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The Spatio-Temporal Distribution and Development Modes of Border Ports in China

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Abstract: Border ports play a substantial role in socio-economic exchanges, which reflect the diplomatic relations between neighboring countries. This paper maps and analyzes the evolution process of border ports in China since the 1930s, in terms of the spatial distribution, transport modes, cargo and flows of people. Four development modes of border ports and cities are summarized based on the functions and development level of border ports and their proximity to urban core areas. The four modes include: (1) Port-Port mode; (2) City-Port-Port-City mode; (3) City (Port)-Port-City mode; (4) City (Port)-City (Port) mode, which also reflect the spatio-temporal evolution process of certain border ports and cities. The results show that the development of border ports is closely related to the bilateral relations with neighboring countries and their complementarities of natural resources and economic development, national foreign policies, as well as the physical, historical and cultural context. The findings of this study are helpful to promote the sustainable development of the border port system which is crucial for win-win reciprocity between China and its neighboring countries.

Keywords: border ports; border cities; border trade; development mode; China

1. Introduction

Border regions are central to the nationalist agenda and the development of nation states [1]. The inland border region of China has a large land area and a long boundary. From the northeast to the southwest, China's border region is adjacent to 14 countries: the Democratic People's Republic of Korea (DPRK; hereafter referred to as North Korea), Russia, Mongolia, Kazakhstan, Kyrgyzstan, Tajikistan, Afghanistan, Pakistan, India, Nepal, Bhutan, Myanmar, Laos and Vietnam. By early 2014, there were 136 counties (cities or municipal districts, hereafter referred to as counties in the remainder of the paper) within nine provinces (or autonomous regions) in the border region, which is sparsely populated with a relatively low level of socio-economic development and a high proportion of ethnic minorities. The border region has 22 percent of China's total land area but only accounts for 1.7 percent of the total population and 0.11 percent of total industrial output by value. Forty-five percent of the total population in the border region is ethnic minorities.

A set of national policies have been announced by the Chinese central government to increase the development of the border port system since economic reforms were instituted in the late 1970s. The Western Development Strategy implemented by the Chinese central government is one of several important policies to facilitate infrastructure construction, as well as economic development and ecological protection in the western region where China shares long borders with its neighboring countries. This systematic development strategy has promoted the further opening and sustainable development of border ports. In 2010, China put forward more policies to speed up the opening up of the border regions and to develop special outward oriented industries and industrial bases in its Twelfth Five-year Plan (2011–2015). In a conference on diplomatic work with neighboring countries in 2013, President Xi Jinping emphasized the importance of regional economic cooperation and integration, including making joint efforts with neighboring countries to accelerate infrastructure connectivity, implementation of a free trade zone strategy and opening up of border regions. Recently, China also proposed creating a Silk Road Economic Belt and Maritime Silk Road for the 21st century. The former covers 18 Eurasian countries with a total area of 50 million square kilometers and a population of three billion people. The regions in this belt are rich in energy, mineral, cultural and agricultural resources which are important for social-economic exchange and the win-win development of countries. Inland border ports and border cities are undoubtedly enjoying these preferential policies for development. Statistics also show the economic achievements after the opening-up reform and related national policies. In monetary term, the trade between China and the 14 neighboring countries has increased rapidly and reached 121.4 billion US dollars in 2012 with an annual increase of 7.7 percent since 2005 [2,3]. The sustainable development of border ports is related to adequacy of land, environmental capacity, labor force and economic cooperation. The development of the national border port system is crucial for creating a sound surrounding environment for the common development of China and its neighboring countries [4].

Existing research has discussed the importance of border regions for the development of nation states [1]. Borders are changing over time and space and usually located in strategic locations, such as

interior checkpoints or offshore detention and processing [5] (p. 65). Borders have a cost because of the barriers to trade and free flow of goods and people [6]. “Cross-border interactions are more likely to occur when the ‘other side’ is easily accessible, in contrast to when people live farther away from the border” [7] (p. 7). Ehlers, Buursink and Boekema organized a special issue in *GeoJournal* on binational cities and their regions [8]. The studies indicate that economic development of border regions is important to foster a strong regional economic development, but they are still lagging behind in reality. The functions of border cities change from former peripheral locations in their countries to cross-border municipalities that attract attention from multi-level governments once the neighboring border cities start to cooperate. Local tensions and divergence of views exist in bi-national cities despite economic linkages being strong between bi-national cities [8,9]. However, examples are also given to argue that the border communities interact to develop similar and often parallel, regulatory transportation or environment policies [10].

Another group of studies focused on the role of inland ports in the transportation chain, port regionalization, and cross border economic cooperation. Witte *et al.* [11] analyzed the development of the inland port system in Netherlands, the expansion of both cities and ports, and port-city challenges in terms of infrastructure, and spatial, governance and economic structures. Lee *et al.* [12] studied the border city Hunchun, in the province of Jilin of China, which shares two international boundaries with North Korea and Russia. The establishment and operation of the Hunchun Border Economic Cooperation Zone facilitates an increasing exchange of goods and population and the development of trans-border industries. However, two of the challenges identified are the selection of major industries and the labor supply for its sustainable development. Ducruet *et al.* [13] analyzed port system evolution in North Korea and how economic and political factors affect its development.

