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FOREWORD

Northeast Asia has witnessed a huge leap in regional trade volumes for the last 10 years. In spite of this, there has been no progress in the preparation of institutional devices to facilitate economic exchanges within the region. The Free Trade Agreement (FTA) discussions between Korea and Japan, or between Korea, Japan and China are at a standstill and appear to take a considerable length of time before reaching any conclusion. Therefore, at this point in time, it seems natural to seek alternative methods for promoting economic cooperation in Northeast Asia. In this context, this study focuses on the land transport linkages between Korea and China, the revitalization of inter-Korean economic cooperation and exchanges since the June 2000 summit, as well as Russia and China's increasing interest in the land transport linkages with Korea also clearing the path ahead of the land transport linkages between Korea and China.

It is evident that the Korea-China land transport linkages will constitute an integral part of Northeast Asian transport systems and provide an opportunity to extend their reach to Europe in the long run. The study, however, confines the realm of its discussion to the land transport linkages between Korea and China, between which, the land transport demand is continuously rising. Necessities may arise in the future to complement the study in terms of potential land transport corridors and inter-modal transport demand evaluations as political and economic situations change in the region. Yet the study is valuable in that it highlights the Busan-Shenyang route as a major land transport corridor to carry freight and passengers between Korea and China, with estimates on the diversion effect from sea and air transport to land transport. In addition, the study provides government authorities with policy recommendations to make the most use of Korea-China land transport linkages.

It is regretful, however, that the study could not be carried out based on the wide consensus of South and North Korean and Chinese experts because of the absence of North Korean experts. Nevertheless, we are very grateful to Jin Fengjun, Institute of Geography, Chinese Academy of Sciences; Wang Huijun, Economies & Planning Research Institute of the Ministry of Railway, China; and Zhu Junfeng, Institute of Comprehensive Transportation, the State Development Planning Commission of China for their cooperation. A seminar was held in Korea on April 16, 2001 as part of the study and we are also very thankful to Il-Soo Jun, vice president of the Korea Transport Institute; Sun-Duck Suh, professor at Hanyang University; Kwang-Myung Ahn, manager of the Ministry of Finance and Economy; Jin-Seok Choi of the Korea Railroad Research Institute; and Jae-Young Ryu of KRIHS, who contributed valuable recommendations and advice at the seminar. Finally, we hope that this report will help the readers to understand the issues involved in the integration of Northeast Asian transport systems.

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1
ECONOMIC COOPERATION AMONG NORTHEAST ASIAN COUNTRIES

Economic Cooperation between South Korea, China and Japan

The reform and opening of the Chinese economy that began in the 1990s have accelerated economic cooperation between Northeast Asian countries, but mainly between Korea (refers to South Korea unless specified otherwise), China and Japan. However, economic cooperation is expected to expand and spread to a larger area when North Korea turns to reform and opening of its own, with Russia and Mongolia succeeding in structural transition. Even in such a case, however, it is understood that the lack of transportation and telecommunications infrastructure, disparate economic systems, and different levels of economic development among Northeast Asian countries may impede regional economic integration as we have seen in the case of the European Union. In this context, the study stresses an improvement of transport systems within the region for the facilitation of intra-regional trade and passenger transport. The major concerns of Northeast Asian transportation systems are known to be the lack of transport facilities, insufficient integration of transport systems and inadequate international transport linkages. Intra-regional trade by sea and air transportation has grown remarkably during the past decade between the three major players, i.e., between South Korea and China, between China and Japan, and between South Korea and Japan. However, insufficient hinterland connections from seaports and airports present an obstacle to the smooth flow of goods and people. Therefore, the expansion and renovation of transport systems and the development of inter-modal transport linkages are considered essential elements for the facilitation of economic cooperation in Northeast Asia.

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Another rationale behind the integration of transport systems in Northeast Asia lies in the expectation that if Northeast Asian transport systems are connected to Central Asia and further to Europe, it would bring trade revitalization between Asia and Europe. The Trans-Siberian Railway and the Trans-Chinese Railway, which recently attract our attention, will certainly contribute to the promotion of transcontinental trade between Asia and Europe by taking advantage of low transport

costs. However, when considering the trend of increasing interdependence between South Korea, Japan and China in trade, the renovation of transport systems within these three countries seems to be the most critical item (Table 1-1), together with its transcontinental dimension.

Table 1-1 Regional trade distribution of Korea, China and Japan in 1999

Unit: million US$

	Korea		China[1]		Japan	
	Export	Import	Export	Import	Export	Import
Northeast Asia[2]	29,558	33,009	40,207	50,996	46,539	59,208
Europe[3]	26,127	16,579	36,206	32,651	81,935	52,521
North America	31,113	26,715	44,436	21,823	137,140	75,425
Others	56,887	43,449	74,301	60,318	153,753	124,108
World total	**143,685**	**119,752**	**195,150**	**165,788**	**419,367**	**311,262**

Notes: 1) Excluding Hong Kong and Macao
2) Only Korea, China and Japan are included
3) Including Russia
Sources: IMF, Direction of Trade Statistics Yearbook, 2000
Korea Customs Service (http://www.customs.go.kr)

Of particular interest here is the possibility of making land connections between the Korean peninsula and the continent by taking advantage of the opening of North Korea. Until now, South Korea and Japan have been island nations because of the closed border between South and North Korea. The opening of land transport between China and South Korea will bring significant changes to the current pattern of transport between the two countries. However, it is not expected to have a great impact on the current transport pattern between China and Japan, which can be characterized as freight by sea and passengers by air.

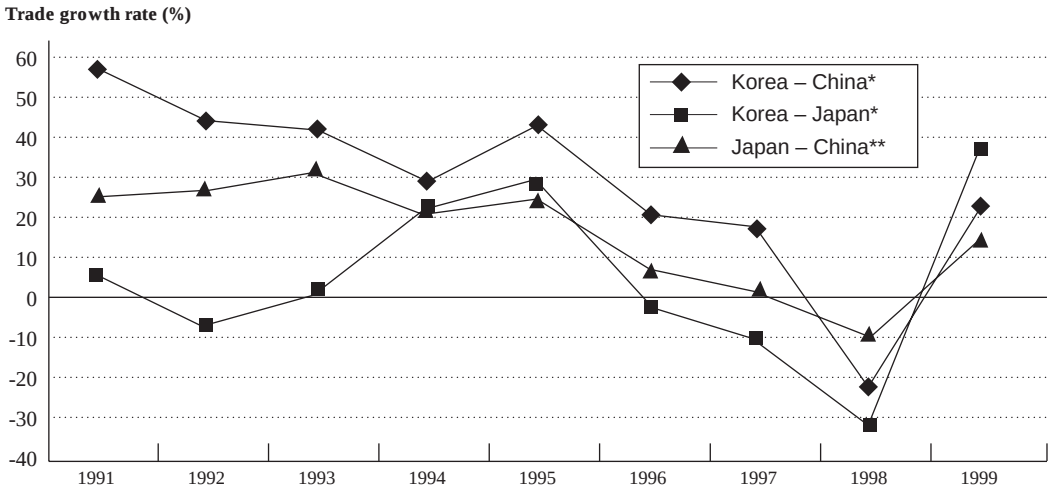
Trade among the three countries has continued to grow over the past 10 years, especially between Korea and China (Table 1-2 and Figure 1-1). The rapid growth of the Chinese economy has resulted in a sizable growth of China's export in manufactured goods, which is anticipated to further accelerate in the future. When looking into trade items between China and South Korea, primary products, such as grain and coal, are China's major export items to South Korea even though the share of manufactured goods, such as machinery, has been rapidly increasing as of recent. On the contrary, South Korea exports mainly manufactured goods to China (Table 1-3) and such features are more prominent in China-Japan trade.

Table 1-2 Growth of trade among Korea, China and Japan

Unit: million US$

	China		Japan		Korea		World total		Ratio of intra-regional trade(%)	
	1991	1999	1991	1999	1991	1999	1991	1999	1991	1999
China	-	-	20,284	66,167	3,245	25,036	135,701	360,938	17.3	25.3
Export	-	-	10,252	32,399	2,179	7,808	71,910	195,150	17.3	20.6
Import	-	-	10,032	33,768	1,066	17,228	63,791	165,788	17.4	30.8
Japan	22,853	66,520	-	-	32,469	39,227	551,785	730,629	10.0	14.5
Export	8,605	23,450	-	-	20,088	23,089	314,786	419,367	9.1	11.1
Import	14,248	43,070	-	-	12,381	16,138	236,999	311,262	11.2	19.0
Korea	4,444	22,552	33,476	40,005	-	-	153,395	264,495	24.7	23.7
Export	1,003	13,685	12,356	15,863	-	-	71,870	144,745	18.6	20.4
Import	3,441	8,867	21,120	24,142	-	-	81,525	119,750	30.1	27.6

Note: Based on data announced by the government of each country.
Source: IMF, 1996, 2000 Direction of Trade Statistics Yearbook



Note: * Data provided by Korea.
** Data provided by Japan.
Source: IMF, 1996, 2000 Direction of Trade Statistics Yearbook

Figure 1-1 Trend of trade growth rates among Korea, China and Japan

Table 1-3 Trade volumes by commodity between Korea and China

Unit: thousand US$, %

Item	Korea → China			China → Korea		
	1998	1999	2000*	1998	1999	2000*
Grain	13 (0.0)	1 (0.0)	288 (0.0)	358,171 (5.5)	188,888 (2.1)	621,441 (5.3)
Oil	1,148,305 (9.6)	1,304,998 (9.5)	1,689,635 (10.0)	395,103 (6.1)	234,626 (2.6)	402,441 (3.4)
Fat	3,767 (0.0)	2,182 (0.0)	3,134 (0.0)	4,978 (0.1)	4,826 (0.1)	5,430 (0.0)
Fertilizer	9,500 (0.1)	4,981 (0.0)	855 (0.0)	3,995 (0.1)	3,720 (0.0)	13,999 (0.1)
Cement	1 (0.0)	10 (0.0)	1,585 (0.0)	6,440 (0.1)	10,552 (0.1)	20,608 (0.2)
Coal	135 (0.0)	0 (0.0)	54 (0.0)	311,910 (4.8)	452,709 (5.1)	640,096 (5.5)
Timber	34,817 (0.3)	48,914 (0.4)	52,111 (0.3)	96,960 (1.5)	156,932 (1.8)	181,173 (1.5)
Salt	6 (0.0)	14 (0.0)	7 (0.0)	4,035 (0.1)	7,065 (0.1)	4,510 (0.0)
Miscellaneous ore	8,409 (0.1)	14,111 (0.1)	20,813 (0.1)	186,078 (2.9)	200,747 (2.3)	212,361 (1.8)
Sand	1 (0.0)	5 (0.0)	15 (0.0)	1,537 (0.0)	1,399 (0.0)	2,930 (0.0)
Processed food	17,485 (0.1)	15,793 (0.1)	25,696 (0.2)	131,594 (2.0)	168,756 (1.9)	215,673 (1.8)
Marine products	92,195 (0.8)	57,435 (0.4)	74,781 (0.4)	185,294 (2.9)	396,755 (4.5)	417,398 (3.6)
Iron ore	0 (0.0)	0 (0.0)	0 (0.0)	1 (0.0)	1,303 (0.0)	0 (0.0)
Machinery	3,047,365 (25.5)	4,153,913 (30.4)	5,772,726 (34.1)	2,120,352 (32.7)	3,306,231 (37.3)	4,230,184 (36.1)
Steel	1,115,870 (9.3)	1,076,532 (7.9)	1,215,121 (7.2)	461,220 (7.1)	565,347 (6.4)	856,449 (7.3)
Others	6,466,124 (54.1)	7,004,508 (51.2)	8,074,514 (47.7)	2,216,213 (34.2)	3,161,027 (35.7)	3,906,571 (33.3)
Total	**11,943,993 (100.0)**	**13,683,397 (100.0)**	**16,931,335 (100.0)**	**6,483,881 (100.0)**	**8,860,883 (100.0)**	**11,731,264 (100.0)**

Note: Figures in asterisked years are calculated from January to November.
Figures in parentheses are the ratio of a commodity volume to the total trade volume of each year.
Source: These data are a reproduction of data obtained at http://www.customs.go.kr.

China is very likely to become a world leading center of manufacturing, exceeding Japan in terms of export volume in a short period of time, which implies that there would be a rapid increase in container cargo transport to and from China. It will require transport networks within Northeast Asia on the one hand and the

extension of transport systems to such transport destinations as Europe and North America on the other. The transport of containerized or general cargoes between China, Japan and South Korea is currently dependent on ships. If land transport between China and South Korea becomes available, some portion of those cargoes can be transferred to land transport.

Intra-regional investment is also increasing among Northeast Asian countries in proportion to the increase of trade (Table 1-4), but the scale of investment compared to trade is relatively small. For instance, Japan has been increasing foreign direct investment (FDI) since the 1990s, but its investment in China and South Korea was merely 2.6% and 0.7% in 1998. In considering China as an important target country for overseas investment, Korea has been investing more than 10% of its total FDI in China since 1992. On the contrary, China is not in a position to invest overseas, but rather to take in FDI. Korea in particular, as well as Japan, mostly invest in the Chinese manufacturing sector. Japan, however, is also actively creating inroads into the Chinese service sector. In this sense, asymmetry is another notable feature of the investment structure of the three countries. As mentioned earlier, China is receiving investment from South Korea and Japan, whereas Korea is receiving investment only from Japan, while Chinese investment in South Korea and Japan and South Korean investment in Japan are small.

Table 1-4 Flow of foreign direct investment among Korea, Japan and China

Unit: million US$

		1991	1992	1993	1994	1995	1996	1997	1998	1999
From the world	To China	4,366	11,007	27,515	33,767	37,521	41,726	45,287	45,487	_
	To Japan	4,339	4,084	3,078	4,155	3,930	7,085	5,605	10,239	_
From the world	To Korea	1,116	803	728	991	1,358	2,309	3,088	5,215	10,357
From China		1	3	2	2	7	3	3	3	13
From Japan		203	174	157	340	338	279	236	423	806

		1991	1992	1993	1994	1995	1996	1997	1998	1999
From Japan	To the world	42,211	34,989	37,333	41,882	52,698	49,728	54,739	39,851	_
	To China	584	1,090	1,757	2,625	4,592	2,600	2,015	1,041	_
	To Korea	265	230	260	411	460	430	449	296	_
From Korea	To the world	1,115	1,219	1,262	2,300	3,072	4,248	3,230	3,893	2,482
	To China	42	141	264	632	824	836	633	631	289
	To Japan	12	28	6	58	105	81	64	23	48

Note: Data in upper table are presented by host countries.
Data in lower table are presented by investing countries.
Source: The Ministry of Finance and Economy, Foreign Direct Investment as of December 1999

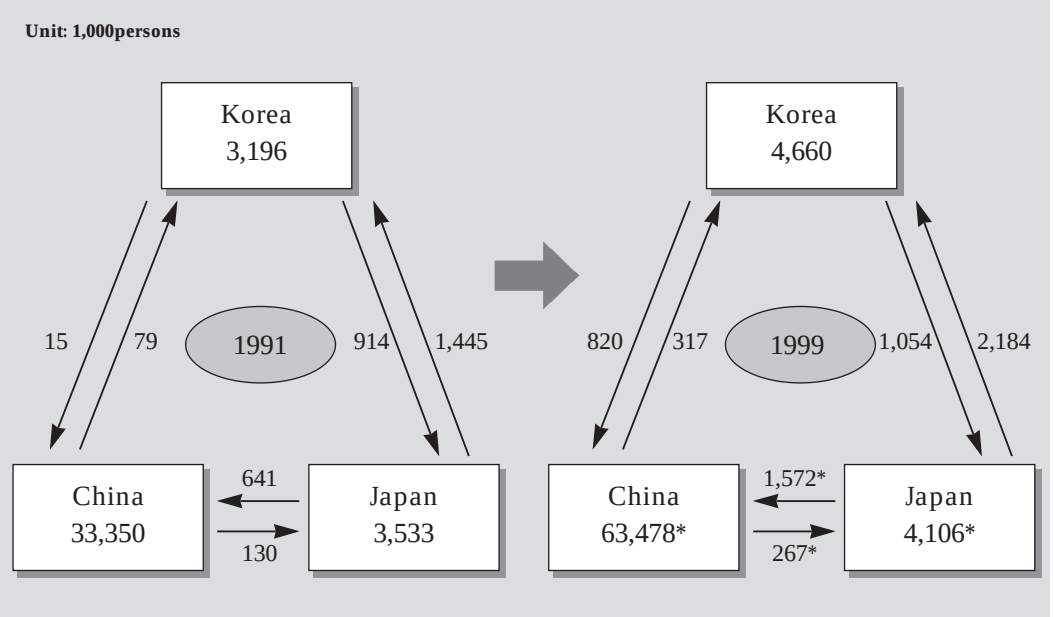
When looking into the details of investment between Korea and China, the primary reason for Korea's investment in China is to take advantage of cheap labor in China. Large corporations are increasing investment in China to advance into the Chinese market, and thus, the average amount of investment is showing an upward tendency. However, Korea's investment in China drastically decreased in the aftermath of the 1997 financial crisis and since then has continuously decreased. One of the notable features of Korea's investment in China is its geographical concentration (Table 1-5). Korea's investment is concentrated in the three northeast provinces of China and the Bohai region, accounting for more than 60% of Korea's investment in China. Japan's investment in China also distinctively features spatial concentration in Northeast China and the Bohai region. It leads to the conclusion that the land transport linkage between Korea and China will work to intensify investment connections between Korea, China and Japan, and at the same time, facilitate the transport of materials and goods as a result of investment and human exchanges.

Table 1-5 Geographical distribution of Korean and Japanese investments in China (1996)

	Shandong	Liaoning	Jilin	Heilongjiang	Tianjin	Beijing	Shanghai	Jiangsu
Number of investments	950	780	395	201	350	227	106	160
Ratio of the number of investments relative to the total number of national investments (%)	26	22	11	6	10	6	3	5
Amount of investments (Unit: million US$)	1,288	493	155	167	435	372	396	374
Ratio of the amount of investments relative to the total amount of national investments (%)	33.2	12.7	4.0	4.3	11.2	9.6	10.3	9.7

Source: Won Bae Kim & Young-Sub Kwon, 1998

Passenger traffic has also increased very rapidly in Northeast Asia, and this trend is anticipated to continue in the future (Figure 1-2). The liberalization of overseas travel in China will have positive effects on the economies of Korea and Japan, increasing the demand for packaged tour linking the three countries..



Note: * Data in 1998
Source: KNTO, 1992, 1999, Annual Statistical Report on Tourism
JNTO, 1992, 1998, Statistics on Tourism - Japan.
World Tourism Organization, 1995, 1998, Yearbook of Tourism Statistics

Figure 1-2 Visitor flows among Korea, China and Japan

Even though passengers mostly travel now by sea and air between Korea, China and Japan. If tourists are, however, allowed to travel to Northeast China or North China via the Korean peninsula, there would be a substantial demand for land transport. This is because there is an increasing tourism demand for a program to travel to South and North Korea, and the three northeast provinces and the Bohai region of China among the Japanese who have the highest income in Northeast Asia. It is estimated that South Korea will have a substantial tourism demand to travel to Mt. Baekdu and the three northeast provinces of China via North Korea. Likewise, the growth of the Chinese economy will result in the increase of the overseas travel demand. In particular, it is very likely that a portion of the Chinese passengers in the three northeast provinces and the Bohai region will use land transportation when traveling to South Korea.

North Korea's Economic Exchanges with South Korea, China and Japan

Currently economic exchanges in Northeast Asia are centered upon South Korea, China and Japan. When North Korea takes economic reforms with an open-door policy and Russia and Mongolia stabilize their economies, the exchanges between

The economic reform and opening of North Korea will provide a new turning point in economic exchanges between South and North Korea, China, Russia and Japan

these countries and the three major players will be invigorated. In particular, the economic reform and opening of North Korea will provide a new turning point in economic exchanges between South and North Korea, China, Russia and Japan, as well as between North and South Korea. South Korea, China and Japan are the three major trading partners with North Korea and therefore can exert a great influence on the success or failure of the North Korea's reform and opening. Cooperation between Russia and North Korea is an important factor for the operation of the Trans-Siberian Railway, but seems to be secondary in importance to the cooperation between South Korea, China and Japan, in economic terms.

North Korea will play a crucial role in the land transport linkages between Korea and China

North Korea will play a crucial role in the land transport linkages between Korea and China. The restoration of the Seoul-Sinuiju Railway and the reconnection of the railway between Munsan in South Korea and Gaeseong in North Korea are presently under way by agreement between the two Koreas. If these works are successfully completed, it will at least prove North Korea's strong intention to open its door and then more concrete discussions over the land transport linkages between South Korea and China will be possible. The lack of reliable data on North Korea does not afford a complete picture of the current status of North Korea's economic exchanges with neighboring countries. However, it is possible to look into the relationship partially between South and North Korea, between China and North Korea, and between North Korea and Japan. First, inter-Korean trade has increased since 1990, and South Korea's export to North Korea is continuously increasing (Table 1-6). As inter-Korean economic exchanges will be in the form of South Korea's consigning commission processing to North Korea, freight movements are expected to flow from South Korea to North Korea for the time being.

Table 1-6 Trade between North and South Korea

Unit: million US$

		North Korea								
		1991	1992	1993	1994	1995	1996	1997	1998	1999
South Korea		112	174	186	194	287	252	308	222	334
	Export	6	11	8	18	64	70	115	130	212
	Import	106	163	178	176	223	182	193	92	122

Source: Ministry of Unification (http://www.unikorea.go.kr)

China-North Korea trade has been declining since reaching its peak in 1993, but is expected to rise when the North Korean economy shows signs of recovery. Similar to inter-Korean trade, China's export to North Korea surpasses North Korea's export to China by a great margin (Table 1-7). If North Korean light industries are revived with the introduction of an open policy, meaning that its export capacity increases, North

Korea's export to China will also increase. Currently, China-North Korea trade is taking place in major transport nodes along the border. Railways and roads are being used as the major transport nodes for freight and passengers between China and North Korea.

Table 1-7 Trade between North Korea and China

Unit: million US$

	North Korea								
	1991	1992	1993	1994	1995	1996	1997	1998	1999
China*	611	694	898	624	550	566	656	408	371
Export	525	540	602	425	486	497	534	357	329
Import	86	154	296	199	64	69	122	51	42

	China								
	1991	1992	1993	1994	1995	1996	1997	1998	1999
North Korea**	655	734	932	648	593	609	699	438	400
Export	78	140	269	181	58	62	111	46	38
Import	577	594	663	467	535	547	588	392	362

Note: * Data presented by China, ** Data computed by IMF
Source: IMF, 2000 Direction of Trade Statistics Yearbook.

According to the World Tourism Organization, the number of North Korean visitors to China has decreased since 1991. However, considering that it is not a sharp decline, human exchanges based on traditional friendly relations are considered to have been continuing. Meanwhile, mainly Chinese tourists visit North Korea rather than the other way around. Short tour programs at the border areas are known to be popular among Chinese living in Jilin and Liaoning provinces. In addition, there are 4 or 5-day programs departing from Beijing to Gaeseong via Pyongyang.

Even though Japan-North Korea trade has decreased in quantitative terms, it still occupies an important position in North Korea's foreign trade (Table 1-8). If North Korea firmly adopts reform and an open policy and establishes diplomatic relations with Japan, trade between the two countries will expand to the point where it may be comparable to inter-Korean trade. In particular, exchanges will be reinvigorated between cities on the east coast of North Korea including Rajin, Cheongjin and Wonsan, and cities on the west coast of Japan.

Table 1-8 Trade between Japan and North Korea

Unit: million US$

	North Korea								
	1991	1992	1993	1994	1995	1996	1997	1998	1999
Japan*	499	478	465	498	593	517	475	392	347
Export	224	223	221	171	257	226	179	175	147
Import	275	255	244	327	336	291	296	217	200

	Japan								
	1991	1992	1993	1994	1995	1996	1997	1998	1999
North Korea**	496	477	465	485	588	514	466	390	343
Export	250	231	222	297	306	265	269	197	182
Import	246	246	243	188	282	249	197	193	161

Notes: * Data presented by Japan, ** Data computed by IMF.
Source: IMF, 2000 Direction of Trade Statistics Yearbook.

2
TRANSPORT SYSTEMS IN NORTHEAST ASIA AND TRANSPORT DEMAND BETWEEN KOREA AND CHINA

Despite the rapid increase in intra-regional trade and investment in Northeast Asia, the integration and international connection of transport systems remain insufficient. Air and sea transporters simply stress inter-regional connections, but do not duly pay attention to the intra-regional transport demand. Though both intra-regional air and sea transportations have been initiated by mutual agreement between concerned countries, it apparently is still a long way off, and will remain so until an efficient region-wide transport system is established. The division of the Korean peninsula also prevents an establishment of intra-regional land transportation. Though the need for the connection and integration of transport systems has been mounting since the reform and opening of China and Russia, restrictive regulations on freight and passenger border-crossings are still in place, thus impeding the efficient flow of such. This chapter elaborates on the transport conditions and demands in Northeast Asia.

