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**Hang-Yong High-Speed Railway and Ningbo's Industrial Structure: A Conceptual  
Analysis**

A thesis submitted in partial fulfillment of the requirements for the  
degree of Master of Urban and Regional Planning at Virginia Commonwealth University

By

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December 3, 2014

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December 3, 2014

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## Abstract

### **HANG-YONG HIGH-SPEED RAILWAY AND NINGBO'S INDUSTRIAL STRUCTURE: A CONCEPTUAL ANALYSIS**

By Dongxuan Ying, Master

A thesis submitted in partial fulfillment of the requirements for the degree of Master of Urban and Regional Planning at Virginia Commonwealth University.

Virginia Commonwealth University, 2014

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High speed railway and promote the economic development of the city. So the operation of high-speed railway in Ningbo to Hangzhou, Ningbo's opportunity and challenge, tourism, transportation, business, industry, real estate industry, headquarters economy, financial, cultural and creative industries, attract talent. Although short-term high iron research is very difficult to see effect, but through some research can guess and judge the impact of high-speed rail industry of Ningbo city and some Suggestions put forward the Ningbo, Hang-Yong high-speed railway.

# Hang-Yong High-Speed Railway and Ningbo's Industrial Structure: A Conceptual Analysis

## 1. Introduction

High-speed rail (HSR) in China may refer to any commercial train service with an average speed of 200 km/h (124 mph) or higher. By that measure, China has the world's longest HSR network with over 11,028 km (6,852 mi) of track in service as of December 2013, including the world's longest line, the 2,298 km (1,428 mi) Beijing–Guangzhou High-Speed Railway.

Since high-speed rail service in China was introduced on April 18, 2007, daily ridership has grown from 237,000 in 2007 to 1.33 million in 2012, making the Chinese high-speed rail network the most heavily used in the world. China's high-speed rail network consists of upgraded conventional railways, newly built high-speed passenger dedicated lines (PDLs), and the world's first high-speed commercial magnetic levitation (maglev) line. Nearly all high-speed rail lines and rolling stock are owned and operated by the China Railway Corporation, the national railway operator formerly known as the China Ministry of Railways. The Shanghai Maglev Train is owned and operated by Shanghai's city government.

Over the past decade, the country has undergone an HSR building boom with generous funding from the Chinese government's economic stimulus program. The network is rapidly expanding and is expected to reach 18,000 km (11,000 mi) by the end of 2015, including 6,700 km (4,200 mi) of track capable of accommodating train speeds of 300–350 km/h (190–220 mph) and 11,300 km (7,000 mi) of track for train speeds of 200–250 km/h (120–160 mph). The pace of high-speed rail expansion slowed for a period in 2011 after the removal of Chinese Railways Minister Liu Zhijun for corruption and a fatal high-speed railway accident near Wenzhou, but has since rebounded. Concerns about HSR safety, high ticket prices, low ridership, financial sustainability of high-speed

rail projects and environmental impact have drawn greater scrutiny from the Chinese press.

China's early high-speed trains were imported or built under technology transfer agreements with foreign train-makers including Alstom, Siemens, Bombardier and Kawasaki Heavy Industries. Chinese engineers then re-designed internal train components and built indigenous trains that can reach operational speeds of up to 380 km/h (240 mph).

Hang-Yong High-Speed Railway began its commercial operation in 2013, and it connects two big cities, Hangzhou and Ningbo. It passes through seven stations. The scale and logistical significance of China's High-Speed Railway can create new opportunities in many sectors, such as car rental, consumer staples, retailers and brands, restaurant and catering, budget hotels and tourism. The impacts of the high-speed railway systems in the short-run and long-run can be very complex. I analyze Hang-Yong High-Speed Rail's impacts on the industrial structure of Ningbo. I chose to study the effect of Hang-Yong high-speed rail to Ningbo because of Hangzhou in the Yangtze River delta important position, its urban development and change of industrial structure may be influenced by many factors, such as the Shanghai and Hangzhou, Hangzhou and Nanjing high-speed opening is earlier than the Hang-Yong high-speed rail. Hang-Yong high-speed rail is one of the new line, nor are there any special expert dedicated to this line of research, I am very interested in doing some research, and Ningbo also is my hometown. The question is answered through a combination of case studies and literature review. Accessibility indicator is used to show the ease with which activities can be reached from a given location by using a particular transportation system.

### **1.1 The development status of China's high-speed railway**

Improving transportation conditions for economic development in a particular region is important. Since the 21<sup>st</sup> century, China, especially for Yangtze River Delta, has been expanding its high-speed railway network dramatically. Also, this district has the highest level of overall economic strength in China. According to Brian D. Sands, high speed rail is considered to be the most visible form of new technology, which accelerates

the transformation to an information based economy (Sands, 1993). The development of inter-city high-speed railway offers increased opportunities of face-to-face communication among the knowledge-handing workers (Kobayashi and Okumura, 1999). With the expansion of urban scale and intercity transportation, the economic links and interaction between regions are gradually integrated.

In 2008, just six years ago, high-speed rail system in China was opened and it is a mid-to-long-term rail network plan. Its main objective is to transport freight and passengers over long distance. Comparing with China's airline industry, high-speed rail system carries almost twice as many passengers in every month. According to *The New York Times*, many transportation specialists and economists regard the high-speed rail system as one reason China's economy grows continually while other emerging countries are faltering.

According to Takagi (2003), the executive vice president of Japan Railway Technical Service, in terms of the speeds and lengths of lines in operation, China's high-speed rail operation has already surpassed that in Japan. It makes China's high-speed rail network be at the leading position in the world. A blue paper from the Morgan Stanley points out that China's high-speed rail system will affect over 700 million people in the next ten years. Hang-Yong High-Speed Railway was built in East China.

High-speed rail system in this area covers Shanghai Municipality, Zhejiang and Jiangsu Provinces. Modes of transportation have influenced the spatial pattern in the Yangtze River Delta. These changes are summarized in the following table.

### **1.11 Industrial structure: the tertiary industry ushers in a golden development**

Highway passenger and cargo transportation can offer convenience for the second industry, contribution to the development of secondary industry is greater than the third industry. And high speed railway is general passenger transport is given priority to, so can't improve the second industry development for bulk cargo transportation efficiency. Relative to the influence of the high speed highway, high-speed railway mainly depends on the influence of the third industry, especially to emphasize rapid transit, the flow of information and industry the most significant effect.

According to the survey, the French high-speed rail (TGV) , 72% of the third industry, the company often use high-speed rail between Paris and Lyon region, of which belong to the company decision-making core technology research and advisory services and management services of travel activity. High-speed rail directly expand "movable move assets" and "mobile assets" market range, the former such as information service, and the latter such as hotel industry. In addition, because of the cost of the information service is reduced, the development of the third industry get better competitive advantage Lille, for example, as the largest industrial city of northern France, through the construction of high-speed rail hub, from an industrial city to a commercial office building of the urban transformation.

### **1.12 Regional development, agglomeration effect and diffusion effect**

High-speed rail has certain catalyst for regional development, is not a simple. Despite the high speed railway for the growth of population and industry distribution have a significant impact, but to improve traffic conditions is only a necessary condition for regional development, rather than the full article. Promote the development of the region, in addition to improve transportation, also with the other development conditions needed to be successful. The influence of high speed railway to regional development can be divided into metropolitan area, the regional center and rural areas.

High-speed railway to improve accessibility of metropolitan area, make the space of the metropolitan area competitive advantage more. So will appeal to urban area to concentrate in urban areas, the population of the resulting congestion and pollution, public facilities, service levels drop not economic factors such as scale, can lead to fall under space competitiveness of metropolitan area, population and industry may gradually to transfer outside the metropolitan area or other areas.

According to Japan's experience, High-speed rail station will make regional center city population increase, if add on highway complement each other, the development of population and industry will be affected by positive, makes the region center along the high-speed, the emerging development of node has a positive effect for relieving metropolitan area population pressure. Based on the experience of France, the introduction of high speed railway although it is difficult to increase the attraction of the

Paris region, but outside Paris, high-speed rail service area benefit is obvious, especially relative to Paris to Lyon area the competitiveness has gradually enhanced the trend.

### **1.13 Market behavior: increased competition lead to localization of the industry**

High-speed rail to reduce transport costs between areas between blocking barrier to reduce competition in the market. Consumers can choose more manufacturers in the larger space range of products, companies face more fierce market competition, industry localization phenomenon is more prominent, division of labor cooperation between urban system are established, thus the production efficiency is improved, the consumer get more economic benefits. However, from a single city, point of view, this industry localization could lead to it in the middle of a low value-added industry division of labor system.

### **1.14 High-speed rail hub: traffic functions and additional functions simultaneously**

High-speed rail hub of different function and performance, will have different impact on the city. For high-speed rail hub of positive methods should be scientific and reasonable, shouldn't be a "good". Development of city features should take precedence over high-speed rail traffic, because take the high-speed rail is not an end in itself but there are worth to the cause of local, therefore must formulate industry development and the construction and operation of high-speed rail hub complementary development strategy, adhere to high quality features of the region as a development goal, achieve the function of high-speed rail hub of transportation and additional functions.

### **1.15 Transportation: the redistribution of the transportation market is obvious**

High-speed rail has a large transport capacity, high speed, good security, punctuality rate, comfortable, convenient, low energy consumption and environmental impact small transport properties. According to calculation, Stroke within 85 ~ 1058 km on high-speed trains than on other public transportation means to save time. At the same time, the operating cost is the advantage of high speed railway and aviation industry. Because with strong competitiveness, rapid growth, high speed railway freight volume of transportation market competition have significant changes.

Table1. Spatial Pattern Changes of Yangtze River Delta under the Impact of Different Ways of Transportation

	Period	Transportation	Industry Characteristics	Spatial structure
Railway Age	1978 to 1980s	Rely on Shanghai-Nanjing Railway and Shanghai-Hangzhou Railway	Secondary sector of economy was dominated, such as textile industry	Z-shaped
Highway Age	1990s to early 21 <sup>st</sup> century	Highway network	The leading industries became high-tech industry and electro-mechanical industry	
High-speed Rail Age	After 2010	Shanghai Nanjing High-speed Railway, Shanghai Hangzhou High-speed Railway, and Hang-Yong High-Speed Railway	The development of high-tech industry, financial and commercial industry, tourism is rapid	Networked

Source: Department of Urban Planning and Design, Nanjing University.

### 1.2 Characteristics of the Hang-Yong High-Speed Railway

The Hang-Yong High-Speed Railway connects two major cities, Hangzhou and Ningbo. Literally, “Hang” is a short name for Hangzhou, and “Yong” stands for Ningbo. It spans about 149.8 kilometers and passes through seven stations: Hangzhou East, Hangzhou South, Shaoxing North, Shangyu North, Yuyao North, Gaoqiao and Ningbo

South. If I draw a circle centered at Hangzhou on the map, with a radius of one hour's drive, Ningbo and Shanghai will be found within that circle, as shown in the following figure 1. With the formation of Hang-Yong High-Speed Railway, the One Hour Traffic Circle between Hangzhou and Ningbo becomes a reality. According to Yuhua Li, the chief engineer of this project, Hang-Yong High-Speed Railway is the fastest, most straight and cleanest railway. Because there is little tiny fragment of stone, coal and other materials on the road, it is regarded as the cleanest railway (Figure 1).