Studies on border ports in China have increased in recent years in various disciplines. A group of studies analyzed the geographic environment and the development level of China’s border ports system to understand the advantages and challenges in promoting border cooperation [14,15]. Some historians studied the development process of ports and their impacts on regional economic development [16–18]. Researchers also focused on the regional cooperation and functions of specific border ports. For example, Gu and Womack studied the policy history of border relations with respect to economic cooperation and development between China and Vietnam in the 1990s [19]. Zhang, Ma and Yu studied the urban function and spatial development of the Manzhouli border port in Inner Mongolia [20]. Cho studied the conflict, cooperation and competition in Sino-Russian relations [21].

Geographers are interested in studying the hinterlands of border ports and the interaction mechanisms between port cities and urban hinterlands [22–24]. There is, however, little research, on the spatial and temporal development patterns and linkages between the development of border ports with environmental and economic sustainability in border regions between China and its neighboring countries, particularly in mainstream international journals.

This paper aims to map and analyze the evolution process of border ports in China since the 1930s, and examine the development mode of border ports and the nearest cities based on the geographical and socio-economic environment, as well as the functions of the border ports and their proximity to the urban core areas. The data for this research are collected from the “China’s Ports-of-Entry Yearbook” (2013) and “Yearbook of China Transportation and Communication” (2013) [25,26]. The results of this study are helpful for understanding the impacts of the development of border ports for cooperation between

China and its neighboring countries. It is argued that trade and communications at border ports reflect improving bilateral relations. The study also contributes to a better understanding of the sustainable development of China's border region. The second section of the paper focuses on the temporal and spatial distribution of border ports in China. The third section analyzes and summarizes the four development modes of border ports and port cities. Following a discussion of the findings, the conclusions of this research are summarized in the final section.

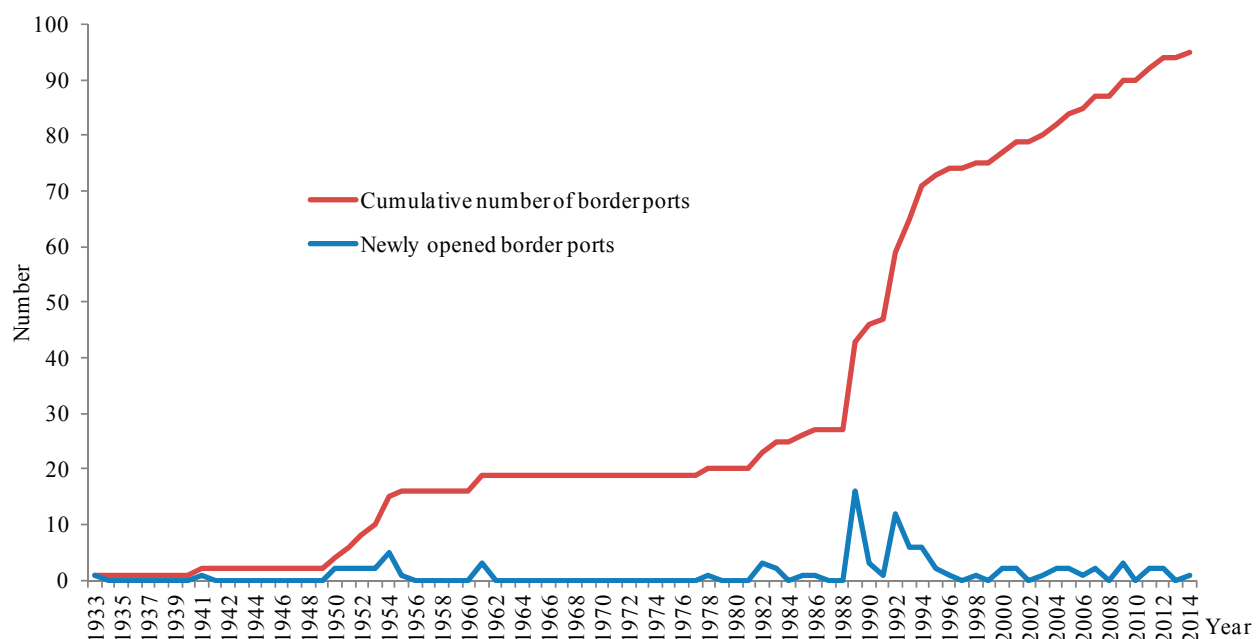
2. Temporal and Spatial Distribution of the Border Port System

There is no consensus on the definition of inland border ports in the existing literature due to the various roles and functions of border ports. A broad definition of ports is that the towns are located in a border region with the functions of export and import. A more specific definition refers to ports that are approved by a government to open up to neighboring countries, which are located at harbors, railway or highway stations, or airports with infrastructures for inspection and legal entry and exit of people, cargo and transport [27]. The border ports in this study refer to first class border ports (approved by the Chinese central government) in the inland border region since 1930 that have the functions of population, cargo and transport entry and exit. The types of border ports include railway ports, road ports, river ports (with ferries), and airports.

2.1. Development Process

Diplomatic relations between China and its neighboring countries and multilevel government policies play an important role in border port openings. The development of the border port system in China has gone through four stages: pre-1949, 1950–1979, 1980–1999, and post-2000 (Figure 1).

Figure 1. The development history of border ports in China since 1930.



2.1.1. Pre-1949: Passive Opening to Active Opening

The opening of sea ports in China can be dated back to the 19th century (the ports here do not refer to the first class national border ports). Five sea ports, including Guangzhou, Fuzhou, Xiamen, Ningbo, and Shanghai were forced to open under the provisions of “Treaty of Nanking” (1842) between China and the United Kingdom. Subsequently, the locations of the ports were expanded from the southeast coastal area to Taiwan, areas along the Yangtze River, North China, Northeast China, Xinjiang Uygur Autonomous Region, and Inner Mongolia Autonomous Region.