Transport Systems in Northeast Asia

Air transport

Economic development and deregulation of the air transport market have contributed to the rapid increase of air transport demand in Northeast Asia

Economic development and deregulation of the air transport market have contributed to the rapid increase of air transport demand in Northeast Asia. While the world air transport market grew by 6.7% per annum during the period of 1985-1997, air transport demand in Northeast Asia increased by 18.1% per annum for the same period. Such a sharp increase in air transport exceeded the capacity of existing airports, thus requiring construction or expansion of airports in Northeast Asia. In particular, the rapid growth of the Chinese air transport market has caused the overload of Chinese airport facilities and created sharp competition between hub airports within the region to attract international passengers both inbound and outbound from China. The International Air Transport Association predicted that air transport markets in Northeast Asia would maintain a high growth rate in the 2000s and mentioned that there exists a possibility that it may be taken up by large U.S. or

Table 2-1 Number of flights in major Asian airports

As of August 1995

	Domestic flights		Intra-regional flights		Inter-regional flights		Total	
	Number of flights	Ratio of domestic flights to the total domestic flights in major Asian airports (%)	Number of flights	Ratio of intra-regional flights to the total intra-regional flights in major Asian airports (%)	Number of flights	Ratio of inter-regional flights to the total inter-regional flights in major Asian airports (%)	Number of flights	Ratio of the total number of flights to the total number of flights in major Asian airports (%)
Tokyo	1,979	15.42	266	10.77	712	27.67	2,957	16.54
Taipei	1,453	11.33	369	14.94	338	13.12	2,160	12.08
Osaka	1,425	11.11	147	5.95	265	10.28	1,837	10.28
Seoul	1,138	8.87	329	13.32	351	13.62	1,818	10.17
Hong Kong	0	0.00	710	28.74	600	23.28	1,310	7.33
Beijing	906	7.06	119	4.82	95	3.69	1,120	6.27
Guangzhou	933	7.27	40	1.62	26	1.01	999	5.59
Kaoshiung	802	6.25	49	1.98	75	2.91	926	5.18
Fukuoka	752	5.86	71	2.87	51	1.98	874	4.89
Sapporo	852	6.64	9	0.36	11	0.43	872	4.88
Shanghai	619	4.82	137	5.55	18	0.70	774	4.33
Busan	410	3.20	48	1.94	0	0.00	458	2.56
Xiamen	241	1.88	21	0.85	17	0.66	279	1.56
Sendai	196	1.53	13	0.53	11	0.43	220	1.23
Hangzhou	159	1.24	13	0.53	1	0.04	173	0.97
Shenyang	148	1.15	16	0.65	0	0.00	164	0.92
Fuzhou	142	1.11	21	0.85	0	0.00	163	0.91
Dalian	134	1.04	21	0.85	0	0.00	155	0.87
Harbin	124	0.97	5	0.20	0	0.00	129	0.72
Qingdao	112	0.87	16	0.65	0	0.00	128	0.72
Khabarovsk	86	0.67	12	0.49	4	0.16	102	0.57
Vladivostok	89	0.69	3	0.12	0	0.00	92	0.51
Nigata	70	0.55	11	0.45	0	0.00	81	0.45
Tianjin	60	0.47	12	0.49	0	0.00	72	0.40
Ulan Bator	0	0.00	12	0.49	0	0.00	12	0.07
Pyongyang	0	0.00	0	0.00	2	0.08	2	0.01
Macao	0	0.00	0	0.00	0	0.00	0	0.00
Total	**12,830**	**100.00**	**2,470**	**100.00**	**2,577**	**100.00**	**17,877**	**100.00**

Source: Rimmer, 1999

European aviation companies due to the inefficiency of Northeast Asian aviation companies. In particular, it is necessary for Northeast Asian aviation companies to discard the notion that only domestic airports can be their hub airports. Instead, while establishing domestic airports as a primary hub airport, they should make an effort to utilize regional airports as secondary hub airports for intra-regional transport systems to be mutually established (Oum 1998).

Industrial transition in Northeast Asia is expected to increase the demand for air transport of freight (Miyasita and et. al. 1998). In particular, the air transport demand for light, high value-added goods such as semiconductors and electronic parts, and light consumption goods transacted through e-commerce is expected to continue to increase. In this regard, prompt efforts should be made to integrate Northeast Asian transport systems into a uniform logistics system, for example, the linking of an airfreight system with a door-to-door delivery system.

Currently, the air transport networks in Northeast Asia are configured centering upon 5 cities: Tokyo and Hong Kong at the top, with Seoul, Taipei and Osaka of the secondary rank. Tokyo and Hong Kong together play the role of the gateway to the Northeast Asian region by collectively accounting for over 20% of the total inter-regional flights. Taipei and Seoul have about the same proportion of inter-regional and intra-regional flights (Table 2-1). Beijing and Shanghai have not yet reached the level of these 5 cities, but have a great potential to rise as a hub airport city in the future considering large demand in China. It is noteworthy that air traffic within Northeast Asia is concentrated in the triangular zone of Tokyo, Beijing and Hong Kong (Rimmer 1999). It suggests that Seoul will be able to take part in the intra-regional air transport market by strengthening its services for intra-regional air transportation.

Seoul will be able to take part in the intra-regional air transport market by strengthening its services for intra-regional air transportation

Sea transport

Most freight transport relies on transport by sea in Northeast Asia because of its geographical characteristics and political situations

Most freight transport relies on transport by sea in Northeast Asia because of its geographical characteristics and political situations. The increase of sea transport is quite remarkable, attributable to the rapid growth of the Chinese economy. In particular, the container cargo volume in China increases by more than 20% a year on average, which indicates the need for the renovation and expansion of seaport facilities (Table 2-2). The increase rate of container cargo volumes moving within the region has surpassed the increase rate of container cargo volumes moving outside the region, which resulted from the growth of manufacturing industries. Therefore, it is necessary to systemize the intra-regional transport of containerized cargoes (Tsumori 2000).

Hong Kong, Kaoshiung, Busan, Kobe and Yokohama play the role of base ports for the transshipment of freight to and from China. When connecting these port cities with railways or roads, they form a giant growth corridor. For instance, Yokohama-Tokyo, Busan-Seoul, Hong Kong-Guangzhou, and Kaoshiung-Taipei have formed a high-dense growth corridor. Second rank ports such as Dalian, Tianjin and Qingdao are forming growth corridors in connection with inland cities such as Shenyang,

Beijing and Jinan (Figure 2-1). However, technological development such as the appearance of large-scale ships and the operation of high-speed ferries for intra-regional sea transport is expected to bring alterations to Northeast Asian sea and inland transport systems. In addition, the configuration of long distance railways, which is to be discussed in the later part of the study, is expected to greatly impact on the sea transport system.

Table 2-2 Trend of container cargo volumes in major Northeast Asian countries

Unit: thousand TEU

	1986	1990	1992	1994	1995	1996	Average annual growth rate during 1986-1996
North of Shanghai, China	237	577	862	1,451	2,238	2,576	26.95%
Japan	5,649	8,094	8,965	9,914	10,835	10,983	6.87%
Korea	1,533	2,669	3,178	4,130	5,005	5,300	13.21%
Russian Far East	145	307	248	60	109	111	-2.64%
Total	**7,564**	**11,646**	**13,253**	**15,555**	**18,232**	**18,970**	**9.63%**

Note: Container volumes for export and import excluding empty container volumes
Source: Japan Maritime Press & Tsumori 2000

The configuration of long distance railways is expected to greatly impact on the sea transport system

Railway transport

The rapid increase of intra-regional trade in Northeast Asia is responsible for the sharp increase of air and sea traffic volumes. Land transport including railways has not taken a share in the transport of international freight and passengers because the land transport of each country is not currently connected across the border. Even though the Trans-Chinese Railway has newly taken over the role of the international transportation route, the role of railways in long distance transport has continuously decreased for the last decade due to a decreased demand for the Trans-Siberian Railway (Table 2-3). If the disconnected railways between South and North Korea are refurbished and connected to the Trans-Chinese Railway and the Trans-Siberian Railway, it will increase the railway transport demand. In particular, as seen in the increased role of railways in Europe since the emergence of the European Union, railways are expected to take over some portion of the mid-to-long distance transport demand when the closed borders are opened and customs clearance procedures are simplified in the Northeast Asian region (Yeon-Hye Choi, 2000).

At present, railway networks in the Northeast Asian region have been disconnected and Korea and Japan are separated by the sea. In South and North Korea, Japan and China, standard gauge railway lines are being used, whereas Russia, Mongolia and Kazakhstan use the broad gauge system. This difference creates

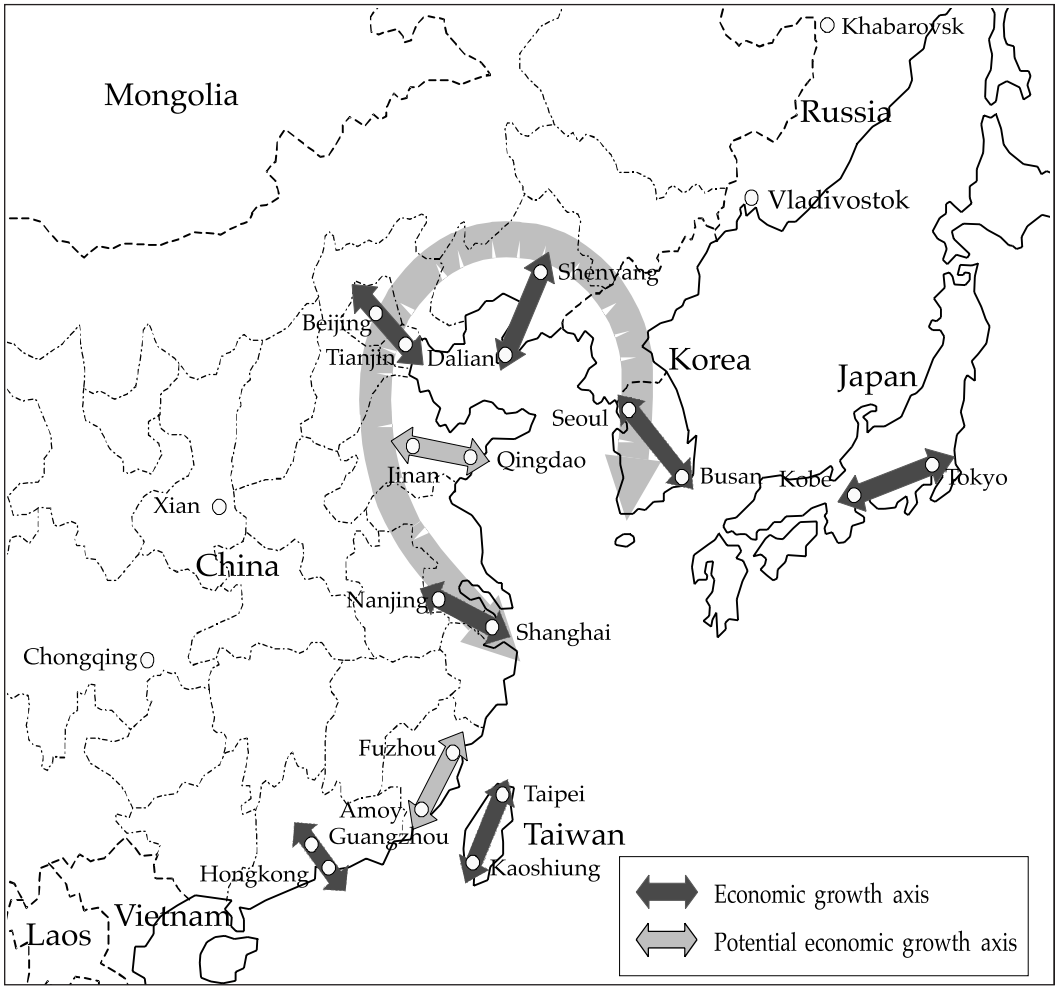


Figure 2-1 Growth corridors of Northeast Asia

Table 2-3 Demand for the Trans-Siberian Railway by Korea and Japan

Unit: TEU

	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Korea	25,648	29,466	37,958	42,796	50,645	52,087	50,875	48,455	42,560	-
Japan	81,566	57,509	44,577	26,811	17,121	15,878	14,721	-	-	-
Total	**107,214**	**86,975**	**82,535**	**69,607**	**67,766**	**67,965**	**65,596**	-	-	**39,200**

Note: (-) Data not available
Source: Jong-Gwan Lim, 2000

inconveniences such as transshipment and transfer between the European railways and Asian railways. Save for the previous, operational problems should be resolved first to avoid wasted time and the expense of border-crossing procedures in order for railways to play the role as a long distance transportation mode in Northeast Asia. The Trans-Siberian Railway possesses many defects in terms of speed, accuracy and safety, but the Russian government is endeavoring to rectify the situations (Kachura 2000). Contrary to the decline in the demand for the Trans-Siberian Railway since the mid 1980s, the demand for the Trans-Chinese Railway is recently showing an upward tendency. However, its share of freight bound for Europe is not expected to increase sharply without substantial renovation and expansion, for it crosses more borders than the Trans-Siberian Railway does and its transport services are very poor (Tables 2-4 and 2-5).

Table 2-4 Trend of freight volumes by the Trans-Siberian Railway

Unit: million TEU

	1987	1988	1990	1992	1994	1996
Freight volumes	3.0	4.5	3.7	1.0	0.6	0.3

Source: Hyung-In Jin, et. al., 1998

Table 2-5 Trend of freight volumes by the Trans-Chinese Railway

Unit: thousand TEU

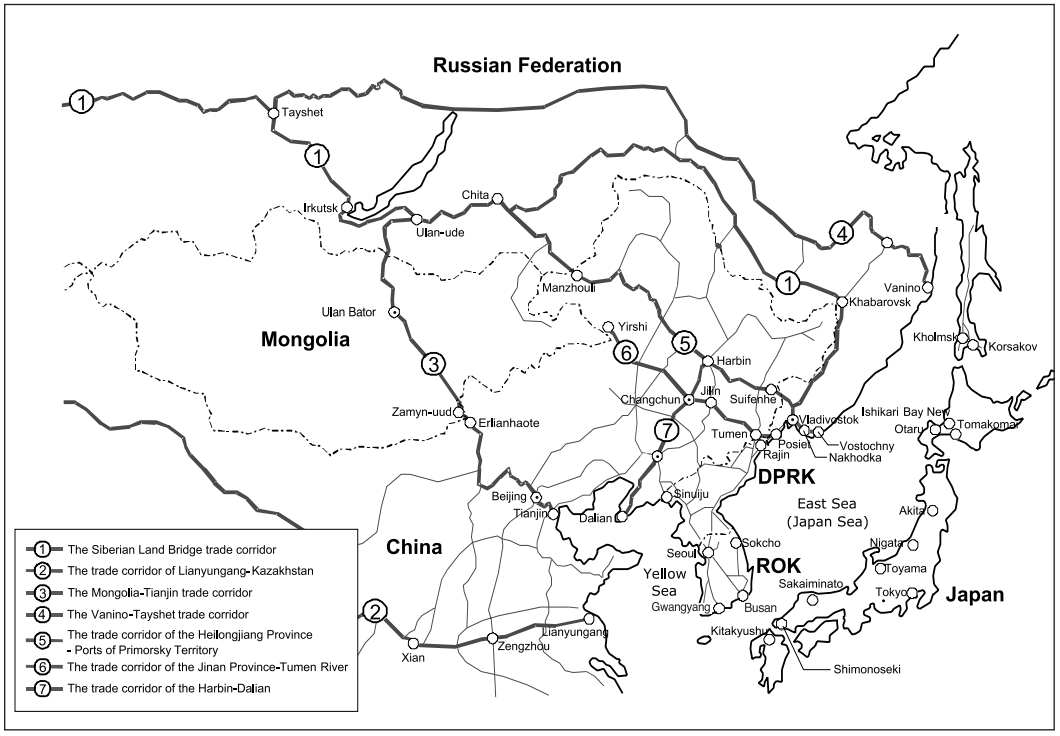
	1994	1995	1996
Freight volumes	478	1,113	2,100

Source: Hyung-In Jin, et. al., 1998

Insufficient railway transport infrastructure and impediments to border crossings have been pointed out as the major obstacles to the integration and efficient operation of Northeast Asian railways. In particular, dilapidated North Korean railways are posing a serious problem in land connection among Korea, China and Russia. North Korea has three major railways such as Gaeseong-Sinuiju Railway, Pyongyang-Rajin Railway and the Suncheon-Manpo Railway. As these railways operate at very low speeds and are mostly single-track, they are not efficient to operate as international railways, and thus are now used only for trade with China.

When focusing on railways for middle-distance transportation, the Trans-Mongolian Railway that begins from Beijing and crosses Mongolia to be connected to the Trans-Siberian Railway, the Manchurian Railway that starts from Vladivostok to be connected to the Trans-Siberian Railway via Harbin and Manzhouli, the Trans-Manchurian Railway that begins from Rajin or Zarubino to run to Yiersi via Tumen and Changchun, and the Harbin-Dalian Railway via Shenyang, which deals with a substantial portion of freight from the three northeast provinces of China, fall into this

category (Figure 2-2). The Trans-Manchurian Railway and the Trans-Mongolian Railway serve as international railways albeit insignificantly and the Tumen-Changchun Railway will be able to operate as an international railway when its missing section to Mongolia is newly built.



Source: Ministry of Transportation, Government of Japan, Report on international logistics infrastructure in the East Sea (Japan Sea) Rim, 2000

Figure 2-2 Transport corridors of Northeast Asia

Meanwhile, the Trans-Siberian Railway (TSR) cannot be guaranteed reasonable profits only by handling freight from Vladivostok and Nakhodka ports. The TSR can be activated only when it is connected to Busan port, which is one of the largest ports in Northeast Asia. From the standpoint of Korea, however, it is more urgent to connect its railways to China, Korea's third largest trade partner than to the Trans-Siberian Railway in order to transport even part of the freight moving between Korea and China by land. Korea can be linked with Japan by ferry, but it is more advantageous for Korea to use seaports in trade with Japan , Russia or Europe at present. Meanwhile, China can use both railways and seaports in trade with North and South Korea and Japan. In particular, the three northeast provinces of China are very likely to begin to transport part of their freight by train, which is now handled at Dalian port (ERINA 2001).

Transport modal shares and its trend

Railways play an important role in transporting freight and passengers in Northeast Asia, especially in China and North Korea. Railways have been mainly used to transport low-value and bulk goods domestically such as coal and grain, and no significant change is expected to reverse this trend in the future. Nevertheless, sea transport is occupying a superb position in inter-regional as well as intra-regional trades. The demand for short-distance sea transport is expected to increase as much as intra-regional trade grows, which is expected to continue to increase in the future. Technological development in the sea transport sector such as the emergence of high-speed ferries will impact on the sea transport system of Northeast Asia (Il-Soo Jeon, 2000).

The continuous growth of the Chinese economy and increased demand for tourism and leisure in Korea and Japan are expected to bring significant changes to the socio-economic environment in Northeast Asia, which in turn will create air transportation demand. The majority of Chinese people travel long-distances by railway at present but a number of them are very likely to travel by air. However, as the Chinese government is considering the construction of high-speed railways for passenger transport as Korea and Japan have, the relative competitiveness of railways will not decrease significantly.

The transport of freight or passengers calls for fast and safe door-to-door service

Even though it is difficult to forecast how technical development will rearrange the share of transport modes, it is certain that the transport of freight or passengers calls for fast and safe door-to-door service. This trend can be found in China, which used to heavily rely on railways. The share of road in total transportation that was 9% in 1990 has already surpassed 20%, and some arterial roads have begun to experience congestion problems (Northeast Asia Research Center 2000). It means that road transport is rising as a relatively advantageous transport means for short distance and that railways can be more competitive when they are combined with sea transport.

Northeast Asian transportation systems will have to be transformed to integrated systems

In this regard, the linkage of sea, air and land transportation is emerging as an important factor for international transportation. Currently combined sea and land transportation rarely takes place in Northeast Asia. But as the demand for an integrated transportation system becomes strong, Northeast Asian transportation systems will have to be transformed to integrated systems (Il-Soo Jeon, Lee & Shon, 1999).

Transport Demand between Korea and China

Freight transport demand

Despite the increase of intra-regional trades and travels in Northeast Asia, insufficient transport infrastructure causes inefficiency of logistics systems. Theoretically, optimal transport systems among Korea, China and Japan can be developed by transport mode and route in consideration of their geographical, industrial structural and traveling

Insufficient transport infrastructure causes inefficiency of logistics systems

characteristics. Nonetheless sea transport will continue to have the largest transport modal share in the future because of the geographical location of the three countries, facing the sea. As explained in the previous chapter, the share of air transport is also expected to increase with the increase of the number of travelers and transport of light and high-valued goods by air (Miyasita, 1998). Railways do not play an important role in Northeast Asia due to the lack of international linkages and low level of transport services at the moment. However, they will be important for freight transportation from Korea, China and Japan to Europe and Central Asia, and at the same time, they could be competitive in terms of transport cost and the security of stable transport routes.

As the primary objective of the study lies in investigating the possibility of land transport linkages between South Korea and China, firstly examined will be the current status and structure of the transport demand between Korea and China. Of course, it would be necessary to study the logistics demand, each between China and Japan, and between Korea and Japan. However, in the perspective of land transport between South Korea and China, it does not seem appropriate to consider Japan as a direct beneficiary of land transport, being isolated from Korea and China by the sea. Of course, it can be assumed that a portion of Japanese travelers will move on to China via Korea after crossing the sea by car ferry. However, such demand is deemed to be much less than land transport demand between South Korea and China.

The transport demand between Korea and China can be outlined as follows. The transport volume between Korea and China has increased substantially since the 1990s. China's export to Korea and Korea's export to China in 1998 were estimated to be 24.3 million and 23.8 million revenue tonnage, respectively, which can be converted into 21.9 million metric tons and 21.6 million metric tones, respectively. In the case of container cargoes, Korea exported 330,000TEU[1] to China, whereas China exported 390,000 TEU to Korea in 1998 (Table 2-6). When looking into the trade volumes between Korea and China by commodity, Korea exported to China mainly oil, steel and machinery, whereas China exported to Korea soft coal, oil, miscellaneous ores and steel in 1998. Both Korea and China used containers for exports of steel, machinery and others at a high rate of usage (Table 2-7).

Table 2-6 Volume of container cargoes between Korea and China in 1998

Korea → China		**China → Korea**	
Tonnage equivalent unit	Revenue tonnage	Tonnage equivalent unit	Revenue tonnage
333,071	4,252,888	392,711	4,948,332

Source: Korea Railroad Research Institute, 1999

[1] Tonnage equivalent unit.

Table 2-7 Cargo volumes by commodity between Korea and China in 1998

Unit: thousand revenue tonnage

	Total cargo volumes			Volumes of uncontainerized cargoes		
	China→Korea	Korea→China	Total	China→Korea	Korea→China	Total
Grain	1,605	1	1,606	1,602	0	1,602
Oil	2,255	11,295	13,550	2,254	11,267	13,521
Fat	14	33	48	14	1	15
Fertilizer	107	30	137	104	29	133
Cement	306	17	323	306	17	323
Hard coal	2,322	0	2,322	2,322	0	2,322
Soft coal	174	2	176	174	2	176
Timber	355	146	501	317	48	365
Miscellaneous	1,695	191	1,886	1,677	184	1,861
Salt	133	0	0	132	0	132
Sand	57	0	57	57	0	57
Processed food	909	58	967	722	9	731
Marine products	206	59	265	27	13	40
Machinery	791	1,327	2,118	743	584	1,327
Steel	1,228	2,034	3,262	1,117	1,546	2,663
Others	12,089	8,577	20,666	7,141	4,324	11,465
Total	**24,248**	**23,770**	**48,018**	**18,710**	**18,024**	**36,734**

Note: These figures were calculated by applying the average containerization rate of export and import in Korea in 1998.
Source: Korea Railroad Research Institute, 1999

Among the total 11.57 million metric tons(M/T) of Korea's import from China in 1998, 3.15 million M/T was imported through Ulsan port and 1.95 million M/T through Daesan port, which handled most oil-related products in Korea, as well as 2.99 million M/T through Incheon port and 1.13 million M/T through Busan port. Meanwhile, among the total 13.7 million M/T of Korea's export to China, Ulsan port also handled the largest volume with 5.51 million M/T followed by Yeosu·Gwangyang port (3.42 million M/T) and Daesan port (3.03 million M/T), which are mainly used for oil export. The flow of container cargoes between Korea and China

revealed that Korea's trade with China mostly takes place in the capital and Busan regions. Nevertheless, Incheon port and Busan port handled only 27% and 30% of Korea's import from China, respectively. The reason for this can be found in the high proportion of transshipment cargoes to and from China at these ports.