Hang-Yong high-speed opening operation will shorten the time of resident's travel between cities, intercity effects will appear. Hang-Yong high-speed opening, both in Shaoxing to Nanjing, or in Shanghai, between the two travel times will be reduced to more than an hour; this means that high-speed rail is formed between Shaoxing and HuNing "one hour city circle." At the same time, Shaoxing to Hangzhou, Ningbo travel time will be reduced to within half an hour, Yangtze River Delta city effect among the cities will be appeared to maximize.



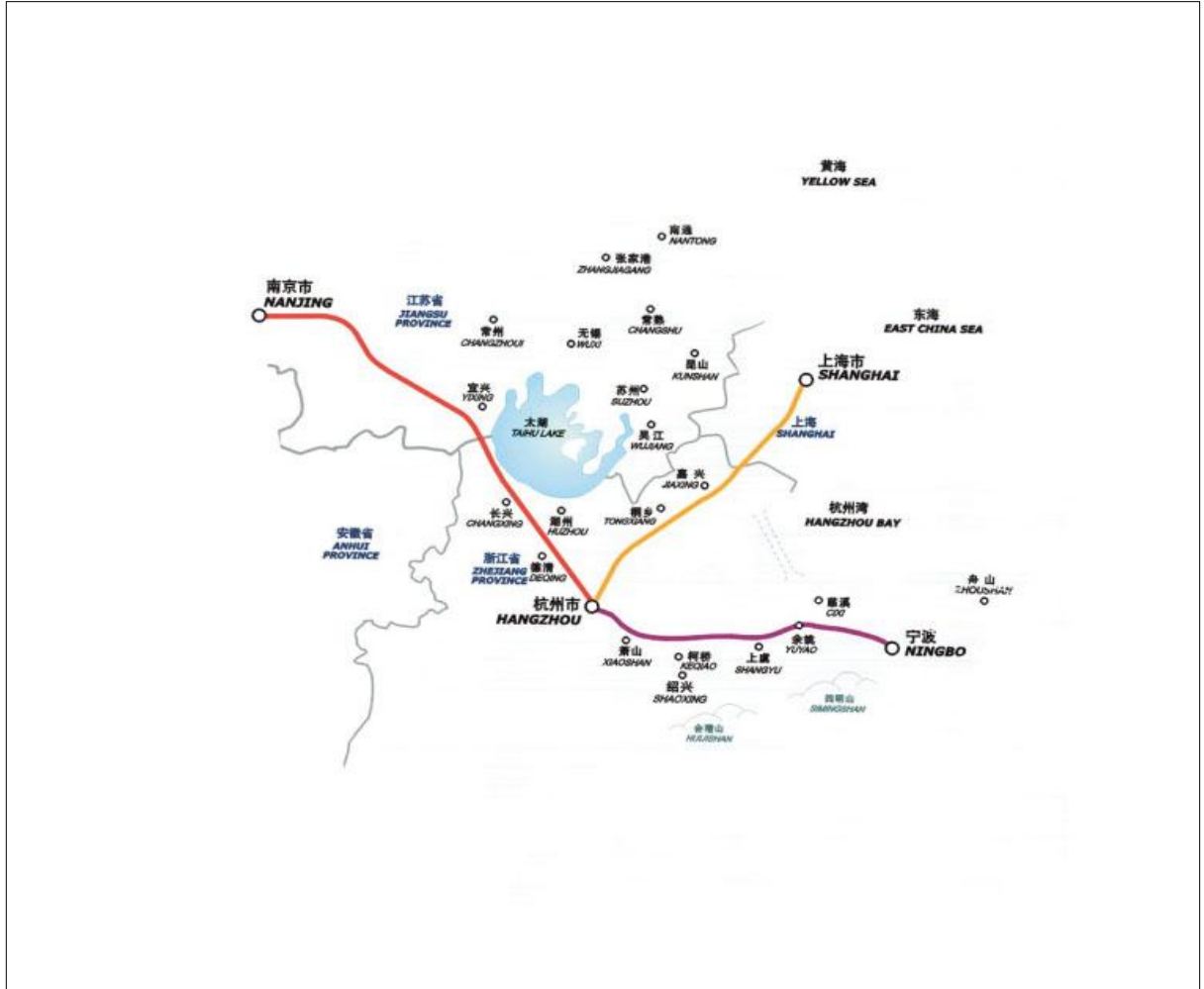


Figure1. Map of the One Hour Traffic Circle

Hang-Yong High-Speed Railway started its commercial operations on July 1, 2013. The gross investment of this project reached ¥21.2 billion. With the design speed of 350 kilometers per hour (220 mph), the journey from Hangzhou to Ningbo will take only 53 minutes. If people choose the inter-city conventional train, it would take almost three hours. Hang-Yong High-Speed Railway is mainly for passenger transport.

In 2015, Ningbo to Shanghai, Nanjing, and Hangzhou fastest isometric triangle's main city travel time are within 90 minutes (Table 2). From the standpoint of urban and inter-city traffic, relying on one or more the external transport mode, the transition of internal and external traffic sites concentrate in the same space layout, transportation organization and management, transit transfer, the information flow, the auxiliary

services seamlessly within the framework of space and transport and the formation of a large capacity, integration of the passenger, cargo transfer system.

Table2. In 2015, Ningbo and the surrounding major cities contact efficiency

Unit: minute

City	Existing travel time	2015 travel time	Mode
Ningbo-Shanghai	120	90	Passenger dedicated line
Ningbo-Hangzhou	97	45	Passenger dedicated line
Ningbo-Nanjing	300	90	Passenger dedicated line
Ningbo-Zhoushan	60	60	High-speed way
Ningbo-Taizhou	49	49	CRH
Ningbo-Wenzhou	80	80	CRH

Hang-Yong region is the core of the economic development of Zhejiang Province, city distribution, the average distance between cities is about 30 km. Ningbo is a deputy provincial city, which as a coastal open city and famous historical and cultural city, solid economic foundation, dense population, social development level is higher. Hang-Yong railway will bear the Yangtze River Delta and the southeast coastal city of part of the long-distance passenger, communication between co-workers triangular in between cities and cities along the Hang-Yong intercity passenger communication, can greatly shorten the Yangtze River Delta and the Pearl River Delta and the southeast coastal area of time and space distance, the passenger quality greatly improved.

### 1.3 The Development Status of Industrial Structure in Ningbo

The economic and social development in Ningbo, China has entered a new stage. According to Ningbo Statistic Bureau, the annual per capita gross domestic product in Ningbo in 2013 has reached ¥93,176 RMB (\$15,046 US dollars). Industrial structure issue of cities is the core theoretical problem of studying urban economy. Reasonable industrial structure is the prerequisite for the healthy development of the urban economy. Industrial structure issue not only is advantageous to fully explore the urban resources, give full play to city's advantages, improve the economic performances of urban sectors, strengthen the economic potentiality of the city but also can help the city to meet the city's growing population and social development needs. As the economy in Ningbo is booming, the conventional railway, the Xiao-Yong Railway, is unable to meet the demand for railway travel between the two largest cities in Zhejiang, Ningbo and Hangzhou.

How to promote the adjustment of industrial structure and how to actively encourage sound development of industries is a significant subject that is of universal concern to the whole society. Industrial structure directly affects the speed and the quality of economic growth, while any current industrial structures are shaped by the past industrial investment structure. Ningbo is located in the middle of the mainland coast line and the south of Yangtze River Delta. Ningbo is adjacent to Hangzhou and Shanghai. In recent years, Ningbo has become the economic center and manufacturing center in the south of the Yangtze River Delta. Manufacturing industry develops rapidly, and petrochemical industry, steel industry, and garment industry have become the pillar industries of Ningbo.

Ningbo basically completed the economic take-off in the 1990s. The main task of the early and middle is at a middle stage of industrialization, which is from the stage of high-speed economic development to the stable development phase transformation. In this critical period, Ningbo has raised the scientific development of the strategic height, seize opportunities, promote the upgrading of industrial structure, focus on transformation of the mode of economic development, efforts to promote the city's economic and social development to scientific development and sustainable development, stability and development of benign development track.

#### 1.4 Definition of industrial structure

In theory, a nation's economy can be categorized into different sectors. The primary sector of the economy uses natural resources directly. Raw materials and basic foods are the typical products of this sector. It also includes the agriculture, mining, farming, fishing, forestry and extraction of oil and gas industries. Industries of the secondary sector produce finished, tangible products. This sector can be categorized into heavy and light industries, such as automobile production, construction, chemical and engineering industries. The service industry is the tertiary sector of the economy, which offers intangible services. It includes healthcare, education, insurance, banking, tourism, retail sales, hospitality industry, and the media. By comparing China with other similar emerging countries at present as well as the past experience of developed countries with the similar level of per capita gross domestic products, scholars stated that the service industry in China is undeveloped.

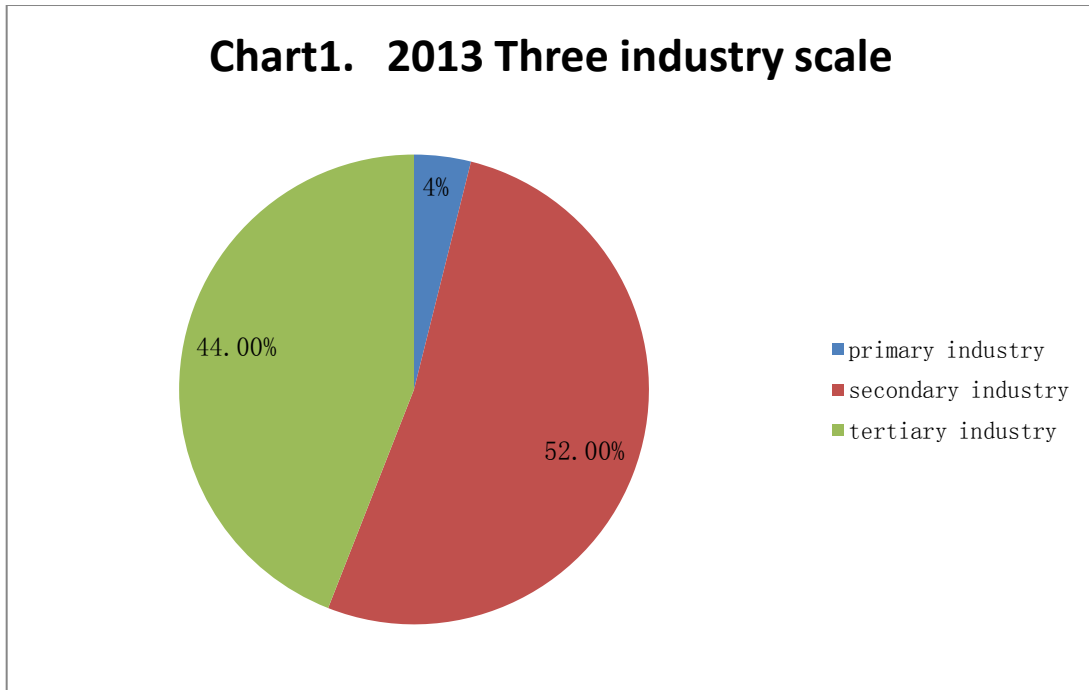


Figure2. 2013 Three industry scale

In 2013, the city's primary sector added value 27.64 billion Yuan, down by 1.2% over the previous year; The secondary sector added value of 374.17 billion Yuan, an increase of 8.2%; The tertiary sector to realize the added value of 311.08 billion Yuan, an

increase of 8.8%. The ratio of the three industries is 3.9, 52.5, 43.6, the added value of tertiary sector proportion of GDP increased by 1.1% over the previous year.