The history of opening border ports was a little bit later than the opening of sea ports mentioned above. In 1852, Yili and Taerbahtai (Tacheng today) in Xinjiang were open under the “ILI Taerbahtai Trade Regulations” between Russia and China. Kashgar was open in 1881 [28]. Before the foundation of People’s Republic of China, nearly all the ports were open under the unequal clauses except for the border ports between China and North Korea. Only two first class national inland border ports were opened before 1949 and both of them were open to North Korea. The first one was Kaishantun port located in Yanbian, Jilin Province with its corresponding port Sanfeng located in North Korea, which was opened in 1933. In 1941, China opened its second road port (Sanhe port) also in Yanbian, Jilin Province with Huining port as its corresponding port in North Korea.

2.1.2. 1950–1979: Slowly Opening and Spatial Concentration in Northeast China

After the foundation of the People’s Republic of China (PRC) in 1949, more border ports were gradually opening, especially in the northeast border region. During the second stage (1950–1979), 18 border ports were open, which included six road ports and three railway ports open to North Korea, one railway port to Russia, three road ports to Nepal (the Pulan port was open to both Nepal and India), two road ports and one railway port to Vietnam, and two road ports to Myanmar. The development of the port system reached its first peak in the early 1950s due to the stable political environment after the foundation of PRC. Between 1950 and 1955, a total of 14 ports were opened, including nine road ports and five railway ports. All the railway ports (except for the Hekou port in Yunnan Province) opened in this stage were located in the northeast region where the railways in China were first built before 1945 [29]. Some railways were built by Russia and connected to its railway network such as the Harbin-Suifenhe railway and the Harbin-Manzhouli railway in Heilongjiang Province, operated in 1902 and 1903, respectively [30] (p. 108). The Suifenhe port was the first railway port in China, which was open to Russia in 1952 with the Pogranichny port as its corresponding port. In addition, the Korean War (25 June 1950–27 July 1953) between the Republic of Korea (South Korea) and North Korea influenced the opening of border ports between China and North Korea. During the war, China intervened to support North Korea and nine border ports were open to North Korea during this period. National executive powers played an important role in the border ports opening during this period.

2.1.3. 1980–1999: Rapidly Opening and Westward Orientation

The number of the border ports was greatly increased during the third stage (1980–1999) with 55 new open ports and an annual increase of 2.75 border ports because of the “opening-up reform” in China in 1978 (changing from a central-planned economy to a market economy). Opening new border ports was

one of the actions in the reform. Meanwhile, the bilateral relations between China and Russia gradually normalized after the reform. After the dissolution of the Soviet Union in 1991, the independence of Kazakhstan, Kyrgyzstan and Tajikistan in Central Asia and their establishment of diplomatic relations with China facilitated border port openings in the western border region. Five border ports were opened during 1982 and 1983, including three road ports, a river port and an airport. In 1982, the first river port (Heihe port) was open in Heilongjiang with Blagoveschensk port in Russia as its corresponding port. The Kashgar airport in Xinjiang was open to Central Asia. In the late 1980s and the early 1990s (1989–1995), a total of 46 ports (almost one half of all the border ports today) were open with an annual increase of 9.2 ports on average, including 24 road ports, 14 river ports, four railway ports and four airports.

Most of the 46 ports are located in Heilongjiang Province (16 ports), Xinjiang (11 ports), and Inner Mongolia (eight ports). With regard to countries, the ports are mainly open for Russia (20), Mongolia (eight), Kazakhstan (seven), and Vietnam (four). Among the border ports between China and Russia, most of them are river ports since the Heilongjiang River is the national boundary.

2.1.4. Post-2000: Stable Increase and All-Round Opening Up

During the fourth stage (post-2000), the opening of China's border ports was relatively stable, with an average increase of one or two new ports each year. A total of 20 ports were open for eight countries after 2000. The goals of border ports openings in China at this stage was transformed from opening new border ports to improving infrastructure and port functions as well as developing an outward oriented economic system in the border region. The Western Development Strategy and policy emphasis on regional economic cooperation facilitated the opening up of border regions. Most of the ports were open to Mongolia, Vietnam, Myanmar and Russia. In terms of the types of border ports, there were 60 road ports, 16 river ports, 11 railway ports and eight airports among the 95 border ports by early 2014. With regards to the length of open time, ports are open on a seasonal basis, 79 ports are open during the entire year, among which 47 ports are open to the neighboring countries and at least one third country and 32 ports are only open to the neighboring countries. Eleven ports are only seasonally open due to weather conditions. In addition, five ports are temporarily closed.

2.2. Spatial Distribution

Through early 2014, China has opened border ports to 12 neighboring countries (Figure 2). The reasons for no border ports between China and Afghanistan or Bhutan are different. As for Afghanistan, the natural environment of the border areas between the two countries is challenging for opening a port. In the case of China and Bhutan, geopolitical factors play a significant role because the two countries have not established diplomatic relations yet. The border ports are mainly distributed along the China-Russia border (23 ports), China-North Korea border (15), China-Mongolia border (13) and China-Kazakhstan border (9), which accounts for 70.1 percent of the total ports (excluding airports). The spatial distribution of border ports is uneven in the border region due to physical, historical, socio-economic and cultural differences (Figure 2). There are 87 border ports opened in the three regions (Northeast China, Southwest China, and Northwest China) out of the total 95 border ports, accounting for 91.6 percent of the total (Table 1).

Figure 2. The spatial distribution of the first class national border ports in China.**Table 1.** The spatial distribution of various types of border ports in China.