Container cargoes between Korea and China are mostly handled in the Incheon and Busan ports in Korea and in Shanghai, as well as Tianjin, and Qingdao of China, which are located north of Shanghai (Table 2-8). This trend is identical to the regional distribution of Korea-China trade in China. Chinese provinces such as Guangdong (US$5.5 billion), Shandong (US$4.2 billion), Shanghai (US$2 billion), Tianjin (US$1.9 billion) and Liaoning (US$1.7 billion), are playing an important role in Korea-China trade (Table 2-9).

Table 2-8 Korea-China container cargoes by Chinese ports in 1998

Unit: TEU

	Shanghai	Tianjin	Dalian	Qingdao	Weihai	Nanjing	Lianyungang	Others*	Total
Korea→China	88,802	80,014	44,382	73,838	10,599	4,277	3,805	31,802	337,519
Export	62,462	46,390	30,274	58,621	10,599	3,725	2,555	19,432	234,058
Transshipped volumes	26,340	33,624	14,108	15,217	-	552	1,250	12,370	103,461
China→Korea	83,782	111,178	66,706	85,658	8,642	1,198	7,568	27,979	392,711
Import	23,924	30,155	19,513	32,934	8,642	429	5,256	12,000	132,853
Transshipped volumes	59,858	81,023	47,193	52,724	-	769	2,312	15,979	259,858

Note: * Dandong, Qinhuangdao, Yantai, etc.
Source: Yellow Sea Region Regular Liners' Deliberation Council

Table 2-9 Korea's trade with major Chinese provinces in 1999

Unit: million US$

	Beijing	Tianjin	Hubei	Liaoning	Dalian	Jilin	Heilongjiang	Shanghai	Shandong	Guangdong
Total	382	1,893	458	1,758	847	265	242	2,051	4,250	5,546
Export	72	576	323	735	307	195	110	635	1,579	-
Import	310	1,317	135	1,023	540	70	132	1,416	2,671	5,546

Source: Wang 2001

In the meantime, air transport, which plays an important role in transportation within Northeast Asia, had once shrunken temporarily facing the 1997 financial crisis. However, since 1999, it has begun to show an upward tendency and its share in intra-regional transportation has been increasing. As of 1998, 1.06 million passengers and 60 thousand tons of freight were transported by air between Korea and China (Table 2-10). The demand for air transport is expected to increase as the Chinese economy continues to maintain a high growth rate and Korea succeeds in the restructuring of its economy.

Table 2-10 Air transport between Korea and China

	Passengers (persons)		Freight (metric tons)	
	1988	1998	1988	1998
Korea - China	-	1,058,399	-	62,493

Note: Transport by regular and unconventional airlines. Airlines did not operate between Korea and China in 1988.
Source: Korea Civil Aviation Development Association

The dominance of air and sea transportation in Northeast Asia will be mitigated to some extent when land transport modes such as railways and roads are made available. However, the rapid growth of the manufacturing sector in China will induce the increase of containerized cargoes, which would lead to the conclusion that sea transport will continue to take an important role in Northeast Asian transportation in the future. Even in such a case, railways are expected to take over middle-distance freight transport. Passengers will also consider railways running between South Korea and China as an alternative or supplementary transportation means, particularly those tourists who are indifferent to length of time and prefer to travel by land than by air.

Traveling demand

Travel demand in Northeast Asia is rising in accordance with the increase of personal income. Similar to Korea, China, which had regulated overseas travel, is now gradually deregulating travel restrictions. China included Korea and Japan into a group of countries to which its people are allowed to take oversea travels. When looking into the purpose of visits between Korea and China, Koreans travel to China mainly for the purpose of business, whereas Chinese overwhelmingly travel to Korea for sightseeing (Table 2-11).

Travel demand in Northeast Asia is rising in accordance with the increase of personal income

Passengers between Korea and China mostly travel by air and sea. The ratio of travel by air to travel by sea was 4 to 1 for passengers traveling from Korea to China in 1999. Passengers from China to Korea travel by air more than by sea in the ratio of 2:1 in 1995, but the ratio of travel by sea surpassed the ratio of travel by air in 1999 (Table 2-12). This was due to the relatively low cost of sea transportation. Meanwhile, Chinese

Table 2-11 Number of visitors by purpose of visit between Korea and China

Unit: persons

	Korea → China								
	1991	1992	1993	1994	1995	1996	1997	1998	1999
Tourism	-	-	-	54,834	143,696	196,524	185,704	71,282	237,328
Business	-	-	-	108,202	158,224	207,753	244,304	265,832	394,746
Site visit	-	-	-	16,160	26,963	40,474	58,938	59,650	82,266
Official business	-	-	-	1,797	1,890	1,575	1,925	1,119	1,704
Conference	-	-	-	1,604	2,951	3,338	4,864	3,793	7,116
Others	-	-	-	51,078	70,697	82,668	88,752	82,333	96,960
Total	**15,200**	**42,896**	**110,585**	**223,675**	**404,421**	**532,332**	**584,487**	**484,009**	**820,120**

	China → Korea								
	1991	1992	1993	1994	1995	1996	1997	1998	1999
Tourism	-	-	-	4,440	-	32,761	35,578	54,300	137,816
Business	-	-	-	21,044	-	24,609	28,920	26,643	35,623
Official business	-	-	-	531	-	1,692	683	1,088	1,308
Others	-	-	-	114,970	-	140,542	149,063	128,631	141,892
Total	**78,640**	**86,865**	**99,957**	**140,985**	**178,359**	**199,604**	**214,244**	**210,662**	**316,639**

Note: (-) data not available
Source: Korean tourism statistics for 1991-1999 by the Korea Tourism Corporation

are more sensitive to the transport cost than Koreans because their average income is relatively low and they visit Korea mostly for the purpose of tourism.

If inexpensive and safe land transportation means are developed between Korea and China, a great number of passengers are likely to take advantage of this

Judging from the high growth of the Chinese economy and the deepening relationship between South Korea and China, travel demand between South Korea and China is expected to increase very rapidly. Therefore, if inexpensive and safe land transportation means are developed between Korea and China, a great number of passengers are likely to take advantage of this. The Chinese, who have a low level of national per capita income, are likely to make use of relatively inexpensive railway transportation when traveling to Korea. In particular, as Korean tourists or businesspersons mostly travel to the three northeast provinces or the Bohai region of China, the probability is very high that they would travel by land transportation so long as the delay compared with air transportation is not that great.

Table 2-12 Transport modal split for passengers between Korea and China

Unit: persons

	Korea → China								
	1991	1992	1993	1994	1995	1996	1997	1998	1999
By sea	7,628	12,675	27,133	34,093	48,197	53,497	59,541	85,156	161,193
By air	7,572	30,221	83,452	189,582	356,224	478,835	524,946	398,853	658,927
Total	**15,200**	**42,896**	**110,585**	**223,675**	**404,421**	**532,332**	**584,487**	**484,009**	**820,120**

	China → Korea								
	1991	1992	1993	1994	1995	1996	1997	1998	1999
By sea	8,041	14,182	27,784	40,697	62,055	68,871	77,219	89,645	178,278
By air	70,599	72,683	72,173	100,288	116,304	130,733	137,025	121,017	138,361
Total	**78,640**	**86,865**	**99,957**	**140,985**	**178,359**	**199,604**	**214,244**	**210,662**	**316,639**

Note: All passengers excluding visitors by sea were considered as visitors by air.
Source: Korean tourism statistics for 1991-1999 by the Korea Tourism Corporation / Immigration statistics for 1991-1999 by the Ministry of Justice.

3
LAND TRANSPORT LINKAGES BETWEEN KOREA AND CHINA

Land transport corridors between Korea and China should be designed based on the results of survey on the current state of land transportation and at the same time, all plans promoted by concerned countries should be considered so as to find the most efficient and reasonable method of establishing the land transport linkages. In this context, this chapter diagnoses the existing land transport corridors and examines the potential land transport linkages and weak sections between Korea and China

Current State of Land Transport in South and North Korea and Northeast China

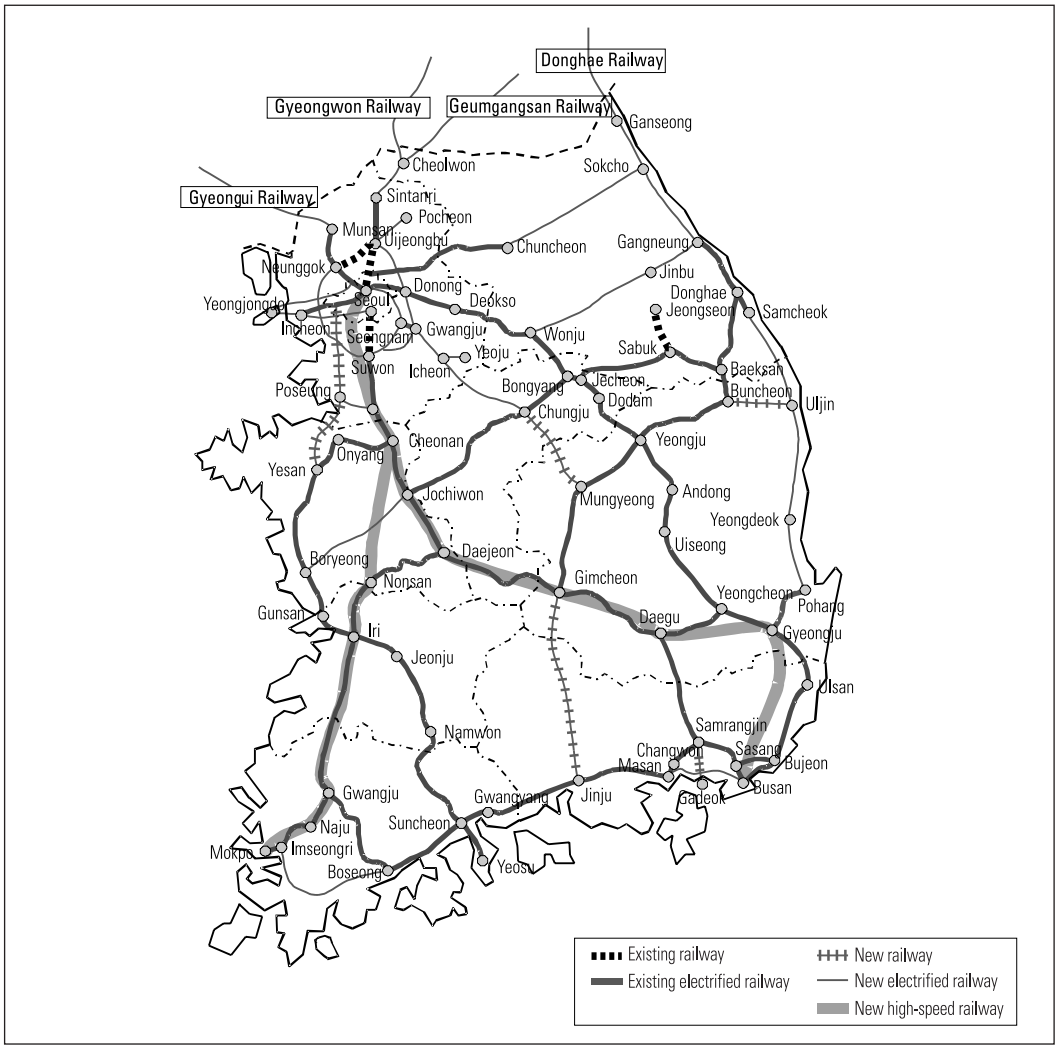
South Korea

a) Railways

Among the total 3,118kilometers of South Korean railways, only 28% is double-tracked and 18% (661,3km) is electrified. In addition to the relatively low density of railways, dilapidated railway facilities pose a problem in railway transport. Fundamentally, South Korea consists of two major arterial railway corridors of the Seoul-Busan Railway and the Seoul-Mokpo Railway. The former can extend to China passing through Sinuiju, whereas the latter can be connected to Russia via Wonsan and Rajin. The South Korean government is endeavoring to expand and renovate national arterial transport networks by 2020 with an aim to build an integrated transport network to meet the ever increasing land transport demand and to prepare for Korean reunification (Ministry of Construction and Transportation, 1998).

The South Korean government is endeavoring to expand and renovate national arterial transport networks by 2020 with an aim to build an integrated transport network

National projects are underway such as the construction of high-speed railways and the elevation of the ratio of double-track lines and electrified railways. In addition, high-speed railway networks will be built in an X-shape across South Korea to link the Seoul capital region with the rest of the country. Major arterial railways will be rehabilitated, electrified and linked to high-speed railways for high-speed trains to run along. As part of this plan, the construction of the Seoul-Busan High-speed Railway is



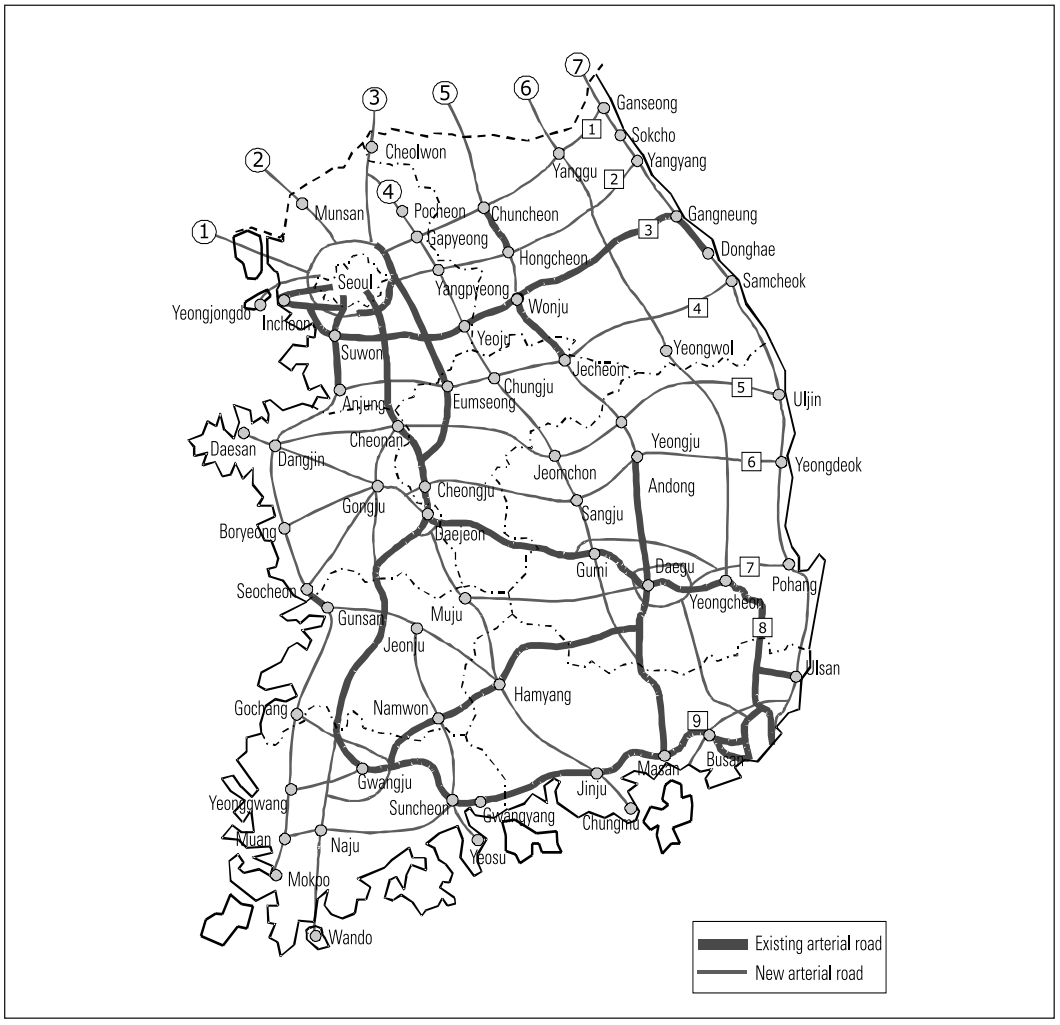
Source: The 4th comprehensive national territorial plan in Korea (2000-2020), Government of the Republic of Korea

Figure 3-1 Design of arterial railways in South Korea

to be completed by 2007, and the construction of the Seoul-Mokpo High-speed Railway is now under consideration (Figure 3-1). Lastly, in order to mitigate the mounting transport demand resulting from concentration in the Seoul capital region, the bottlenecked railway section between Suwon and Cheonan will be quardruple-tracked and electrified.

b) Roads

The total length of South Korean roads is 86,989km as of 1999 and the ratio of paved roads is fairly high, accounting for 74.5%. However, the low road density per unit area



Source: The 4th comprehensive national territorial plan in Korea (2000-2020), Government of the Republic of Korea

Figure 3-2 Design of arterial roads in South Korea

causes a rise of logistics cost, and the weak structures of expressways (a total length of 1,996km) and national roads create bottleneck sections. The South Korean government has a goal to build up a latticed arterial road network to eliminate bottleneck sections and to meet the increasing transport demand. For this purpose, a plan has been designed to construct 7 arterial road axes to connect the south to the north and 9 arterial road axes to connect the east to the west, as well as expanding national roads that are connected to these arterial axes (Figure 3-2). In order to integrate road networks in South and North Korea, it is planned to extend the south-north axes in the South to the North and connect them to the Asian expressway network after building connecting roads to China and Russia.

North Korea

a) Railways

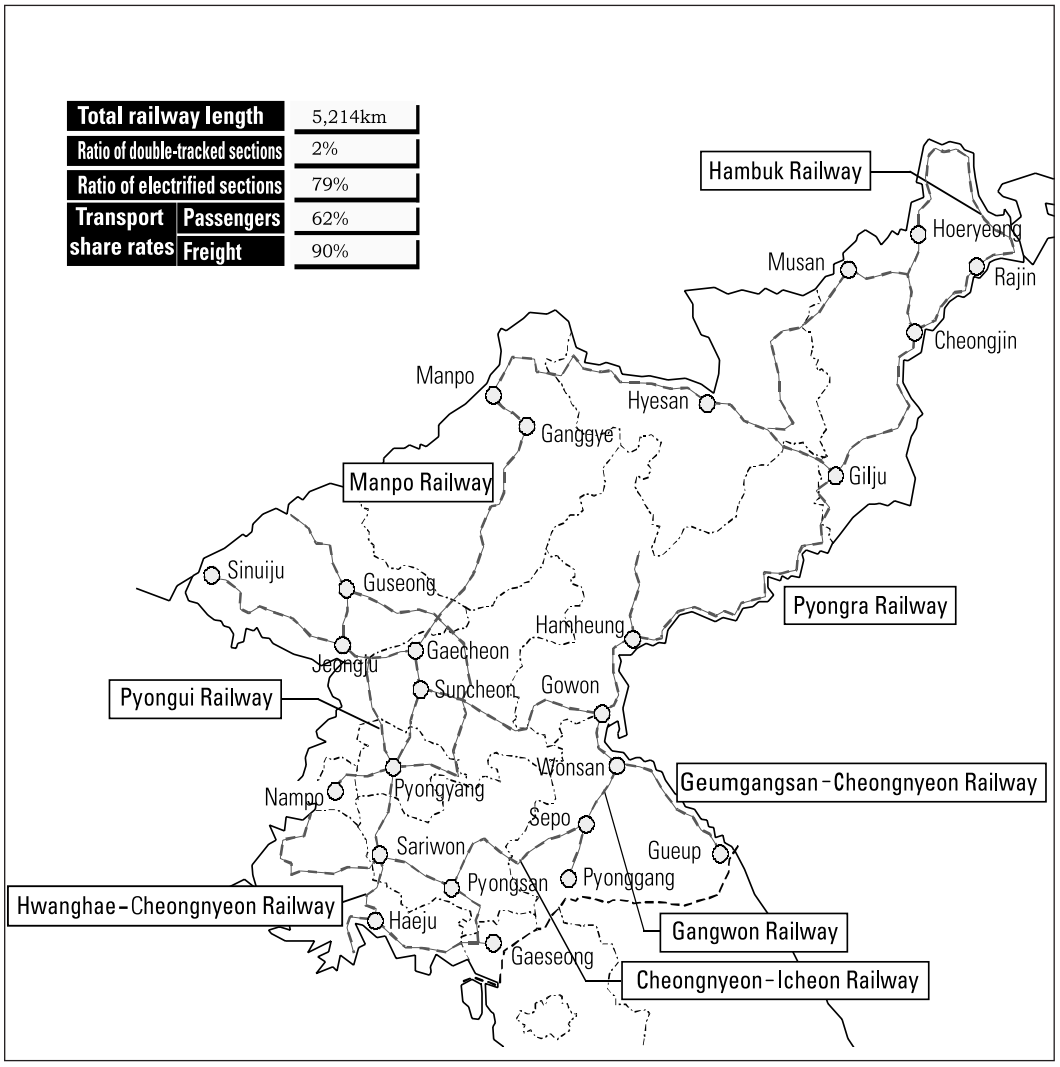
North Korea has a transportation system centered on railways, which handle 60% of passenger transport and 90% of freight. The total length of its railways is 5,214km and the ratio of electrified railways accounts for 79%, which is higher than that of South Korea (Table 3-1). However, most railway sections are single-tracked and dilapidated and cannot be sufficiently utilized. Moreover, many sections are out of operation due to the lack of electricity. Arterial railway networks in North Korea are H shaped, consisting of the west railways, the east railways and the railways connecting the east to the west (Figure 3-3). However, the conditions of the rail beds, linear rails and rail tracks are so poor that the railways are known for their slow transport speeds and low capacity.

Most railway sections in North Korea are single-tracked and dilapidated and cannot be sufficiently utilized

Table 3-1 Major arterial railways of North Korea

Name of railways		Operating section	Total railway length (km)	Ratio of electrified sections	Ratio of double-tracked sections
West railways	**The Pyongui Railway**	Pyongyang-Sinuiju	225	100%	15%
	The Pyongbu Railway	Pyongyang-Gaeseong	187	100%	-
East-west railways	**The Cheongnyeon-Icheon Railway**	Pyongsan-Sepo	141	-	-
	The Pyongra Railway	Ganri-Rajin	781	100%	-
East railways	**The Hambuk Railway**	Banjuk (Hoeryeong)-Rajin	327	-	-
	The Gangwon Railway	Gowon-Pyonggang	145	100%	-
	The Geumgangsan-Cheongnyeon Railway	Anbyeon-Gueup	102	-	-
Inland railway	**The Manpo Railway**	Suncheon-Manpo	303	-	-
West circular railway	**The Hwanghae-Cheongnyeon Railway**	Sariwon-Haeju	100	-	-

Source: Il-Soo Jeon, et. al., 1998, the Korea Transport Institute, 1998



Source: Il-Soo Jeon, et. al., 1998

Figure 3-3 Arterial railways in North Korea

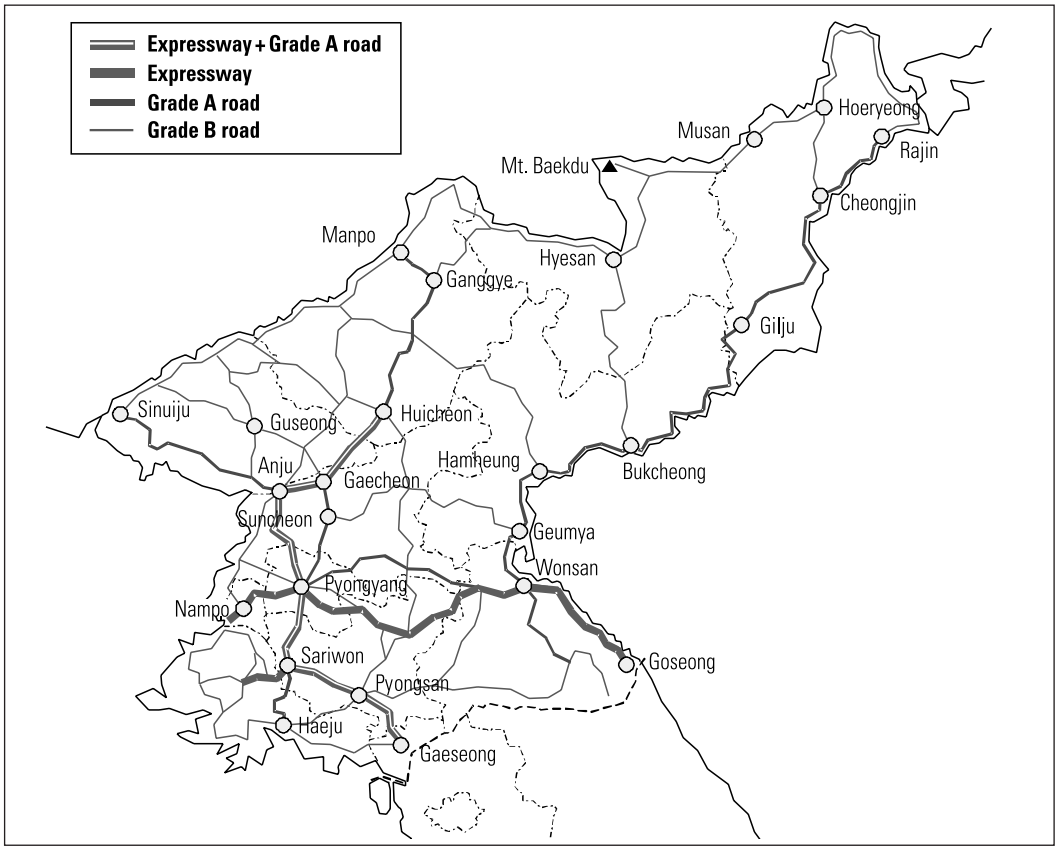
North Korea is planning to renovate and repair the Namyang-Rajin Railway (160km) to facilitate the development of the Rajin-Seonbong Free Trade Zone. The Namyang-Rajin Railway was electrified in 1996 and had handled 70% of containers from China until very recently but now is facing the problems of dilapidated rail tracks and lack of capacity (ERINA and FIAS 2000). If locomotive and freight trains are secured, more tunnels and bridges are constructed, and the track conditions are improved, estimated to cost approximately US$45 million, transport capacity would be enhanced. Recognizing this, the North Korean government is placing priority on the improvement of the Namyang-Rajin Railway but financing remains as a big problem.

b) Roads

Roads, as a subsidiary means of transportation to railways, are mainly used for short-distance transport in North Korea

Roads, as a subsidiary means of transportation to railways, are mainly used for short-distance transport in North Korea. The ratio of paved roads is very low, accounting for 8.1% in 1998, which in turn lowers the efficiency of roads.

