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Analysis of economic impacts of the Hangzhou-Ningbo expressway

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Abstract: This paper presents an analysis of the effects of the Hangzhou-Ningbo Expressway (in Zhejiang Province of the People's Republic of China) on the region's economic development. An econometric model shows the estimated contributions attributable to the expressway have increased year by year. And statistical data indicate that the Hangzhou-Ningbo Expressway has promoted to some extent the region's economic development in various aspects.

Key words: Expressway, Regional economic development, Econometric model
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INTRODUCTION

Transportation has been a basic industry in China's national economy. By the end of 2001, expressways in China have reached to 19 000 kilometers, ranking second (behind the United States) in the world.

Internationally, there had been numerous studies on the relationship between road investment and productivity (Fernald (1999) on the U.S. experience; Khanam (1996) on the Canadian experience; T&E Report (1996) on the research development and European experience concerning roads and economy). There are also a number of studies dealing with the economic impacts of transportation projects (McDonald *et al*. (1995) on the effects of transportation improvement on residential values; Corsi *et al*. (1999) on the impact of interstate highway commercialization on economic activity at interchanges; Louis Berger and Associates (1998) on a framework for analyzing social and economic effects of transportation projects; and PBQD (1999) on a methodology to identify and assess land use impacts of transportation investments).

In China, in response to rapid development of expressway construction, there have been some research studies on the economic impacts of expressways, including a series of research reports compiled by the Ministry of Communications (1995) on several expressway projects built in early 1990s. There are also several national symposiums focusing on expressway and social economic development (PCESED, 1998; SPBEA, 2000). Methodologies for most of these studies, however, have been qualitative and descriptive in nature.

Based on the existing literature, economic effects of transportation projects can be defined as temporary and permanent effects, and direct and indirect effects. Temporary economic effects occur during the construction stage, both directly and through demand (backward expenditure) effects indirectly. Permanent direct effects include transport cost and time benefits for people and freight. Besides direct effects, there are also permanent indirect economic effects. First, these relate to the backward expenditure effects of the exploitation and use of infrastructure. Second, these involve the induced effects, which are defined as the consequences of the reduction in transport cost for production and location decisions of people and firms, and subsequent effects on income and employment of population at large.

The promoting impacts of expressways can be briefly explained using gravity models in regional science (Batten *et al*., 1986). The opening of an expressway linking two cities enhances spatial interaction between activities or land uses in the surrounding region, which is measured by accessibility that represents the attractiveness of po-

tential destinations and ease of reaching them. The potential for interaction between any two places increases as the cost of movement between them, either in terms of money or time, decreases. The region with this location advantage will attract those transport-dependent businesses and production factors, leading to the geographic concentration and cluster of industrial distribution, and thus promoting the region's economic development.

This paper examines the permanent indirect economic effects of the Hangzhou-Ningbo Expressway (HNE), the first expressway built in Zhejiang Province and opened to traffic in December of 1996. The opening of HNE has certainly generated significant impacts on the economic development along the line. However, many of these positive effects have not yet been analyzed and assessed in a quantitative way. This paper attempts to quantify the economic effects of HNE and provide some policy implications for the Zhejiang provincial government's transportation decision making.

PROFILE OF THE REGION AND THE HNE FACILITY

1. Regional economic environment

Since adoption of economic reform and open-door policies, Zhejiang Province has been one of the fastest growing provinces in China in terms of its economic activities. Between 1979 and 2000, Zhejiang Province witnessed a double-digit annual average growth rate of 13.2 percent with its GDP reaching 603.6 billion yuan in 2000. In parallel to its economic boom, transportation investment in Zhejiang Province also grew rapidly with an annual average growth rate of 20 percent between 1995 and 2000, reaching 16 billion yuan and ranking third in the nation in 2000. By the end of 2000, highways in Zhejiang Province had reached a total of 41 970 kilometers, and expressways had reached to 627 kilometers, representing increases of three percent and 60 percent from 1999, respectively.