Regions	Number of ports	Type of border ports				Foreign trade cargo (%)	Entry-exit people (%)
		Air	Railway	Road	River		
Northeast China	49	5	7	23	14	37.7	49.5
Southwest China	20	1	2	15	2	7.6	35.5
Northwest China	18	1	2	15	0	36.2	9.7
Others	8	1	0	7	0	18.5	5.4
Total	95	8	11	60	16	100	100

Data source: China's Ports-of-Entry Yearbook (2013) [25].

As defined in the Northeast Area Revitalization Plan, Northeast China covers Heilongjiang, Jilin, and Liaoning provinces as well as the five cities and municipal districts in the eastern region of Inner Mongolia with 21, 14, 2, and 12 ports, respectively. Figure 3 shows the spatial distribution of border ports in Northeast China. Among the 49 border ports, 14 of them are river ports (87.5% of the total river border ports) as Heilongjiang River and Yalujiang/Tumen River are the national boundaries between China-Russia and China-North Korea. Seven ports are railway ports (63.6% of the total in China) in Northeast China as a result of the well-developed railway network and their connections with neighboring countries in the early period. Overall, the border ports in Northeast China account for 51.6 percent of the total border ports. The cross-border cargo and entry-exit flow of people in this region, however, only accounted for 37.7 percent of the total foreign trade cargos and 49.5 percent of the total entry-exit of people in 2012.

Figure 3. The spatial distribution of border ports in Northeast China.

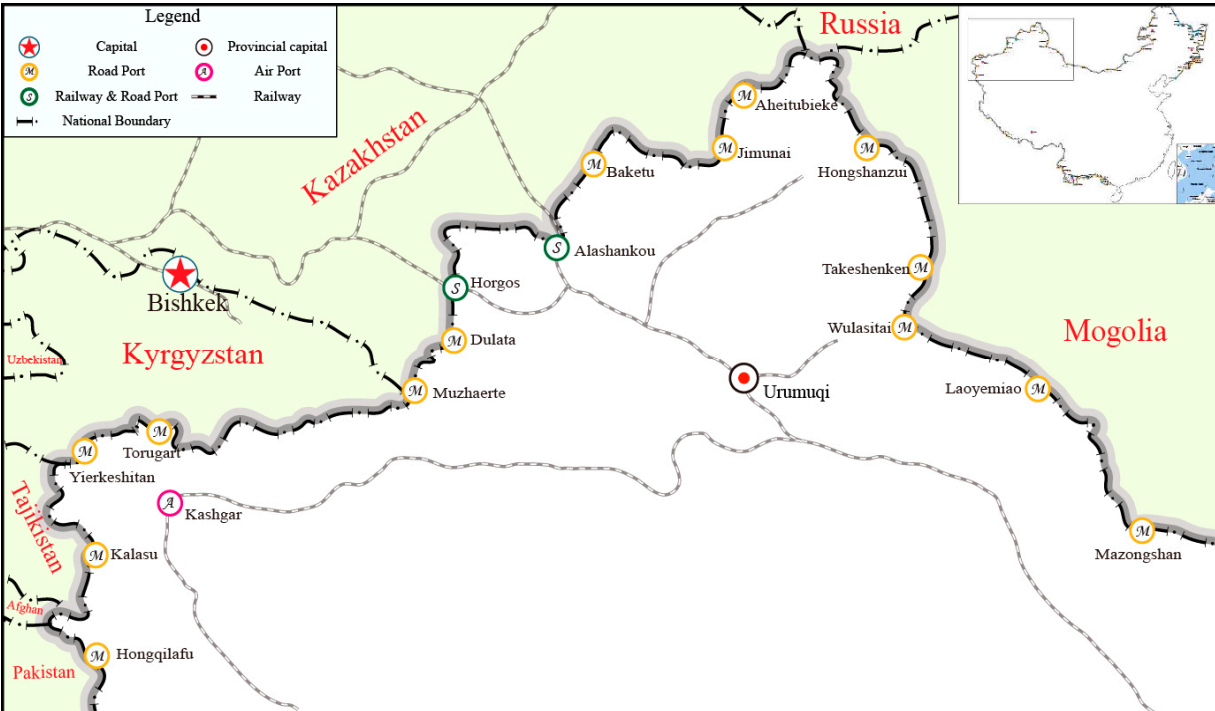
Southwest China includes Yunnan Province and Guangxi Zhuang Autonomous Region with 14 and 6 ports, respectively, which account for 21 percent of the total ports (Figure 4). Among the 20 border ports in Southwest China, 75 percent are road ports. The two river ports are located in Yunnan Province, but the water transport conditions are not as good as those in Heilongjiang Province. The natural environment in this region is relatively better for opening border ports than the northwest border region. The border ports in Yunnan and Guangxi, however, support 7.6 percent of the total cross-border cargo but 35.5 percent of the total entry-exit of people in 2012. In other words, the border ports in Southwest China play a more important role in the exchange of people rather than the flow of cargo traffic due to similar cultural backgrounds, population agglomeration, as well as port city development along the borders.

In Northwest China, Xinjiang has opened 18 border ports which account for 21.1 percent of the total ports (Figure 5). In the region, half of the ports are open to Kazakhstan, which shares the longest national boundary with China among the countries in Central Asia and is also the largest border trade partner of China there. Most border ports in Northwest China are located in areas with severe natural environments and sparse population. They, however, are very important for China for the importation of mineral and energy resources from Central Asia and the export of industrial products and daily necessities in exchange. The percentage of cross-border cargo traffic (36.2% in 2012) was much higher than the percentage of entry-exit of people (9.7%) of the total ports. The significance of the border ports in this region is increasing due to the proposal to develop the Silk Road Economic Belt, which will also enlarge the hinterlands of the border ports in this region and form an important traffic corridor.