The total length of roads is 34,999km and about 10,000km of this length is known to be narrow roads with widths of 2.4m or less, making driving very difficult. There are 6 expressways in the total length of 661km, most of which are not fit for high-speed driving. The use rate of expressways is low due to a low car ownership rate and lack of automobile fuel. North Korea has an H-shaped structure of road networks similar to their railway networks, including the Gaeseong-Pyongyang-Sinuiju Expressway in the west coast, the Goseong-Wonsan-Cheongjin-Rajin Expressway in the east coast and the Pyongyang-Wonsan Expressway connecting the west to the east (Figure 3-4). In addition to these, there are the Sinuiju-Manpo-Hyesan-Musan expressway running from the west to the east along the border with China and the inland expressway from Pyongyang to Ganggye (Table 3-2).



Source: Il-Soo Jeon, et. al., 1998

Figure 3-4 Arterial roads in North Korea

Table 3-2 Main features of major arterial roads in North Korea

		Sections	Length (km)	Width (m)	Pavement condition	Remarks
Expressways			661			
	East coast axis	Wonsan-Goseong	114	12	Concrete	High-speed road
	East-west axis	Pyongyang-Wonsan	189	7	Concrete	4~5 lanes
	West coast axes	Pyongyang-Sunan	15		Concrete + asphalt	
		Pyongyang-Nampo	53	7	Concrete + asphalt	4 lanes
		Pyongyang-Gaeseong	170		Asphalt	4 lanes
		Pyongyang-Huicheon	120			4lanes
Arterial roads			3,158			
	East coast axes	Goseong-Onseong	867	2.7~7.3		
		Wonsan-Gimhwa	143	4.6~5.5	Unpaved	
		Cheongjin-Wonjeongri	113	4.6~7.3	Unpaved	
	East-west axes	Pyongyang-Wonsan	197	7	Concrete	
		Sinuiju-Gomusan	861	2.7~6.1	Unpaved	
	West coast axes	Gaeseong-Sinuiju	461	4.9~7.3	Concrete	
		Sariwon-Haeju	72	5.2~7.6	Unpaved	
		Pyongyang-Nampo	53	5.5	Paved	
		Jeongju-Sakju	100	4.6~6.4	Unpaved	
		Anju-Manpo	291	3.7~4.9	Unpaved	
Grade A roads			1,252			Radial shape surrounding Pyongyang
	East coast axis	Bukcheong-Hyesan	186	2.7~4.9		
	East-west axes	Gaeseong-Haeju	88	6.1		
		Geumcheon-DMZ	150	3.7~6.1		
		Pyongyang-Geumyaman	242	3.7~7.3		
	Midland axes	Yangdeok-Pyongsan	145	2.7~4.9		
		Hoecheon-Yangdeok	58			
	West coast axes	Pyongyang-Tosan	142	3.1~5.5		
		Jaeryeong-Nampo	47	5.5~7.6		
		Suncheon-Uiju	194			
Grade B roads			2,560			Connected to Grade A roads

Source: Ministry of Construction and Transportation, 1998

In the North's trade with China, the Dandong-Sinuiju route plays the most important role followed by Wonjeong-Rajin route. Freight trucks are currently running from China to Rajin port by this Wonjeong-Rajin road but due to its small capacity, it is known that it will not be able to meet future demands. If a new road is not constructed between Wonjeong and Rajin in the short term, it is very likely that freight trucks from China will not operate to Rajin port any longer and instead they will divert to destinations in Russia. The North Korean government is placing the highest priority on the construction of a new road between Wonjeong and Rajin. But due to difficulties in financing, they plan to construct part of the new road with foreign capital, while postponing the remaining part in expectation of support from China or South Korea. The secretariat of the United Nations Development Programme (UNDP) for the Tumen River Development strongly recommends that a new road should be built between Wonjeong and Rajin in the development of the Tumen River region and the security of Northeast Asian transport corridors (Gombo 2001).

Northeast China

a) Railways

The railway networks in Northeast China consist of the Harbin-Dalian Railway running from the south to the north, the Manzhouli-Harbin-Suifenhe Railway running from the east to the west and the Changchun-Tumen Railway also running from the east to the west (Figure 3-5). The Harbin-Dalian Railway that runs south to north is completely double tracked and plays a pivotal role in freight transport for Northeast China. In the case of the Manzhouli-Harbin-Suifenhe Railway that runs east to west, as both its ends meet with the Russian Trans-Siberian Railway, it also handles international freight. The total length of railways in Northeast China is 15,533 km, which accounts for more than one fourth of the total length of Chinese railways and has the highest railway density in China. Nevertheless, the low levels of facility provision and dilapidation lower the efficiency of railway transport. The rapid increase of freight and passenger transport since China's reform and opening is responsible for the shortage of railway transport capacity in Northeast China (Wang 2001).

The rapid increase of freight and passenger traffic since China's reform and opening is responsible for the shortage of railway transport capacity in Northeast China

The Railway Management Bureau in Northeast China, whose offices are located in Heilongjiang and Shenyang, is endeavoring to provide indirect support by way of connecting railways with regional or foreign ports so as to meet an increasing transport demand by burgeoning international trade. Northeast China and South Korea have close relations in the exchange of commodities and people, and South Korea is an important source country of trade, investment and tourism of Northeast China. Northeast China, which also maintains close relations with North Korea, operates railways with North Korea such as the Dandong-Sinuiju Railway, the Tumen-Namyang Railway and the Jian-Manpo Railway. The Shenyang-Dandong Railway runs 283km in length, including 88.6km of double-tracks, and operates at the maximum speed of approximately 80km / h. It is enjoying such a large demand beyond

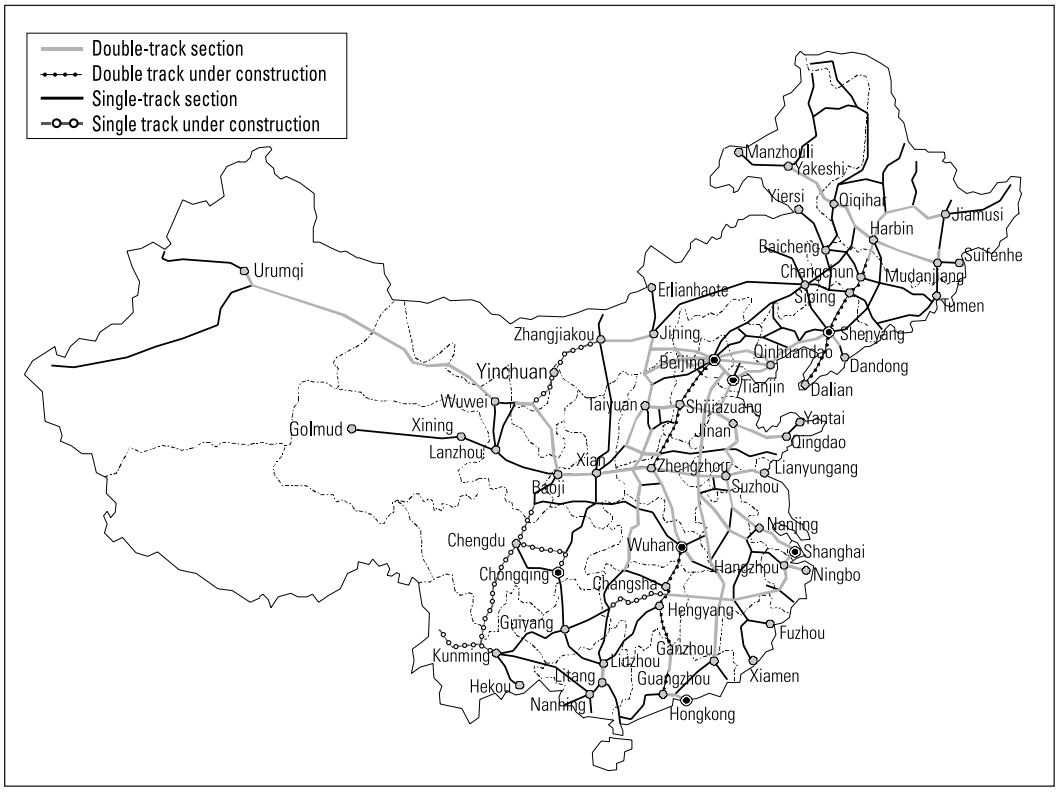


Figure 3-5 Arterial railways in China

its capacity that it is causing overload in some sections. The Tumen-Changchun Railway is 518.9km long and single-tracked for the most part. Steam locomotives transport freight on this railway, but the freight volume that can be transported is limited. The Jian-Meihekou-Manpo Railway is 244.3km long and all its sections are single-tracked (Wang 2001).

China is considering electrifying the Harbin-Dalian Railway and newly constructing passenger transport railways between Qinhuangdao and Shenyang. Facility improvement is also considered for those railway points that are connected to the Trans-Siberian Railway. These plans are expected to reinforce the role of Northeast China in freight transport not only between China and Europe, but also between Korea, Japan and Europe (Zhu 2001).

b) Roads

Arterial roads in Northeast China consist of the Beijing-Shenyang-Changchun-Harbin Road and Aihun-Harbin-Jilin-Shenyang-Dalian Road, which run south to north, along with the Baicheng-Changchun-Jilin-Yanji-Hunchun road and the Harbin-Mudanjiang-Suifenhe road, which run east to west (Figure 3-6). An expressway is under construction between Harbin and Changchun and thus all the sections between Harbin

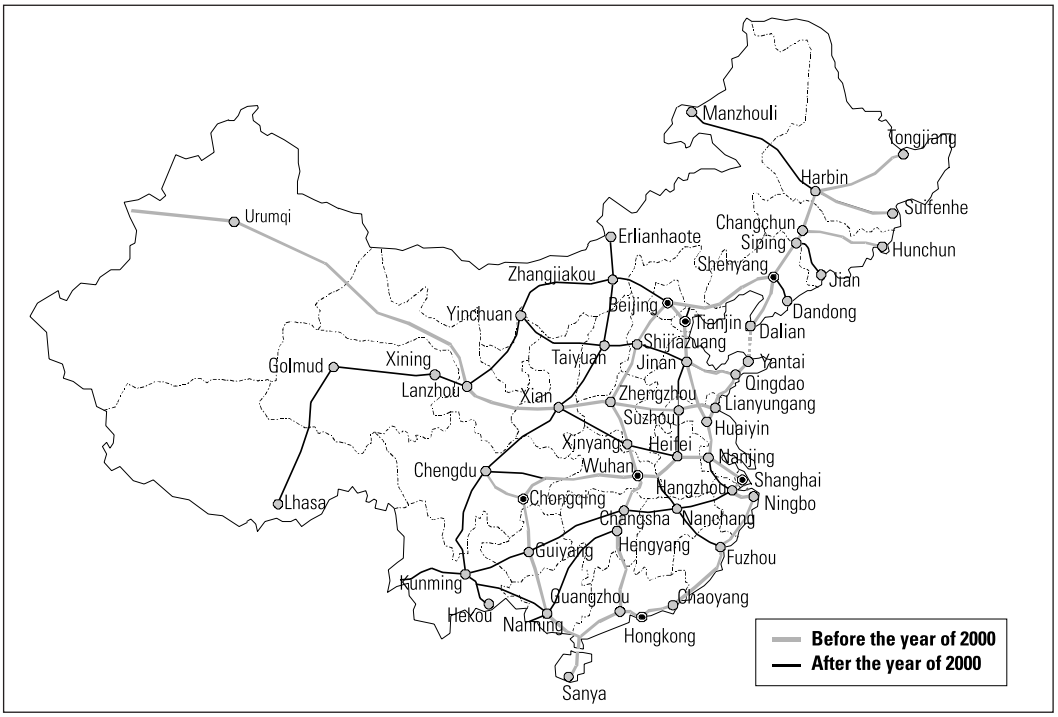


Figure 3-6 Arterial roads in China

and Dalian will become expressways in the near future, and expressways are being designed to partially connect Suifenhe and Manzhouli. For the section between Shenyang and Dandong, a major route connecting China to North Korea, an expressway is scheduled to be completed by the end of 2002(Zhu 2001).

Land Connections between China and North Korea

North Korea was estranged from China temporarily when China experienced the Cultural Revolution in the 1970s and signed a treaty of amity with South Korea in 1992. But generally, China and North Korea have maintained economic cooperation and trade based on their traditional friendly relationship. Trade volume between China and North Korea has decreased mainly due to the recession of the North Korean economy since the 1990s. However, China is maintaining the reform and open policy in its border areas with North Korea in such cases as the Dandong special economic zone and the Hunchun special economic zone. Manpower and commodity exchanges are still ongoing in border areas according to the trade and travel agreement established between the two countries. The freight volume transported by railway between China and North Korea amounted to 4.4 million M/T in 1985 but since then has continually diminished, amounting to 870 thousand M/T in 1999 (Wang 2001).

The major trade item between China and North Korea is coal but its volume has

drastically decreased since 1990 when the North Korean economy began to suffer recession, thus causing the decrease of the total trade volume between China and North Korea. During the period of 1985-1999, more than half of the total freight volume transported between China and North Korea passed through Dandong Station, followed by Tumen located opposite Namyang in North Korea. Jian, which is close to Manpo, handled less than 100,000 M/T a year, with the exception of 1995 (Table 3-3).

Table 3-3 Trade volumes of China with North Korea

Unit: ten thousand M/T

	Dandong		Tumen		Jian		Total trade volumes		
	Export	Import	Export	Import	Export	Import	Export	Import	Total
1985	161	98	54	124	2	3	217	225	442
1990	107	80	34	105	2	5	143	190	333
1991	60	13	21	4	5	5	86	22	108
1992	73	72	68	58	2	5	143	135	278
1993	36	62	96	114	5	9	137	185	322
1994	25	51	66	120	4	5	95	176	271
1995	385	93	39	42	24	19	448	154	602
1996	37	10	22	5	3	4	62	19	81
1997	95	80	32	97	1	6	128	183	311
1998	10	39	4	10	4	2	18	51	69
1999	38	9	29	5	2	4	69	18	87

Source: Wang 2001

No statistical data are available on exchanges of visitors between China and North Korea. There is only the estimated number of visitors from China to North Korea, approximated at 200,000 persons a year. On the contrary, the number of visitors from North Korea to China, known to be in the range of 30,000 persons in 1990, increased to 70,000 persons, more or less, in 1999, and most of them traveled by railway or road. Dandong also plays an important role in passenger transport, which handles approximately 10,000-20,000 visitors to and from North Korea a year.

Currently, the major connecting points between China and North Korea are Sinuiju at the northwest tip of the peninsula, Manpo in the northern inland, Namyang at the northeast tip of the peninsula, and the Rajin·Seonbong area. As for the transportation infrastructure condition in these areas, a single-tracked railway and

one-lane road are available between Sinuiju and Dandong. More than half of the border trade volume between China and North Korea passes through Dandong and most Chinese visitors travel to North Korea via Dandong (Table 3-4).

Table 3-4 Amount of border trade between China and North Korea

Unit: thousand US$

	1998			1999		
	Export	Import	Total	Export	Import	Total
Total amount of trade between China and North Korea	355,705	57,313	413,018	328,660	41,709	370,369
Trade via Dandong	207,970	24,933	232,390	170,437	16,836	187,273
Ratio of trade via Dandong (%)	58.5	43.5	56.4	51.9	40.4	50.6
Amount of border trade between China and North Korea	92,901	37,659	130,581	n/a	n/a	n/a
Trade via Dandong	58,503	16,302	74,805	43,041	12,811	55,852
Ratio of trade via Dandong (%)	63.0	43.3	57.3	n/a	n/a	n/a
Ratio of border trade between China and North Korea						
Border areas other than Dandong (%)	26.1	65.7	31.6	n/a	n/a	n/a
Dandong (%)	28.1	65.4	32.2	25.3	76.1	29.8

Source: KOTRA

Other important connecting routes between China and North Korea are the sections between Tumen in China and Namyang in North Korea and between Quanhe in Hunchun, China and Wonjeong-ri in North Korea. There are railways and roads between Tumen and Namyang and the North Korean-Chinese tour train operates twice a week. The Rajin-Namyang Railway was electrified in 1996 and transports container cargoes from the Jilin Province in China to Rajin port in North Korea. The lack of locomotives and the dilapidated railway track and tunnels are diminishing the transportation potential of the Rajin-Namyang Railway (ERINA and FIAS 2000). The section between Quanhe and Wonjeongri is an important route for transportation of cargoes from the Jilin Province of China to Rajin port. Chinese freighters expect that freight volumes will increase very rapidly in this section in the future. The Wonjeongri-Rajin Road is known to currently handle approximately 250,000 M/T of freight per year, and is expected to handle more than 3 million M/T of freight per year if a new road is constructed in this section (Eun-Chul Lee, 2000). The volume of container

cargoes is expected to increase from the current 5,300TEU to over 20,000 TEU per year in the future. North Korea also has a plan to raise the railway capacity to handle freight to and from China for up to 33 million M/T a year so as to facilitate the development of the Rajin·Seonbong area.[2]

The number of foreign visitors to the Rajin·Seonbong area is known to be around 15,000 persons a year, which is expected to increase to 20,000 persons after the opening of Mt. Chilbo. Foreign visitors traveling in the Rajin·Seonbong and Chinese border areas amounts to 600,000 persons a year and it would reach 800,000-1,000,000 persons a year provided that traffic conditions improve. Therefore, it is quite evident that the number of visitors to North Korea will increase only if North Korea is ready to accept them.

There is concern that the lack of or dilapidation of transport facilities in North Korea will create some problems in the movement of freight and passengers when North Korea reforms and opens its economy and exchanges between China and North Korea expand in the future

Other routes for small-scale trade and tourist visits between China and North Korea are Jian-Manpo, Kaishantun-Jongseong, Shatazi-Saebyeol, Sanhe-Hoeryeong, Changbai-Hyesan, Linjiang-Junggang, and Nanping-Chilseongri. Among these, Sanhe, Kaihantun, Nanping, Linjiang, Jian, and Quanhe including Dandong and Tumen are Grade A trade and commercial districts designated by the Chinese government and they are potential areas to contribute to the revitalization of economic exchanges between China and North Korea in the future. Only the section between Jian and Manpo is connected by railway, while the rest of the districts connected by roads. As a whole, there is concern that the lack of or dilapidation of transport facilities in North Korea will create some problems in the movement of freight and passengers when North Korea reforms and opens its economy and exchanges between China and North Korea expand in the future.

When examined from the standpoint of the Korean peninsula, among the land transport corridors between China and North Korea mentioned in the above, the Dandong-Sinuiju and Tumen-Namyang sections are expected to play the role of an international transport corridor. This is because Korean railways bound for China have to pass through Sinuiju and Namyang. Trains departing from Busan can run to Shenyang via Sinuiju and Dandong and further to Harbin or Beijing, to be connected to the Pan-Asian Railway, which has been a topic of recent discussion. On the other hand, trains departing from Mokpo can run to Namyang via Cheongjin or Rajin and from there to Tumen, Changchun, Mudanjiang and finally to Harbin. The Seoul-Wonsan Railway can be connected to the Trans-Siberian Railway via Dumangang area and therefore, it can be included as part of the Trans-Eurasian Railway.

As for land connection by roads between Korea and China, the Seoul-Busan Expressway can be connected to the Pyongyang-Gaeseong Expressway. From there, it can extend to the Shenyang-Dalian Expressway now under construction and to the

[2] The plan includes the construction of new railway bridges for the Sanhe-Kaishantun and Hunyung-Hunchun sections, the new construction of the second railway bridge between Dumangang and Khansan, the electrification of the Hoeryeong-Haksong Railway, the double tracking of the Myeongho-Hunyung Railway and the construction of a new railway between Guryongpyeong and Josan (Japan-China Northeast Development Association, 1992).

Beijing-Shenyang Expressway now under planning with the new construction of the Anju-Sinuiju Expressway. Then it would be possible to travel by car from Busan to Beijing via Shenyang in the future. Access to major Chinese economic centers from Beijing by car would be possible by using the Beijing-Shanghai expressway that was completed in 2002. Also, when the west coast expressway in South Korea is extended to North Korea and an expressway is built between Dalian and Dandong, it will partially form a Yellow-Sea expressway. China is designing a Bohai region expressway to include the sections between Beijing and Shanhaiguan, between Beijing and Xinxiang, and between Qingdao, Jinan and Handan, enabling the formation of an expressway connecting all regions along the Yellow Sea.

Land Connections between South and North Korea

Due to the division that has lasted for more than a half century, inter-Korean trade has been carried out only by sea. When the Munsan-Bongdong Railway is restored and a new road is constructed between Munsan and Gaeseong, which are now under construction by agreement between the two Koreas, it will be possible to travel between the South and the North by land for the first time. Other potential railway sections to be connected are the Sintanri-Pyonggang Railway (Gyeongwon Railway), the Cheolwon-Naegeumgang Railway (Geumgangsan Railway), and the Gangneung-Onjeongri Railway (Donghae Railway) (Figure 3-7).

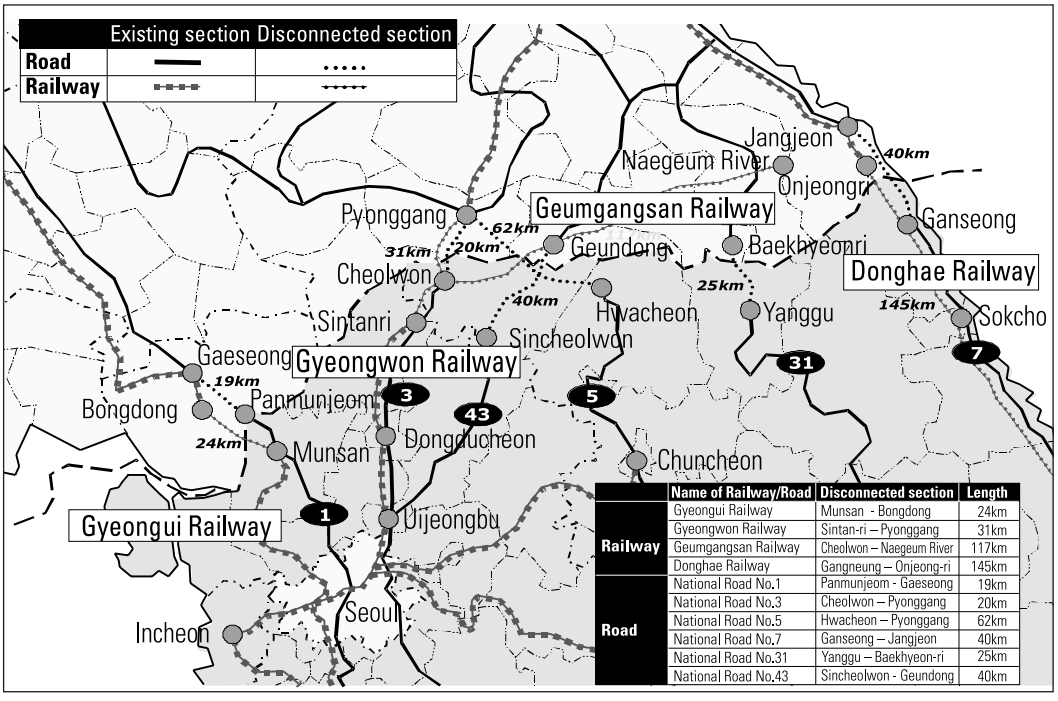


Figure 3-7 Disconnected land transport routes between South and North Korea

In the case of expressways, the West Coast Expressway will be fully functional when a new expressway is constructed in the North Korean section between Haeju and Sinuiju. The new road between Munsan and Gaeseong will work as a chain to link the Seoul-Busan Expressway in the South to the Gaeseong-Pyongyang Expressway in the North. The Central Inland Expressway in the South can be extended to Ganggye and Manpo in the North passing through Cheolwon in the South to be a Trans-Korean Expressway. The road between Ganseong and Jangjeon will link the east coast from Busan in the South to Rajin in the North.

