pattern of inter-Korean maritime trade flows under rapidly changing circumstances such as embargo, natural disasters, political transition, and reforms in North Korea. This research illustrates how South Korea, despite political tensions, was the main hub for North Korean foreign maritime trade before North Korea shifted under the overwhelming influence of China. The second work on the USSR demonstrates through mathematical models and graph-theoretical methods the variability in the impact the USSR's collapse had on the Soviet ego-network. The two African studies investigate, at least partly, the influence of border changes on the design of regional maritime networks, from the colonial to post-colonial era. Comparisons with South Asia remain difficult due to the permanency of border effects overtime. In the case of the Maghreb, however, permanency was overcome by establishing Tangier-Med, a new transshipment hub which centralized regional flows for transit, rather than real trade.

There are two studies, Redding, Sturm, and Wolf (2011) and Xu and Itoh (2017), that are more closely linked our research. While Redding et al. (2011) did not address maritime issues, it investigated how Germany's division let to a shift in airline networks, namely how the majority share of passenger traffic shifted from Berlin to

[1] Such a historical evolution of shipping route networks in South Asia, itself, is a relatively new field of research, given the scarcity of empirical analyses of maritime networks throughout the world (see Ducruet, 2016 for a review).

Frankfurt during pre-war and division periods between 1937 and 1988. Xu and Itoh (2017) showed further evidence of change in regional hub systems by looking at an earthquake hitting Kobe, a Japanese western hub port. They found that northern Japanese regional ports, relatively far from Kobe, switched their hub ports from Kobe to Busan, Korea. These studies are unique cases where shocks changed the stable structure of port hierarchy. In our research, we expand upon their research to identify patterns in larger spans of time and space by using detailed port-to-port data across one century.

The Indian subcontinent can be recognized among the primary examples of regional disintegration due to its size and the presence of similar institutions across varying regions under British rule. As the Indian subcontinent was an important colony of the British Empire, Indian domestic markets became integrated into international import and export markets via coastal port cities, such as Kolkata, Bombay (Mumbai), Madras (Chennai), and Rangoon (Yangon) which served each capital city and presidency, as well. The relatively smaller surrounding ports also traded directly and indirectly with other regional and international ports. For over a century, Kolkata, Bombay and Madras, and for at least a half century, Yangon and the city's neighboring areas, established strong trade linkages with each other and the UK under the British Empire.[2] In fact, the trade link between South Asia and the UK has a long tradition. For example, in his book, Smith (1902), Adam Smith mentions the following.

> What goods could bear the expense of land-carriage between London and Calcutta? … Those two cities, however, at present carry on a very considerable commerce with each other, and by mutually affording a market, give a good deal of encouragement to each other's industry. (p62-p63)

As is reflected in Smith's words, the presence of economies of scale in maritime transportation and port trade is critical in understanding maritime networks. So, in looking at such economies of scale and the shifts in port traffic similar to Redding et al. (2011)'s examination of the shift in traffic shares for German airport hubs, we examine how regional disintegration affected port hierarchy in South Asia.

In our understanding of an integrated South Asia during the colonial period, we treat the onset of the post-colonial era as regional disintegration. This paper examines Indian regional disintegration, specifically in maritime networks, by employing newly available data on vessel movements registered in the *Lloyd's Shipping Index*. This brings

[2] For example, migration of people to Burma over the Bay of Bengal is well described in Amrith (2013).to Burma, for example.

to light missing knowledge on maritime transport geography and the economic history of international trade in South Asia during the 20th century, which has previously been absent from the literature. While studies on international or domestic trade use bilateral information, vessel movement data has the combined advantage of enabling the application of network-analytical methods and revealing maritime transport-specific factors (e.g. ports and shipping) that are often not taken into account in more aggregated trade statistics. Our data brings novelty to this study as it provides a more detailed account on origin-destination information and uses consistent units to quantify vessel movements.

In section 2, we explain the historical background and our corresponding data on maritime networks. Section 3 then details our empirical strategy, and Section 4 provides the subsequent results, followed by a section for our discussion and conclusion.

2. An Overview of the Background, Data, and the Evolution of Shipping Networks

This section provides a brief historical overview of each country in South Asia. Then we describe our data on maritime shipping and explain the trends of each country.

2.1. The end of the British Empire in South Asia

The partition of British India in 1947 opened some of India's intra-regional trade to international markets, and all trade between India and Pakistan became international. On the East, one presidency separated into East Pakistan and West Bengal, so Bengali trade between Kolkata and Chittagong, for example, became foreign trade, while East-West Pakistani trade was still considered intra-national despite its inevitably long-haul shipping.

Other subsequent events include the independence of Bangladesh which had a direct impact breaking Pakistan's trade link between the east and west. In addition, the Declaration of Socialistic State of Burma created trade sanctions and isolation, altering Burma's international trade trends thereafter. These events offer compelling examples of trade transitions to conduct a series inquiry and analysis, and so, we incorporate Burma (current Myanmar) into our study as a primary country with a strong legacy of British colonialism and connectivity in trade during the colonial period.[3]

The transfer of power in South Asia was an outcome of continuous efforts towards independence in India. While Gandhi and many hoped for a united India, partition

[3] See Tsubota et al (2017) for a brief overview of the region and of each country.

was inevitable due to fundamental disagreements on forming new independent nations.