Figure 4. The spatial distribution of border ports in Southwest China.



Figure 5. The spatial distribution of border ports in Northwest China.



2.3. Bilateral Trade

The volume of foreign trade cargo and number of entry-exit people vary among the border ports (Table 2). The foreign trade cargo is mainly exchanged in the border areas between China and Kazakhstan, Mongolia, and Russia and reached 107.5 million tonnes in 2012, accounting for 88.3 percent of the total volume of foreign trade cargo. Meanwhile, the number of entry-exit people is concentrated at the border ports between China and Russia, Vietnam, and Mongolia and reached 10.8 million person-times in 2012, accounting for 75.6 percent of the total person-times. In terms of border types, the foreign trade exchange was mainly through railway and road ports while most of the entry-exit people go through the road ports.

Table 2. The foreign trade cargo and entry-exit people at border ports by countries in 2012.

Country	Ports Number	Foreign trade cargo (1000 tonnes)	Percent (%)	Entry-exit people (1000 person-times)	Percent (%)
Russia	23	31,783	26.1	4575	32.1
North Korea	15	3513	2.9	572	4.0
Mongolia	13	34,851	28.6	2435	17.1
Vietnam	10	4655	3.8	3754	26.4
Kazakhstan	9	40,884	33.6	1200	8.4
Burma	5	3621	3.0	1148	8.1
Laos	4	1005	0.8	322	2.3
Nepal	4	174	0.1	108	0.8
Kyrgyzstan	2	1048	0.9	93	0.7
Pakistan	1	59	0.0	18	0.1
Tajikistan	1	173	0.1	11	0.1

Data source: China's Ports-of-Entry Yearbook (2013) [25]. Note: The statistics above does not include the cargo and entry-exit people at airports, because the destinations of cargo and exchange of people through airports may have destinations in various countries which are different from the road ports, railway ports and river ports.

The main products China exports are steel and non-ferrous metals, chemical products, industrial machinery, steel, and mineral-based building materials, while it imports metal ores, timber, oil, coal *etc.* In 2012, the foreign trade throughput by railway was 54.24 million tonnes and most of the cargo went through four border ports, namely, Manchuria in Inner Mongolia (36.3%), Alashankou in Xinjiang (30.1%), Erlianhot in Inner Mongolia (16.2%) and Suifenhe in Heilongjiang (15.0%), which accounted for 98 percent of the total.

Regarding the trade cargo and entry-exit people through the road ports, the number was 69.4 million tonnes and 12 million person-times, accounting for 57 percent and 81 percent of the total, respectively. The trade cargo was spatially concentrated at Horgos port in Xinjiang (24%), Ganqimaodu port in Inner Mongolia (18%), Alashankou port in Xinjiang (15%), and Ceke port in Inner Mongolia (14%). Exit people were slightly more than the entry people, which were mainly concentrated at Dongxing and Friendship Gate ports in Vietnam, Manchuria and Erlianhot ports in Inner Mongolia, Horgos port in Xinjiang, Suifenhe and Dongning port in Heilongjiang, and Hekou port in Yunnan. The number of the entry-exit people in each of the above road ports was more than 0.5 million person-times in 2012, accounting for 67.4 percent of that among the total road border ports.

3. Modes of Border Ports and Cities

Infrastructure construction, investment cooperation, technology exchange and labor cooperation promote the development of industries and attract population agglomeration in the border ports, which are necessary for the sustainable development of the border regions. Border ports and border cities are simultaneously developing but at different paces due to the variation in environmental, socio-economic, and transport conditions. Four modes of border ports and border cities can be defined in terms of their functions and development level, their proximity to urban core areas on both the Chinese side and the neighboring countries' side of the border, and their relationship with border cities. The four modes include: (1) Port-Port (PP); (2) City-Port-Port-City (CPPC); (3) City (Port)-Port-City (CPC), and (4) City (Port)-City (Port) (CC). Figure 6 shows the four modes of border ports and cities as well as their relationships on both sides of the national boundary. The cross-border trade in all the four modes is significantly influenced by the geopolitical environment and bilateral relations on both sides of national boundaries. Table 3 summarizes the examples of the four modes of border ports and border cities. Examples of each mode are discussed in the following section and are representative in terms of typical features of each mode and locations in various border regions.

Figure 6. Four modes of border ports and cities in the border region.

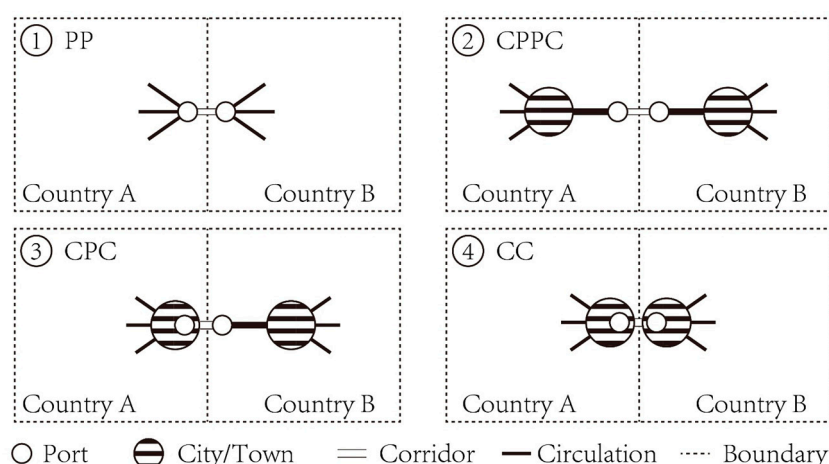


Table 3. Classification of inland border ports in the border region of China.