Considering future land connections between Korea and China, railway connection should have priority in the restoration of land connections between the South and the North

Considering future land connections between Korea and China, railway connection should have priority in the restoration of land connections between the South and the North; railways are more advantageous than roads in terms of both long-haul transportation and environmental impact. Among railway connections, the Busan-Sinuiju corridor should be the first to be connected and renovated when considering the large demand in this corridor for freight and passenger transport between Korea and China. However, it does not seem necessary to urgently expand and renovate the Gyeongwon Railway to connect with the Jilin province of China and the Russian Far East, as long as sea transport to Japan by using the Rajin and Cheongjin ports maintains its comparative advantages in terms of price and frequency.

The Busan-Sinuiju-Shenyang-Beijing corridor is also important from the perspective of building a Eurasian railway. As the building of a Eurasian railway is a long-haul project that requires multi-national agreements as well as renovation of railway facilities, it should be promoted in a way that satisfies the increasing transportation demand for passengers and freight within Northeast Asia, especially between South Korea and China. It is desirable to promote the corridor as part of the transport corridors between Asia and Europe (Jong-Gwan Im, 2000). As the Busan-Sinuiju-Shenyang-Beijing corridor has been verified to contribute to the promotion of trade between Central Asian countries, it has firm ground to be preferentially promoted (Hyung-In Jin, et. al., 1998).[3]

Road connections between the South and the North need to be developed so as to connect the Korean peninsula with Northeast China and the Bohai region

When considering the limited capacity of railway transport in China and North Korea, road connections between the South and the North need to be developed so as to connect the Korean peninsula with Northeast China and the Bohai region, and create the effect of facilitating the smooth movement of freight and passengers. In particular, the expressway from Busan to Shenyang via Seoul and Pyongyang can function as an important transport corridor to connect China's northeast provinces with the Korean peninsula. When the Beijing-Shenyang Expressway is built in China, the Busan-Shenyang Expressway can be easily connected. The extension of the west coast highway to the North can be one way to mitigate the overloaded traffic demand

[3] According to a study on the building of an international combined transport corridor by using the TAR, the Busan-Dumangang-Trans-Siberian Railway is considered advantageous for trade between Korea and Europe, whereas the Busan-Beijing-Trans-Chinese Railway is considered so for trade between Central Asian countries in terms of transport conditions (Hyung-In Jin, et. al., 1998).

of Seoul, and therefore, it should be considered in conjunction with the Busan-Sinuiju Expressway. On the other hand, the expressway running through Korea's east coast should be designed from the long-term perspective, for it will absorb a considerable proportion of freight and passenger demands between the Korean peninsula, the Jilin province of China, and Russian Far East.

Although detailed information about the conditions of railways and roads in North Korea is not available, fragmentary information obtained thus far is as follows. First, the railway between Seoul and Sinuiju is disconnected in the 24-km section between Munsan and Bongdong, which is under reconstruction.[4] The section from the demilitarized zone to Sinuiju with the length of 421km is single-tracked and suffering from track dilapidation as well as other substandard facilities. Second, the railway between Seoul and Wonsan contains a disconnected portion of 31km between Sintanri and Pyonggang. The total length of this Seoul-Wonsan line is 750km of single track, and because of deterioration, this line is reported to be in need of substantial repair and improvement. Both the Seoul-Sinuiju and Seoul-Wonsan railways, which are single-tracked lines at the moment, can function as temporary transport channels between Korea and China if essential elements such as signaling systems, bridges, tunnels and rails are repaired and replaced.

Expenditures needed for such railway connections between the South and the North and the renovation of North Korean railways are estimated as follows: first, the connection of the disconnected Seoul-Sinuiju Railway and the improvement of the North Korean section of the Seoul-Sinuiju Railway are estimated to cost US$ 125 million[5] and US$ 1 billion respectively. In addition, the costs for the reconstruction of the disconnected Seoul-Wonsan Railway and the improvement of the railway between the demilitarized zone and Dumangang are US$ 217 million and US$ 1.88 billion, respectively. Other than these, the Geumgangsan Railway and the North East Sea Railway can be reused after connecting their disconnected sections, which will cost a respective US$ 217 million and US$ 233 million(Ministry of Construction and Transportation, 2000a, Byung Min Ahn, 2000).

In the case of roads, a number of disconnected roads between the North and the South can be reconstructed in the long term. However, when considering connecting the Korean peninsula to China by land, priority should be given to the connection of the Seoul-Busan Expressway to the Pyongyang-Gaeseong Expressway, the connection of the Seoul-Wonsan Road and the connection of the east coast road in the South to the east coast expressway in the North. South Korea has started to work on its portion in the section between Panmunjeom to Gaeseong (19km) according to the agreement between North and South Korea. The Ganseong-Jangjeon section (40km) needs

[4] North Korea has withdrawn construction workers who had been dispatched to restore the disconnected Seoul-Sinuiju Railway due to the recent tension between the North and the U.S., and between the South and the North. But the completion rate of the construction of the South Korean portion is 56% as of the end of May 2001.

[5] The exchange rate of 1,200 Korean won for US$ 1 is used for conversion.

construction and expansion of road. Then, it can extend to Rajin and Namyang through the Jangjeon-Wonsan Expressway but before that, the present two-lane road between Wonsan and Namyang needs to be expanded into a four-lane road. For the transportation of freight and passengers to the northeastern part of the Korean peninsula, as well as China and Russia, a new expressway should be constructed between Seoul (Jeongok) to Wonsan.

It is necessary to take phased approaches to these matters in the perspective of Northeast Asia and financing measures should be also prepared

For traveling from Busan to Sinuiju by expressway, a four-lane expressway with the length of 139km should be newly constructed between Anju and Sinuiju and the Pyongyang-Gaeseong Road needs repavement. Such road connections between the South and the North and the renovation of North Korean road require a great amount of money. Therefore, it is necessary to take phased approaches to these matters in the perspective of Northeast Asia and financing measures should be also prepared.

Institutional Improvements

Border crossing procedures and technical and institutional impediments in the operation of land transport means are major obstacles

Although the disconnected railways and roads, and the lack of physical facilities are posing problems in the land transport linkages between the Korean peninsula and China, border crossing procedures and technical and institutional impediments in the operation of land transport means are also major obstacles. In particular, as the North and the South do not grant visas, special measures should be prepared for freight and passenger transportation even if the two countries are connected by land. As can be seen in the data discussed in relation to the Tumen River development project, border crossing impediments are no less important than transport facilities (PADECO 1999, ERINA & FIAS, 2000). In particular, unnecessary procedures that take time in border crossing, limited border crossing time, the cost and time needed for processing entry visas and restrictions on the operation of other countries' cars are being pointed out as major obstacles to the flows of people and commodities. They should be eliminated to facilitate economic cooperation and exchange within Northeast Asia in the future.

According to the results of a study conducted by PADECO, one of the institutional problems is the complicated customs clearance procedure. Five Chinese government agencies and 6 North Korean government agencies are involved in clearing freight and documents through customs, thus making the customs clearance procedures complicated. In the case of the operation time of customs offices, China and North Korea have agreed to adjust the operation time of customs offices to reduce the inconveniences of users. Between North Korea and Russia, however, the operation time of customs offices is known to have been partially adjusted, but that inconvenience is still caused in border crossing. In particular, the operation time of customs offices for freight is so limited, and with service unavailable on Sundays and holidays, it causes difficulties in freight transport and trade.

One notable aspect in truck transport between China and North Korea (limited only to the Rajin·Seonbong areas) is that Chinese trucks can operate in North Korea and vice versa. Chinese trucks can travel as far as the Rajin and Seonbong areas, with

North Korean trucks as far as Hunchun, China (PADECO, 1999). Foreign trucks should have a visa granting 15-day operation per each time but 20-day operation is possible with a multiple visa.

The different format and processing of customs clearance documents between North Korea and China are known to be the causes in the delay. Another reason lies in the insufficient computerization of North Korean operations. It is known that the border crossing visa system between China and North Korea substantially reduced the inconvenience of passengers. However, the excessively fastidious inspection of North Korea on quarantine and hand-carried goods have been pointed out as improved upon. Railways also pose many problems such as the compulsory railway compensation regulations.

The institutional problems can be improved according to the agreement between concerned countries at no cost contrary to the problem of the lack of facilities needing investment

The institutional problems mentioned in the above are no less important than the lack of facilities in some sense and can be improved according to the agreement between concerned countries at no cost contrary to the problem of the lack of facilities needing investment. In particular, the North and the South need to establish a traffic agreement and join the international transport pact.[6] At the same time, railway connections between the North and the South will be fruitful only when the operational systems such as the level of electric voltage, signaling system, operation time, etc. are adjusted through negotiations between the two Koreas. The differences in road signal systems and signposting, etc., should be also removed to facilitate road traffic between the two countries (Hyung-In Jin, et. al., 1998).

[6] Please refer to the report, "Measures to build a transport network for the northern corridors of the Trans-Asian Railway," by the Korea Transport Institute (1997) for more details on the international transport pact.

4
ALTERNATIVE LAND TRANSPORT CORRIDORS FOR THE INTEGRATION OF TRANSPORT SYSTEMS IN CHINA AND KOREA

International transport linkages should be oriented toward the establishment of an integrated inter-modal transport system, the satisfaction of actual transport demand, and the maximization of the effect of regional development in Northeast Asia

Considerations in the Land Transport Linkages between Korea and China

An integrated inter-modal transport system as well as the strengthening of international transport connections must be considered to facilitate the broadening and expansion of economic cooperation in Northeast Asia. International transport linkages, in particular land transport linkages between Korea and China, should be oriented toward the establishment of an integrated inter-modal transport system, the satisfaction of actual transport demand, and the maximization of the effect of regional development in Northeast Asia. Also efforts should be made to minimize any negative environmental effects that may arise in the process of building transport systems.

Currently, major issues in the transport systems in Northeast Asia include: 1) deficiency and dilapidation of transport infrastructure (particularly between China and North Korea); 2) absent and weak links in land transport; 3) overloading in certain sections of land transport and seaports; and 4) border crossing impediments. The first issue mentioned may require continuous investment over a long period of time, and thus does not need to be discussed any further. The second and third are of particular interest in this study; rebuilding non-existing links and enhancing weak links are necessary to facilitate economic cooperation and cultural exchanges in Northeast Asia. The governments of concerned countries can resolve these problems through joint efforts. In particular, the matters arising from freight transshipment and passenger transport while crossing borders can be solved only through international negotiations.

The discussion on the transportation system covering the entire Northeast Asian region is a digression from the objective of this study, and so only the transportation system to strengthen land transport links between the Korean peninsula and China will be discussed. By this criterion, the north of Shanghai, particularly the Bohai region and the three northeast provinces of China and the Korean peninsula will be the

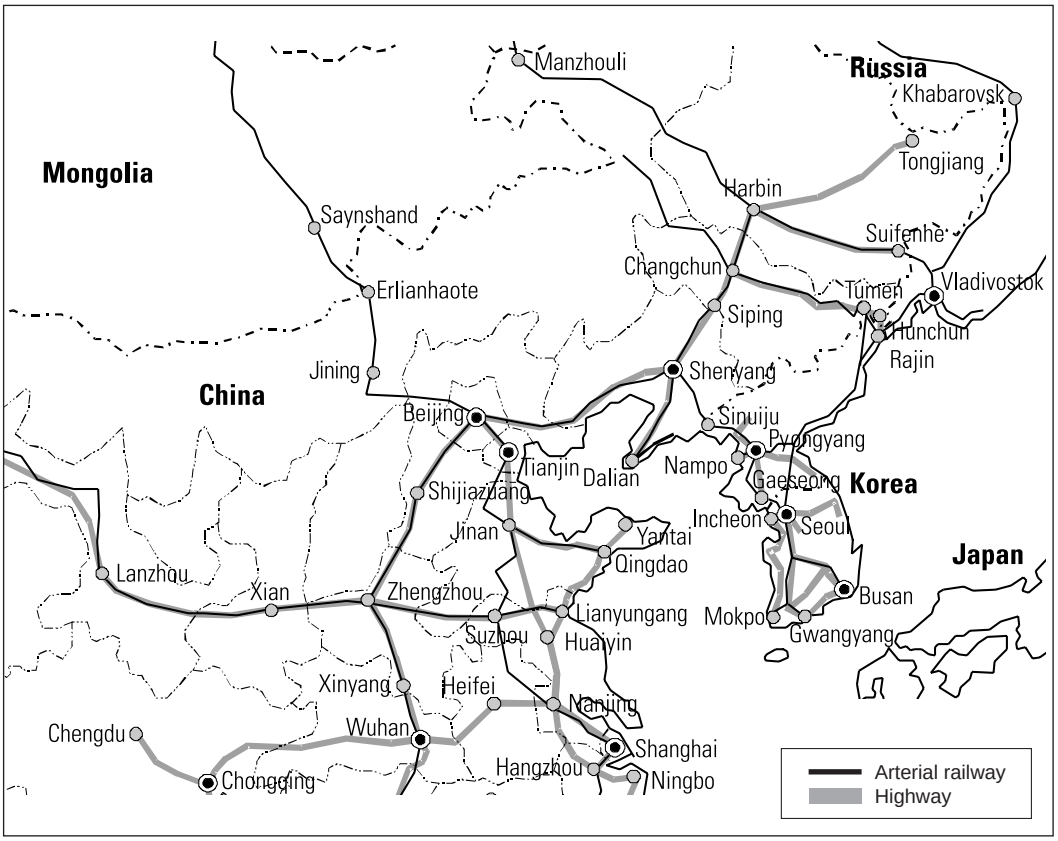


Figure 4-1 Major land transport corridors in Northeast Asia

primary impact area. The Russian Far East, Mongolia, Japan, and the rest of China will be the secondary impact area. As shown in Figure 4-1, Qingdao, Tianjin and Dalian in the Bohai region of China, and Nampo, Gwangyang, Busan and Cheongjin/Rajin in the Korean peninsula are functioning or will be able to function as trading ports in the future. Railways and roads connecting these ports to inland areas include the Beijing-Tianjin Railway and Expressway, the Qingdao-Jinan Railway and Expressway, the Dalian-Harbin Railway and Expressway, the Seoul-Busan Railway and Expressway and its extension to Sinuiju through the Gaeseong-Sinuiju Railway and Expressway, the Mokpo(Gwangyang)-Gwangju-Seoul Railway and Expressway, the Nampo-Pyongyang Expressway and the Rajin-Cheongjin-Pyongyang Railway. In addition to these land connections between ports and hinterland centers, there are transport corridors connecting one inland center to another such as the Beijing-Shenyang Railway and road, the Beijing-Shanghai Railway and Road, the Manzhouli-Harbin-Suifenhe Railway and Road, and the Changchun-Tumen Railway and Road in China, along with the Pyongyang-Wonsan Railway and Expressway, the Seoul-Wonsan Railway (up to Rajin) and the Incheon-Mokpo Expressway and others in Korea.

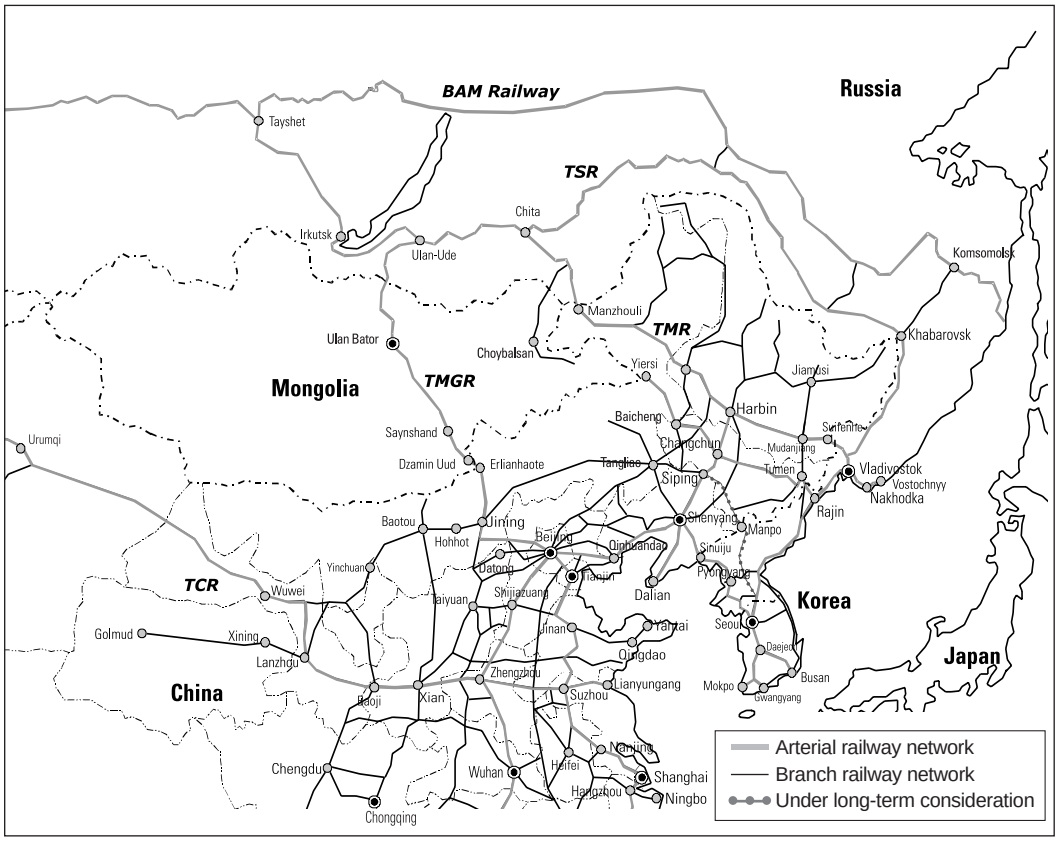


Figure 4-2 Design of Korea-China railway networks

Potential Land Transport Corridors

Considering the existing configuration of land transport corridors and seaports, the most important section in linking land transport corridors between Korea and China is the section between Shenyang and Dandong. This is because it can be connected to the Dalian-Harbin corridor, the Beijing-Shenyang corridor and further to the Beijing-Shanghai corridor (Figure 4-2). A railway is currently operating in the section between Pyongyang and Shenyang and an expressway has been opened since the end of 2002.

[7] It seems necessary to expand and adjust the railway networks in the Seoul capital region to meet the logistics demand to be concentrated in the Seoul capital region after the reunification of Korea. The construction of a new road bypassing the Seoul Metropolis will be necessary, and in this case, a circle railway that connects the suburbs of the Seoul capital region may be considered as an alternative. A bypass bound for the west coast will run from Seonghwan to Daegok and from Daegok, the existing Seoul-Busan Railway can be extended to Munsan (Jong Seo Shin, Executive Director of the Korea Railroad Technical Corporation). This section can be connected to the new airport railway to be opened in 2007, which then will enable air and railway combined transportation.

Judging from this, the Chinese government's position toward the land transport linkages between Korea and China appears to be favorable. But North Korean portions and the overloaded section between Seoul and Cheonan in the South pose problems.[7] As for railway connections, the portion in North Korea is known to have problems of weak track foundation and single tracking, and the overloaded section between Seoul and Cheonan in South Korea requires quadruple tracking instead of the double-track. In the case of road connections, the Pyongyang-Gaeseong Expressway needs renovation and a new highway needs to be constructed between Anju and Sinuiju.

The second most important section to be connected urgently is between Rajin (Cheongjin) in North Korea and Tumen·Hunchun (Yanji) in China. This section can play an important role in trade between the Jilin and Heilongjiang provinces in China, as well as Korea and Japan, for it can extend to Changchun in the Jilin province of China both by railway and road as well as to the Manzhouli-Suifenhe corridor, the east-west transport corridor in Northeast China. Furthermore, it may produce the effect of relieving the pressure on the overloaded Harbin-Dalian Railway. The

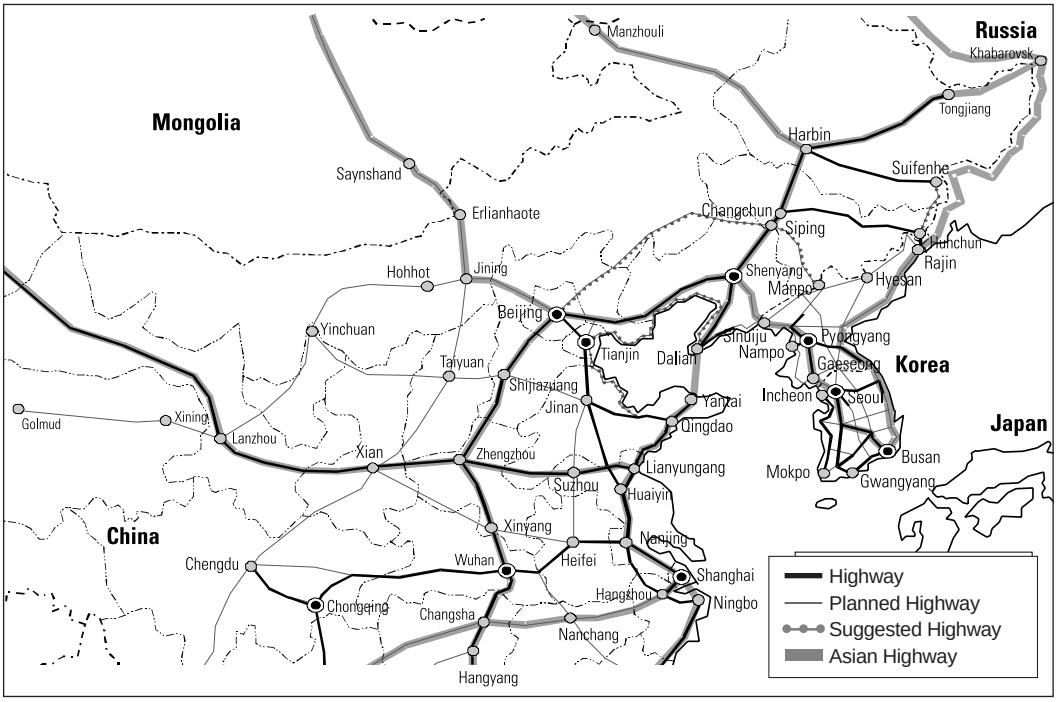


Figure 4-3 Design of Korea-China road networks

[8] The secretariat office of the United Nations TRADP, which plays a leading role in the development of the Tumen River region suggested that the Rajin-Namyang Railway should be urgently repaired and improved and that a new road should be constructed between Wonjeongri and Seonbong. The costs for the repair and improvement of tunnels, the renovation of track conditions and the increase of the number and capacity of locomotives are estimated to be US$45 million. Meanwhile, the cost in the construction of a new road for the Wonjeongri-Seonbong section is estimated to be US$10 million (ERINA and FIAS, 2000).

extension of the Changchun-Tumen Railway and road is near completion in China, but the Rajin-Wonjeongri Road and the Rajin-Namyang Railway in North Korea are so dilapidated that they are in need of urgent renovation.[8] The railway between Rajin to Seoul via Cheolwon also requires urgent repair and renovation. When the disconnected road between Goseong in the North and Ganseong in the South is reconnected, it will enable the formation of the east coast transport corridor, which would result in the connection of Korea with China and Russia (Figure 4-3).

As suggested by previous studies, potential arterial roads in Korea that can be linked to Eurasian transport corridors include the railway from Busan to Shenyang via Sinuiju and the railway from Mokpo to Tumen in China and to Khasan in Russia via Rajin (Ministry of Construction and Transportation 1998, Il-Soo Jeon, et. al., 1998, Hyung-In Jin, et. al., 1998). The railway starting from Cheolwon in South Korea to Jian, Meihekou, Jilin in China via Manpo in North Korea can be a long-term consideration (Ministry of Construction and Transportation 1998).

In the case of roads, the plan to connect the Seoul-Busan Expressway in the South to the Pyongyang-Gaeseong Expressway in the North to extend it up to Shenyang via Sinuiju and Dandong has been given top priority. The east coast corridor from Busan to Tumen in China and Khasan in Russia via Rajin is a long-term consideration (Il-Soo Jeon, et. al., 1998). The connection between Manpo in North Korea and Jian in China is under consideration (Kyung-Seok Kim, 2000).

In addition, for the connection of Korea with the Bohai region in China, it seems necessary to extend South Korea's West Coast Expressway as far as the Dalian-Dandong Expressway, which is now under construction through Ganghwa in the South, and Haeju, Nampo and Sinuiju in the North. If this is the case, the West Coast Expressway would not only function as a subsidiary to the Busan-Sinuiju Expressway but would also constitute part of the Yellow Sea Expressway network in the long-term (Won-Bae Kim, 2000).

Concrete investment plans for transport connections and the enhancement of transport capacity should be established based on the analysis of economic feasibility and by taking into account the present and future demands for land transport connections between Korea and China

Albeit less important than the land transport linkages mentioned earlier, international expressways can be considered to relieve the increasing traffic between Korea and China by extending the central inland expressway in South Korea to Siping in the Jilin province of China via Ganggye and Manpo in North Korea. In this case, a new expressway should be constructed from Cheolwon to Gangdong, Huicheon and Manpo. Also considered is another expressway linking Busan to Changchun in China passing through Cheolwon, Hyesan around Mt. Baekdu and Tunhua in China to accept tourists to Mt. Baekdu.