For Bengal and Punjab, parliamentary votes resulted in a partition of the provinces, and Boundary Commissions were assigned to determine how to draw boundary lines for both provinces in limited time. The demarcation was primarily motivated by political wills and geographical features, such as river systems.[4]

2.2. Lloyd's data

We utilize a unique dataset detailing vessel movement among ports. The data was digitized from *Lloyd's Shipping Index* and published by *Lloyd's List*, the world's leading maritime intelligence and insurance company, over the period from 1890 to 2000. In particular, this periodical published daily vessel movements among ports across the world. As the number of publication volumes is large, we selected one publication around April to May every five years in order to have comparable snapshots of maritime activity in the region over a large span of time. We select 1890 as our starting year, as this marked when the corpus expanded its coverage from British fleets to the world.

To clarify terminologies, we denote "a call" as a voyage from one port to another, and in order to classify the difference in regions, we use "domestic" for within the region of a current country, "regional" for within South Asia (including Myanmar), and "international" for outbound routes to the rest of the world.

2.3. Evolution of vessel movements

Among the regions in South Asia that are now different nations, Indian ports exhibited the highest frequency of calls.[5] We normalize vessel movements by the average within the data for the colonial period (1890–1940).[6] Figure 1 shows India's historical trend in international and intra-regional calls, and among its five countries, there are three diverging trends: 1) increasing in Bangladesh and Pakistan, 2) decreasing in Myanmar, and 3) stable in India and Sri Lanka. As we hypothesized, Bangladesh experienced a sharp increase in intra-regional calls following the partition of India, and there was a relatively smaller, but noticeable increase in Pakistan's calls. Alternately, Myanmar experienced a declining trend in intra-regional calls, most prominently following 1950. Finally, India and Sri Lanka maintained a similar level of

[4] See Chatterji (2007) for details.

[5] Historical tendency of absolute number of calls by each country is shown in Appendix Figure 1, which correspond to Figure 1,

[6] We have excluded 1945, which was severely affected by WWII.

trade activity, experiencing only some fluctuations.

=Figure 1 and Table 1 come around here.=

Table 1 shows the average number of vessels, routes, and ports listed in our data, and across all regions and time periods, averages have clearly trended upwards. As vessel size increased substantially compared to the late 19th century, associated trade volume also increased, albeit to a higher degree than vessels. In Bangladesh, for example, there are only a few ports listed, while there has been a substantial increase in trade routes. This indicates that Bangladeshi ports were substantially connected to international ones. As a result, the number of routes and vessels increased by approximately six times their original amounts. On the other hand, the number of ports listed in Myanmar decreased, and likewise, the number of routes decreased to less than half their previous amount.

2.4. Different impacts of regional disintegration

The partition of India affected the maritime networks both directly and indirectly, particularly as some routes became international as a result. We categorize these changes in maritime networks following 1947 as three types of routes within the existing trade structure: 1) international trade among new independent countries, 2) intra-national trade within each country (e.g. in the case of Pakistan), and 3) trade links to international markets. Among these differences, the impacts of regional disintegration are also different. The first category represents the partition's direct effects on trade routes, and the second and third categories show trade structures influenced by changes in shipping demand and were therefore indirectly affected by the partition. For example, East Bengal was the neighboring region to Kolkata port. As the partition severed links between the ports and adjacent inland regions, these regions then needed to establish new trade links with alternative ports. This shift in import and export transport demand increased throughput and international shipments from the main port in the region.

3. Empirical Strategy

3.1. Our hypotheses

Our hypothesis is whether partition and independence shifted a stable spatial equilibrium to another in the maritime networks. In large scale infrastructure such as

ports and airports, it is pointed out they are the stabilizer of the spatial equilibrium. As Redding et al (2011) argues, "the existence of multiple steady state locations may be reinforced by network externalities, which imply that the profitability of operating a connection to an airport is likely to be increasing in the number of other connections to that airport." Xu and Itoh (2017) is one of the exceptional works which shows an evidence of multiple steady state of port choice by testing the shift of port choice by a big earthquake at hub port.

We hypothesize that regional disintegration due to the partition of India and countries gaining independence increased trade costs for routes where origin and destination fall in different countries, c.f. after the partition, the shipments for such routes became international and are required to accompany necessary documents, and additional costs and time. Given such increase in trade costs and transaction costs, some shipments may be diverted. Such diversion may be happened not only through the sea as well as on land. As international borders emerged, some railway links became disconnected, such as routes from Delhi to Karachi, Assam to Kolkata, and vice versa. Overall shifts from the pre-partition equilibrium to post-partition equilibrium shall be reflected by the frequencies of vessel movements. Thus, by utilizing the time-consistent data on vessel movements, we test the changes in trends at 1947 for partition and independence of India and 1971 for independence of Bangladesh.

3.2. Empirical specifications for impacts on maritime networks

We follow the same methodology employed by Xu and Itoh (2017) which examined the impact of an earthquake on the maritime networks of ports by exploring the impacts of partition and independence on trade direction in South Asia.