Ningbo will vigorously implement the "12th five-year plan" period, the industrial "4 + 4 + 4" industrial upgrading project, strive to industrial output value reached 2 trillion Yuan, more than double by the end of the "11th five-year plan" period.

"4 + 4 + 4" industry including new equipment, new material, new energy, a new generation of information technology and so on four big strategic emerging industries, energy conservation, environmental protection, health, ocean high technology, design and so on four big emerging industry, petrochemical, auto and parts, textile and clothing, electrical appliances and so on four big traditional superior industries.

A high-speed promoted the Yangtze River Delta region traffic increases; Second, high-speed stimulated medium- and short-distance travel; Three is the high-speed rail will promote the development of business travel; Four is the opening of the high-speed rail will accelerate the process of regional tourism cooperation; Five is the opening of the high-speed development and conducive to shift concept, improve the image of tourist destination.

First, the high-speed opening make the original passenger transport capacity can be shifted to the logistics, the logistics industry a better environment for development, especially in railway logistics development faster. 2. People travel more convenient and cheaper; can choose a way to travel more. Transport differentiation competition gradually formed.

With high iron significantly shorten the transportation time; using High-speed commuter is significantly more frequently in urban areas and the urban areas of journeys, commuter circle expanding population to urban areas peripheral distribution trends. Living environment will be improved; spreading type urbanization road will be reversed. Vigorously promote the construction of Ningbo east city.

#### **1.41 Harbor industry**

In 2013 the city's industrial enterprises above designated sized to achieve output of 1.2795 trillion Yuan.

In 2015, Ningbo port-surrounding industrial output will reach 800 billion Yuan, Accounted for 40% of the city's total industrial output. (Petrochemical industry, steel industry, automobile industry, shipbuilding industry, papermaking industry)

Strive for to 2015, the automobile production capacity of 800,000 cars, 500,000 sets of production engine, automobile and parts industry to achieve output value 200 billion Yuan, become the important economical and intermediate car and parts manufacturing base and the supporting center, one of the regional development base of a car.

#### **1.42 Traditional industries**

Strive to up to the end of the 12th five-year (2010-2015), the city's traditional advantage industry achieve gross value of industrial output 500 billion Yuan, industrial output value accounted for about 25%. (Clothing, household appliances, spinning, electrical engineering and electric apparatus, mould, stationery)

#### **1.43 Modern service industry**

At the end of the 2015, the added value of producer services accounted for 55% of the total value added of the service industry, emerging producer services added value accounts for above 15% of the total value added of the service sector. To 2015, the city's imports and exports totaled \$150 billion, exports of \$88 billion, \$62 billion of value.

#### **1.44 Emerging industry**

Creative design "grafting" clothing, household appliances and other traditional industries by 2015, the creative design industry output value of 12 billion Yuan. Predicting 2015, the city's strategic emerging industries output value will reach 600 billion Yuan, reach 30%, the proportion of total output value of industrial value adds rate is higher than the industry average of 3% over the same.

## 2. Literature review

### 2.1 Hoffmann Ratio

Hoffmann (1931) summarized the rules of dynamics of industrial structure in the industrialization process. With the advances in technology, the tertiary industry would be in the dominant position instead of the secondary industry. He has studied the pattern of industrial growth in about twenty countries and divided the years after 1770 into four periods. The situations of countries from the beginning of their industrial revolutions in each period were compared. Mr. Hoffmann computed the “changes in the ratio of net output of consumer- goods to that of capital goods” (Hoffmann, 1931). His conclusion is that the relative amounts of the factors of production or the state of technology may be different; all industrializing nations follow a uniform pattern of growth through three stages. Consumer goods industries refer to the food, textile, leather and furniture industries. While the vehicle building, engineering and chemical industries are typical examples of capital goods industries. During the first stage, consumer goods sectors are predominant, and the ratio of the net outputs of consumer goods and capital goods should be  $5(\pm 1):1$ . In the second period, capital goods sectors develop more rapidly than consumer goods industry, and the ratio is  $2.5 (\pm 1):1$ . In the last stage, the ratio decreases to  $1(\pm 1):1$ .

I use the ratio of light industry and heavy industry to approximate the Hoffmann Ratio. Table 2 below indicates the industrialization process of Hangzhou during the period of 1997 to 2003. It shows that Hangzhou was in the third stage according to the theory of Hoffmann Ratio.

Table3. Approximate Hoffman Ratio of Hangzhou from 1997 to 2003

Year	Light Industry (in %)	Heavy Industry (in %)	Approximate Hoffmann Ratio (in %)
1997	53.5	46.5	1.15
1998	51.6	48.4	1.07

1999	51.1	48.9	1.04
2000	49.4	50.6	0.98
2001	51.9	48.1	1.08
2002	51.8	48.2	1.08
2003	48.9	51.1	0.96

## 2.2 High-Speed Railway Systems' impact on regional economy

Kobayashi and Okumura (1997) designed a dynamic multi-cities growth model. They connected multiple regions with a high-speed railway system, which provides the chance of face-to-face communication of knowledge exchange. As a result, it accelerates the economic development process of a city system. They emphasized the differences in qualitative and geographic elements in the high-speed railway system can have a profound impact on economic development in the region (Kobayashi and Okumura, 1997). They came up with the conclusion that the quality of the high-speed railway systems is one important factor influencing the development processes of knowledge and capital stocks in each region (Kobayashi and Okumura, 1997). They only considered one sector economy without international trades. However, the influences of international trade cannot be ignored in reality.

Some scholars focus on studying high-speed railway systems within their own countries. Mathieu (1993) analyzed the lessons can be learned from the French experience with high-speed rail systems. Besides some direct benefits, such as increased employment in activities associated with the construction of the new line, some permanent jobs and business activities are created. Services industry associated with the new line developed rapidly, such as lodging, food service and retail trade. After the successful operation of high-speed rail, Lyons became the city with the highest development level. What's more, Lille used to be a classic industrial city. With the help of high-speed rail, its industrial structure had been changed. As its tertiary sector developed dramatically, the major driver of Lille's economy became tourism and handle official business (Mathieu, 1993).



### **2.3 High-Speed Railway Systems' Impacts on Industrial Structure in Regions**

As for the empirical study, Hu and Sheng (1999) analyzed Beijing-Shanghai (Jing-Hu) high speed railway's impacts on the economic developments of the region along the railway. They stated that high-speed railway systems play an important role in easing transportation pressure, accelerating the economic integration, stimulating the development of knowledge economy and providing more employment opportunities.

Sand (1993) is a professor of Institute of Urban and Regional Development at University of California. He studied the development effects of high-speed railway systems by focusing on three cases of the French TGV, German ICE, and Japanese Shinkansen. He found out that high-speed railway systems have a relationship with increased growth rates in retail, industrial, construction, and wholesale sectors (Sands, 1993). In particular, in the cities along the Sanyo Shinkansen Line in Japan, strong growth had been seen in the food and accommodation sectors. As shown in the figure, information, investigation, advertising services grew more rapidly than in the case without Shinkansen. Also, he believed that railways' routing can affect their ability to cause growth.

Table4. Information Exchange Industries Employment Growth (Percent) in Regions with Population Increase, 1981- 1985

	Shinkansen & Expressway %	Expressway only%
Business Services (Total)	42	12
Information, Investigation, Advertising Services	125	63
R & D and Higher Education	27	21
Political Institutes	20	11
Other	57	28
Banking Services	27	28
Real Estate Agencies	21	3
Total	22	7

Chen (2005), a professor at Beijing Jiaotong University, analyzed the impact of high-speed passenger railway on regional economic development. He established a mathematic model and built a regression equation to produce a quantitative analysis. He took the Qinhuangdao Shenyang special passenger line as a typical example and came up with the conclusion that the operation of high-speed rail system can promoted the Tertiary Industry.

In 2013, the World Bank Transport team tried to identify and quantify the impacts of China's emerging high speed rail program. They supported both on-the-ground surveys and economic studies. They piloted a methodology to evaluate benefits for several high-speed railway projects, which has found them to be significant - of the same order as direct transport benefits. Crucially, these benefits of larger and better connected markets accrue to businesses and individuals even when they themselves do not travel as the flow of ideas and people accelerate. The paper highlights this research and methodology and some of the policy implications to maximize these benefits in practice (Salzberg, 2013).

Ollivier (2013), World Bank's Senior Transport Specialist working on the high speed rail program in China, gave an example: "Look at the case of Zhengzhou on the 2,298 km Beijing to Guangzhou line opened on December 26," he said. "In the past, in a three hour conventional train journey on this line, about three million people from Anyang, Xinxiang and Handan can reach Zhengzhou; today, with the opening of the new high speed line, this number will surge to 28 million people from eight cities. These cities will start to work more closely together as a return trip within a day will be within reach. The impact in terms of economic exchanges, accessibility, and productivity gains are expected to be significant, and extend beyond traditional transport savings. The scale and scope of the Chinese high speed rail program offer a unique opportunity to try to measure such impacts."

## **2.4 Three sector hypothesis (Petty's Law)**

### **2.41 Overview**

Three sector hypothesis or Petty's Law is an empirical theory that reveals the change of industrial structure in the process of economic development. In the 17<sup>th</sup> century, a Western economist William Petty found that with the continuous economic development, industrial centers will gradually shift from the production of tangible goods to the production of intangible services. In 1691, based on the actual situation in the United Kingdom, William Petty clearly pointed out that as the profits generated by the manufacturing industry are usually much larger than those of agriculture, and the profits generated by the commerce industry are usually much larger than those of manufacturing industry. As a result, labors would work in the manufacturing industry rather than in the agriculture, and eventually work in the commerce industry.

Later in 1940, based on William Petty's study on the relationship between income and labor flow, Colin Clark, a British economist, measured and compared the trends of employment in the distributed architecture in development of thrice industries at different income levels. Colin Clark believed that his findings confirm Petty's theory which was raised in 1691.

According to the three-sector hypothesis, there are three types of economic activities. These activities are named as sectors. They are very different from each other. They are also called as the primary, secondary, and tertiary sector. They are:

- The extraction of raw materials (Primary sector);
- Manufacturing goods (Secondary sector); and
- Providing services (Tertiary sector).