Concrete investment plans for transport connections and the enhancement of transport capacity should be established based on the analysis of economic feasibility and by taking into account the present and future demands for land transport connections between Korea and China. The study premises that railways should precede roads in the consideration of the relationship between South and North Korea and the political currents in Northeast Asia. In particular, connecting railways to potential growth regions in China should be given first consideration to facilitate

commodity and traveler movements between Korea and China.[9] There are two alternatives to the building of a railway transport system between Korea and China. One is the Busan-Shenyang Railway as mentioned earlier and the other is the Mokpo-Rajin-Tumen (Hyesan) Railway.

The Mokpo-Rajin-Tumen (Hyesan) railway holds two important points in that it will contribute to the formation of the Eurasian railway by using the Trans-Siberian Railway and will facilitate exchanges between Korea and the southeastern part of the Jilin province of China. However, it does not appear that it will create a significant effect on the facilitation of economic exchanges between Korea and China. According to the estimation of the distribution of freight from the three northeast provinces of China by port, Dalian and Tianjin ports handle 38% and 34%, respectively (Wang 2000, Northeast Asia Research Center 1999). The remaining 29% is shared between Vladivostok, Zarubino, and Vanino ports in Russia and Rajin port in North Korea. It seems that Vladivostok and Zarubino ports are used for trade between the three northeast provinces of China and Japan but Rajin port handles a small volume of trade between the three northeast provinces of China and South Korea. The Mokpo-Rajin-Tumen (Hyesan) Railway is also behind the Busan-Shenyang Railway in terms of the trade volume between Korea and China. It looks to play an important role in the distant future when the North Korean economy recovers and the transport volume between Korea and Europe increases, but its demand is not likely to be large in the near future. In this context, the study considered the Mokpo-Rajin-Tumen (Hyesan) Railway and the Cheolwon-Manpo-Jian Railway as mid-to-long term options but not

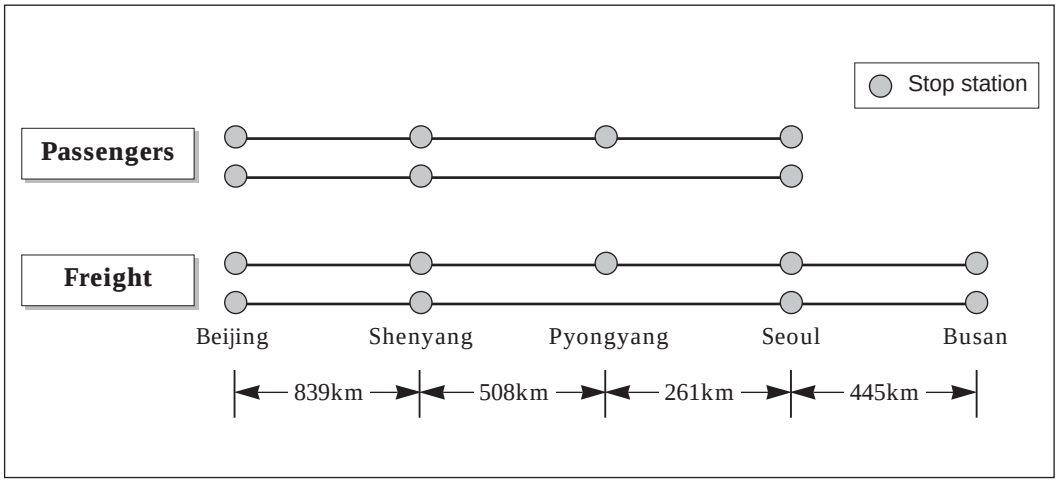


Figure 4-4 Diagram of international railway routes

[9] Roads may be more efficient than railways for mid-to-short distance transportation between China and North Korea. However, when considering the connection between the Korean peninsula and China and further with the Eurasian land transport system as well as impacts on the environment, there seems no alternative more favorable than railways.

as transport corridors to enjoy a large demand in the near future.

Even in the case of roads, the Busan-Rajin-Tumen Road on the east coast and the Gwangyang-Seoul-Manpo-Jian Road have less efficiency than the Busan-Shenyang Road. Therefore, they may well be considered for the mid-to-long term transport demand within the Korean peninsula but not for the transport demand between Korea and China. However, in the case of the Wonjeong-Rajin Road and the Namyang-Rajin Railway of which the demand is increasing substantially, it is desirable to include them in priority list of land transport linkages, for they will also become part of the arterial transport corridors in the Korean peninsula in the long term.

There may be several alternatives in the connection and operation methods of railways according to circumstantial development. From the standpoint of three countries including China, and South and North Korea, an express railway running from Seoul to Beijing passing through North Korea is most likely. It can be an extension of the now operating Beijing-Pyongyang International Railway and is expected to minimize any adverse effects on North Korea by making no additional stops in North Korea (Figure 4-4). Provided that North Korea agrees, the construction of a new Beijing-Pyongyang-Seoul express railway will absorb more passenger volume. For freight transportation, the Busan-Seoul-Pyongyang-Shenyang-Beijing (Tianjin) corridor and the Busan-Seoul-Pyongyang-Shenyang-Harbin corridor are very likely to be potential routes (Jin and Pang, 2001).

An additional study is needed on the economic feasibility of the Beijing-Shenyang-Seoul-Busan Railway. However, when an express railway is constructed between Seoul and Busan in 2007 and the Beijing-Shenyang-Dandong passenger-only railway is renovated in China, it will be possible to travel from Busan to Beijing within 15 hours, and subsequently, the economic feasibility of this railway would increase.

Significance and Effects of Korea-China Land Connections

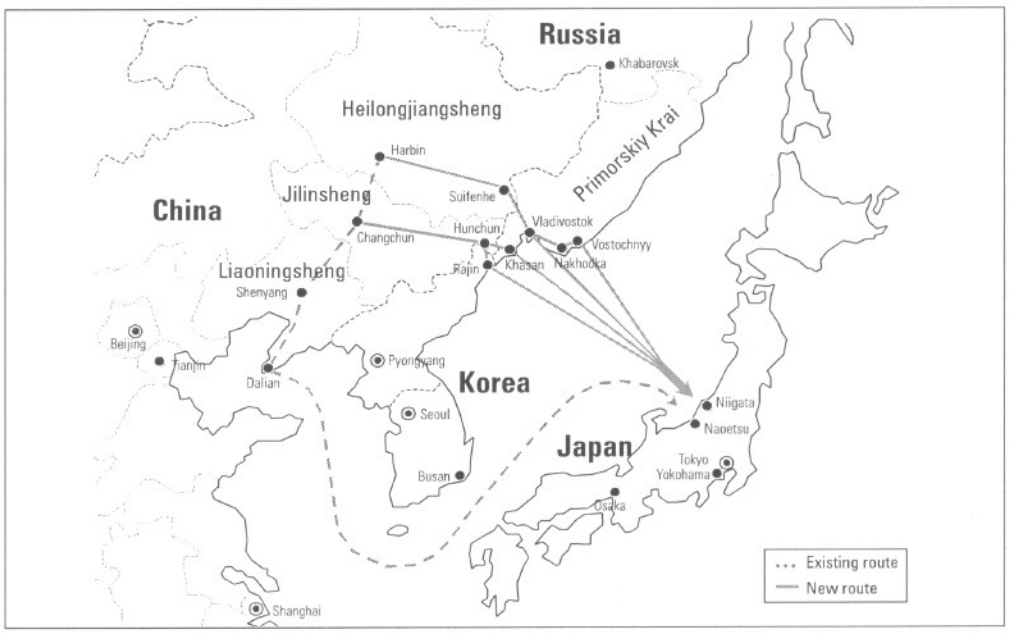
Freight and passengers moving between China and South Korea are currently using sea and air transportation. Such sea and air transport can be diverted to land transport depending on a series of factors including the continuous economic growth of China and increases in trade and travel demand between Korea and China. Land connection between Korea and China is expected to impact greatly upon freight and passengers with a low time value. Given the fact that most freight and passengers between China's northeast provinces and North Korea are transported by road and railway and that the majority of Chinese tourists cannot afford to travel by air, a considerable diversion effect will be created. In addition, a portion of the freight and passengers from the southwestern part of Japan and the three northeast provinces of China may travel passing through the Korean peninsula. At a time when border crossing becomes easier between South and North Korea and the opening of North Korea begins to bear fruits, it may be possible for Japanese tourists to travel to Northeast China after visiting the major tour sites in South and North Korea.

Table 4-1 Estimated freight volumes between Japan and the three northeast provinces of China in 2020

Unit: million tons

		Total	Dalian	Rajin	Zarubino	Vladivostok
Liaoning province	2010	15.71	15.71	0.00	0.00	0.00
	2020	30.30	30.30	0.00	0.00	0.00
Jilin province	2010	16.38	8.14	4.00	1.54	0.00
	2020	34.48	21.97	9.47	3.04	0.00
Heilongjiang province	2010	15.01	13.79	0.00	0.00	1.22
	2020	46.10	44.10	0.00	0.00	2.00
Total	**2010**	**47.1**	**37.64**	**4.00**	**1.54**	**1.22**
	2020	**110.88**	**96.37**	**9.47**	**3.04**	**2.00**

Source: MOT of Japan, 2000



Source: MOT of Japan, 2000

Figure 4-5 Trade routes between Japan and the three northeast provinces of China

Nevertheless, the probability of trade between China and Japan taking place passing through the Korean peninsula is not so high as claimed in previous studies. It is because trade between Japan and China's three northeast provinces are expected to take place by utilizing such seaports as Dalian, Rajin, Zarubino and Vladivostok as the Transportation Ministry of Japan estimated in 2000 (Table 4-1) (Figure 4-5).

If a high-speed railway is constructed from Japan to Beijing across the Korean strait, the concept of the BESETO corridor could be realized, and furthermore, a growth corridor will start to take shape from Busan to Shenyang via Sinuiju (Figure 4-6). Under such a scenario, there is a high possibility that a portion of the passengers and freight from China's three northeast provinces will take advantage of the Beijing-Seoul-Tokyo high-speed railway. In addition, a combined transport system centering upon Busan port can be established as in the case of Hong Kong. As the railway connecting Hong Kong to Chinese inland areas provides container transport service as far as Urumqi at present, Korea can consider providing container transport service by railway from Busan to major cities in the three northeast provinces of China or in the northwestern part of China such as Xian.

As the land transport linkages between Korea and China is preconditioned on the linkage between South and North Korea, it is expected to have a significant effect on the transportation and trade between South and North Korea

As the land transport linkages between Korea and China is preconditioned on the linkage between South and North Korea, it is expected to have a significant effect on the transportation and trade between South and North Korea. For example, the freight cost from Incheon port in the South to Nampo port in the North ranges between US$1,000-1,100 per 20 feet container by sea but it can be reduced to one-fifth

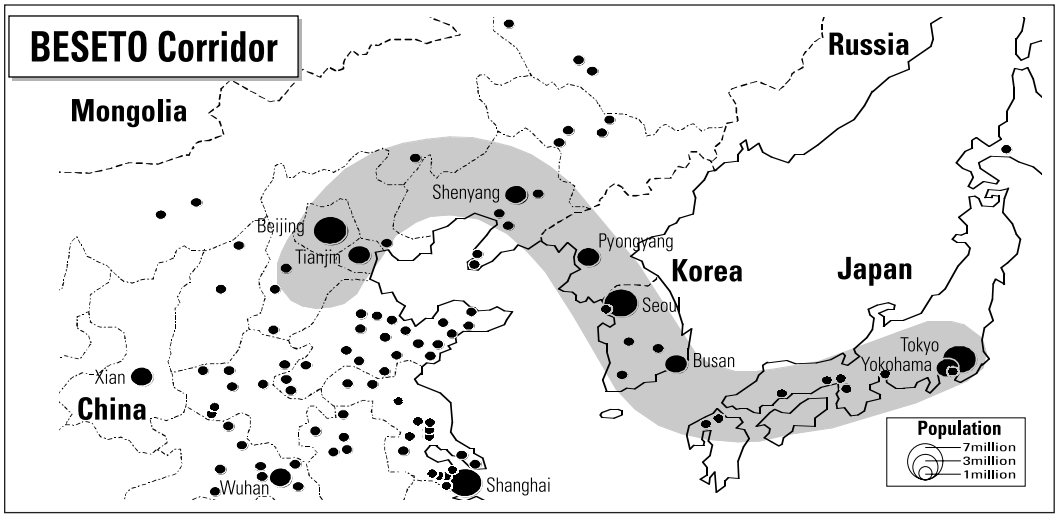


Figure 4-6 Cities with populations over one million within the BESETO corridor

by railway transport (Byeong-Min Ahn, 2000). The reduction in freight costs will, in turn, create the effect of increasing trade and investment between the two Koreas and it will contribute to the development of the North Korean economy, as they will be able to collect railway toll fees.

Whether railway or road, it is evident that the shaping of land transport corridors in the Korean peninsula and China will bring a considerable development effect to major cities and nodal points within the corridor. Logistics centers will be needed in nodal points that constitute land transport corridors, inland areas and ports, and border crossing points, with facilities to handle the transshipment of freight and passengers. In addition, tourist resources scattered around and within the corridor will undergo the start of earnest development, thus creating substantial effects of regional development. In addition to such regional development effects, the land transport linkage between Korea and China will work to reinforce cooperation between cities within. As the investment flow from major Korean and Japanese cities to Northeast China suggests, the Busan-Seoul-Shenyang land transport corridor will facilitate cooperation and exchange between Northeast Asian cities and the evolution of integrated economic space through the formation of inter-city networks.

In the longer term, land connection between Korea and China will result in the increase of mutual understanding and create learning effects between South and North Korea and China

In the longer term, land connection between Korea and China will result in the increase of mutual understanding, owing to the exchange of people, and create learning effects between South and North Korea and China. It will, in turn, contribute to the formation of regional production systems and the creation of business zones across borders.

What impacts the land transport linkages between South Korea and China will bring to both countries is an important factor in deciding the promotion of the project. First of all, from the standpoint of China, as its economic relationship with South Korea and Japan in terms of trade and investment is no less important than it relationship with the U.S. and Europe, the land transport linkage will bring positive effects to the international economic cooperation of China. At present, there is no region more important to China than Korea and Japan in terms of the accessibility to China by land. China is increasing economic cooperation with Central Asia, Southeast Asia, Mongolia and Russia, but is far behind comparing its relationship with South Korea and Japan in terms of quantity and quality. For example, the number of service operations and capacity of Chinese international trains to and from North Korea are much greater than those to other regions (Table 4-2 & 4-3). When considering the economic recession in North Korea and the decrease in trade between North Korea and China in recent years, it implicates that the operation of international trains will become more frequent when North Korea implements the opening and reform policy.

The land transport linkages between Korea and China are expected to accelerate the increase of freight and passengers by land between Northeast Asia and Europe in the long term

Moreover, the land transport linkages between Korea and China are expected to accelerate the increase of freight and passengers by land between Northeast Asia and Europe in the long term. Even though freight movement by the Trans-Siberian Railway is showing a decreasing trend, it will be reinvigorated when the railway connections between Korea and China are completed and the operation of the Trans-Siberian Railway is improved. The land connection between Asia and Europe is significant, not only as a transport corridor, but also as a physical platform to develop and utilize the affluent Eurasian resources in joint with Northeast Asian countries and stimulate the development of regions neighboring the transport corridor.

Table 4-2 International express railways departing from Beijing

Routes	Beijing-Ulan Bator-Moscow	Beijing-Manzhouli-Moscow	Beijing-Pyongyang	Beijing-Ulan Bator	Beijing-Hanoi
Distance(km)	7,865	9,004	1,371	1,561	3,010
Time required (hours)	110	145	24	30~42	50
Passenger capacity (persons)	390	584	912	448	898
Number of trains	15	19	14	16	17
Stops	Jining, Erlianhaote	Shenyang, Harbin	Shenyang, Dandong		
Customs house	Erlianhaote	Manzhouli, L.Baykal	Dandong, Sinuiju	Erlianhaote	Pingxiang
Service frequency	Once a week	Once a week	Four times a week	Once a week	Twice a week

Source: Jin and Pang, 2001

Table 4-3 Border crossing regional railways

Routes	Huhehaote-Ulan Bator	Harbin-Khabarovsk	Urumqi-Almata	Kunming-Hanoi
Type of train	International express train	International tourist train	International express train	International express train
Distance (km)	1,210	813	1,374	
Time required (hours)	36.5	26.5	34.5	23
Number of trains	9	14	10	12
Customs house	Erlianhaote, Dzamin Uud	Suifenhe, Vladivostok	Alashankou, Drujhba	Hekou, Laojie
Service frequency	Once every two weeks	Three times a week	Twice a week	Twice a week

Source: Jin and Pang, 2001

5
LAND TRANSPORT DEMAND ESTIMATION BETWEEN KOREA AND CHINA

Discussions on the propriety of land transport linkages between Korea and China, particularly by railway, cannot help but embrace subjectivity, for transportation between the two countries has been mainly dependent on air and sea transportation so far. Furthermore, the unstable political currents in this region may make land transport demand estimations volatile. The fact that transportation through the Seoul-Sinuiju Railway or the Panmunjeom-Gaeseong Road can be stopped at any time by Pyongyang's unpredictable policy changes also poses a problem. Despite the difficulties of making short-term forecasts, it is still meaningful to estimate land transport demand between South Korea and China. It is because Northeast Asian countries are becoming more and more aware of the need for intra-regional economic cooperation, and North Korea has begun to implement policies in pursuit of economic interests since the end of 1990.

Different from previous studies that presented point estimates, the study attempts to carry out a sensitivity analysis to input estimated figures through established conditions so as to see how they react to them. In the process, the study takes into account all the variables foreseeable and explicitly specifies the grounds of the estimations for future studies. As there is large room for error while calculating travel time and transport costs for non-existent land transport sections, the estimation of shifting from sea and air transport to land transport has limitations. For this reason, the study intends to confine the use of its estimations to roughly grasp the magnitude of transport modal shift between Korea and China, instead of inquiring into the accurateness of its estimations.

Estimation of Freight Transport Demand for the Seoul-Beijing Section

Data and Assumption

a) Basic data

Data on freight volumes, travel time and transport costs are essential for the estimation

of future freight transport demand between Korea and China. Used here is the forecast of Korea Railroad Research Institute on the trend of freight volumes between Korea and China for the period of 2001-2021, which is based on container cargo volumes in revenue tonnage computed by the Ports and Harbors Bureau under the Ministry of Maritime Affairs and Fisheries. As for data on travel time and transport costs, data in previous studies and data provided by Chinese authorities are incorporated.

b) Geographical boundary

The geographical boundary of land transport between Korea and China is limited to the Korean peninsula, China's three northeast provinces, Beijing and Tianjin in the study. The reason is that land transport is not competitive compared to sea transport when traveling from Korea to the central and southern parts of China or Chinese inland areas. On the assumption that cities in Chinese inland areas have a tendency to use the nearest ports when combining land transport with sea transport, hinterlands of Dalian and Tianjin ports are selected as potential areas for combined transportation. In fact, Dalian and Tianjin ports handle most of the freight from China's three northeast provinces and 48% of the total container cargoes between Korea and China.

c) Model formulation

Between the price ratio logit model (1) and price difference logit model (2), it is decided to apply the price ratio logit model to the study, which uses the relative ratio of the transport costs by different modes. The price ratio logit model is superior to the price difference logit model because the latter contains a great margin of error in the estimation of travel time and transport cost of each transport mode between South Korea and China (Boyer 1977, Oum 1979abc, Zlatoper & Austrian 1989).

■ Price ratio logit model

$$\log S_L / S_S = A_0 + A_1 \cdot P_L / P_S + \sum_{n=2}^{N} A_n X_n \qquad (1)$$

■ Price difference logit model

$$\log S_L / S_S = A_0 + A_1 (P_L - P_S) + \sum_{n=2}^{N} A_n X_n \qquad (2)$$

L: transport mode *L* *S*: transport mode *S*

S_L: the probability that transport mode *L* is taken

S_S: the probability that transport mode *S* is taken

A_0: the ratio of travel time between transport modes

A_1: coefficient

P_L: transport cost by deducting travel time cost from the total cost of the transport mode L

P_S: transport cost by deducting travel time cost from the total cost of the transport mode S

The coefficient A_1 is derived by adjusting coefficients that are used in other studies (Table 5-1). Finally, the logit model (3) is derived as follows:

$$\log S_L / S_S = A_0 + A_1 \cdot P_L / P_S \qquad (3)$$

The study assumed two conditions: one is that only railways are available and the other is that both railways and roads are available for land transport. In addition, the study defined commodities to be transported in two types: commodity type I includes food products, fishery, chemicals, machinery and others, and commodity type II includes commodity type I plus 50% of steel, mineral and construction materials.

Table 5-1 Comparison of research results for the calculation of coefficient A_1

	Boyler (1977)	KRRI (1998) *	KRIHS (1998) **	
Railway (A)	3.21 $/ton·mile	91 won/ton	24.20 won/ton·km	
Road (B)	10.41 $/ton·mile	95 won/ton	74.07 won/ton·km	
Ship (C)	-	-	7.48 won/ton·km	
(B)/(A)	3.24	1.04	3.06	
(A)/(C)	-	-	3.24	-
(C)/(A)	-	-	-	0.31
Price ratio	-6.77	-2.18	-6.77	-0.65
Price difference	-1.04	-0.33	-1.04	-0.10

Note: * Korea Railroad Research Institute
** Korea Research Institute for Human Settlements
1) Figures in shaded cells are estimated in the study.
2) Data on the transport cost and travel time for freight transport between Korea and China are borrowed from other studies.

Transport mode choice between ship and train

The preferential intensity (A_0) of train over ship can be represented by the ratio of travel time by ship to travel time by train. In other words, the shorter travel time the train has, the higher preferential intensity it has. If it takes 30.5 hours by ship and 20.5 hours by train, the preferential intensity of train over ship in terms of travel time is

$$A_0 = 30.5 / 20.5 = 1.4878$$

A_1 is determined according to Table 5-1. As the time cost has been already reflected in the calculation of A_0, each transport cost of train and ship is estimated by way of deducting the time cost from the total cost. As it costs 10,000 won / MT by ship and 39,000 won / MT by train, the logit model (3) can be substituted as follows:

$$\log S_R / S_S = 1.4878 - 0.65 \times (39{,}000 / 10{,}000) = -1.0472$$
$$e^{-1.0472} = 0.3509$$

S_R: the probability that train is chosen
S_S: the probability that ship is chosen

Therefore, the probability that the train is chosen over the ship is estimated to be 26%. In addition, the freight volume to be shifted to railway transport from a port can be calculated by multiplying the volume of a selected commodity type at the port by the probability that the train is chosen over the ship (equation (4)).

The freight volume to be shifted to railway transport = (4)
the total freight volume of a port ×
the rate of a selected commodity type to the total freight volume of a port ×
the probability that train is chosen over ship

The freight volume to be shifted to railway transport in the Seoul-Beijing section is calculated based on the freight volumes of Tianjin port. The freight volumes and ratios of commodity types I and II at Tianjin port for the Seoul-Beijing section are as shown in Table 5-2.

Table 5-2 Freight volumes and ratios of commodity type I and II at Tianjin port for the Seoul-Beijing section

	Seoul → Beijing	Beijing → Seoul
Total freight volume (tons)	2,528,236	3,684,508
Ratio of Korea-China freight volume (%)	19.28	14.21
Volume of commodity type I (tons)	1,331,273	1,451,875
Ratio of commodity type I (%)	52.66	39.40
Volume of commodity type II (tons)	1,929,755	2,568,192
Ratio of commodity type II (%)	76.33	69.70

By using the Formulation (4) and data in 1997, the shift volume from ship to train for the Seoul-Beijing section is calculated as shown in Table 5-3.

Table 5-3 Estimates of rail cargo for the Seoul-Beijing section based on 1997 origin-destination data

	Commodity type I		Commodity type II	
	Shift volume from ship to train	Ratio of the shift volume from ship to train to the total freight volume of Tianjin port	Shift volume from ship to train	Ratio of the shift volume from ship to train to the total freight volume of Tianjin port
Seoul→Beijing	345,817 tons	13.68%	501,281 tons	19.83%
Beijing→Seoul	377,145 tons	10.24%	667,124 tons	18.11%

The transport modal share between ship and train for the Seoul-Beijing section is as shown in Table 5-4.