As our data allows us to identify the origin-destination port pairings, our analysis is at the port to port level. We estimate the following equations for our analysis. The dependent variable is the share of the vessel movements between some port p and some port q within the Indian subcontinent at time t.

$$share_{pqt} = \alpha_0 + \beta_{pq} Post_t * Affected_{pq} + \delta_p + \gamma_q + \mu_t + \epsilon_{pt} \quad (1)$$

Post is a time dummy variable taking the value "1" for the years after 1947, and *Affected* is a dummy variable taking the value "1" for the routes whose pair of origin and destination locations became international. The interaction between these two dummy variables captures the treatment effect of regional disintegration. To further explore these effects, we take the heterogeneity of country pairs into account by separating

each pair of countries in the treatment group dummy to examine their specific trends individually. In equation 1, all affected routes are treated similarly.

$$share_{pqt} = \alpha_0 + \beta_{pq} Post_t \sum_{r=1}^{R} Affected_{pq}^{r} + \delta_p + \gamma_q + \mu_t + \epsilon_{pt} \quad (2)$$

There are several points to be discussed for the robustness of our findings. Firstly, we analyze the entire data period from 1890 to 2000. This longitudinal detailed port level data allows us to discuss the historical evolution, possible rock-in effects,[7] and the multiplicity of spatial equilibria. It is important to note, however, that by using a longer time range, it may inevitably invite factors apart from our focus and contaminate our results. So, we restrict ourselves to shorter ranges of time period c.f. 30 and 20 years before and after the partition.

Secondly, our analysis of regional disintegration represents a regional phenomenon within the Indian subcontinent. We separate out international trends by excluding them from the denominator and instead, focus on the evolution of regional trade share. This separation is particularly important if there are systematically different trends in international trade post WWII.

Thirdly, by focusing our discussion on the relationship between East and West Pakistan, we can identify another example of regional disintegration. East Bengal gained independence in 1971 following nearly a year of civil war against Pakistan. As East Bengal was situated within a country, trade between East and West (wing trade) was considered domestic between 1947 and 1971. After independence, their trade links shrunk but never vanished. In comparing regional and domestic trade within South Asia, an analysis of the breakup of Pakistan presents another potential study.

Fourthly, the relationship between the UK and the Indian subcontinent also demands serious inquiry and therefore, we use the independence of nations from the British Empire as the basis of further study. In fact, most independent nations remained within the Commonwealth of Nations, apart from Myanmar who never joined the Commonwealth.[8] Notably, trade routes to UK were only affected during disintegration, and in light of this, we look at international data through the same empirical strategy to analyze the region's separation from the UK.

Fifthly, we explore the impact of disintegration on port hierarchy, similar to Redding et al (2011). As the empirical specification for such study requires modification to equation (1) and (2), we explain this setup separately in the following section.

[7] Rock-in effect is the self-enforcing effect coming from network externalities, here.

[8] The Maldives left the Commonwealth of Nations in 2016.

3.3. Empirical specifications for impacts on port hierarchy

Redding et al (2011) examined the division of Germany and its impact on shifting the share of passenger traffic from the Berlin to Frankfurt airport. Similar to this study, we examine port hierarchy by aggregating the number of vessel movements at the port level and comparing changes in each port's share within each country and across the broader Indian subcontinent. We modify our equations to be estimated as follows:

$$share_{pt} = \alpha_0 + \beta_p Post_t \sum_{r=1}^{R} Port_p^r + \delta_p + \mu_t + \epsilon_{pt} \quad . \tag{3}$$

We estimate equation 3 through two specifications. First, we take the dependent variable with the share of vessel movements within the Indian subcontinent. Then, we replace it with the share of vessel movements within each country. In these specifications, we can illustrate how the port changed its presence within its country and across the Indian subcontinent.

4. Impacts of Regional Disintegration

4.1. Impacts on maritime networks

The South Asian maritime network went through drastic changes in terms of topology and overall spatial pattern, as seen in Figure 2. While the main port cities in each country were once connected principally, we observe polycentric shifts culminating in 2000. This pattern clearly confirms the demise of India as the main trade connector within the region, particularly after 1970 when trade become more evenly distributed and exhibits lower intra-regional connectivity.

=Figure 2 and Table 2comes around here.=

Our baseline results are shown in Table 2. The first three columns depict the impacts on the share in total links including international links and columns four to six show the impacts on the share in regional links. The first and fourth columns show the full time range from 1890 to 2000. The other columns limit time frames to 20 years before and after 1945. All results that come from the interaction of *Past* and *Affected* indicate a negative and statistically significant impact of treatment group. The size of the coefficients in total links are -3 percentage points (pp) for the entire period and -2.7 pp for the time range about 20 years. For the regional links, the size of the coefficients increases to -5.3 pp for entire period and -4.4 pp for the time range about 20 years. In comparing coefficient size, it is clear that coefficients are larger as the

timeframe in questions expands. This suggests that regional disintegration has both long lasting and lock-in effects. When we separate these impacts into bilateral relationships, we see notable changes in the total at column (3) and regional trade at column (6) between Bangladesh and Myanmar, Bangladesh and Sri Lanka, and India and Pakistan. The size of coefficients for these links ranges from -6.3 to -4 pp for total trade links and -13.7 to -5 pp for regional trade links. Including the links with Myanmar, we see consistent results showing substantial and statistically significant declines after partition.

=Table 3 comes around here.=

In looking at the independence of Bangladesh, we limit the time range to 15 or 20 years from 1971 and show the results in Table 3. We drop data for 1945 in the second and fourth columns as trade is negatively affected by WWII. Most of the results for different time period are consistent. For total trade links in column (2), there is a -2.8 pp impact on routes between Bangladesh and Pakistan and a -2.3 pp impact on routes between Bangladesh and India as well as between Bangladesh and Sri Lanka. The coefficient size of the route between Bangladesh and Myanmar is not statistically significant, albeit -2.5 pp. Both coefficient size and statistical significance change, however, in looking at the impacts within regional trade links. In column (4), there are 6.8 pp and -6.7 pp impacts on Bangladeshi routes with India and Sri Lanka, respectively, that are statistically significant. The Bangladeshi route with Pakistan is -2.4 pp but not statistically significant.