Petty's Law reveals the evolvement rule of labor force's distribution structure in the three industrial sectors during the process of economic development. Because of the relative income differences among different sectors, labors tend to move to sectors with higher income levels.

#### **2.42 Assumptions**

There are three significant assumptions of Petty's Law:

- This law studies the evolution rule of industrial structure, which is based on the changes that occurred in several countries over time. This time series corresponds to the rising national average income level.
- This law studies the evolution rule of industrial structure, in which labor force is used as an indictator. It studies the changes of distribution of labor force in different sectors during the process of economic development.
- The basic framework of this law is the three sector classification method. All economic activities are classified into primary sector, secondary sector, and tertiary sector. Petty's Law summaries the experience of changes of industrial structure. It not only can be proved from the time series of economic development of one country but also can draw similar conclusions from the comparison of various countries at different development levels at a fixed time point. That is to say, in terms of economic conditions of various countries at different development levels at a fixed time point, in countries where the national average income level is relatively low, the proportion of labor force in the primary sector is relatively large, while the proportion of labor force in the secondary and tertiary sectors are smaller. On the contrary, in countries where the national average income level is relatively high, the proportion of labor force in the primary sector is relatively low, while the proportion

of labor force in the secondary and tertiary sectors are larger. Therefore, Petty's Law is an economic law reflecting the industrial structure changes.

### **2.43 Main Content**

The main content of Petty's Law is: due to the income differences in different industries, labor forces tend to move to sectors with higher income levels. With the improvement of national average income level, labor forces would move from primary sector to secondary sector. With the further increase of national average income level, labor forces would move to the tertiary sector. As a result, in terms of distribution of labor force in various sectors, the proportion in primary sector will decrease, while the proportion in secondary and tertiary sectors will increase.

## **3. Research purpose, question and plan**

### **3.1 Research purpose**

Industrial structure issue of cities is the core theoretical problem of studying urban economy. Reasonable industrial structure is the prerequisite for the healthy development of the urban economy. Industrial structure issue not only is advantageous to fully explore the urban resources, give full play to city's advantages, improve the economic performances of urban sectors, strengthen the economic potentiality of the city but also can help the city to meet the city's growing population and social development needs. Studying on Hang-Yong High-speed Railway's impacts on Ningbo's industrial structure is beneficial for Ningbo Government to carry out solutions to upgrade the economy structure.

The development of the tertiary industry is the important symbol of economic development. Vigorously developing the tertiary industry to build a socialist harmonious society and implementation of the modernization three-step strategy is of great significance in China.

Speeding up the development of the tertiary industry can effectively promote the industrialization and modernization process. Human social development law and the rules of the development of the industry showed that speeding up the development of the

tertiary industry, to promote regional development from agricultural society to industrial society, industrial society to the modern information society. In the process of the two, the third industry, mainly by raising labor productivity and technology innovation, to promote the intensive degree of socialization of agricultural production and industrial production, so as to realize industry optimization.

Speeding up the development of the tertiary industry is advantageous to the transformation of the mode of economic growth. Speeding up the development of the tertiary industry, which is beneficial to improve the quality of the overall level and development of the industrial development, can promote the industry chain extension, improve the technological content of products, and enhance the sustainable development of resource industry.

### **3.2 Research question**

The central research question of this research is as following:

What is the current status of Ningbo's industrial structures? What are the existing problems?

In the following sections, the whole contents will be concentrated upon this research question. As to answer the central research question, the sub-questions should be answered step by step as following:

What are the impacts of Hang-Yong High-speed Railway on the industrial structures of Ningbo City?

### **3.3 Research plan**

First of all, I plan to review the literature works and academic theories in the related fields. Then, I got the first-hand data through interviews with 1000 visitors at the locations of Mount Putuo and Tianyi Square from my co-workers who are in Ningbo city planning design institute in May, 2013 and October, 2013; when I also, accessibility indicator and share-shift analysis are applied in order to explore the industrial structures of Ningbo. What's more, secondary research will be conducted. In the end, a conclusion will be drawn for the whole research.

## **4. Research Methodology**

I conduct both primary and secondary research in order to explore Hang-Yong High Speed Railway's impacts on Ningbo's industrial structure.

### **4.1 Primary research**

#### **4.11 Shift-share analysis**

Shift-share analysis is a popular tool in regional science, political economy and urban studies. Daniel Craig, an American economist, raised the traditional form of the shift-share analysis in the early 1940s. Later, it was formalized by Edgar S. Dunn in the 1980s. Shift-share analysis is widely applied in the analysis of regional and urban economic structure. It is probably due to the fact that this method requires very elementary statistical information and provides quite large analytical possibilities (Marquillas, 1972). Unlike other methods, Shift-share analysis has relatively strong levels of integrity and dynamics. This method can reveal the extent and causes of changes of regional and urban industrial structure and help the city to determine the predominating direction of economic development in the future.

##### **4.111 Rationale of shift-share analysis**

Shift-share analysis regards the changes of regional economy (Ningbo) as a dynamic process. It uses the economic development of the whole area or the whole country as the frame of reference. In this thesis, the economic conditions of Zhejiang Province are used as the frame of reference. This technique intends to find out factors that cause the differences of growth among the regions. For a given period of time, each regional change can be divided into three components: national growth effect (RS), industry mix effect (PS), and local share effect (DS). This method can explain the reasons of development or recessions of regional economy. It explores the strengths, weaknesses, opportunities and threats of regional economy structures. As it can find out the certain industrial departments which have relatively strong competitive advantages, it helps the regions to determine the rational direction for future economic development and principles of adjusting industrial structures.

##### **4.112 Mathematics model**

According to the shift-share analysis theory, every regional change can be divided into three parts: national growth effect (RS), industry mix effect (PS), and local share effect (DS). National growth effect is the part of change which attributes to the total growth of the national economy as a whole. Industry mix effect is the part of change which attributes to the performance of the specific economic industry. Local share effect is the part of change which attributes to regional influences.

The formula can be expressed as:

Growth of regional economy (G) = National growth effect (RS) + Industry mix effect (PS) + Local share effect (DS)

So the actual growth of regional economy can be divided into three components.

$$\text{National growth effect: } RS = \sum Y_i^0 R$$

Where, RS is the growth share of Ningbo if every industry grows at the rate of the whole research area (the growth rate of gross domestic product of Zhejiang Province) is the expected production value of industry i in Ningbo, while R is the growth rate of GDP in the Zhejiang Province. I compare the assumed level of growth with the actual level of growth. If the assumed value is higher than the actual value, the overall deviation value of Ningbo is positive. If the assumed value is lower than the actual value, the overall deviation value of Ningbo is negative.

$$\text{Industry mix effect: } PS = \sum Y_i^0 R_i^0 - \sum Y_i^0 R = \sum Y_i^0 (R_i - R)$$

Where PS is the difference between the growth amount of Ningbo at the growth rate of industry i in the Zhejiang Province and the growth amount at the growth rate of GDP in the Zhejiang Province. This value reflects the growth or decline of industry i in Ningbo along with the growth or decline of industry i in Zhejiang.  $R_i$  is the growth rate of industry i in Zhejiang Province. If the majority of industries in Ningbo are rapid growth industries, PS value is larger than 0, and vice versa.

$$\text{Local share effect: } DS = \sum Y_i^0 r_i^1 - \sum Y_i^0 R_i^1 = \sum Y_i^0 (r_i^1 - R_i^1)$$

In the equation, DS is the difference between in Ningbo industry I's growth amount at the rate of actual growth and the growth amount at the growth rate of the same industry in Zhejiang Province. Comparing with the case in Zhejiang, this value reflects regional



advantages or regional disadvantages of industry one in Ningbo represents the actual growth rate of industry i in Ningbo.

The relationship among these three factors is:

$$G=RS+PS+DS=\sum Y_i^0 R + \sum Y_i^0 (R_i-R) + \sum Y_i^0 (r_i^1 - R_i^1)$$

Similarity, the economy growth rate of Ningbo ( $G_r$ ) can be expressed in the terms of  $R$ ,

$(R^*-R)$ , and  $(G_r^1 - R^*)$ :

$$G_r^1 = R + (R^*-R) + (G_r^1 - R^*)$$

Where  $G_r^1$  is the economy growth rate of Ningbo,  $R$  is the growth rate of GDP in Zhejiang province,  $R_i$  is the estimated growth rate of various industries in Ningbo according to the estimated growth rate of the whole region (Zhejiang Province)

$$R^* = \sum Y_i^0 (R_i^1 + 1) / \sum Y_i^0 - 1$$

If the majority of industries in Ningbo are rapid growth industries, then  $-R$  is larger than 0; If the majority of industries in Ningbo are non-rapid growth industries, then  $-R$  is smaller than 0. If the competitive force of Ningbo is stronger than the level in the whole research region, it will be larger than 0. If the competitive force of Ningbo is weaker than the level in the whole research region, then  $-R$  is smaller than 0.

#### 4.12 Accessibility indicator

Mario Artuo proposed a new indicator, Economic Mass, to evaluate the relationship between one city's accessibility to other cities and its size of economy. Zhao Dan, a professor of Department of Urban Planning and Design at Nanking University, proposed an accessibility indicator (Zhao, 2014). Accessibility indicator is used to show the ease with which activities can be reached from a given location by using a particular transportation system. The author focused on the Hong Yong high-speed rail. In order to measure the regional accessibility, a weighted average travel time indicator is used. I need to compute the weighted average of the length of travel time between locations with regard to the major economic activity center along the high-speed rail line. Then take as weights of the Gross domestic product of the destination economic activity center as below:

$A_i$  is the accessibility of location  $i$

$T_{ij}$  is the length of travel time through the network between location  $i$  and  $j$

$M_j$  is the gross domestic product (GDP) of the destination  $j$  economic activity center

Here, the author considers the Ningbo, Shaoxing, and Hangzhou along with the Hang-Yong High-Speed Railway.

Another common indicator is Economic Potentials. Its assumption is that there is transparency of information and exchanges in the economy install a general equilibrium state which is characterized by “spatial and temporal efficiency” (IPCC, 2011). Daily Accessibility is also a popular indicator to analyze the accessibility impact of high-speed rail system. Unlike Economic Potentials and Daily Accessibility, this model is more suitable in the case of Hang-Yong High-Speed Railway for two reasons.

Besides high-speed rail facilities and their spatial location, levels of economic development, particularly gross domestic product, also have an impact on the accessibility. As a result, it is scientific to take GDP into consideration.

The change of accessibility and the degree of transportation convenience can be directly showed by the length of travel time

Two situations are taken into consideration, one is to 2010 (Hang-Yong High-Speed Railway did not start commercial operation at that time) and the other situation is to 2020.

Data collection

Quantitative data are needed. In order to compute the Accessibility indicator, I need to gather the length of travel time and the gross domestic product of Ningbo, Shaoxing, and Hangzhou along the Hang-Yong High-Speed Railway. The information in situation of 2010 can be collected from the local government official websites. US-China Exchange Association provides GDP data of major Chinese cities. This association offers information about Hangzhou. The official website what's on Ningbo tells about GDP of Ningbo.