HNE connects the three important cities of Hangzhou, Shaoxing and Ningbo, which represent three respective prefectures (the administrative unit that is below province and above county in China) in Zhejiang Province (Fig.1). Hangzhou City, the western end of HNE, is the capital of Zhejiang Province and also a famous tourism city. Shaoxing City, located in the middle part of HNE, is famous for its textile industries. The eastern end of HNE is Ningbo City, the second largest port (behind Shanghai) in China with a throughput capacity of 102 million tons in 2000.

The region of the three cities as a whole had a total population of nearly 16 million in 2000, making up over 35 percent of that of Zhejiang Province. The economy for the three-city region plays a significant part in Zhejiang Province. In 2000, total GDP for the three-city region reached 333.8 billion yuan, accounting for over 55 percent of GDP for the entire Province. Between 1996 and 2000, the economy in terms of GDP for the three-city region rose rapidly with an annual average growth rate of 12.7 percent, exceeding 11.4 percent for Zhejiang Province during the same period.

2. HNE enhancing the Hangzhou-Ningbo corridor's transportation capabilities

HNE has a total length of 145 kilometers with two lanes in each direction. The opening of HNE greatly shortens the distance and travel time between the Hangzhou-Ningo Corridor. Between Hangzhou and Ningbo Cities, travel distance is shortened by 70 kilometers and travel time is reduced from six hours previously to two hours at present. For passenger travel, HNE provides more frequent and faster services than its competitor - railway. For example, during peak periods of a day, the Expressway Bus Company offers non-stop services between Hangzhou and Ningbo every ten minutes with a travel time of one hour and 45 minutes, nearly half hour reduction in travel time compared to the passenger railway line.

HNE has changed the modal shares and promoted the highway transport development in the region. As shown in Table 1, highway is the dominant mode of serving both passenger and freight traffic in the three-city region. In 2000, nearly 96 percent of total passenger traffic and over 75 percent of total freight traffic were transported by highway. For freight, waterway is another important mode because of the rich water resources in the region, accounting for nearly 21 percent of total freight traffic.