While we cannot conclude statistically significant results supporting regional disintegration between Bangladesh and Pakistan, we see a decrease in trade links between Bangladeshi and India as well as between Bangladesh and Sri Lanka. One possible interpretation of these results showcases the increase in importance of Chittagong port, the largest international port in Bangladesh; some transshipments via India and Sri Lanka could have shifted to direct shipments from Chittagong. The increase in the number of international routes from Chittagong following regional disintegration supports this. Furthermore, since the coefficients of post-partition for trade links between Bangladesh and Sri Lanka depicted in column three and six of Table 2 are statistically significant, it is likely that this tendency continued through the second half of the 20th century. This finding can support partial evidence of the persistent impacts of the 1947 partition.

=Table 4 comes around here.=

Turning to the impacts of the end of British Empire on South Asia, the results are shown in Table 4. The impacts are statistically significant at -3.8 pp for the entire period and -2.4 pp for 20 years from 1947. Separating the links shows approximately a -2.2 pp impact for Bangladesh, India, and Pakistan. Extending our sample periods to 30 years, the coefficient becomes larger. Compared to the first ten years, the next ten years (between 1965 to 1975) experienced further decline of -4.8 pp and -3.4 pp, particularly for Bangladesh and India. While the size of decline became larger in Myanmar, it remained statistically insignificant. Finally, the size of decline became smaller in Pakistan.

4.2. Impacts on port hierarchy

By aggregating our data at the port level, we obtain the total number of vessels called at the port and use this as a proxy for throughput. In our first analysis we calculate the concentration of vessels across the region during the study period not only at a node (port) level but also at a link (inter-port) level by the Gini and Herfindahl Index, depicted in Figure 3. This analysis confirms our previous cartography in Figure 2; the region clearly went through a traffic decentralization process, especially since the 1950s. Before this period, port hierarchy and the maritime network are relatively stable, notwithstanding some fluctuations. At the same time, from India's independence up until 2000, a noticeable decentralization process had clearly accelerated. India's independence thus constitutes a turning point in the evolution of regional port hierarchy, although such changes were also influenced by broader factors such as the likely effects of WWII and the rapid technological changes throughout port and maritime sectors (cf. the global spread of Diesel engines, the increased speed and size of vessels, etc.).

=Figure 3 and Table 5 comes around here.=

For the next step, we estimated two equations by taking different dependent variables for each. In Table 5, the first column shows the results for the share of calls in South Asia, and the second column shows the share of calls in the country. The results in both columns show the rise or fall of ports in a relative term. Please note that as the total number of vessel calls increases, the decline in its share doesn't necessarily mean an absolute decline. From the first column, the largest and statistically significant increases are found at Chittagong by 5.3 pp, at Karachi by 4.1 pp, and at Mongla by 3.8 pp. The largest and statistically significant declines are found at Yangon by -7.4 pp, at Kolkata by -1.4 pp and Mawlamyine by -1.1 pp. These trends are also consistent with

national trends, where increases are found in Bangladesh and Pakistan and declines in Myanmar. Looking closer at Indian ports, Kolkata and Mumbai experienced substantial declines, perhaps attributed to the emerging ports at different parts of the coastal lines. The above results become much clearer in looking to the second column which creates a better picture of the changing hierarchy among Indian ports.

As such, in the second column, we see the emergence of secondary ports in Bangladesh, namely Mongla and Chulna. While Chittagong remained the sole primary port, these secondary ports decreased the relative position of Chittagong by approximately -32 pp. However, as this is the relative position, the absolute number of vessel movements increased for 8 to 10 times that from averages of ports in the current Bangladeshi territory during the colonial period. As the total number of calls and ports increased in Bangladesh, we see a similar story unfold in Pakistan. The relative position of Karachi declined by -8.3 pp, suggesting the magnitude of increasing secondary ports is much smaller than Bangladesh. Though Md. Bin Qasim increased by 23.5 pp, the port's initial average number of calls during the colonial period was close to zero.

Kolkata's noticeable decline may be direct evidence that neighboring regions in East Bengal became disconnected and were therefore diverted to Chittagong. Among other influences disrupting Kolkata's economic, the loss of market accessibility due to the partition represents a strong factor. At the same time, the rise of Chittagong port can be explained through the diversion from Kolkata, now a foreign port.

5. Discussion and Conclusion

This paper examines the evolution of maritime networks in South Asia by taking two events, the end of the British Empire and the Independence of Bangladesh. We first examine the impacts of these events on trade networks (routes) and then examine the changes in port hierarchy (throughput).

Overall impacts of the end of the British Empire were negative, statistically significant, and of non-negligible size. By defining routes affected by this event as those that became international only after 1947, we see there -3% point of impacts in total and -4.4 % point of impacts in regional trade. By decomposing the bilateral linkages almost all of the routes affected got negative impacts. The end of British Empire not only affected within South Asia but also the direct link to UK. On the direct link to UK, -4% point for the entire sample period covering 20th century, -2.4% for 1950 to 1970.