Type of modes	Inland border ports
PP	Shiwei (Heilongjiang); Heishantou, Arihashate, Ebuduge, Aershan, Zhuengadabuqi, Mandula, Ganqimaodu, Ceke (Inner Mongolia); Mazongshan (Gansu); Wulasitai, Takeshenken, Laoyemiao, Hongshanzui, Hongqilafu (Xinjiang); Pulan (Tibet); Houqiao, Mengkang, Jinshuihe (Yunnan); Pingmeng (Guangxi)
CPPC	Guchengli, Nanping Sanhe, Kaishantun (Jilin); Dongning, Mishan, Hulin (Heilongjiang); Torugart, Yierkeshitan, Kalasu, Dulata (Xinjiang); Mengding, Daluo, Mohan, Tianbao (Yunnan); Shuikou, Longbang (Guangxi)
CPC	Tumen, Ji'an, Linjiang, Hunchun (Jilin); Suifenhe (Heilongjiang); Manzhouli (Inner Mongolia); Alashankou, Horgos, Jimunai (Xinjiang)
CC	Dandong (Liaoning); Heihe, Mudanjiang (Heilongjiang); Ruili, Wanting (Yunnan); Hekou, Youyiguan, Dongxing (Guangxi)

Note: The name of provinces where the border ports are located is indicated in the brackets.

3.1. Port-Port Mode

The border ports of the PP mode show that ports are located on both sides of the national boundary without any city as its hinterland (Figure 6). The border ports have limited urban functions due to the adverse natural environments and sparse population for urban development. This mode of ports exists for two reasons. First, there is a demand for cargo and the exchange of people across the border. For example, Mandula, Ceke, Arihashate, Ganqimaodao in the Inner Mongolia (China) and their corresponding ports in Mongolia mainly exist of import and export mineral and energy resources. In these border ports, the volume of foreign cargo trade is large relative to the exchange of people.

A second reason for the PP mode is related to the historical origins and religious purposes. The Pulan border port (Pulan port (in China), Gongji port (in India) and Yali port (in Nepal)) can be used to illustrate this explanation for the PP mode. The three ports are located on the south slope of central Southern Himalaya in the border areas of China, India, and Nepal. Historically, Pulan is an important pass for the Hinduism believers making their pilgrimages to a “sacred mountain” and “holy water”. Pulan border port was opened to India and Nepal in 1954 and 1961, respectively, as a crossing for people and traditional trade by the residents in the border region. Gongji, the border port of India, however, was closed in 1962 because of the Sino-Indian Border conflict and it was reopened in 1992 when Sino-Indian relations recovered. Due to political and border security reasons, China and India maintain strict controls on the scope of goods and set limits for the open hours for cross-border trade. As a result, the trans-border trade exchange between China and India is underdeveloped and the border trade volume is extremely small. The severe natural environment also limits the cross-border trade between Sino-India and Sino-Nepal and the development of urban functions of the border ports.

3.2. City-Port-Port-City Mode

In the CPPC mode, there is a city located near the border port as its major hinterland (Figure 6). The port functions and urban functions are, however, spatially separated. The urban functions at the border ports are limited as a result of severe natural environments and limited development in the border region, which is similar to the PP mode. Most cases of the CPPC mode in China are located in the western border region at high elevations, on barren lands, and where the weather is severe. The cities are located within a proximal distance from the ports with land resources and where natural environments are less severe and provide support for the ports as their major hinterlands. The border ports and cities are connected by transport lines and their relationships are evolving with new socio-economic development and the construction of transport infrastructures.

Kashgar-Torugart (in China) and Torugart-Naryn (in Kyrgyzstan) is one example of the CPPC mode. Torugart is a border port in the Tianshan Mountains between the Naryn Province of Kyrgyzstan and Xinjiang of China. In 1881, Russia and China first established a port of entry at the Torugart crossing at the elevation of 3795 m. The Torugart port, however, was closed in 1969 due to the deterioration in Sino-Soviet relations and reopened in 1983. The high elevation, extremely cold weather, little precipitation, and limited flat space constrained the development of Torugart port and interfered with the cross border exchange between China and Kyrgyzstan. In 1995, the Torugart port was relocated to a lower elevation (2000 m). Kashgar and Naryn, over 100 km away from the Torugart port, are the major

hinterlands as well as its nearest cities. In 2010, the Kashgar Special Economic Zone was established, which is the implementation of the Shenzhen model in west China. The central government announced a series of policies covering areas of administration, finance, tax, land use, industry and aiming to develop Kashgar as an export processing zone and logistics distribution center for the countries in Central Asia. In 2012, the volume of foreign cargo trade in Torugart port was 466,000 tonnes and the entry-exit of people reached 45,367 person-times. China mainly imported oil, minerals, and wood which are rich in Kyrgyzstan and exported food, fertilizer, daily necessities, and light industrial products in exchange. Guchengli port in Jilin Province, Dongning port in Heilongjiang, Mengding port in Yunnan Province, Shuikou port in Guangxi and their corresponding border ports in the neighboring countries are other examples of the CPPC mode in the border region.