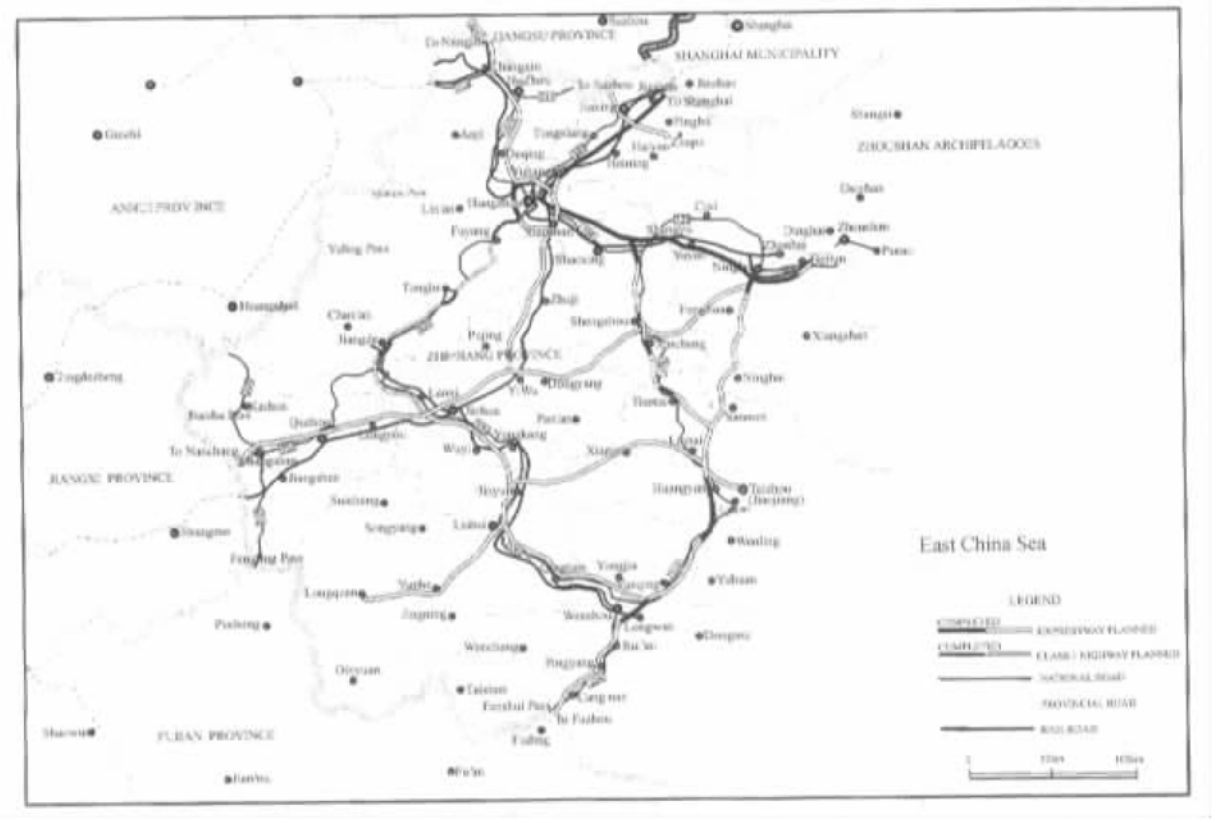

Fig.1 The Hangzhou-Ningbo expressway

Table 1 Passenger (1000 persons) and freight (1000 tons) traffic by mode in the region: 2000

	Passenger		Freight	
	Traffic	Percent	Traffic	Percent
Three-City Total	533978	100%	287 650	100%
Highway	511100	95.7%	216 440	75.2%
Railway	17884	3.3%	12 090	4.2%
Waterway	3142	0.6%	59 120	20.6%
Civil Aviation	1852	0.4%	——	——

Source: Zhejiang Statistical Yearbook.

3. Traffic characteristics of HNE

Since commencing operation in December 1996, the average daily traffic volume (ADTV) of HNE has surged rapidly. In 2000, the ADTV of HNE reached 17 006 vehicles (26 176 passenger car equivalents), representing an increase of over 17 percent from 1999 (ADTV of HNE in 1999 increased by 29.5 percent from 1998). The rapid growth in traffic volume was principally attributable to the following:

The economy in the three-city region maintained a steady growth momentum, with a double-digit GDP growth rate during the period;

A network effect was created when HNE became fully operational;

More people have chosen to use HNE to travel for tourism and vacations;

Road conditions and service qualities had been improved.

Currently, HNE is operated by the Zhejiang Expressway Corporation. Users of HNE pay a toll including an entrance fee (yuan per vehicle) and a mileage fee (yuan per vehicle-km). The toll rates vary with five different vehicle classes and are presented in Table 2.

Table 2 Toll rates for the Hangzhou-Ningbo expressway

Vehicle class	Classification standard	Entrance fee (Yuan/Vehicle)	Distance fee (Yuan/Vehicle-km)
1	Passenger vehicles with up to 20 seats; Trucks with tonnage of 2 tons or below	5	0.45
2	Passenger vehicles with seats above 20 and below 40 (inclusive); Trucks with tonnage of above 2 tons and below 5 tons (inclusive)	10	0.80
3	Buses with more than 40 seats (including sleeping buses with more than 32 seats); Trucks with tonnage above 5 tons and below 10 tons (inclusive)	15	1.20
4	Trucks with tonnage above 10 tons and below 20 tons (inclusive)	20	1.60
5	Trucks with tonnage above 20 tons and below 50 tons (inclusive)	25	2.00

Source: 2000 Annual Report of Zhejiang Expressway Co., Ltd.

With respect to the vehicle composition on HNE, Class 1 vehicles (cars and light trucks) made up a larger share of nearly 66 percent in 2000 as compared to the previous year. In 2000, Classes 2 and 3 vehicles (buses and medium trucks) commanded an aggregate share of 32.8 percent, which was less than that in the previous year; while Classes 4 and 5 vehicles (heavy trucks) had an aggregate share of approximately 1.2 percent, increasing annually on the whole.