Regarding the impact on port hierarchy, there were drastic changes. It was widely observed that the port system became more decentralized as the number of

international ports increased. As Bangladesh and Pakistan increased their calls and their chief ports at Chittagong and Karachi increased their rankings within South Asia, the relative positions of traditional chief ports in India such as Kolkata, and Mumbai, decreased substantially. The decline of Kolkata was noticeable, showing the loss of market accessibility and changes in its fundamentals.

This study also contributes to a better understanding of port and maritime network dynamics, especially their ability to both reflect, absorb, and transform in times of major changes. It is also a contribution to network science in general, where spatio-temporal change in network topology and connectivity remains poorly studied empirically. Networks embedded in space exhibit specific features where the physical/human geography factor is paramount compared with other types of networks (Barthelemy, 2015); in the maritime case, we could confirm that spatial friction, path- and place-dependency as well as political and technological changes cannot be ignored when observing spatial network evolution.

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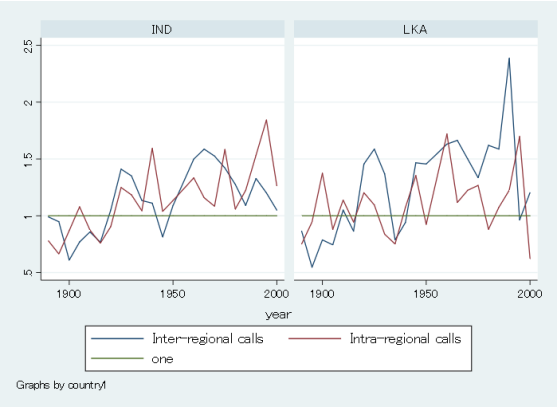
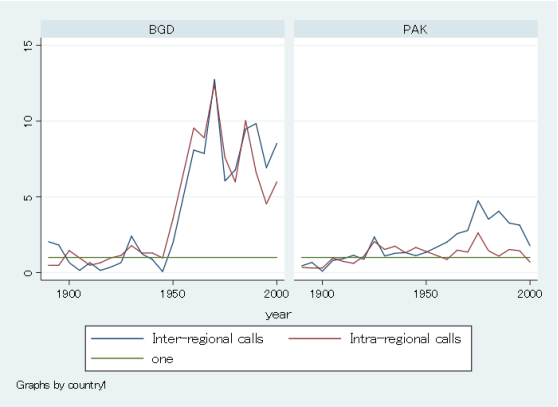
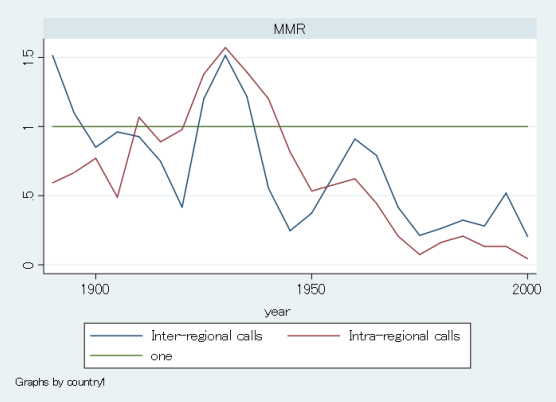
Figure 1. Total number of calls by country and by destination