3.3. *City (Port)-Port-City Mode*

The cross-border cooperation of this mode as shown in Figure 6 is relatively nascent with most activities and constructions generated on the side of country A, while the port in the neighboring country B is less developed. The border port located in the city of country A is a part of the urban functions, while the border port in the neighboring country B has very limited urban functions and is located separately from the nearby city. Reasons for the different development patterns of border ports on the two sides of the boundary involve the natural, political, and social differences in the two countries. The Chinese government has implemented a series of preferential strategies for the development of border ports in recent years. Well-developed infrastructure and economic development leads to population aggregation, which facilitates the formation of a city and its urban functions. On the side of the neighboring country, the border port has a relatively small population, limited urban functions, and lagging infrastructures. Alashankou is a typical example of CPC mode and is located in a strategic position as part of the Silk Road Economic Belt proposed by China.

Alashankou port is located in the border region of Xinjiang in China and it is a key port on the Eurasian Land Bridge. The corresponding port is Druzhba in Kazakhstan, which is 580 km away from Almaty City. In 1991, the railway port of Alashankou was open as a first class national port. Before 2012, Alashankou was the sole port with railway, road, and pipeline crossings (Horgos also has railway, road and pipeline border ports now) and was also the largest border port in China in terms of cross-border cargo trade. Before 2000, local industries and the economy, however, developed slowly and urban functions were not fully developed for the formation of a city due to the severe natural and climate conditions. Most cargo trade was the transshipment trade at that time. Since the Tenth Five-year Plan (2001–2005), Alashankou has gradually grown in urban functions. In 2008, the Xinjiang provincial government approved the establishment of the Alashankou industrial park and offered preferential policies to attract industrial investment. Three years later, the Alashankou national comprehensive Free Trade Zone (5.6 square kilometers with 800 million Yuan investment), the first one in Xinjiang, was approved by the state council of China to develop export processing industry and strengthen strategic cooperation in energy and mineral resources between China and the countries in Central Asia. In 2012, the international cargo volume through Alashankou reached 23.8 million tonnes, accounting for nearly 20 percent of the total border trade. With the rapid increase of cross-border cargo and entry-exit people, Alashankou was set up as a county-level city and is at the forefront of opening up West China. At present,

the city has about 40,000 residents. As a result, Alashankou and Druzhba have been gradually evolving from the PP mode in the early stage to the CPC mode with the formation of urban functions in Alashankou. Other border ports, such as Tumen and Hunchun in Jilin Province, Suifenhe in Heilongjiang Province, Manzhouli in Inner Mongolia and their corresponding border ports in the neighboring countries are also examples of the CPC mode.

3.4. City (Port)-City (Port) Mode

The CC mode border port has two important characteristics. First, the border ports are located in urban areas and provide important functions for the cities on both sides of the national boundary. Second, the two cities are spatially adjacent (Figure 6). The urban functions, such as administrative, industrial, and commercial activities as well as sound infrastructures, are well developed in this mode. CC mode border ports are normally located in places with relatively abundant natural resources such as water and land resources, as well as a moderate climate. Socio-economic exchanges are frequent between the binational border cities since they share similar cultural, ethnic and religious backgrounds. The cooperative national relationship and preferential border trade policies also facilitate exchanges across the border. The border ports of this mode mainly have long histories with well-developed cross-border trade and transport systems. Heihe in Heilongjiang Province, Ruili and Wanting in Yunan Province, Hekou in Guangxi and their corresponding border ports in the neighboring countries, are examples of the CC mode.

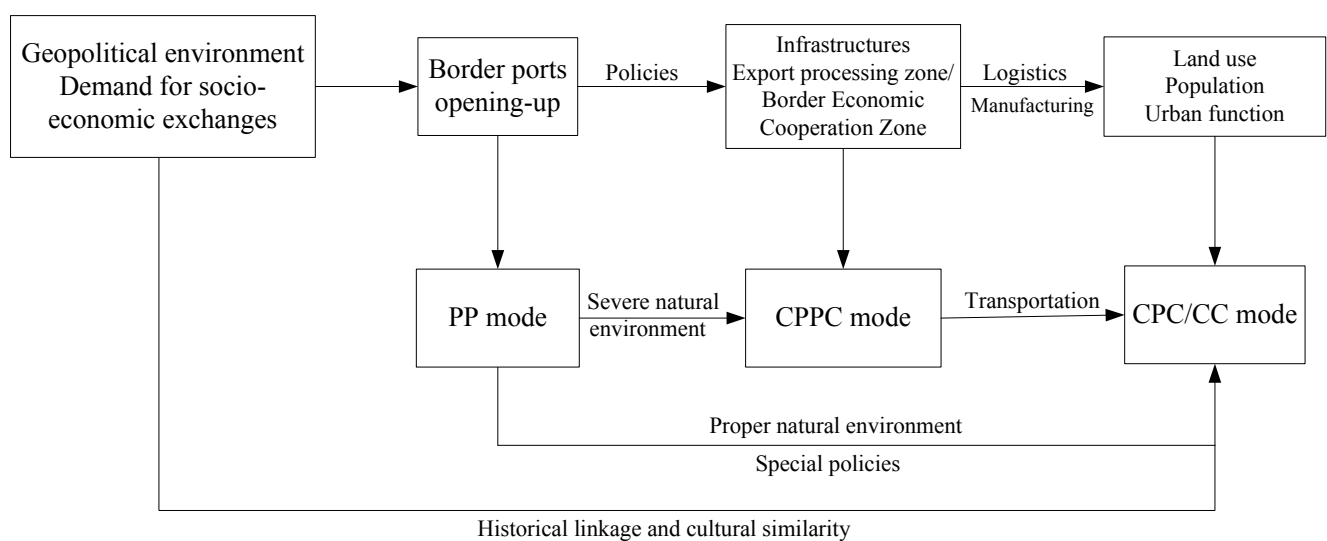
As an example of a CC mode port, Heihe (in the Northeast China) and Blagoveshchensk (in the Far East of Russia) are two adjacent cities located on both banks of the Heilongjiang River (also called Amur River in Russia) which is the boundary between China and Russia. The population size of Heihe and Blagoveshchensk are similar at 192,100 and 214,000, respectively. The two cities opened river ports in 1982. In 1994, the Chinese and Russian central governments approved the binational border port to be an international passenger and cargo transport port. Heilongjiang Province in China (where Heihe is located) and Amur Oblast in Russia (where Blagoveshchensk is located) share some common characteristics, such as similar natural environments, a peripheral location relative to the major national population and economic centers, a significant role of agriculture in their economies, delayed industrialization, and a substantial share of non-market/state-regulated economic activities (particularly in the natural resource sector) [31]. Along with the opening of border trade between China and Russia, cooperation and exchanges in the fields of culture, education, sports, and health care are rapidly developing. In 2012, the entry-exit population reached 1.1 million person-times at the Heihe port, ranking fourth among all the inland border ports of China and accounting for 7.5 percent of the total entry-exit population. The volume of international cargo trade at the Heihe port was 377,000 tonnes, ranking the 28th among all the border ports in the same year.