As for the situation in 2020, the Official Outline Plan of China's High-Speed Railway Network can offer relevant information. Geographic information System (GIS) helps us to collect the geographical data. Geographic information System (GIS) is applied in this research in order to map a dense transport dataset of high-speed railways. GIS is a

helpful tool that can capture, manage, analyze and display various forms of geographical data (ESRI, 2014).

As I need to compare the industrial structure in the cities before and after the operation of high-speed rail system, percentages of three sectors in the economy should be collected. Also, information about tourist volume and tourism revenue before and after the commercial operation of Hang-Yong High-Speed Railway should be collected. For example, Ningbo Tourism Bureau offers specific information about its tourist volume and revenue.

Transport policy is an important goal is to realize the regional integration, because it closely related to economic and social policies. From the perspective of the strategic plan for the integration of motivation to promote the construction of the project. Europe's transport network engineering efforts to reduce some areas development bottlenecks caused by the poor accessibility, which eliminate the hinterland. In traffic related studies, the integration effect refers to the new infrastructure changes to the regional distribution of accessibility. Are usually represents the distribution more uniform, the effect of new infrastructure that has made the distribution more conversely polarized, so it is not fair. The accessibility of distribution usually study from two Angle, society and space. On the other hand, through the accessibility studies in the distribution of different groups, to discuss the concept of social equality. These studies from the perspective of individual, the microcosmic perspective, and study the issue of a city or city category in general. Through accessibility in different areas, on the other hand, the distribution of the study, or is the regional equality concept is usually involved in the regional integration.

## **4.2 Hang-Yong high-speed rail for the main effect of economic development of Ningbo city**

### **4.21 Tourist industry**

Opportunities: in the future to travel in Hangzhou will continue to grow, the tourism development of golden period. The high-speed opening reduces travel time cost, has a direct stimulus to the development of tourism. In 1964, for example, Japan Tokaido Shinkansen opening, the famous tourist city of Kyoto Japan has resulted in 10 years the

tourism development of golden period, tourist arrivals in 1970 around 50% more than in 1964.

Challenge: a number of tourism industry competition, if the lack of response may result in Hangzhou local industry weakness, and finally eliminated by the market. For example, the Hang-Yong high-speed opened city effect makes the expansion of circle of visitors a day, to Ningbo passengers may choose to travel in Ningbo during the day, night stay in Hangzhou, Ningbo hotel industry competition. Also, such as, with the complete construction gradually Hangzhou railway station may also cause travel tourists, restricted development of Ningbo local tourist attractions.

#### **4.22 Transportation**

Opportunity: first, the high-speed opening make the original passenger transport capacity can be shifted to the logistics, the logistics industry to get better environment for development, especially in railway logistics development faster. Second, people travel more convenient and cheaper; can choose a way to travel more, transportation differentiation competition gradually formed.

Challenges: first, the Hang-Yong passenger car market will shrink, between the passenger transportation market in the short term excess capacity, to ensure that the passenger market orderly transition becomes a challenge. Second, the Ningbo international airport faces increasing competition. With China's high-speed rail network is built, the high-speed rail travel instead of air travel, air transport market has been compressed. At the same time, the city of Hang-Yong effect makes the competition between airport and the airport, Xiaoshan international airport is further compressed the Ningbo airport air passenger market share.

#### **4.23 Commerce Industry**

Challenge: high-end purchasing power is likely to flow to Hangzhou, Ningbo business circle development environment is more competitive. Between the opening of the high-speed promoted the city system, intensify the competition between cities, each cities according to their own competitive advantage to form their own characteristics. Circle of Japan, for example, Kinki Osaka, Kyoto and Kobe, respectively is the "business of Osaka", "Kobe port" and "culture of Kyoto" famous throughout the world, the

radiation can reach the Kinki Osaka business circle, Osaka, Kyoto and Kobe went to high-end purchasing power. Ningbo population reached 7.64 million in 2013, and Osaka, Kyoto and Kobe three city population is only about 5.6 million people in 2002, Ningbo is entirely possible that form has a broad radiation area compared with the Shanghai business circle is not inferior in the business circle. At present people's way of thinking is Hangzhou is famous for its lakes and mountains, leisure fairyland. This way of thinking, after Hang-Yong high-speed rail way open, the impact of the Ningbo business circle will be larger.

#### **4.24 Real Estate**

Opportunities: with high iron significantly shorten the transportation time, using High-speed rail commuting is significantly more frequently in urban areas and the urban areas of journeys, commuter circle expanding population to the urban areas of peripheral distribution trends, living environment will be improved, spreading type urbanization road will be reversed, vigorously promote the construction of Ningbo east city.

Challenge: first, the high-speed opening to promote the development of residential suburbanization, the residential real estate demand for Ningbo city are likely to reduce, including surrounding city. Second, insufficient for residential suburbanization trend estimation, adapt to residential suburbanization supporting facilities.

## **5. Results and Findings**

### **5.1 Primary Research**

#### **5.11 Interview results**

## Chart2. Is this your first visit to Ningbo?

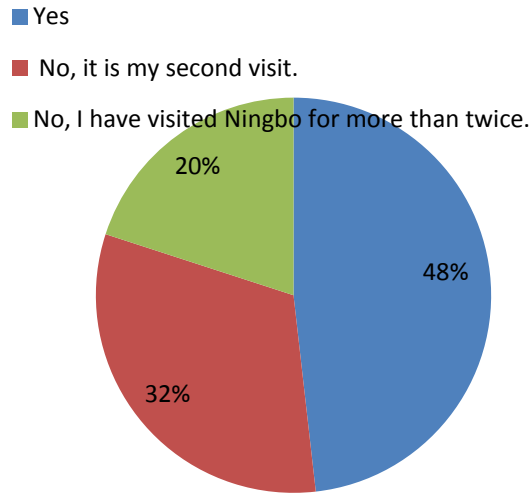


Figure3. The number of tourists to visit Ningbo

Forty-eight percent of visitors for the first time to Ningbo, 32% of visitors is the second time to come to Ningbo, 20% of visitors is the third time already, or more than three times visit to Ningbo. It seems that people often to visit Ningbo are a relatively small percentage in all the tourists.

**Chart3. What are the main reasons for your visit to Ningbo?**

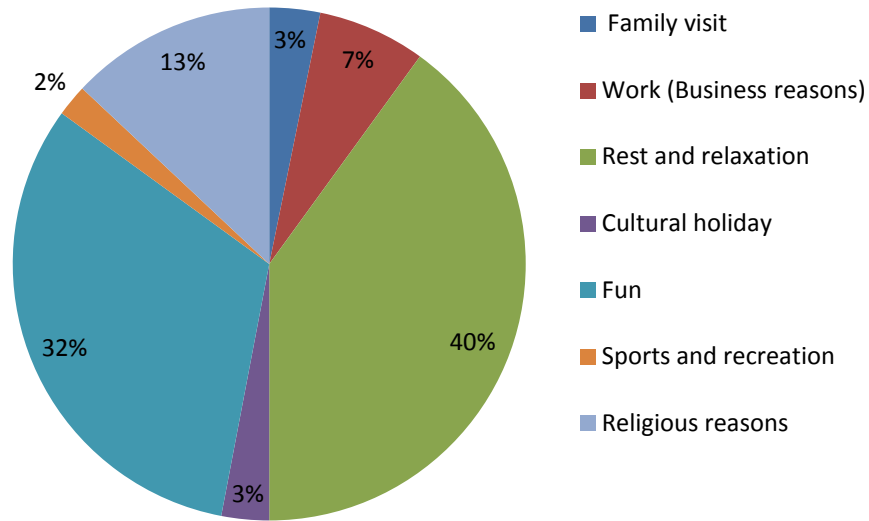


Figure4. The reason of tourists to visit Ningbo

Around 50 percent of visitors travel to Ningbo for the first time, 32 percent of them have visited Ningbo for the second time. Also, a substantial proportion of respondents, 20 percent, have traveled to Ningbo for several time, indicating Ningbo is a good place for travelling.

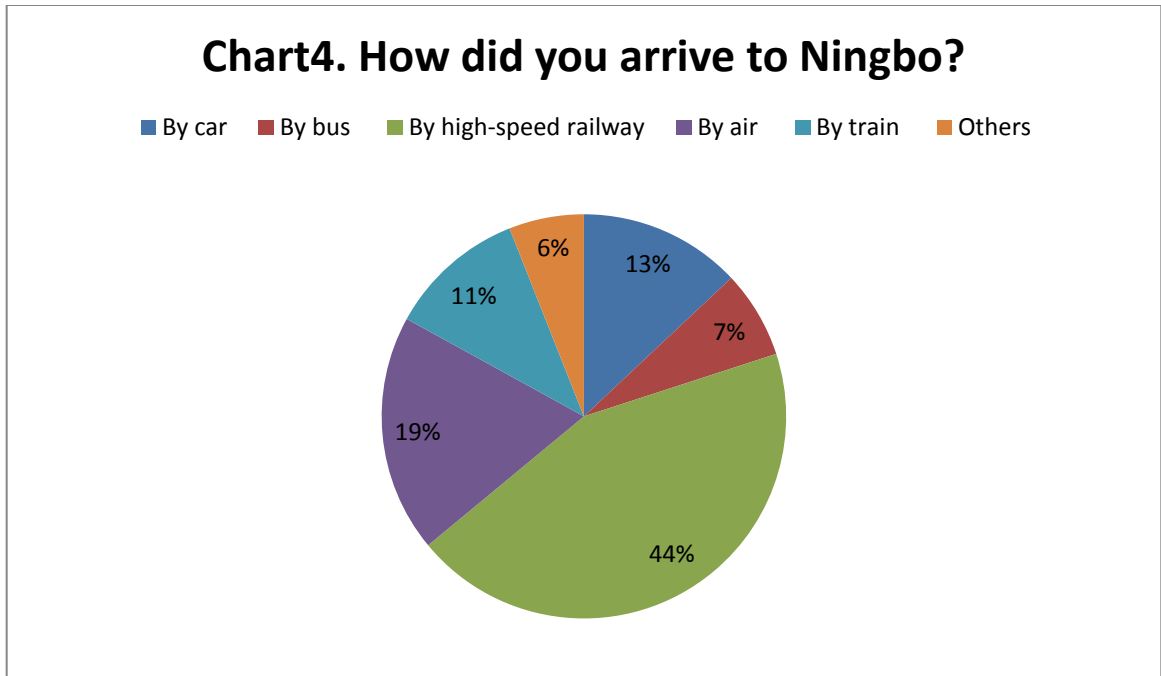


Figure5. The mode of transport of tourists to visit Ningbo

This is a pie chart which illustrates the respondents' choice of transportation when they visit Ningbo. I can see clearly that nearly half of the respondents choose high-speed railway. According to Ningbo Government, self-drive tours, suburban tours and countryside tours are turning hot among visitors. Over ten percent of the samples choose car as the means of transportation. The figure lead us to the conclusion that high-speed rail is gaining its popularity.