(a) India and Sri Lanka

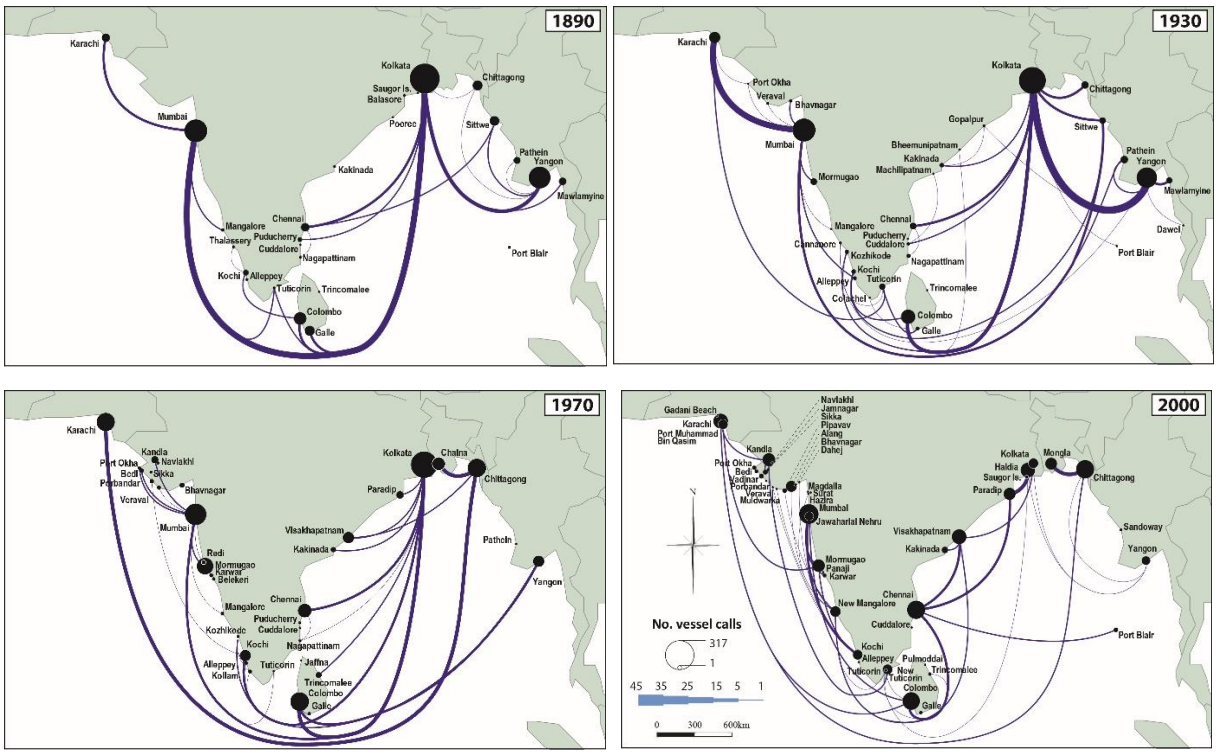


(b) Bangladesh and Pakistan



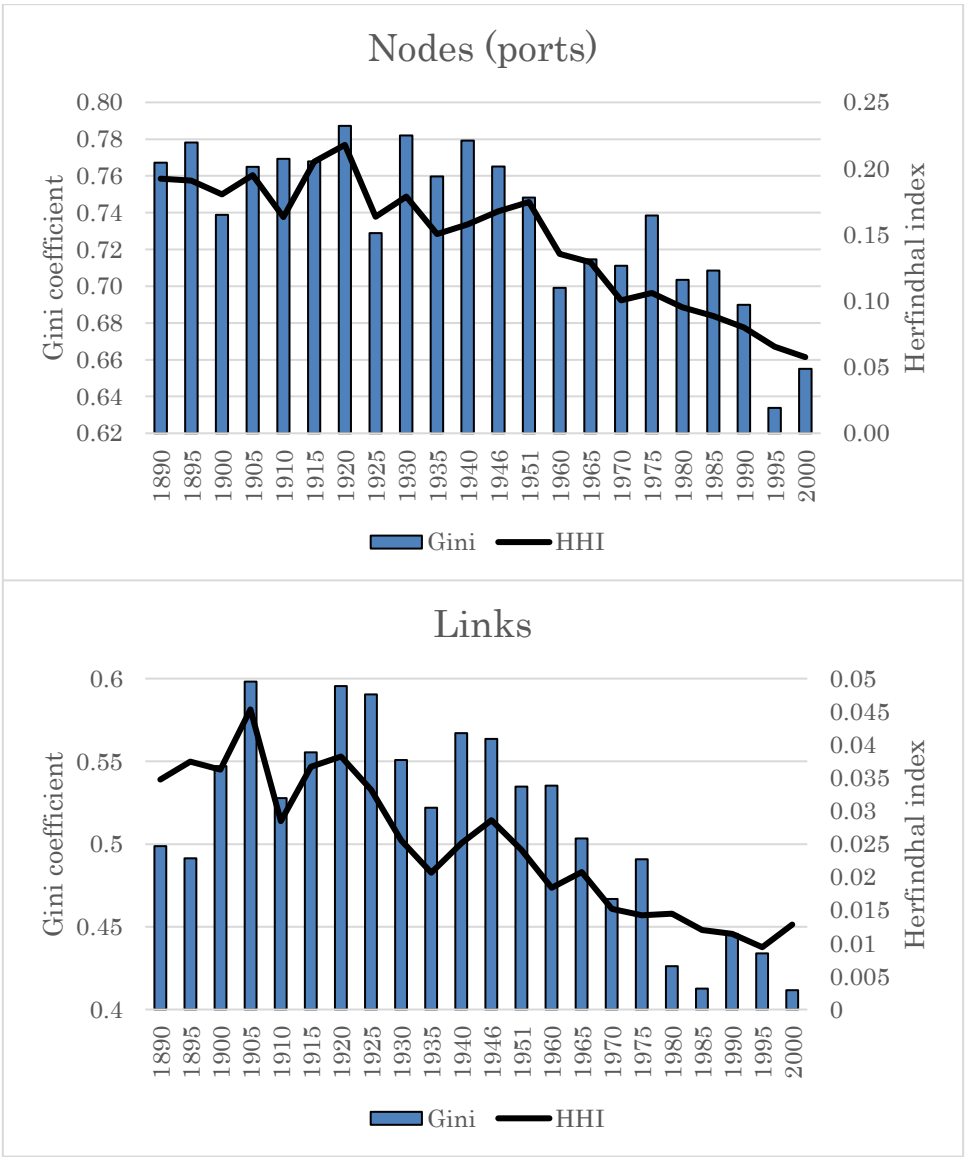
(c) Myanmar

Figure 2. Single linkage analysis of the South Asian maritime network at selected years, 1890-2000



(source: own elaboration)

Figure 3. Port and inter-port traffic concentration in South Asia, 1890-2000



(source: own elaboration)