MODEL FOR ASSESSING HNE'S EFFECTS ON REGIONAL ECONOMY

1. Model specification

The primary economic impacts associated with the HNE are its contributions to the three-city region's economy. An econometric model is used to calculate the effects of HNE on the regional economy as a whole. The model is a Cobb-Douglas function in logarithmic-linear form (Khanam, 1996):

$$\ln GDP_t = b_0 + b_T T_t + b_L \ln L_t + b_K \ln K_t + b_D D_t + \varepsilon_t \quad (1)$$

where

t represents time period;

GDP is total real GDP (in 100 millions of 1978 yuan) for the three-city region;

$b_0 + b_T T_t$ represents the level of technology, b_0 is a constant, T is a time trend that the technology increases over time period, and b_T represents the rate of growth per year in technical progress. In this study, $T_t = t$;

L is total number of employed persons (10 000 persons) for the three-city region, and b_L represents the output elasticity of labor which measures the percentage change in GDP for a given percentage change in labor;

K is total investment in fixed assets (in 10 000 of 1978 yuan) for the three-city region, and b_K represents the output elasticity of capital which measures the percentage change in GDP for a given percentage change in capital;

D_t is a dummy variable to reflect the existence of HNE: $D_t = 1$ for year 1996 to 2000 and $D_t = 0$ otherwise. Noting that the expected value $E(\ln GDP_t)$ is equal to $b_0 + b_T T_t + b_L \ln L_t + b_K \ln K_t$ for year before 1996 and is equal to $(b_0 + b_D) + b_T T_t + b_L \ln L_t + b_K \ln K_t$ for year in and after 1996, so b_D represents the change in $E(\ln GDP)$;

ε_t is the error term.

2. Estimation Results

The data used for the study were from 1978 to 2000, the year 1978 marked the beginning of China's economic reforms. The estimation results for model (1) are as follows:

$$\ln GDP = -1.0699 + 0.0726T + 0.162\ln L + 0.3696\ln K + 0.1733D$$
$$(-0.6291)(5.7834) \quad (0.4617) \quad (8.1851) \quad (4.2901)$$
$$R^2 = 0.9993 \quad F = 3066.108 \quad DW = 1.892 \quad (2)$$

where the values in parenthesis are t-values. The estimates of regression coefficients in equation (2) can be explained as follows:

- The coefficient for T (0.0726) indicates that for the annual growth in GDP for the three-city region, technology advanced at a rate of 7.26 percent per year over the period 1978 to 2000.
- The coefficient for $\ln L$ (0.162) is statistically insignificant, partially because the number of employed persons fluctuated due to the restructuring of state-owned enterprises in recent years.
- The coefficient for $\ln K$ (0.3696) indicates one percent increase in investment in fixed assets leads to 0.37 percent increase in the GDP for the three-city region.
- The coefficient for D (0.1733) shows the opening of HNE has significant positive effects on the economic activities in the three-city region.
- The DW statistic (1.892) indicates there is no serial correlation for model (2).

From Eq.(2) one can estimate the GDP for the years 1996 – 2000, with the effect of HNE (including 0.1733D) and without HNE (excluding 0.1733D). The difference between the two GDPs, denoted by GDP_{HNE}, can be approximated as the contributions attributable to HNE. Table 3 shows that the HNE's contributions to the regional economy have risen by year. In 2000, the estimated HNE's contributions were 51.916 billion yuan, accounting for 15.55 percent of the total GDP for the three-city region.

Table 3 Estimated HNE's contributions to the regional economy (billion yuan)

	1996	1997	1998	1999	2000
HNE's Contributions	36.402	39.594	43.500	48.022	51.916
As % of total GDP for the Region	16.43	15.66	15.76	16.16	15.55

Note: the figures in this table are calculated at current prices.
Source: Estimates by the author using the data from Zhejiang Statistical Yearbook.

HNE'S EFFECTS ON THE REGION'S INDUSTRIAL DEVELPOMENT

This section further analyzes the effects of HNE on the three-city region's industrial development. The opening of HNE greatly enhanced the comprehensive transportation capabilities of the Hangzhou-Ningbo Corridor, and intensified the connection between the inland and coast, between city and countryside. By facilitating a massive amount of passenger and goods movement within the region, HNE plays a crucial role in the region's economic development. The promoting effects are evident in (1) improved investment environment, (2) accelerated circulation of commodities, (3) facilitated tourism activities, (4) improved employment and industrial structure, and (5) accelerated development in small towns and urbanization.