About three quarters of respondents say that they visit Ningbo for relaxation or for fun; I can infer that the majority of visitors are leisure tourists. As Mount Putuo has become the center of Chinese Buddhism since the Tang Dynasty, thirteen percent of visitors visit Ningbo for religious reasons. According to the China.Org.cn website, Mount Putuo hold three festivals every year, there are The Spring of Mount Putup. The Nan Hai Guan Yin Cultural Festival and the Guan Yin Incense Festival, millions of people visit Ningbo for celebration from home and abroad during the periods of these three festivals.



**Chart5. Are you an individual tourist or a member of a small tour group?**

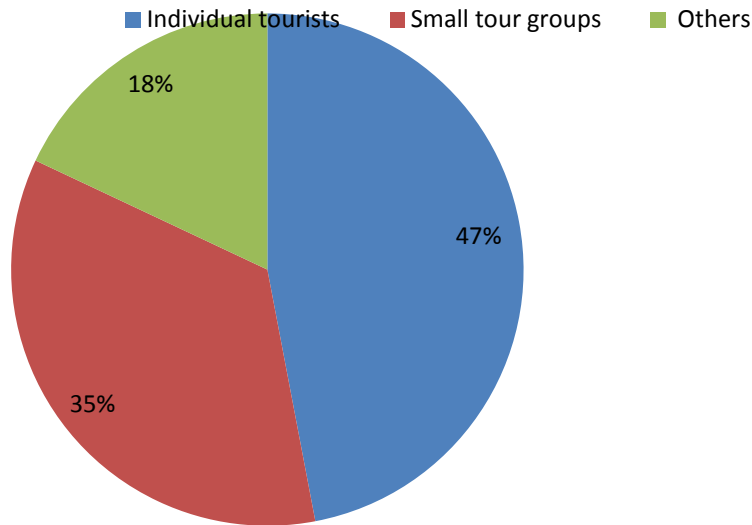


Figure6. An individual tourist or a member of a small tour group to visit Ningbo

As can be seen from the figure, 47 percent of visitors are individual tourists and over thirty percent of respondents come from small tour groups. Just as Chen Minxian, inspector of the Ningbo Tourism Bureau, states that the majority of the high-speed railway tourists are individual tourists or small tour groups.

### Chart6. When you go travelling, what factors do you consider most when you choose the means of transportation?

■ Distance ■ Cost ■ Comfort level ■ Travel schedules ■ Travel time ■ Others

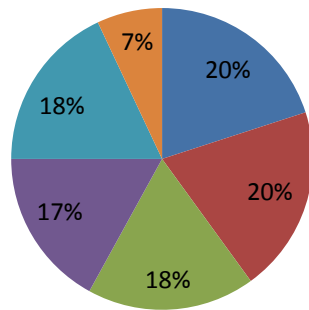


Figure7. What factors do you consider most when you choose the means of transportation?

These five factors are all important to respondents. Around 20 percent of people consider traveling distance as the most important factor, 20 percent regard cost and budget as most significant. The figures for comfort level, travel schedules, and travel are 18, 17, and 18 percent respectively.

### Chart7. Do you know the operation of Hang Yong High-Speed Railway?

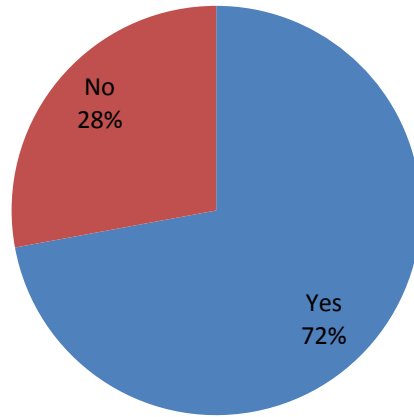


Figure8. Do you know the operation of Hang Yong High-Speed Railway?

Even though Hang-Yong High-Speed Railway began its commercial operation in 2013, it gains popularity. Over 70 percent of travelers have heard about it, while about 25 percent of travelers do not know its operation. If Hang-Yong Line can be promoted in the public, more people may choose to travel to Ningbo.

### Chart8. If you visit Ningbo next time, what means of transportation would you choose?

■ By car ■ By bus ■ By high-speed railway ■ By air ■ By train

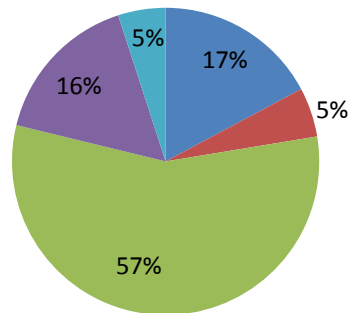


Figure9. What means of transportation would you choose next time?

After knowing that Hang-Yong High-Speed Railway is the fastest, most straight and cleanest railway, and with the design speed of 350 kilometers per hour (220 mph), the journey from Hangzhou to Ningbo will take only 53 minutes, over half of respondents state that they may consider high-speed railway for travelling to Ningbo next time.

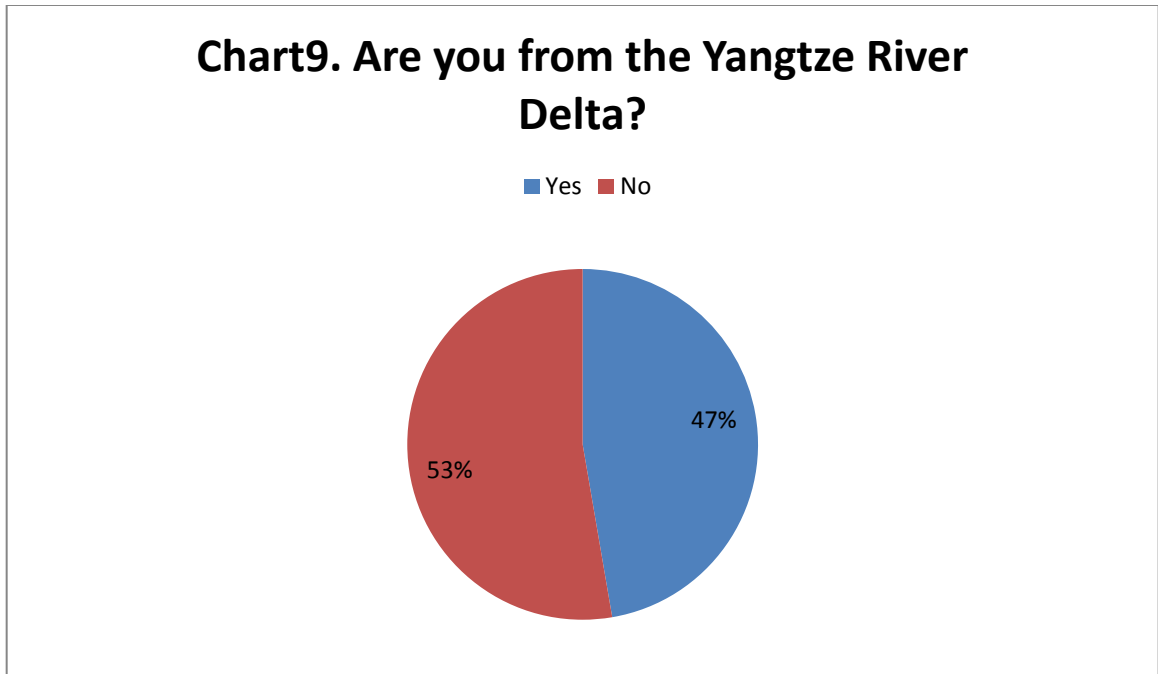


Figure10. What means of transportation would you choose next time?

As can be seen in the chart, nearly half of the samples come from the Yangtze River Delta, I can infer that a substantial proportion of visitors travel to Ningbo for short trips. Hang-Yong High-Speed Railway connects the cities in the Yangtze River Delta, it is inferred that this line may make contributions to the growth of tourism in Ningbo.

**Chart10 . For those answer is Yes of question 8) Did you choose Hang Yong High-Speed Railway for this visit?**

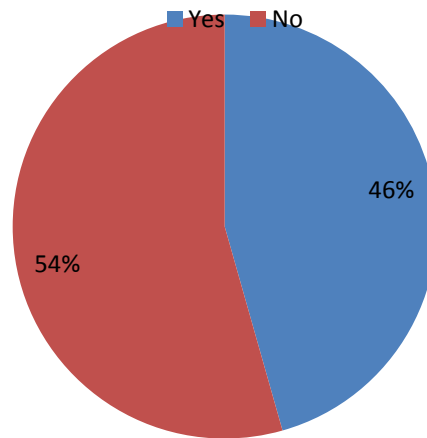


Figure11. For those answer is yes of question (8) did you choose Hang Yong High-Speed Railway for this visit?

Further, I give a follow up question for respondents whose answer is Yes of Question 8. As for travelers who come from the Yangtze River Delta, 45.6 percent of them stated that they chose Hang-Yong High-Speed Rail for their trips. Due to the popularity of self-drive tours, about a quarter of interviewers come to Ningbo by car.

### **5.12 Conclusions of interviews**

High speed rail development has a link with the prosperity of tourism industry. According to Chen Minxian, inspector of the Ningbo Tourism Bureau, Ningbo is expected to be a new tourist city for tourists from Beijing, Tianjin as well as the Yangtze River Delta (Chen, 2012). As for the traditional tourism industry, it faces transformation and promotion because the fact that the majority of the high-speed railway tourists are individual tourists or small tour groups. Chen suggests that it is necessary for Ningbo to develop new tourism products like unique vocational villages, theme hotels, and

functional hotels and cultivate new operational types of tourism (Chen, 2012). The new high-speed train between Hangzhou and Ningbo will eventually integrate the cities.

High-speed railway encourages Chinese leisure visitors to travel more. Greater accessibility is beneficial to tourist attractions in Ningbo. The high-speed railway technology changes the experience of leisure travel in Ningbo. The time and costs have been decreased significantly. For instance, the ticket prices of Business Class, First Class and Second Class from Hangzhou East to Ningbo East are 232 Yuan, 123.5 Yuan and 73.5 Yuan, respectively. Also, it takes only 53 minutes from Hangzhou East to Ningbo East. The availability of high-speed rail can increase the frequency of travel.

### **5.13 Shift-share analysis results**

By using shift-share analysis, this research collects the Gross Domestic Product value and the output value of the primary sector, secondary sector and tertiary sector of Ningbo and Zhejiang Province from 2010 to 2013. Year 2010 is treated as the base period, and Year 2013 is the last period. The statistics are shown as below.