Table 5-4 Transport modal share between ship and train for the Seoul-Beijing section

Unit: %

	By ship		By rail	
	Commodity type I	Commodity type II	Commodity type I	Commodity type II
Seoul→Beijing	86.32	80.17	13.68	19.83
Beijing→Seoul	89.76	81.89	10.24	18.11

Table 5-5 Estimated sea and railway transport volumes for the Seoul-Beijing section

Unit: tons

		By ship		By rail	
		Commodity type I	Commodity type II	Commodity type I	Commodity type II
2006	**Seoul→Beijing**	5,589,800	5,191,612	885,736	1,283,924
	Beijing→Seoul	5,743,125	5,239,586	654,900	1,158,438
2011	**Seoul→Beijing**	7,236,482	6,720,994	1,146,662	1,662,151
	Beijing→Seoul	7,085,369	6,464,147	807,958	1,429,181

Therefore, the Korea-China freight volume for railway transport at Tianjin port in a target year can be calculated by multiplying the estimated total Korea-China freight volume at Tianjin port in the target year by the ratio of the shift from ship to train to the total freight volume of Tianjin port. However, it is conditioned that the transport modal share between ship and train be the same as that of 1997 (Table 5-5).

Transport mode choice between ship, train and truck

It is assumed that the probability that truck is chosen over ship or train increases when ship has a longer travel time and train has a shorter travel time than truck. If it takes 30.5 hours by ship and 14 hours by truck, the preferential degree (A0) of truck over ship in terms of travel time is

A_0 = 30.50 hours / 14.00 hours = 2.1786

A_1 is determined in the Table 5-1. As time cost has been already reflected in the calculation of A_0, transport costs of ship and truck are estimated by way of deducting time cost from total cost. As it costs 10,000 won / MT by ship and 101,000 won / MT by truck between Seoul and Beijing, the probability that truck is chosen over the ship can be obtained as follows:

$\log S_T / S_S = 2.1786 - 0.65 \times (101{,}000 / 10{,}000) = -4.3864$
$e^{-4.3864} = 0.0124$

S_T: the probability that truck is chosen
S_S: the probability that ship is chosen

Therefore, the probability that truck is chosen over ship is estimated to be 1.23%. In addition, the freight volume to be shifted from ship to truck can be calculated by multiplying the volume of a selected commodity type at a port by the probability that truck is chosen over ship (equation (5)).

The freight volume to be shifted to truck transport = (5)
the total freight volume of a port ×
the rate of a selected commodity type to the total freight volume of a port ×
the probability that truck is chosen over ship

In order to avoid the problem of double counting, that is, railway transport volume is recounted for truck transport volume, it is necessary to modify the railway transport volume by way of deducting truck transport volume from it. The transport modal share rates between ship and train and between ship and truck can be expressed as Equations (6) and (7), and the transport modal share rate between ship, train and truck should satisfy Equation (8).

$$S_S : S_R = 74.02 : 25.98 \quad (6)$$
$$S_S : S_T = 98.77 : 1.23 \quad (7)$$
$$S_S + S_R + S_T = 100 \quad (8)$$

Therefore, the transport modal share rate between ship, train and truck can be modified as follows:

ship : train : truck = 73.35% : 25.74% : 0.91%

According to the transport modal share rate between ship, train and truck for the Beijing region, each freight volume by ship, train and truck is calculated as shown in Table 5-6.

Table 5-6 Freight volumes by ship, train and truck between Seoul and Beijing

Unit: tons

		By ship		By train		By truck	
Years	**Routes**	**Commodity type I**	**Commodity type II**	**Commodity type I**	**Commodity type II**	**Commodity type I**	**Commodity type II**
1997	**Seoul→Beijing**	2,173,424	2,013,916	342,660	496,705	12,152	17,615
		85.97%	79.66%	13.55%	19.65%	0.48%	0.70%
	Beijing→Seoul	3,297,553	3,000,031	373,702	661,034	13,253	23,443
		89.50%	81.42%	10.14%	17.94%	0.36%	0.64%
2006	**Seoul→Beijing**	5,566,760	5,158,214	877,651	1,272,204	31,125	45,118
	Beijing→Seoul	6,367,272	5,096,471	867,146	1,256,976	30,753	44,578
2011	**Seoul→Beijing**	7,206,655	6,677,758	1,136,195	1,646,979	40,294	58,409
	Beijing→Seoul	7,064,352	6,426,970	800,583	1,416,135	28,392	50,222

Sensitivity analysis of freight volumes by ship, train and truck for the Seoul-Beijing section

Any change in the conditions of the logit model such as transport cost or travel time may result in different outputs. In order to complement this weakness, it is necessary to perform a sensitivity analysis of freight volumes by ship, train and truck. Here, changes in freight volumes in the Seoul-Beijing section are examined by establishing two assumptions – one is that travel time of train and truck each increases by 20%, and the other is that the transport costs of train and truck increases by 20%.

a) If the travel time of both train and truck increases by 20%
If the travel time of both train and truck increases by 20%, it will take 24.6 hours by train and 16.8 hours by truck for freight transport between Seoul and Beijing. Then, freight volumes by transport mode will be as shown in Table 5-7.

Table 5-7 Freight volumes for the Seoul-Beijing section with 20% increase in travel time of train and truck

Unit: tons

		By ship		By train		By truck	
Years	Routes	Commodity type I	Commodity type II	Commodity type I	Commodity type II	Commodity type I	Commodity type II
1997	Seoul→Beijing	2,234,985	2,103,153	284,266	412,059	8,985	13,024
		88.40%	83.19%	11.24%	16.30%	0.36%	0.51%
	Beijing→Seoul	3,364,691	3,118,791	310,018	548,384	9,799	17,333
		91.32%	84.65%	8.41%	14.88%	0.27%	0.47%
2006	Seoul→Beijing	5,724,437	5,386,776	728,086	1,055,402	23,013	33,359
	Beijing→Seoul	6,375,287	5,322,297	719,371	1,042,769	22,738	32,959
2011	Seoul→Beijing	7,410,782	6,973,650	942,571	1,366,309	29,792	43,186
	Beijing→Seoul	7,208,183	6,681,390	664,152	1,174,804	20,992	37,133

The results of the sensitivity analysis show that railway transport volume is estimated to decrease by 17%, whereas truck transport volume by 26%. Therefore, truck transport is proven more sensitive to the change in travel time.

b) If both transport costs of train and truck increases by 20%
If both transport costs of train and truck increases by 20%, transport costs will be 46,800won/MT by train and 121,200won/MT by truck. Then, freight volumes by transport mode will be as shown in Table 5-8.

Table 5-8 Freight volumes for the Seoul-Beijing section with 20% increase in transport costs of train and truck

Unit: tons

		By ship		By train		By truck	
Years	Routes	Commodity type I	Commodity type II	Commodity type I	Commodity type II	Commodity type I	Commodity type II
1997	Seoul→Beijing	2,292,925	2,187,140	231,642	335,778	3,669	5,319
		90.69%	86.51%	9.16%	13.28%	0.15%	0.21%
	Beijing→Seoul	3,427,880	3,230,564	252,627	446,866	4,002	7,078
		93.03%	87.68%	6.86%	12.13%	0.11%	0.19%
2006	Seoul→Beijing	5,872,837	5,601,890	593,301	860,023	9,398	13,623
	Beijing→Seoul	6,388,739	5,534,836	586,199	849,729	9,285	13,459
2011	Seoul→Beijing	7,602,899	7,252,134	768,080	1,113,375	12,166	17,636
	Beijing→Seoul	7,343,552	6,920,842	541,203	957,322	8,573	15,164

The results of the sensitivity analysis show that the railway transport volume will decrease by 31%, and the truck transport volume by 69%, which leads to the conclusion that both railway and road transportation is more sensitive to transport costs than to travel time. In particular, truck transportation is very sensitive to changes in transport cost. It suggests that an emphasis should be placed on the establishment of an international agreement on the conditions of road operation such as operation time, fares, border-crossing charges, etc., rather than land connection itself in the discussion on the land connections between Korea and China.

Estimation of the Travel Demand for the Seoul-Beijing Section

Premises

a) Basic data

The study uses the KTRI[10] 's forecast on travel demand from China to Korea for the period of 2002-2011. However, due to the lack of data, the travel demand from Korea to China has to be approximated by using the trend line for the same period. The time series decomposition method is used to divide the approximated traveling demand into travels by ship and travels by air according to the transport modal share rate between sea transport and air transport in the 1990s. As for data on travel time and

[10] Korea Tourism Research Institute

transport costs, data in previous studies and data provided by Chinese authorities are incorporated (Tables 8 & 9 in Appendix).

$$S_{t+1} = \alpha A_t + (1 - \alpha)(S_t + T_t)$$
$$T_{t+1} = \beta(S_{t+1} + S_t) + (1 - \beta)T_t$$
$$F_{t+1} = S_{t+1} + T_{t+1}$$

t: time α: exponential smoothing constant
β: trend-reflecting constant S_t: initial estimate for the period of t
T_t: trend-reflecting estimate for the period of t
F_{t+1}: trend-reflecting estimate for the period of t+1

b) Geographical boundary
The three northeast provinces of China and the Beijing region are selected as potential areas for using land transportation, and it is assumed that travelers use the nearest seaports and airports as in the case of freight transport. Accordingly, it includes airports in Beijing, Tianjin, Changchun, Dalian, Harbin and Shenyang and seaports in Dalian, Tianjin and Dandong. In the case of traveling by air, travel time includes the time needed for transportation to the airport. It is assumed that 2 hours are required for cities nearby Beijing to get to an airport, and 3 hours for cities nearby Shenyang, with its larger hinterland than Beijing.

c) Model formulation
Currently people can travel only by sea and air between South Korea and China. However, on the assumption that land transport is available together with air and sea transportation, the number of travelers to shift from air and sea transport to land transport can be estimated by using the following price ratio logit model.

$$\log S_L / S_S = A_0 + A_1 \cdot P_L / P_S + \sum_{n=2}^{N} A_n X_n \qquad (9)$$

L: transport mode *L* S: transport mode *S*
S_L: the probability that transport mode *L* is taken
S_S: the probability that transport mode *S* is taken
P_L: the use rate of transport mode *L* P_S: the use rate of transport mode *S*
A_0: the ratio of travel time by transport mode *L* to travel time by transport mode *S*

A_1 is calculated based on data on air and sea transportation. It is assumed that the air-sea transport relationship in travel time and transport costs applies to the sea-

railway and sea-road relationships as well as to the air-railway and air-road relationships. Based on this assumption, the corresponding volume to be shifted from air or sea transport to railway or road transport can be calculated and moderated. As in the case of freight transport, travelers tend to choose transport modes in consideration of travel time and transport costs and the following equation can be established.

$$\log S_{air} / S_{sea} = A_0 + A_1 \cdot P_{air} / P_{sea}$$

The number of travelers to Beijing from Seoul in 1999 is estimated to be 237,214 persons by air and 19,021 persons by sea. Therefore, A_1 can be derived based on data on travel time, fare and the number of passengers as shown in Tables 5, 6, 7 and 8 in Appendix.

$$\log 237{,}214 / 19{,}021 = 31/4 + A1 \cdot 260/170$$
$$2.523 = 7.750 + 1.529A_1$$
$$\therefore \; A_1 = -3.4174$$

Therefore, the following equation can be derived for travels departing from Seoul for Beijing:

$$\log S_{air} / S_{sea} = A_0 - 3.4174 \cdot P_{air} / P_{sea}$$

Transport mode choice between air, sea and railway in the mid-term

On the assumption that traveling by railway will be possible other than by sea and air transportation in the mid term, first, the transport modal share rate between air and railway can be calculated as follows:

$$e^{-0.7867} = 0.4553 \quad \therefore \text{ Travel by air : 68.71\%, travel by railway : 31.29\%}$$

The transport modal share rate between sea and railway can be calculated as follows:

$e^{-0.3738} = 0.6881$ ∴ Travel by sea: 59.24%, travel by railway: 40.76%

As in the case of freight transport, it is necessary to moderate the transport modal share rates between air, sea and railway in order to avoid double counting. The transport modal share rates after moderation are as shown in Table 5-9.

Table 5-9 Mid-term transport modal share between air, sea and railway for travels departing from Seoul for Beijing

1999		When railway becomes available		
Air	Sea	Air	Sea	Railway
92.58%	7.42%	63.61%	4.40%	31.99%

A large portion of travelers by air or by sea, particularly travelers by air, is expected to shift to railway transportation.

Transport mode choice between air, ship, railway and road in the long term

On the assumption that traveling by road will be possible other than by sea, air and railway transportation in the long term, first, the transport modal share rate between air and road transportation can be calculated as follows:

$e^{-1.7610} = 0.1719$ ∴ Travel by air : 85.33%, travel by road : 14.67%

The transport modal share rates between air and railway is already figured out in the above as follows:

$e^{-0.7867} = 0.4553$ ∴ Travel by air : 68.71%, travel by railway : 31.29%

It is necessary to moderate the transport modal rates between air, railway and road in order to avoid double counting.

Travel by air : travel by railway = 68.71 : 31.29
Travel by air : travel by road = 85.33 : 14.67
∴ Travel by air : 61.46%, travel by railway : 27.98%, travel by road : 10.56%

The transport modal share rate between sea and road can be calculated as follows:

$e^{-1.3838} = 0.2506$ ∴ Travel by sea : 79.96%, travel by road : 20.04%

The transport modal share rates between sea and railway is already calculated in the above as follows:

$e^{-0.3738} = 0.6881$ ∴ Travel by sea : 59.24%, travel by railway : 40.76%

It is necessary to modify the transport modal rates between sea, railway and road in order to avoid double counting.

Travel by sea : travel by road = 79.96 : 20.04
Travel by sea : travel by railway = 59.24 : 40.76
∴ Travel by sea : 51.58%, travel by railway : 35.49%, travel by road : 12.93%

Finally, the transport modal share rates between air, sea, railway and road transportation can be adjusted as shown in Table 5-10.

Table 5-10 Long-term transport modal share between air, sea, railway and road for travels departing from Seoul for Beijing

1999		When both railway and road become available			
Air	Sea	Air	Sea	Railway	Road
92.58%	7.42%	56.89%	3.83%	28.54%	10.74%

Some portion of travelers by air or by sea is expected to shift to railways and roads. It implies that the diversions to land transport may be greater than estimated when considering that travelers value the merits of road travel such as safety, comfort and flexibility, which are not reflected in the logit model.

Sensitivity analysis of the share of travelers between air, ship, railway and road for the Seoul-Beijing section

The sensibility analysis of the share of travelers by transport mode is performed on

two assumptions: one is that the standard travel time of railway and road transportation increases by 20%, and the other is that the standard transport costs of railway and road transportation increases by 20%. The result of the sensibility analysis is as shown in Table 5-11.

Table 5-11 Sensitivity analysis of the transport share by mode for passengers from Seoul to Beijing

	Air	Sea	Railway	Road
When the travel time by railway and road increases by 20%	57.46%	4.19%	28.02%	10.34%
When the transport cost by railway and road increases by 20%	61.94%	4.48%	25.79%	7.79%

When the travel time of land transport increases by 20%, it results in a small decrease of the shift from traveling by air or sea to traveling by railway or road. But when the transport cost of land transport increases, it tends to depress the diversion from traveling by air or sea to traveling by railway or road more than the increase of travel time. Therefore, the diversion effect from traveling by air or sea to traveling by railway or road is more sensitive to the transport cost than to travel time. In particular, road transportation is more sensitive to the transport cost than railway transportation.

Significance and limitations of Land Transport Demand Estimation

The following Tables 5-12 and 5-13 show transport modal share rates for freight transport and passengers obtained through a sensibility analysis. In the case of freight transport, the diversion effect from sea to railway transportation goes far beyond the diversion effect from sea to road transportation. However, the diversion effect from sea or air to road transportation is quite substantial. Both freight and passengers are more sensitive to the increase of transport cost than to the increase of travel time, and therefore, transport fares and border crossing costs are important factors for determining railway or road transport demands.

The reason that inbound and outbound transport modal share rates are different for both freight and passengers is because the composition of trade items is different between Korea and China. For example, the ratio of manufactured goods that can be containerized is higher in Korea's export to China than in China's export to Korea. Meanwhile, in the case of passengers it is assumed that the transport modal share rates between traveling by air and by sea also applies to the transport modal share rates between air, sea and land transport. Therefore, as the share of air transport for traveling from Seoul to Beijing is higher than that for traveling from Beijing to Seoul (because of income differences between Seoul and Beijing), air transport can maintain the dominant position in the transport modal share even after land transport becomes as an alternative mode of travel.

The study has limitations in estimating transport modal share rates of freight and passengers. It is mainly because all estimations must be based on the present price structure and travel time in spite of the undeniable fact that transport costs and travel time are subject to change according to technological development or institutional improvement. In addition to this, there is a possibility of an inaccuracy in the data on transport costs and travel time used in the study. Moreover, it is very difficult to make estimations by taking into account all possible future changes. To address these shortcomings, the study has performed a sensitivity analysis.

Table 5-12 Transport modal share for freight transport

Unit: %

			By sea	By railway	By road
When only railways are available for land transport			○	○	×
Seoul→ Beijing	Transport modal share rates		80.2~86.3	13.7~19.8	-
	Sensitivity analysis	When the travel time of land transport increases by 20%	83.6~88.7	11.3~16.4	-
		When the transport cost of land transport increases by 20%	86.7~90.8	9.2~13.3	-
Beijing→ Seoul	Transport modal share rates		81.9~89.8	10.2~18.1	-
	Sensitivity analysis	When the travel time of land transport increases by 20%	85.0~91.5	8.5~15.0	-
		When the transport cost of land transport increases by 20%	87.8~93.1	6.9~12.2	-
When both railways and roads are available for land transport			○	○	○
Seoul→ Beijing	Transport modal share rates		79.7~86.0	13.6~19.7	0.5~0.7
	Sensitivity analysis	When the travel time of land transport increases by 20%	83.2~88.4	11.2~16.3	0.4~0.5
		When the transport cost of land transport increases by 20%	86.5~90.7	9.2~13.3	0.15~0.2
Beijing→ Seoul	Transport modal share rates		81.4~89.5	10.1~17.9	0.4~0.6
	Sensitivity analysis	When the travel time of land transport increases by 20%	84.7~91.3	8.4~14.9	0.3~0.5
		When the transport cost of land transport increases by 20%	87.7~93.0	6.9~12.1	0.1~0.2

Table 5-13 Transport modal share for passengers

Unit: %

			By air	By sea	By railway	By road
When only railways are available for land transport			○	○	○	×
Seoul→ Beijing	Transport modal share rates		63.6	4.4	32.0	-
	Sensitivity analysis	When the travel time of land transport increases by 20%	64.0	4.7	31.3	-
		When the transport cost of land transport increases by 20%	67.1	4.9	28.0	-
Beijing→ Seoul	Transport modal share rates		53.2	19.7	27.1	-
	Sensitivity analysis	When the travel time of land transport increases by 20%	53.5	20.8	25.8	-
		When the transport cost of land transport increases by 20%	56.3	21.8	21.9	-
When both railways and roads are available for land transport			○	○	○	○
Seoul→ Beijing	Transport modal share rates		56.9	3.8	28.5	10.7
	Sensitivity analysis	When the travel time of land transport increases by 20%	57.5	4.2	28.0	10.3
		When the transport cost of land transport increases by 20%	61.9	4.5	25.8	7.8
Beijing→ Seoul	Transport modal share rates		49.7	18.5	25.3	6.5
	Sensitivity analysis	When the travel time of land transport increases by 20%	50.1	19.7	24.2	6.0
		When the transport cost of land transport increases by 20%	53.9	21.1	21.1	4.0

6
STRATEGIC APPROACHES AND TASKS AHEAD

Needless to say, land transport links between Korea and China must be considered in terms of promoting economic cooperation in Northeast Asia. New construction or expansion of these land transport links should take into account integration with other transport modes such as seaports, airports and inland depots. With these two broad goals in mind, the direction of strategies to develop land transport corridors between Korea and China should be set. In doing so, demand factors, eliminating overloaded sections, regional development and minimum environmental effects should serve as major criteria for the configuration of the details of those land transport connections.

Impact analysis is a must for choosing alternatives and detailed plans. Crude benefit-cost analyses will be useful in deciding which corridor and which particular section takes priority. In addition to the economic impact of land transport connection projects, it is necessary to consider the qualitative effects of the project on economic cooperation as well as the contributing effects on the establishment of an integrated inter-modal transport system in Northeast Asia. Practically, China and South Korea, let alone North Korea, are financially constrained, and therefore, projects that require large sums of investment cannot be implemented in the immediate future. These large projects can be implemented in the future when the situation in the Korean peninsula improves and financial aid from international organizations is possible. While having mid-to-long term strategic plans for land transport corridors between Korea and China, it is necessary to focus on the expansion and renovation of land transport corridors that are expected to have a large demand in the short term.

While having mid-to-long term strategic plans for land transport corridors between Korea and China, it is necessary to focus on the expansion and renovation of land transport corridors that are expected to have a large demand in the short term

The study has proposed the Busan-Sinuiju-Shenyang Railway linking the peninsula with Northeast China as the first priority. For this, it is necessary to reconnect the disconnected sections between North and South Korea, to upgrade and refurbish all sections in North Korea and the section from Dandong to Shenyang as well. The section between Tumen and Cheongjin needs immediate attention in order to meet an increasing demand for freight transport between Jilin province and South Korea and Japan. The restoration of the Seoul-Wonsan Railway and linking it to Russia and China should be pursued as a mid-to-long term project since land transport

Table 6-1 Korea-China and Korea-Russia land transport linkage projects in phases

	Short term (3-4 years)	Mid term (5-10 years)	Long term (over 10 years)
Railways	• The connection of the Busan-Shenyang Railway • The renovation of the Rajin-Namyang Railway	• Doubling the Busan-Shenyang electric railway • The connection of the railway corridor of Mokpo (Gwangyang)-Rajin-Namyang-Tumen-Harbin • The connection of the railway corridor of Mokpo (Gwangyang)-Dumangang-Nakhodka	• Doubling the Mokpo (Gwangyang)-Nakhodka electric railway
Roads	• The connection of the Seoul-Gaeseong Road • The new construction of the Wonjeong-Rajin Road	• The expansion and renovation of the Busan-Shenyang Expressway • The connection of the Ganseong-Jangjeon Road	• The extension of the west coast expressway in South Korea to the Bohai region of China • The extension of the midland expressway in South Korea to Manpo and further to Changchun, China • The extension and renovation of the east coast expressway from Busan to Rajin

demand between Korea and Europe and Russia is not large at the moment.

As for road connections, the first priority project can be the connection of the Seoul-Busan Expressway in South Korea to the Pyongyang-Gaeseong Expressway in North Korea, and the construction of a new road between Anju and Sinuiju. The construction of an alternative expressway connecting Mokpo-Incheon-Haeju-Sinuiju should be considered after reaching an agreement with North Korea, for it needs substantial investment. If North Korea officially requests, South Korean firms may construct a new road between Wonjeong-Rajin by the BOT (Build, Operate, Transfer) method under the guarantee of the South Korean government. As this section can be part of the east coast expressway connecting Busan in the South to Rajin in the North, and with regard to its necessity for freight transport between China and North Korea, the South Korean government needs to render special consideration on this section.

Together with priority setting for land transport linkages, it is necessary to form a cooperation committee among China, North Korea and South Korea so as to discuss detailed strategies to build land transport linkages. It is known that China and North Korea have already started to negotiate the double tracking of the Dandong-

Pyongyang Railway[11] and the refurbishment of the Tumen-Cheongjin Railway and South and North Korea have agreed to reconnect the Seoul-Sinuiju Railway and the Seoul-Gaeseong Road. Thus, it appears not difficult to form a triangular cooperation committee on land transport development.

In addition to project development and financing, the committee can discuss various ways and means to remove impediments of border crossings both between China-North Korea and between North and South Korea and to unify signal systems, operation time and other technical matters. As pointed out by the Transportation Working Committee for the UN Tumen Region Development Project, the elimination of border-crossing impediments can bring the effect of promoting trade without any financial costs. In particular, the simplification of customs clearance and quarantine procedures, unification and computerization of customs clearance documents, adjustment of the operation time of customs offices, and the unification of customs service windows are expected to considerably promote the increase of trade and investment among the three countries.

Discussions should be made on the conditions of railway operation to enhance the technical and institutional compatibility of railway operation systems in the three countries. The agreement made between China and North Korea on the currently operating international train can be applied to the international train to be operated between Beijing and Seoul. A traveling agreement between South and North Korea is a must for railway operation to be successful. South and North Korea have made an agreement on investment protection and double taxation prevention, but one on traveling such as the guarantee of personal safety, traveling and telecommunication has not been made as of yet. In addition, South and North Korea should also join in the international transport pact.

Even though further studies are required on the estimation of budget and financing for the expansion and renovation of land transport linkages between Korea and China, the study proposes several preliminary directions as follows. It is desirable to connect railways and roads between South and North Korea and China through trilateral cooperation in the short term, and international financing organizations should be utilized as financing sources in the mid-to-long term. In particular, an idea being considered is for the three countries to invest in the Busan-Shenyang Railway jointly for common use. For example, China would take responsibility for the Sinuiju-Pyongyang section, while South Korea provides financial and technical support for the Seoul-Pyongyang section, with North Korea supplying manpower and materials. If the three countries agree on such terms of cooperation, and thereafter the Busan-Shenyang section is to be built, financing from the World Bank or Asian Development Bank will be available for the doubling and electrifying of the railway in the mid-to-long term.