While the promoting effects of HNE are exemplified, other factors, especially the institutional policies that have guided China's and Zhejiang Province's economic reforms and development since 1978, also play important roles in promoting the economic development in the three-city region (Zou, 2000). Due to the limitation of space of the paper, these institutional policies are not analyzed here.

1. Improving Investment Environment

The opening of HNE led to more effective and reasonable utilization of resources and made the region more attractive to investors, especially those from foreign enterprises, to engage in economic and trade activities in the region. Foreign funded enterprises (including those from Hong Kong, Macao and Taiwan) are operating in three forms: foreign venture, co-venture, and co-operation. Table 4 shows between 1996 and 2000, the number of signed contracts for utilization of foreign capital in the three-city region increased nearly 56 percent, in contrast to the increase of 40 percent for Zhejiang Province as a whole. In 2000, the region's total value of foreign capital actually used amounted to 1.18 billion US dollars, accounting for 47.6 percent of that for Zhejiang Province.

HNE has also promoted foreign trade in the region along the expressway. In 2001, among the top ten export oriented counties of Zhejiang Province, six of them were located along HNE. Among Hangzhou, Ningbo and Shaoxing, the performance of Ningbo is most impressive. The external economy in Ningbo City has developed rapidly in recent years by businessmen who rely on HNE to link the inland and Ningbo Port in their trade activities. In 2001, Ningbo City

ranked first in the Province in terms of total value of exports and utilization of foreign capital. In this year, there were 829 foreign funded enterprises newly registered in the City, with total value of investment (accumulation) reaching 2.647 billion US dollars, representing 55 percent and 96 percent increases respectively from the previous year.

Table 4 Signed contracts for utilization of foreign capital

	1996	2000	Change
Three-City Total	655	1021	55.9%
Hangzhou	221	315	42.5%
Ningbo	329	550	67.2%
Shaoxing	105	156	48.6%
Zhejiang Province	1243	1742	40.1%
Three-City as % of ZP	52.7%	58.6%	

* ZP = Zhejiang Province

Source: Zhejiang Statistical Yearbook.

2. Promoting commodity exchange and circulation

Development of the commodity markets has been the key factor promoting the economy of Zhejiang Province. Convenient transportation by HNE shortens the distance and time of commodity circulation, promotes the exchange of commodities and reasonably adjusts the distribution of various markets. Statistical data shows that among 20 key commodity markets designated by the Zhejiang provincial government, eight of them are located along HNE. Of the eight markets, the Shaoxing Textile Town is one of the two largest markets in the nation, with its annual exchange value exceeding 15 billion yuan. In Shaoxing City, are 370 commodity markets, including 328 markets for consumer goods, and 42 markets for production materials, with a total exchange value reaching 54.5 billion yuan in 1998.

The effects of HNE on commodity circulation can be seen from the rapid growth in total retail sales of consumer goods (Table 5). Since HNE opened to traffic in 1996, total retail sales of consumer goods within the three-city region rose at an annual average rate of 10.8 percent, exceeding the rate of 9.5 percent for Zhejiang Province on average. In 2000, the total retail sales within the region reached 897 millions yuan, making up 44.1% of the entire province.

Table 5 Total retail sales (100 million yuan) of consumer goods

	1996	2000	Change
Three-City Total	672	1013	50.7%
Hangzhou	273	404	48.0%
Ningbo	259	390	50.6%
Shaoxing	140	219	56.4%
Zhejiang Province	1599	2299	43.8%
Three-City as % of ZP	42.0%	44.1%	

* ZP = Zhejiang Province

Source: Zhejiang Statistical Yearbook.

3. Providing convenient transportation for tourists

Like commodity circulation, tourism is another important economic sector greatly facilitated by HNE. HNE provides convenient, safe and comfortable transportation for tourists visiting the region, and promotes the development of tourism resources along the expressway. The three cities are abundant in tourism resources; in particular, Hangzhou is a key tourism city in China and is famous for its beautiful West Lake.