Table5. Gross Domestic Product value and the output value of the primary sector, secondary sector and tertiary sector of Ningbo and Zhejiang (2010-2013)

Unit: hundred million

		2010	2013	Added value	Growth Rate
Zhejiang	Production value	27,227	37,568.5	10341.5	37.98%
	Primary sector	1361	1784.6	423.6	31.12%
	Secondary sector	14121	18446.7	4325.7	30.63%
	Tertiary sector	11745	17337.2	5592.2	47.6%
Ningbo	Production value	5125.8	7100	1974.2	Gr=38.5%
	Primary sector	218.4	329	110.6	r 1= 50.6%
	Secondary sector	2848.2	4157.2	1309	r 2= 45.96%
	Tertiary sector	2059.2	2613.8	554.6	r 3 = 26.93%



	Growth amount	Growth rate	Growth amount	Growth rate	Growth amount	Growth rate	Growth amount	Growth rate	Growth amount	Growth rate
Primary sector	70.56	37.98%	- 34.50	- 32.1%	- 4.11	- 1.76%	30.52	50.6%	- 40.45	- 32.1%
Secondary sector	624.22	37.98%	56.2	5.25%	- 9.77	- 0.56%	728.35	45.96%	45.97	4.23%
Tertiary sector	520.1	37.98%	- 8.5	- 0.12%	50.34	5.67%	563	26.93%	56.68	6.34%
Total	1214.88	37.98%	13.2	2.3%	36.45	2.45%	1321.8 7	44.32%	62.2	2.44%

I put these data into the mathematic model, so the shift-share of three sectors of Ningbo can be calculated.

According to these two tables, I can reach the following conclusions: during the period of 2010 to 2013, the actual growth amount of Ningbo is larger than the estimated value, the total deviation is 62.2 billion RMB, and its growth rate is 2.11 percent higher than the average level in Zhejiang Province. In other words, the economic development pace of Ningbo is quicker than that of Zhejiang Province. In particular, the growth amount brought by the advantages of industrial structure (PS) is 1.32 billion RMB, and contributes 2.3 percent. The growth amount brought by the regional advantages is 3.645 billion RMB and it contributes 2.45 percent. I can see from this figure that the economic growth brought by the industrial structure advantages is far less than that brought by the regional advantages. As a result, I can conclude that in the process of economic development of Ningbo, the industrial structure is at a competitive disadvantage.

I can see that the industrial structure of Ningbo mainly has the following problems:

The industrial structure is gradually optimizing, but the proportions of three sectors of economy are not optimal.

In the recent four years, the primary sector's proportion of Ningbo has decreased significantly, the proportions of the secondary and tertiary sectors has increased slightly, this satisfies the Petty's Law about the industrial structure evolution law. Even though the growth rate of tertiary sector is faster than that of secondary sector, the tertiary sector still accounts for a low percentage in the economic growth. The development experience of developed countries and districts' industrial structures shows that when the gross domestic product per capita is 1,000 to 2,000 dollars, the tertiary sector accounts for about 40 percent; when the gross domestic product per capita is 5,000 to 8,000 dollars, the tertiary sector is supposed to account for about 50 percent to 60 percent; if the gross domestic product per capita reaches as high as 8,000 to 17,000 dollars, the percentage of tertiary sector is supposed to be 55 percent to 70 percent. According to Ningbo Statistic Bureau, the annual per capital gross national product in Ningbo in 2013 has reached 93,176 RMB (15,046 dollar), the proportion of tertiary sector is supposed to be 55 percent to 70 percent. However, in 2013, tertiary sector only accounted for 40 percent, and its industrial structure was still "manufacturing" structure. The development lag of tertiary sector, especially the development lag of the producer service sector, not only pins down the industrial economy but also hinders the upgrade of industrial structure and the substantial development of economy.

Using the factorization method of structural analysis, to Ningbo and in some cities and provinces, and the change of the proportion of the tertiary industry in some countries the empirical analysis of the factors which influence, according to the results in the rise in the proportion of the tertiary industry, dominated by price factors, namely the tertiary industry, or the development of service industry, increase the proportion in the national economy, more reflected in service prices relatively rapid rise.

The structural level of tertiary sector is not high

According to the shift-share analysis of three sectors, only the PS share of secondary sector is larger than 0, on the contrary, the industrial structures of primary sector and tertiary sector are not advantageous in the economic development. It is due to the reason that the structural level is not high. Especially, in the primary sector, the problems of low labor productivity, single variety, poor overall production capacity, and low economic efficiency exist.

Tertiary sector mainly concentrates on some traditional departments, such as the transportation, telecommunication, and commercial catering business. However, as for industries which offer production and life services, such as finance industry, insurance industry, geological prospecting industry, real estate industry, residential services, tourism, information consulting service industry and other technical service industries, and industries which improve the scientific and cultural level and quality of citizens, such as education, culture, television broadcasting, scientific research, health, sports, and social wealth, these industries do not account for a significant proportion. This condition also stops Ningbo for optimizing its industrial structures.

The scale level of secondary sector is low and the concentration level is not high.

Even though the PS share of secondary sector is larger than 0, which shows that this industrial structure is advantageous in the economic development process. However, with the continuous upgrading of industrialization, the secondary sector of Ningbo faces a bottleneck, the problems are: The scale level of secondary sector is low and the concentration level is not high. In the secondary sector in Ningbo, the percentage of individual business and private business is relatively high. The production scale is relatively small, raw materials, rough finished goods, and primary goods account for a substantial proportion, however, the final goods which are both high-tech and high value-added do not account for a substantial proportion. As the scale of enterprises is not large enough, and their strengths are not strong, a majority of enterprises are lack of long-term planning, which constrains the enterprises' ability of continuous development. What's more, the layout of industrial enterprises in Ningbo is dispersed geographically, and the degree of concentration is only 48.8 percent. As a result, the convergence phenomenon of regional industrial structure is obvious, product structures of many enterprises are very similar, even worse, and they often compete for scarce resources and market shares for their own interest. Therefore vicious competitions repeat, which hinder the upgrading and optimization of industrial structures.

#### 5.14 Conclusions of share-shift analysis

As the economy of Ningbo is transferring to the higher stage of industrialization, under current economic conditions, Ningbo should make the most of Hang-Yong High-Speed Railway to optimize the industrial structures and achieve knowledge concentration.

Based on the actual situation of Ningbo, economic growth patterns should be transformed.

Nowadays, in Ningbo, the overall economic growth pattern is extensive, and it has not been changed. This extensive growth pattern brings resource factors and environment huge pressure. As a result, I have not time to delay the transformation of the economic growth pattern. In the primary sector, the purpose of agriculture should transfer from livelihood security to economic benefits. In addition to liberalization of the agricultural market, superior products should receive enough support and the technological content of agriculture should be improved. As fishery and animal husbandry have high added value, the government should focus on these industries.

#### 5.15 Results of space accessibility changes

Table6. Three main cities' space accessibility changes

	2010	2020	Change rate
Hangzhou	0.644	0.931	30.78
Ningbo	0.972	1.599	39.20
Shaoxing	0.741	1.113	33.42

From the results, space accessibility changes have some characteristics. The regional accessibility is fully upgraded. The indices of these three cities have been improved of different degrees. Ningbo has the largest growth rate as 39.20 percent. These figures have shown that the regional transportation convenience would be largely improved. Because of the constant development of the high-speed railway, cities will be more closely connected.

## 5.2 Secondary Research

### 5.21 Environmental impacts

High-speed Railway Technical Committee of Canada Motor Vehicle Safety Standards (CMVSS) (2012) conducted an environmental and energy assessment of the Turin Lyon High-speed rail. This study focused on passenger transport. It compared the total energy spent of different transportation patterns to carry one passenger for one kilometer, which is expressed in units of mega joules (MJ/p-km).

One of the main ecological benefits of Hang-Yong High-Speed Railway would be the expected decline of pollutant emissions and the energy savings. According to the study from High-speed Railway Technical Committee of Canada Motor Vehicle Safety Standards, they have computed the total energy spent to carry a passenger for every kilometer. A bus is the transportation pattern with the lowest energy consumption with only 0.33 MK/p-km. The worst solution is a car with only one person on board, the figure is 1.87 MK/p-km. As for the conventional intercity train, depending on load factor, this means of transportation shows a better energy performance, and the figure is ranging from 0.62 to 0.77 MK/p-km. On the contrary, the High-speed rail shows a much higher energy demand and indirect GHG emissions. The detailed figure is between 1.02 and 1.44 MK/p-km (HSR Technical Committee of CMVSS).

However, high speed railway is regarded as energy efficient. According to the Environment Law & Policy Center, this means of transportation is over five times as energy efficient as airplanes and three times as energy efficient. If people choose travel by rail instead of driving or flying, our dependence on oil will be decreased and air pollution will be reduced. Currently, major cities in the Yangtze River Delta suffer from severe haze problem, and the dense, polluted air has become a fixture in these cities. Ningbo is one of these cities. The operation of Hang-Yong High-Speed Railway will decrease Ningbo's reliance on automotive transportation. Therefore, ozone emission can be decreased.

### 5.22 Social impacts

What's more, high-speed rail systems create new opportunities in many industries in the tertiary sector, such as car rental, consumer staples, retailers and brands, restaurant

and catering, budget hotels and tourism. One notable sector is tourism. New, higher-speed technology with relatively low cost provides tourists with a new experience of leisure travel in China. Based on China's rapid improvement in infrastructure and economic growth, it is estimated that tourism industry will contribute 4.5 percent of Gross Domestic Product and the number of trips per capita will increase by fifty percent in 2015. The availability of transportation is positively related with frequency of travel.

### 5.23 Tourism in Ningbo

According to Ningbo Tourism Bureau, in 2013, Ningbo achieved a tourist turnover of 95.354 billion RMB, the figure increased by over 10 percent comparing with the previous year. Ningbo received over 46 million domestic visitors between January and September in 2013. Among these domestic tourists, more than 80 percent of them were individual travelers all around China. Also, self-drive tours have gained their popularity (Chen, 2013).

In 2005, Ningbo railway passenger volume reached 14.85 million people; Ningbo-Taizhou-Wenzhou railway began to run in 2009, in 2010, Ningbo railway passenger volume reached 19 million, increased by 27.95% than the previous five years. Is expected in 2015, after Hang-Yong passenger dedicated line and Shanghai-Ningbo railway which across the Hangzhou bay will be built, Ningbo railway passenger volume will reach 35.55 million people. (Table7)

Table7. The number of railway passenger volume per year

Unit: Million

year	railway passengers
2006	14.85
2010	19.00
2015	35.55

## 5.24 Impacts on real estate

According to a study conducted by researchers from University of California and China's Tsinghua University, high speed rail systems connect "second tier" cities to global hubs, therefore more and more citizens choose to move to the smaller cities where housing prices are relatively lower, creating a real estate boom. It is estimated by the researchers that when "market potential" (an access to products, services as well as labor) is increased about ten percent by a new high speed rail line, housing prices would increase by 4.5 percent (Kahn). Matthew Kahn, a professor at the UCLA Institute of the Environment, is a co-author of this study. He defines smaller cities as the cities that "need to be too far to drive to but too close to fly to the nearest 'megacity'". In our study, a trip from Ningbo to Shanghai would take fifty three minutes by Hong Yong High Speed Rail.