Appendix Figure 1. Total number of calls by country

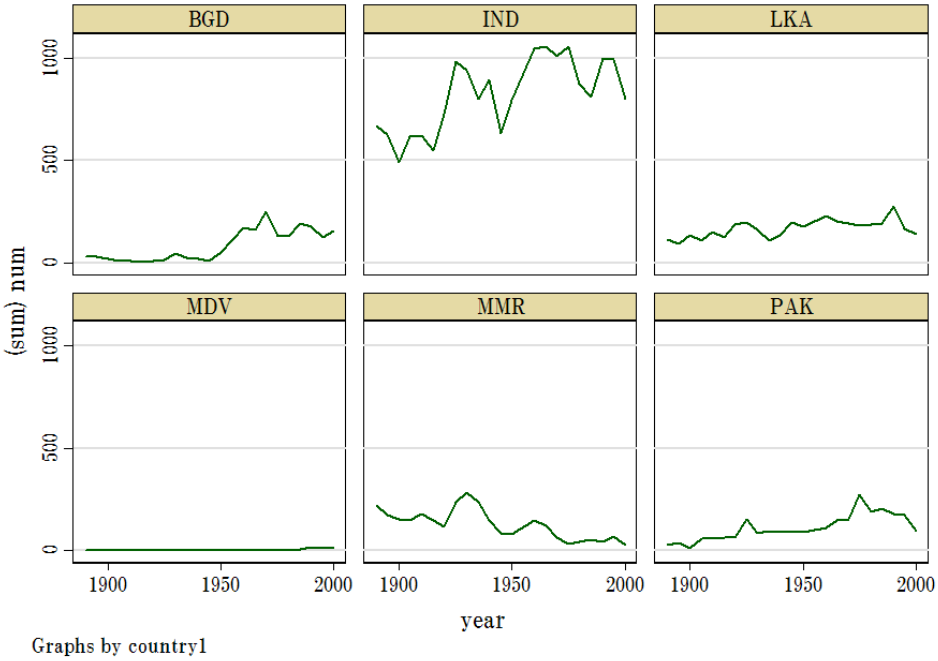


Table 1. Summary Statistics of averages of vessel movements for each period by country

	1890-1920	1920-1945	1950-1975	1975-2000
Number of vessels				
Bangladesh	16.3	22.4	152.8	155
India	615.7	851.2	994.2	897
Sri Lanka	130.6	160	196.8	193
Myanmar	162	197	89	46.6
Pakistan	45.9	102	155.6	169
Number of routes				
Bangladesh	9.9	11.8	78.2	71.4
India	171.7	282.8	429.8	480
Sri Lanka	55.6	62.6	94.2	93.8
Myanmar	72	72.8	44	25.6
Pakistan	16	37.4	68.2	87
Number of ports listed				
Bangladesh	1	1	2.2	2.4
India	14.6	21.2	21.2	29.8
Sri Lanka	2.6	2.4	3.2	4
Myanmar	4.3	5	3	1.6
Pakistan	1	1	1.4	2.2

Table 2. Impacts of Partition of India on vessel movements within South Asia

	(1)	(2)	(3)	(4)	(5)	(6)
Share of calls for in	total	total	total	regional	regional	regional
Period:	1890-2000	1925-1965	1925-1965	1890-2000	1925-1965	1925-1965
Post x Affected	-0.030***			-0.053***		
	(0.007)			(0.016)		
Post (1950-1965) x Affected		-0.027***			-0.044*	
		(0.010)			(0.024)	
Post (1950-1965) x Affected (BGD-IND)			-0.020			-0.047
			(0.012)			(0.031)
Post (1950-1965) x Affected (BGD-PAK)			-0.011			-0.019
			(0.016)			(0.055)
Post (1950-1965) x Affected (BGD-LKA)			-0.042***			-0.074**
			(0.016)			(0.029)
Post (1950-1965) x Affected (BGD-MMR)			-0.063***			-0.137***
			(0.024)			(0.047)
Post (1950-1965) x Affected (IND-LKA)			-0.032*			-0.034
			(0.016)			(0.031)
Post (1950-1965) x Affected (IND-PAK)			-0.035**			-0.062**
			(0.015)			(0.031)
Post (1950-1965) x Affected (IND-MMR)			-0.042***			-0.065
			(0.015)			(0.041)
Post (1950-1965) x Affected (PAK-LKA)			-0.042***			-0.056
			(0.015)			(0.045)
Post (1950-1965) x Affected (PAK-MMR)			-0.059**			-0.109*
			(0.024)			(0.065)
Post (1950-1965) x Affected (LKA-MMR)			0.036			0.046
			(0.051)			(0.067)
Origin port fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
Destination port fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
Observations	11,995	4,323	4,323	2,730	978	978
R-squared	0.615	0.702	0.704	0.593	0.677	0.681

Robust standard errors clustered by origin-destination pair of ports are shown in parentheses. The number of stars indicate the statistical significance at *** p<0.01, ** p<0.05, and * p<0.1.