The opening and development of border ports is influenced by various factors as shown in Figure 7. First, demand for socio-economic exchanges between neighboring countries is essential for border ports to open. Opening and development are also influenced by complementarities in natural resources and industrial products of neighboring countries, the location of border ports, and the alternative trade modes by air or maritime transportation. Second, a stable geopolitical environment is necessary element for opening border ports, which is affected by the political stability of the border region, bilateral diplomatic

relations and the political credibility between the neighboring countries. The opening and closing of border ports reflects the regional development and political interest between the neighboring countries. Third, policies are important for the development of border ports in relation to urban subsystems and with the expansion of urban functions. Preferential policies on infrastructure constructions, tax policies, and the creation of the export processing or border economic cooperation zones facilitate the development of logistics activities and manufacturing activities, which can further result in changes inland use and attract population agglomeration. Fourth, natural environments are the last but not the least important factor for the development of border ports and cities, especially for sustainable development in the border region. Border ports with a more accommodating natural environment and increasing investment and industrial activities are more likely to attract population immigration and develop urban subsystems with functions including administrative management, infrastructures, education, and health care. Therefore, demand for socio-economic exchange, geopolitical environment, policies, and natural environment are the four key factors for the development of border ports and cities.

The four modes reflect the spatio-temporal evolution process of certain border ports and cities. The first step in the process is from the PP mode to the CPPC mode often mediated by a severe natural environment. The second step is from the PP mode via the CPC mode to the CC mode if the natural environment is suitable in the border region and the two neighboring countries are willing to increase border development cooperation. Differences in investment and policies will result from the different levels of development between the border ports in neighboring countries. Transportation is a key element for the evolution from the CPPC mode to the CC mode because improvements in transportation infrastructure can facilitate the integration of border ports and cities. There are also some examples of formation of the CC mode because of the strong historical linkage and cultural similarities without evolution from the PP mode and the CPC mode.

Figure 7. The evolutionary relationship between border ports and cities.



4. Discussion and Conclusions

This study mapped the spatio-temporal distribution of the inland border ports in China and analyzed their development modes. The results show that there were four stages with two peak periods for the

opening of inland border ports. Two peak periods came between 1950 and 1955 and 1989 and 1995. The opening of border ports is highly related to changes in bilateral relations, complementarities of natural resources and economic development between China and its neighboring countries, and national foreign policies. Generally speaking, the border ports along the northeast and southwest borders of China have relatively better natural environments and were developed earlier than the ports along the northwest borders. Moreover, the northeast and southwest border areas have common cultural foundations, which support the development of border ports and integration with urban development in the region as well. The severe natural environment in the northwest border area limits the development of urban functions in the border ports though the volume of foreign trade cargo is large. In addition, differences in ethnic groups, cultures, languages, and bilateral relations on both sides of the national boundary also need to be taken into account when delivering services and developing border areas.

Exchange is the core function of border ports and the development mode of border ports and cities reflects the interaction of human activities and the natural environment. Four development modes of border ports and cities are identified in this research, which are Port-Port mode, City-Port-Port-City mode, City (Port)-Port-City mode, and City (Port)-City (Port) mode, respectively. The border port functions and development level, the proximity of the border port to the urban core areas, and the relationship between the border port and the border city vary among the four modes, which also reflect the evolving processes of certain border ports and cities, though not all border ports follow the same development process.

In conclusion, the development mode is influenced by four key factors: the demand for socio-economic exchange, the geopolitical environment, policies, and the natural environment. The geopolitical environment determines the stability and reliability of border ports. The cargo and population exchange in the border region is affected by the demand for socio-economic exchange of neighboring countries as well as the locations of border ports. The integration of border ports and cities is mediated by the natural environment and policies. The sustainable development of a border ports system needs to find a balance between the interests of economic, political, transport, socio-cultural, and environmental values. The findings of this study contribute knowledge for promoting the sustainable development of the border port system which is crucial for win-win reciprocity between China and its neighboring countries.

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Author Contributions

Jiaoe Wang and Yang Cheng contributed to the design and analysis of the study and writing of the manuscript. Huihui Mo contributed on mapping and revising the manuscript. All authors read and approved the final manuscript.

Conflicts of Interest

The authors declare no conflict of interest.

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