Matthew Kahn and his co-author Siqi Zheng (2013) found that high speed rail systems unintentionally created new suburbs about sixty miles to four hundreds and seventy miles from "megacity". They called these new suburbs as "sweet spots". The distance between Hangzhou and Ningbo is around 141.06 kilometers, which is equal to 87.65 miles. With the designed speed of 350 kilometers per hour, Hong Yong High Speed Rail is able to provide a good connection between Ningbo and other cities, particularly the mega city Hangzhou. It is estimated that cities along the high speed rail line would experience "revitalization of downtowns and add multi-family units" near rail stations. On the one hand, both the selling price and rents are high in the mega city, it is likely that the subset of households as well as companies that are less willing to pay to locate in mega city would consider relocating to the second tier cities. For instance, in February 2014, the average residential housing price in Ningbo is 13,741 RMB per square meter, while the average residential housing price in Hangzhou reaches 19,284 RMB per square meter (Xi Tai Data). On the other hand, these decentralized households would like to enjoy the unique shopping centers and favorable restaurant options in mega cities. A high speed rail line can meet the requirements of these companies and individuals, as they can easily travel to the major cities. Citizens are allowed to swiftly move from secondary cities to mega cities, they can enjoy the benefits of megacity access without suffering from the social costs, such as soaring housing prices, associated with mega cities' growth.

As a result, real estate developers in Ningbo would choose to build new housing towers which are close to the new public transportation stations. Also, it would stimulate commercial real estate demands, so it is estimated that shopping agglomerates and upscale restaurants will be built close to these transit stations. Because developers have more investment options so they can reduce the competition for the prime sites in the traditional central business district. As transit stations are usually built in the suburban areas, the development of less developed areas will be speeded up.

### **5.25 Impacts on the land use**

Matthew also states that like Internet, the high speed rail can play a similar role. The bullet trains can attract back office activities and help enterprises fragment, so they are able to send their routine activities to less expensive land at the periphery while keep their deal makers in the costly commercial real estate in the mega cities. The rapid development of high speed rail, such as Hong Yong High Speed Rail, can help to provide a more efficient allocation of business activities across space, which is beneficial for firms to control costs. It is considered to be a “win-win” strategy because the scarce and expensive land in the mega city, like Hangzhou, is efficiently utilized, at the same time, the second tier cities, such as Ningbo, can experience local growth (Matthew, 2013).

### **5.26 Impact on industrial clustering**

According to a report conducted by Siemens, high speed rail can help to drive local economies by linking centers of knowledge, finance and technology (Siemens, 2013). All these factors are supportive to industry clustering. In 2013, the American Public Transportation Association conducted a research on the role of transit in support of high growth business clusters in the United State. It points out the importance of transportation. Transportation agencies should be able to provide adequate capacity to serve the industrial clusters. The study shows that traffic congestion can have a negative impact on the growth and productivity of densely developed districts by increasing travel times. Also, it may erase the agglomeration benefits. Researchers found that that “doubling the number of jobs accessible within 20 minutes of driving time leads to an increase in real average wages of 6.5%, while the impact for a similar increase within 20 to 30 minutes is as small as 0.5%.”



In the case of Ningbo, it is one of largest providers in Chinese clothing industry. Currently, there are over two thousand clothing producers in Ningbo, and their production capability can reach as high as 1.4 billion sets per year, which accounted for around 12 percent of the overall production capability in China. Favorable locational conditions can accelerate the development of industrial clusters. This high speed rail line connects Ningbo with other cities, making the transmission of knowledge be easier.

### **5.3 Judge one: Ningbo-Hangzhou's city effect is more significant**

According to the international city development rule, the scope of the metropolitan economic circle by the scale and strength is divided into two kinds: the daily city circle and metropolis circle. Daily city circle is also called the "one hour city circle", that is, from the core cities to the surrounding city in 1 hour or so, one-way time distance between the distance is about 100 km; Also called 3 hour economic circle of metropolitan area, one-way time distance in 3 hours or so commonly, radius of up to 300 ~ 400 km. 1 hour economic circle mainly for commuting between core city and the surrounding city circle, their internal close contact. 3 hour economic circle is mainly embodied as the core cities within the hinterland has strong radiation and influence factors of aggregation and closely with the hinterland cities between radiation diffusion effect.

As the Hang-Yong high-speed rail way opening use, one-way time by the shortest distance between Hang-Yong 2 hours and 18 minutes to 1 hour and 27 minutes, marked the Hang-Yong historic into daily metropolitan circle. Hang-Yong with daily city circle, the two exchanges would like in a city is convenient and frequent, "pendulum" employment way of life in between the Hang-Yong will become increasingly common, "the Hang-Yong urban life circle" rudiment. In both time and space distance Hang-Yong narrowed, makes people they extended their presence to trigger a "weekend" economy. Convenient traffic directly leads to the development of tourism industry, especially in tourism over the weekend. Hang-Yong high-speed rail way opening of changing the Hang-Yong economic ties, both by the original is given priority to with element agglomeration and radiation diffusion effect of phase shift to the city of mutual promoting development stage.

#### **5.4 Judge two: More prominent Hang-Yong dislocation development, Ningbo services high-speed economic growth**

"City effect" is not "the same effect". "City effect" let the free flow of scarce resources, scarce resources by gathering the pursuit of economies of scale benefits, eventually produce industry localization phenomenon. The Hang-Yong dislocation development actually is the Hang-Yong high-speed rail way logical extension of the same effect.

Hang-Yong dislocation development main show is: one is the dislocation development on the level of industry, such as Hangzhou, strong, superior industry, Ningbo is not necessarily, but based on comparative advantage, become bigger and stronger "man without I have, I have strong" features of the industry.

The second is the enterprise development level of dislocation. Hang-Yong between large companies can respectively to set up the branch in both, company managers can back and forth between headquarters and the division of the day. As a result of the existence of the same effect, the difference of corporate headquarters moved to Hangzhou or Ningbo as a whole tend to disappear, corporate headquarters move power tend to be weakened, and set up a branch of behavior can be well meet the requirements of enterprise expand the scope of business activities, make full use of the Hang-Yong city effect.

## 6. Conclusions

In Ningbo, the industrial structure is gradually optimizing, but the proportions of three sectors of economy are not optimal.

- The structural level of three sectors is not high.
- The scale level of secondary sector is low and the concentration level is not high.
- Regional transportation convenience in Yangtze River Delta is largely improved.
- The popularity of Hang-Yong High-speed Railway accelerates the tourism in Ningbo.

The construction and operation of Hang-Yong High-speed Railway make contributions to the optimization of industrial structures of Ningbo. Hang-Yong Line should increase the quality of its service in order to increase customer satisfaction. High level of customer satisfaction has a positive relationship with the sustainable development of tourism. Another notable thing is that the operation of Hang-Yong High-Speed Railway is not only an opportunity for Ningbo to upgrade its industrial structure but also a potential challenge. As this line will eventually integrate the cities of Yangtze River Delta, the competition will be more intense in this area. Ningbo business, especially in the service sector, will have to compete with other major cities, such as Hangzhou and Shanghai.

From the point of the present situation and research, because the Hang-Yong high-speed opening time is short, I can't clearly see the opening of the high-speed rail to Hang-Yong Ningbo and surrounding areas is with the function of promoting the development of industrial structure, but the Hang-Yong high-speed opening to Ningbo a good opportunities for development and improvement of industrial structure. I believe in the near future Hang-Yong high-speed rail will be the main impetus to the development of Ningbo city industrial structure.

## Appendix

This research conducts an interview with 1000 visitors at two interview locations, Mount Putuo and Tianyi Square in two long holidays which are National Day and Labor Day. I chose 1000 that are not the registered permanent residence of Ningbo visitors carried on the questionnaire survey, the age between 20 to 50 years old, there is no limit to the gender. The survey is in order to find out the impact of Hang-Yong High-Speed Rail on tourism in Ningbo and People's choice of way to travel.

### Tourist Questionnaire

Good morning/afternoon and welcome to Ningbo. I am pleased that you decided to visit Ningbo. I kindly invite you to participate in a survey which will help us make your future visit even more pleasant. The questionnaire will take about 5-10 minutes.

Is this your first visit to Ningbo?

Yes

No, it is my second visit.

No, I have visited Ningbo for more than twice.

How did you arrive to Ningbo?

By car

By bus

By high-speed railway

By air

By train

Others

What are the main reasons for your visit to Ningbo?

Family visit

Work (Business reasons)

Rest and relaxation

Cultural holiday

Fun

Sports and recreation

Religious reasons

Are you an individual tourist or a member of small tour group?

Individual tourists

Small tour groups

Others

When you go travelling, what factors do you consider most when you choose the means of transportation?

Distance

Cost

Comfort level

Travel schedules

Travel time

Others

Do you know the operation of Hang-Yong High-Speed Railway?

Yes

No

If you visit Ningbo next time, what means of transportation would you choose?

By car

By bus

By high-speed railway

By air

By train

Are you from the Yangtze River Delta?

Yes

No

(For those answer is Yes of question 8) Did you choose Hang-Yong High-Speed Railway for this visit?

Yes

No

#### Question type

I decide to use closed-ended questions during the interviews as they have some obvious advantages. It is a format limiting interviewees with a list of answer choices from which respondents must choose in order to answer the questions. Multiple choices are applied in this research. This type of questions is easier and quicker for people to answer. Another advantage is that it is easier to compare the answers of various respondents, and it's easier to code and analyze the results. However, it is not a perfect type of questions as they may force respondents to make choices that they would not make in the real world. Also, people can be frustrated if their desired answer is not offered as a choice. In order to decline or avoid the possibilities of these problems, when I design the questions, I try to cover all the possible answers.

#### Location of interviews

I should conduct interviews in locations in which visitors are likely to be concentrated. For instance, some good choices are outside major visitors' attractions, such as Tengtou Village, Tianyi Square, and the former residence of Chiang Kai Shek, Xiao Putuo Scenic Spot, and Zhaobao Mountain Scenery Zone or in city shopping centers. As there are a large number of most visited attractions in Ningbo, interview locations are supposed to be rotated so that I can cover the majority of main catchment areas. The rationale of this type of survey is based on the assumption that during tourists' trip to a city, a tourist will go to a specific location or one of the most visited attractions within the city. As a result, careful selection of locations can ensure the generation of a representative sample and plays a significant role of the success of the survey. I select Mount Putuo and Tianyi Square as two interview locations. Because time and budget constraints, I plan to randomly interview 1000 visitors.

#### Length

As for a face-to-face interview, the general rule is that questions should not run for over fifteen minutes. This questionnaire is designed to run for less than fifteen minutes. If the interview last for too long, respondents will lose interest or they even may not agree to be interviewed.

#### Pilot Interviews

Before starting the survey, I must try out the questionnaire with some visitors (not include the actual survey sample). The purpose of pilot interviews is to find out any problems the respondents may have. For instance, they may have misunderstanding of specific questions.

#### Personal details of respondents

The personal details of respondents, such as name, telephone number, age, address, socio-demographic category should be collected. This information should be asked until the end of the interview as a rapport is likely to be established with the respondent.

#### Show cards

Show cards to respondents can ensure that they focus only on the responses that have been set for that certain question. Another alternative is showing the questionnaire itself, but respondents may be distracted. More importantly, it is easy for them to be influenced by the questions that listed below.

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## **Vita**

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