Table 3. Impacts of Independence of Bangladesh on vessel movements

	(1)	(2)	(3)	(4)
Share of calls for	total	total	regional	regional
Period:	1945-2000	1950-1995	1945-2000	1950-1995
Independence x Affected (BGD-IND)	-0.028***	-0.023***	-0.091***	-0.068**
	(0.008)	(0.008)	(0.030)	(0.030)
Independence x Affected (BGD-PAK)	-0.037***	-0.028***	-0.030	-0.024
	(0.014)	(0.009)	(0.053)	(0.054)
Independence x Affected (BGD-LKA)	-0.033***	-0.023**	-0.097**	-0.067*
	(0.012)	(0.011)	(0.038)	(0.034)
Independence x Affected (BGD-MMR)	-0.033*	-0.025	-0.002	-0.004
	(0.020)	(0.016)	(0.049)	(0.043)
Independence x Affected (IND-LKA)	-0.025***	-0.015*	-0.020	-0.002
	(0.009)	(0.009)	(0.021)	(0.020)
Independence x Affected (IND-PAK)	-0.033***	-0.026***	-0.020	-0.021
	(0.011)	(0.009)	(0.020)	(0.024)
Independence x Affected (IND-MMR)	-0.049***	-0.047***	-0.013	-0.028
	(0.015)	(0.018)	(0.030)	(0.031)
Independence x Affected (PAK-LKA)	-0.006	0.011	0.038	0.045
	(0.034)	(0.038)	(0.033)	(0.035)
Independence x Affected (PAK-MMR)	-0.055***	-0.043***	-0.003	-0.008
	(0.015)	(0.013)	(0.038)	(0.039)
Independence x Affected (LKA-MMR)	0.052	0.053	0.102	0.097
	(0.067)	(0.071)	(0.069)	(0.072)
inter	-0.225***	-0.312***		
	(0.064)	(0.086)		
Origin port fixed effect	Yes	Yes	Yes	Yes
Destination port fixed effect	Yes	Yes	Yes	Yes
Year fixed effect	Yes	Yes	Yes	Yes
Observations	7,735	6,780	1,622	1,368
R-squared	0.675	0.677	0.671	0.674

Robust standard errors clustered by origin-destination pair of ports are shown in parentheses. The number of stars indicate the statistical significance at *** p<0.01, ** p<0.05, and * p<0.1.

Table 4. Impacts of the end of British Empire in South Asia on vessel movements

Share of calls for international routes	(1)	(2)	(3)	(4)	(5)
Period:	1890-2000	1925-1970	1925-1970	1915-1975	1915-1975
Post x UK	-0.038***				
	(0.008)				
Post (1950-1970) x UK		-0.024***			
		(0.007)			
Post (1950-1970) x UK-BGD			-0.023*		
			(0.014)		
Post (1950-1970) x UK-IND			-0.022***		
			(0.007)		
Post (1950-1970) x UK-MMR			0.008		
			(0.013)		
Post (1950-1970) x UK-PAK			-0.024**		
			(0.010)		
Post (1950-1960) x UK				-0.030***	
				(0.008)	
Post (1965-1975) x UK				-0.038***	
				(0.008)	
Post (1950-1960) x UK-BGD					-0.015
					(0.013)
Post (1965-1975) x UK-BGD					-0.048***
					(0.013)
Post (1950-1960) x UK-IND					-0.030***
					(0.008)
Post (1965-1975) x UK-IND					-0.034***
					(0.009)
Post (1950-1960) x UK-MMR					-0.008
					(0.011)
Post (1965-1975) x UK-MMR					-0.024
					(0.017)
Post (1950-1960) x UK-PAK					-0.041***
					(0.013)
Post (1965-1975) x UK-PAK					-0.025**
					(0.010)
Origin port fixed effect	Yes	Yes	Yes	Yes	Yes
Destination port fixed effect	Yes	Yes	Yes	Yes	Yes
Year fixed effect	Yes	Yes	Yes	Yes	Yes
Observations	9,265	3,345	3,345	5,102	5,102
R-squared	0.603	0.697	0.696	0.682	0.682

Robust standard errors clustered by origin-destination pair of ports are shown in parentheses. The number of stars indicate the statistical significance at *** p<0.01, ** p<0.05, and * p<0.1.

Table 5. Impacts of the end of British Empire in South Asia on Port Hierarchy

Variables		(1) Share in South Asia	(2) Share in each country
Post x *Port dummy*			
Bangladesh			
	Chittagong	0.053***	-0.322***
		(0.006)	(0.007)
	Chalna	0.035***	0.311***
		(0.007)	(0.006)
	Mongla	0.038***	0.311***
		(0.008)	(0.013)
India			
	Kolkata	-0.146***	-0.222***
		(0.006)	(0.007)
	Mumbai	-0.059***	-0.083***
		(0.006)	(0.007)
	Chennai	0.036***	0.063***
		(0.006)	(0.007)
	Haldia	0.029**	0.051***
		(0.008)	(0.010)
	Kandla	0.033***	0.056***
		(0.008)	(0.008)
	Kochi	0.023**	0.040***
		(0.006)	(0.007)
	Mormugao	0.035***	0.060***
		(0.006)	(0.007)
	Nagapattinam	-0.001	-0.002
		(0.008)	(0.007)
	Visakhapatnam	0.030***	0.051***
		(0.006)	(0.007)
Sri Lanka			
	Colombo	0.009	0.063***
		(0.006)	(0.007)
	Galle	-0.007	-0.092***
		(0.006)	(0.007)
	Trincomalee	0.002	0.017**
		(0.005)	(0.006)
Myanmar			
	Yangon	-0.074***	0.192***
		(0.006)	(0.007)
	Mawlamyine	-0.011**	-0.038***
		(0.004)	(0.003)
	Pathein	-0.008	-0.035***
		(0.005)	(0.004)
	Sittwe	-0.009	-0.046***
		(0.005)	(0.004)
Pakistan			
	Karachi	0.041***	-0.083***
		(0.006)	(0.007)
	Gadani Beach	0.008	0.031**
		(0.009)	(0.011)
	Port Md. Bin Qasin	0.029**	0.235***
		(0.008)	(0.012)
Year fixed effect		Yes	Yes
Country fixed effect		Yes	Yes
Port fixed effet		Yes	Yes
Observations		677	677
R-squared		0.930	0.984

Robust standard errors clustered by country are shown in parentheses. The number of stars indicate the statistical significance at *** p<0.01, ** p<0.05, and * p<0.1.