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Such international cooperation to build arterial railways in Northeast Asia can be

[11] Dae-Soo Song, special correspondent of the Hankookilbo June 25, 2000, dssong@hk.co.kr

replicated in the Mokpo(Gwangyang)-Rajin-Vladivostok route. It will be possible to renovate the Mokpo(Gwangyang)-Vladivostok Railway through the joint investment of South and North Korea as well as Russia which has particular interest in the connection of the Tran-Siberian Railway to Korean railways.[12]

[12] As an alternative to the Mokpo(Gwangyang)-Vladivostok Railway which requires a great amount of investment for improvement and renovation, it will be also possible to connect the Pyongra Railway to the Busan-Shenyang Railway.

7
CONCLUSIONS

The establishment of efficient land transport linkages in Northeast Asia is an essential element for the promotion of intra-regional trade and investment as well as the facilitation of human exchanges

The establishment of efficient land transport linkages in Northeast Asia is an essential element for the promotion of intra-regional trade and investment as well as the facilitation of human exchanges. Under the current situation where the institutionalization of customs union or free trade agreement for intra-regional economic cooperation is not likely to occur in the near future, reduction in logistics costs seems the only way to promote trade within the region. However, the lack of physical facilities and institutional impediments render the structure of transport systems in Northeast Asia inefficient, thus hindering the international integration of transport systems. Another problem in Northeast Asian transport systems other than the absence of international transport integration is insufficient inter-modal transport systems. In particular, insufficient linkages between sea transport and land transport impede the growth of intra-regional trade and human exchanges. Of course, the lack of inter-modal transport systems is attributable to the unique political circumstances of Northeast Asia. However, it seems that we face an opportune time to discuss the integration of Northeast Asian transport systems, since inter-Korean relations are changing toward a positive direction and Northeast Asian countries show a great interest in land transport linkages.

Against these backdrops, the study focused on the land transport linkages between Korea and China on the premise that Northeast Asian land transport systems will be built around the Korean peninsula. The study emphasized the connections between Korea and China because it foresees that the Iron Silkroad or Eurasian Continental Railway will not be realized in the short-to-mid term in spite of their importance for the promotion of trade between Europe and Asia and Siberian regional development in the future. Instead, the study considered trade and other economic exchanges between Korea and China much more urgent and critical.

The study also focused on the restoration of land transport systems. This is because the transport pattern of freight by sea and passengers by air between Korea and China can benefit from an integrated transportation with land transport such as the reduction of logistics costs and the opportunity to use more diverse and

comfortable transportation means. At the same time, the restoration of land transport systems creates regional development effects for transport nodes and neighboring areas different from sea and air transports. Therefore, it may bring the effect of catalyzing regional development on the Korean peninsula and China and a deepening of exchanges and cooperation between cities across the border.

For the building of land transport systems, the disconnected sections between South and North Korea should be reconnected and dilapidated sections between China and North Korea should be renovated

For the building of land transport systems, the disconnected sections between South and North Korea should be reconnected and dilapidated sections between China and North Korea should be renovated. In doing so, priority should be given to the consideration of various factors such as potential demand, policy priority of China, South and North Korea, investment requirement, etc. The study examined alternative land transport links based on potential demands as well as existing facilities and plans of the three countries. As a result, it suggests that the Busan-Shenyang section should play the pivotal role in land transport linkages between Korea and China. This is because potential demand for freight and passenger transport is concentrated in the Busan-Shenyang section. The railway extending to China and further to Russia from Mokpo via Rajin is supplementary, rather than an alternative to the Busan-Shenyang section for two reasons: one is that the Mokpo-Rajin Railway that extends to China, of which hinterland is the southeastern part of the Jilin province, is much smaller than the hinterland of the Busan-Shenyang Railway, which includes Liaoning, Heilongjiang, and the rest of the Jilin province; and the other is that the Mokpo-Rajin Railway that extends to Russia handles only a portion of the freight between Korea and Europe and is not expected to enjoy a rapid increase in freight transport demand in the near future.

An elaborate study is required to estimate how much of shift would occur from sea and air transport to land transport when Busan and Shenyang are linked by land transportation. However, the study attempted to estimate the volume to be shifted from air and sea transport to the Busan-Shenyang section by using a relatively simple price ratio logit model with some assumptions due to limited data. The study excludes the Mokpo-Rajin Railway and Busan-Rajin Expressway in estimating the future demand because their demands will not be greater than that of the Busan-Shenyang section at least within 5 years even though they can be potential considerations in the future.

One of the important conclusions the study has reached is that the diversion effect from sea and air transport to land transport depends on the competitive advantages of land transport means in terms of travel time and transport costs. As the data on travel time and transport costs used in the study are only estimates based on assumptions and not actual data, the meaning of land transport demand estimation lies in having reference points and not in calculating exact estimates. Approximately 10-20% of the total transport demand is expected to be transferred to the Seoul-Beijing Railway if a railway is made available between Korea and China. For the Seoul-Shenyang section that is shorter than the Seoul-Beijing section in distance, the diversion rate is estimated to be approximately 30-60%. If roads are available between Korea and China other than railways, the diversion rates to railways and roads are

estimated to be 10-20% and 0.4-0.6% respectively for the Seoul-Beijing section, and 27-58% and 5-11% respectively for the Seoul-Shenyang section. The shift rate of freight to roads is insignificant compared to its shift rate to railways.

The study also attempted to estimate the diversion rate of passengers to railways, which has never been done before. It is found to be in the range of 27-32% for the Seoul-Beijing section, which implies that not a small number of passengers would use railways, and the Seoul-Shenyang section shows a high diversion rate from air and sea transport to railways and roads at 31-33% and 16-18%, respectively. As claimed by Chinese experts, the Seoul-Beijing and Seoul-Shenyang railways are expected to absorb a portion of tourists and business trip travelers of both countries when considering the current demand for the international train running between Beijing and Pyongyang.

However, as shift rates estimated in the study are subject to change according to the changes in travel time and transport costs, the study also carried out a sensitivity analysis of transport modal share rates. The results suggest that land transport is more sensitive to transport costs than to travel time, which implies that transport cost should be considered as an important factor when designing land transport linkages between Korea and China in the future.

Given the facility level and operating conditions of the Beijing-Pyongyang Railway, it is necessary to improve the Seoul-Pyongyang section for the operation of the Seoul-Beijing Railway. Even though limited operation will be possible as it is, the overall expansion and renovation of the North Korean railway section is required to meet future freight and passenger demand as estimated in the study. However, the double tracking of North Korean railways requires a large amount of funding and therefore, it is necessary to take a phased approach. In the first phase, it is preferable to restore and operate the Seoul-Sinuiju Railway at minimum cost, and in the second phase, to make the route double tracked by the support of international financial organizations. A close cooperation among China, South Korea, and North Korea is required in building and utilizing the Seoul-Sinuiju Railway.

Albeit not a main arterial route like the Busan-Shenyang corridor, the construction of a new road between Wonjeong and Rajin and the renovation of the Namyang-Rajin Railway are necessary for the recovery of the North Korean economy and acceleration of its opening. Both South Korea and China should render support to these projects. In particular, from the standpoint of South Korea, the Korean peninsula will be able to make the most use of its geographical location in the long term when it secures the Mokpo-Rajin transport corridor, besides the Busan-Shenyang arterial transport corridor. Therefore, it is necessary for South Korea to preferentially support the Namyang-Rajin Railway as part of the Busan (Mokpo)-Rajin Railway and the Wonjeong-Rajin Road as part of the Busan-Rajin east coast expressway. With regard to the Busan-Rajin route, in which the Russian government is interested, is important in that it can be linked to the Trans-Siberian Railway, it seems desirable to discuss alternative routes and renovation measures before making investment commitments.

North Korea is the key to making land transport linkages between Korea and China and between Korea and Russia

North Korea is the key to making land transport linkages between Korea and

Those land transport linkages will bring substantial impact upon not only South and North Korea but also China and the entire Northeast Asian region

China and between Korea and Russia. Therefore, it is crucial to convince North Korea of the importance and effects of land transport linkages and obtain their consent. Although North Korea agreed to the renovation of the Seoul-Sinuiju section and the restoration of the Munsan-Gaeseong Expressway with South Korea, it is still doubtful as to how actively North Korea will promote these projects. The recent deadlock in the North Korea-U.S. relationship and the suspension of inter-Korean relations imply that building land transport linkages may take longer than expected. Those land transport linkages discussed in the study will bring substantial impact upon not only South and North Korea but also China and the entire Northeast Asian region and, therefore, international cooperation is essential among Northeast Asian countries. As suggested in the study, it is necessary to form a cooperative commission between South and North Korea and China to discuss and coordinate matters concerned with land transport linkages. As international trains for passengers are currently operating and railways and roads are available for freight transport between North Korea and China, it should not require an additional agreement between them. However, South and North Korea should establish an agreement on traveling and telecommunications and join the international transportation conventions for the operation of railways and trucks. In particular, major issues that the tripartite cooperative commission should handle are border-crossing procedures and operating conditions such as fares. As the Committee for the UN Tumen Region Development Plan emphasized, non-physical obstacles between countries that can be removed through negotiations at the national level without any cost should be the first item to be discussed at the tripartite cooperative commission. Finally, as revealed in the study, the shift of the transport demand to land transport is sensitive to travel time and transport costs. Therefore, negotiations on the time and costs of border crossings including the simplification of complicated customs clearance procedures, computerization of customs operations and unification of documents for customs clearance or border-crossings should start as early as possible.

References

Ahn, Byung-Min and et. al. 2000. The status of railroad in North Korea and the land connections of railroad with continental railroad system. Seminar on Iron Silkroad, New Millennium Democratic Party, October 31, Seoul (in Korean).

Boyer, K.D. "Minimum rate regulation, modal split sensitivities, and the rail problem." *Journal of Political Economy* 85(3): June 1977, 493~512.

Bureau of Port Construction, Ministry of Transportation, Government of Japan, Economic Research Institute for Northeast Asia. 2000. *Report on the possibility of revitalizing Siberian Land Bridge*

Bureau of Port Construction, Ministry of Transportation, Government of Japan. 2000. *Report on the international logistics infrastructure in the East Sea Rim.* Tokyo: Ministry of Transportation (in Japanese).

Choi, Yeon-Hye. 2000. The railway policy of EU and the German experiences in railways integration. Seminar on Iron Silkroad, New Millennium Democratic Party, October 31, Seoul (in Korean).

ERINA and FIAS. 2000. "The Tumen Region Growth Area: Current Impediments and investment Potential." *TREDA Advocacy Workshop 2000: Trade, Investment and Growth in and around the Tumen Region.*

ERINA. 2001. "The Summary of Session 1." *ERINA Report 39.*

Gombo, Tsogtsaikhan. 2001. "TRADP Transport Working Group Summary Report," *ERINA Report* 38: 21~24.

Government of the Republic of Korea. 2000. *The 4th Comprehensive National Territorial Plan in Korea (2000-2020).* Gwacheon, Korea: The Ministry of Construction and Transportation (in Korean).

http://www.exterminal.co.kr/main.htm

http://www.panmunjomtour.com

http://jalingobi.new21.org

IMF. 1996, 2000. *Direction of Trade Statistics Yearbook.*

Japan Maritime Press and Tsumori. 2000. *Inter-port Competition and Linkage in East Asia.*

Japan-China Northeast Development Association. 1992. *Report of field survey team on Northern ports of North Korea*

Jeon, Il-Soo, Ahn, Byung-Min and Lee, Jae-Hoon. 1998. *Plan for building a comprehensive transportation system in preparation for Korean reunification.* Goyang, Gyeonggi-do: Korea Transport Institute (in Korean).

Jeon, Il-Soo. 2000. Prospects for the development of Eurasia Transport networks and the significance of railway connections. Seminar on Iron Silkroad, New Millennium Democratic Party, October 31, Seoul (in Korean).

Jin, Fengjun and Pang Xiaomin. 2001. "Growing cross-border transport linkages between China and Korean Peninsula and the organization of direct railway

transportation," *Workshop on Korea-China Land Transport Connections for the Facilitation of Economic Cooperation in Northeast Asia*, 16 April, Anyang, Korea, Korea Research Institute for Human Settlements.

Jin, Hyung-In, Cho, Yong-Gap and Chon, Hyung-Jin. 1998. *Building international inter-modal transportation system using Trans-Asian rail*. Seoul: Korea Maritime Institute (in Korean).

JNTO. 1992, 1998. *Statistics on Tourism~Japan*.

Kachura, I.I. 2001. "Conditions of the transit container traffic along the Trans-Siberian trunk railway." *Trans-Siberian Land Bridge in the 21st Century, Prospects for Development of the Russian-Korean Relations in the Field of Transportation*, 12~13, February, Seoul, Korea.

Kim, Gyeong-Seok. 1998. "A study on measures for direct land transport within South and North Korea and Northeast Asia," *A collection of treatises on North Korea and Korean reunification*. Seoul, Korea: The Ministry of Unification (in Korean).

Kim, Gyeong-Seok. May 2000. "Where to invest – road," *Unification economy* No. 5: 33-35 (in Korean).

Kim, Won Bae and et. al. 2000. *Inter-city networking strategy in the Yellow sea sub-region*. Anyang, Korea: Korea Research Institute for Human Settlements

Kim, Won Bae and Kwon, Young Sub. 1998. *Prospects for Sino-Korean economic cooperation and collaborative development of the coastal areas of Shandong and West Korea*. Anyang, Korea: Korea Research Institute for Human Settlements (in Korean).

Korea Civil Aviation Development Association

Korea National Tourism Organization. 1991-1999. *Korean tourism statistics*

Korea Railroad Research Institute. 1999. *Supplements and basic plan for the feasibility study of the freight transport by train ferry between Korea and China*. Uiwang-city, Gyeonggi-do: Korea Railroad Research Institute (in Korean).

Korea Trade-Investment Promotion Agency.
http://www.kotra.or.kr/ktc/china/info

Korea Transport Institute. 1998. *Prospects for the development of pan-Asian railway networks and measures to utilize them for Korea*. Goyang-city, Gyeonggi-do (in Korean).

Lee, Eun-Chul. 2000. "Infrastructure expansion in Korea and China for the activation of trade in the Rajin · Seonbong area," *Economic cooperation among South Korea, China and North Korea and prospects for regional development*. Anyang, Korea: KRIHS p219-245 (in Korean)

Lee, Gun Young and Shon, Eui-Young. 1999. "Proposals for the Northeast Asian Integrated Transport System," *A Proposal for a Comprehensive Transportation and Logistics Network in Northeast Asia*. The Korea Transport Institute and the East-West Center.

Lim, Jong-Gwan. 2000. The competitiveness of sea transport and railway

transport and significance of the Trans-Siberian railway in the Eurasian transport network. Seminar on Iron Silkroad, New Millennium Democratic Party, October 31, Seoul (in Korean).

Ministry of Construction and Transportation. 1998. *A study on the measures to build integrated road networks in preparation for the reunification in 3 stages*. Gwacheon, Korea: the Ministry of Construction and Transportation (in Korean).

Ministry of Construction and Transportation. 1998. *Construction · Transportation Statistics Yearbook (Transportation sector)*. Gwacheon, Korea: the Ministry of Construction and Transportation (in Korean).

Ministry of Construction and Transportation. 1999. *Record of road conditions*. Gwacheon, Korea: the Ministry of Construction and Transportation (in Korean).

Ministry of Construction and Transportation. 2000a. *Measures for the promotion of inter-Korean economic cooperation*. Gwacheon, Korea: the Ministry of Construction and Transportation (in Korean).

Ministry of Finance and Economy. 1999. *Foreign direct investment.*

Ministry of Justice. 1991-1999. *Immigration statistics*

Miyasita, Kunio and et. al. 1998. *The function foundation of logistics hub for Kitakyushu in Asian logistics network, the perspective towards East Asia, Kitakyushu* : International center for the study of East Asian development

Northeast Asia Research Center, Northeast Normal University. 1999. TREDA: *Transport Forecast Study, Volume 1: Analysis, unpublished report to UNTRADP.*

Oum, T,H. 1997a. "Across sectional study of freight transport demand and rail-truck competition in Canada." *The Bell Journal of Economics* 10, 463-482.

Oum, T.H. 1979b. "Derived demand for freight transport and inter-modal competition in Canada." *Journal of Transport Economics and Policy* 13(2), 149-168.

Oum, T.H. 1979c. "A warning on the use of liner logit models in transport mode choice studies." *The Bell Journal of Economics* 10(1), 374-388.

Oum, T.H. 1998. "The air transportation system in Northeast Asia." *Conference on Strategies for Developing a Regional Transportation and Logistics System in Northeast Asia*, 13~14 August, Honolulu, Hawaii.

PADECO. 1999. *Study of Non-Physical Impediments at Border Crossing between TRADP Member Countries, Phase 1 Report.*

Rimmer, Peter J. 1999. "Flow of Goods, People and Information among Cities of Northeast Asia." *The Korean Journal of Regional Science* 15(2).

Tsumori, Takayuki. 2000. "Inter-port competition and linkages in East Asia." *The Third Workshop on Intercity Networking Strategy in the Yellow Sea Sub-Region*, April 5~8, Fukuoka, Japan.

Wang, Desheng, 1995. The Chinese land transport dashing for the 21st century. Conference proceedings, Seoul: KOTI (in Korean and Chinese).

Wang, Huijun. 2001. "Reinforcing cooperation between China and Korea by

promoting bilateral economic development." *Workshop on Korea-China Land Transport Connections for the Facilitation of Economic Cooperation in Northeast Asia*, 16 April, Anyang, Korea. Korea Research Institute for Human Settlements.

Wang, Rongcheng. 2000. "A transport forecast study of Tumen River economic and development area." *ERINA Report* 32: 21~35.

World Tourism Organization. 1995, 1998. *Yearbook of Tourism Statistics*.

Zhu, Junfeng. 2001. "The Current Situation and the Future Development of Transportation in China." *Workshop on Korea-China Land Transport Connections for the Facilitation of Economic Cooperation in Northeast Asia*, 16 April, Anyang, Korea. Korea Research Institute for Human Settlements.

Zlatop T.J. and Austrian, Z. 1989. “Freight transport demand: a survey of recent econometric studies.” *Transportation* 16(1), 27-46.

APPENDIX

Table 1. Estimated transport costs for the Seoul-Beijing section by transport mode

	By air	By ship	By railway	By road
Distance(km)	1,140	1,013 (852 + 161*)	1,608	1,361
Remarks		Tianjin-Incheon section: 852km Beijing-Tianjin section*: 137km Incheon-Seoul section*: 24km	Beijing-Dandong-Pyongyang section: 1,347km Pyongyang-Gaeseong section: 187km Gaeseong-DMZ-Munsan-Seoul section: 28km	Beijing-Shenyang section (expressway, 100km / h):539km Shenyang-Dandong section (arterial road, 80km / h):277km Sinuiju-Gaeseong section(50km / h): 464km Gaeseong-Seoul section(arterial road, 80km / h): 81km
Travel time	4h	31h (28h + 2h*)	30h	19h
Remarks (h: hour, m: minute)		Tianjin-Incheon section: 28h Beijing-Tianjin section*: 1h 30m Incheon-Seoul section*: 30m	Beijing-Pyongyang section: 23h Pyongyang-DMZ (37.4km / h): 5h 30m DMZ-Seoul section (43km / h): 1h 30m	Beijing-Shenyang section: 5h 30m Shenyang-Dandong section: 3h 30m Sinuiju-Gaeseong section: 9h Gaeseong-Seoul section: 1h
One-way fare	$ 260	$ 170 ($160 + $10*)	$ 70	$ 150[3] ($115+ $35**) $ 65[4]
Remarks	Economy class by KAL $10 for connecting flight	Jincheon ferry, 2A class	$60 for Chinese and North Korean sections[1] $10 for South Korean sections[2]	

Note: Border-crossing procedures and time are not taken into account.
* travel distance, time and cost by railway, ** expressway toll fee
1) Chinese railway fare rates (express, soft seat)are applied to Chinese and North Korean

sections. 1RMB is equivalent to 151.65 Korean won as of February 6, 2001.

2) The fare for express train (Saemaeul train) between Seoul and Cheonan applies. $1 is equivalent to 1,255.25Korean won as of February 6, 2001.
3) In case of using cars, the price for unleaded oil made by the oil company, SK Corporation is 1,269 KW/L°÷$1/L as of February 7, 2001. The fuel consumption rate is based on 12.3km/L for Hyundai EF-Sonata 2000cc, The expressway toll fees for the Chinese expressway from Beijing to Shenyang (539km) and the North Korean expressway from Gaeseong, Pyongyang to Sunan (185km) are calculated based on Chinese expressway toll fee (535RMB/1,262km°÷0.424RMB/km).
4) In case of using buses, the average cost per person is based on $0.05/km per person for express buses between Seoul and Busan.

Source: Ministry of Construction and Transportation, 1998, Construction/Transportation Statistics Yearbook (Transportation sector)
____, 1999, Actual survey of roads
____, 1998, A study on measures to establish integrated road networks in preparation of reunification (3 stages)
Kyung-Seok Kim, 1998, “A study of direct land transport between North and South Korea and Northeast Asia,” Collected theses on North Korea and Korean reunification, Ministry of Unification
Byung-Min Ahn, 2000, North Korean railways and the extension of Korean railway networks to the continent
Wang, Duk-Saeng, 1995, “The Chinese land transport dashing for the 21st century: Conference proceedings, Seoul: KOTI (in Korean and Chinese)
http://jalingobi.new21.org,
http://www.panmunjomtour.com
http://www.exterminal.co.kr/main.htm

Table 2. Estimated transport costs for the Seoul-Shenyang section by transport mode

	By air	By ship	By railway	By road
Distance(km)	906	957 (533 + 424*)	769	822
Remarks (h: hour)	Distance of detouring North Korean airspace	Dalian-Incheon section: 533km Dalian-Shenyang section*: 400km Incheon-Seoul section*: 24km	Shenyang-Dandong section (63.5km / h):283km Sinuiju-Pyongyang section (63.5km / h):225km Pyongyang-Gaeseong section (37.4km / h):187km Gaeseong-Seoul section (43km / h):74km	Shenyang-Dandong section (arterial road, 80km / h):277km Sinuiju-Gaeseong section (50km / h):464km Gaeseong-Seoul section (arterial road,80km / h): 81km
Travel time	5h	26.5h (20h + 6h 30m*)	15h	14h
Remarks (h: hour, m: minute)		Dalian-Incheon section: 20h Dalian-Shenyang section*: 6h Incheon-Seoul section*: 30m	Shenyang-Dandong section: 4h 30m Sinuiju-Pyongyang section: 3h 30m Pyongyang-Gaeseong section: 5h Gaeseong-Seoul section: 2h	Shenyang-Dandong section: 3h 30m Dandong (Sinuiju)-Gaeseong section: 9h 30m Gaeseong-Seoul section: 1h
One-way fare	$ 170	$ 160 ($150 + $10[1)]*)	$ 50	$ 75[4)] ($65+ $10**) $ 40[5)]
Remarks	Economy class by KAL $10 for connecting flight	Daein ferry 1st class	$40 from Shenyang to Gaeseong[2)]: $10 from Gaeseong to Seoul[3)]	

Note: Border-crossing procedures and time are not taken into account.
* travel distance, time and cost by railway, ** expressway toll fee

1) The short distance Chinese railway fare rate for express and soft seat 68RMB for 100-500km is applied to the Dalian-Shenyang section (400Km). 1RMB is equivalent to 151.65 Korean won as of February 6, 2001.

2) The long distance Chinese railway fare rate for express and soft seat(355RMB for 500-1,000km) is applied to Chinese and North Korean sections.

3) The fare for express train (Saemaeul train) between Seoul and Cheonan applies. $1 is equivalent to 1,255.25Korean won as of February 6, 2001.
4) In case of using cars, the price for unleaded oil made by the oil company, SK Corporation is 1,269wonKW/L ≒$1/L as of February 7, 2001. The fuel consumption rate is based on 12.3km/L for Hyundai EF-Sonata 2000cc, The expressway toll fee for the North Korean expressway from Gaeseong-Pyongyang-Sunan (185km) is calculated based on Chinese Beijing-Shanghai expressway toll fee (535RMB/1,262km ≒0.424RMB/km).
5) In case of using buses, the average cost per person is based on $0.05/km per person for express buses between Seoul and Busan.

Source: Ministry of Construction and Transportation, 1998, Construction/Transportation Statistics Yearbook (Transportation sector)
___, 1999, Actual survey of roads
___, 1998, A study on measures to establish integrated road networks in preparation of reunification (3 stages)
Kyung-Seok Kim, 1998, “A study of direct land transport between North and South Korea and Northeast Asia,” Collected theses on North Korea and Korean reunification, Ministry of Unification
Byung-Min Ahn, 2000, North Korean railways and the extension of Korean railway networks to the continent
Wang, Duk-Saeng, 1995, “The Chinese land transport dashing for the 21st century: Conference proceedings, Seoul: KOTI (in Korean and Chinese)

http://jalingobi.new21.org,
http://www.panmunjomtour.com
http://www.exterminal.co.kr/main.htm