Table 6 shows that from 1996 to 2000, total foreign exchange earnings from international tourism for the three-city region rose by 74.4 percent, much higher than the 40.5 percent for Zhejiang Province as a whole. During the same period, the total number of tourists also grew significantly for the three-city region by 45.7 percent. Of the three cities, the growth was most pronounced for Ningbo (229 percent) and Shaoxing (102 percent), while the growth was steady for Hangzhou (nearly six percent) largely because of its early developed tourism resources which resulted in a larger tourist base; although the three-city region as a whole had a lower growth rate in total number of tourists (45.7 percent) than the entire province (55.8 percent).

In addition to the above effects, tourism also provides significant economic and social benefits to the region, which can be measured by the total number of jobs, sales, and wages generated by the tourist spending. Due to the lack of data, these benefits are not presented here.

4. Improving employment and industrial structure

HNE provides good transportation and lays a firm foundation for the exploitation of resources and the development of the economy. With the advantage of HNE, a large number of industrial development zones and parks were set up along the line. This has led to the increase of enterpris-

es along HNE and the development of new high-technology industries, speeded up the constant adjustment and optimization of the agricultural production structure, and changed the original economic layout to mutual beneficial advantages. As a result, the region's industrial structure has shifted over the years. The shifting process is exhibited in Tables 7 and 8 describing the change of industrial structure from 1996 to 2000 in the regional employment and GDP respectively.

Table 6 Development of tourism

	Total number of tourists (1000 persons)			Total foreign exchange earnings from international tourism (US $ 1000)		
	1996	2000	Change	1996	2000	Change
Three-City Total	2987	4351	45.7%	211770	369400	74.4%
Hangzhou	2246	2376	5.8%	167390	292440	74.7%
Ningbo	378	1242	229%	28980	55880	92.8%
Shaoxing	363	733	102%	15400	21080	36.9%
Zhejiang Province	3773	5870	55.8%	291840	410100	40.5%
Three-City as % of ZP	79.1%	74.1%		72.6%	90.1%	

Source: Zhejiang Statistical Yearbook.

Table 7 Number of employed persons (1000) by type of industry

	1996	1997	1998	1999	2000
Three-City Total*	11159	11139	10461	10409	10375
Primary Industry (%)	33.2	33.2	32.7	32.0	30.9
Secondary Industry (%)	41.2	40.7	39.5	39.8	40.0
Tertiary Industry (%)	25.6	26.1	27.8	28.2	29.1
Zhejiang Province	26251	26197	26125	26252	27261
Primary Industry (%)	43.0	42.5	42.4	41.0	37.4
Secondary Industry (%)	33.8	33.6	32.7	29.9	31.8
Tertiary Industry (%)	23.2	23.9	24.9	29.1**	30.8

* Note the decline in the number of employed persons for the three-city region was largely due to the laying-off of workers as a result of the restructuring of state-owned enterprises in recent years.

** For the 1999 tertiary share of Zhejiang Province, the author believes the figure was significantly overestimated, but still reported here.

Source: Zhejiang Statistical Yearbook.

Table 8 Gross domestic product (100 million yuan) by type of industry

	1996	1997	1998	1999	2000
Three-City Total	2216.2	2528.3	2759.6	2972.1	3338.1
Primary Industry (%)	10.9	9.7	9.3	8.9	8.3
Secondary Industry (%)	55.8	55.9	55.4	55.4	55.1
Tertiary Industry (%)	33.2	34.4	35.3	35.7	36.6
Zhejiang Province	4146.1	4638.2	4987.5	5364.9	6036.3
Primary Industry (%)	14.7	13.7	12.7	11.8	11.0
Secondary Industry (%)	53.1	54.1	54.3	54.1	52.7
Tertiary Industry (%)	32.2	32.2	33.0	34.1	36.3

Note: the figures in this table are calculated at current prices.

Source: Zhejiang Statistical Yearbook.

Industrial structure is classified into three categories: primary, secondary, and tertiary industries. The classification is universal though it varies to some extent from country to country. Industries in China are classified into:

(1) Primary industry includes farming, forestry, animal husbandry, sideline production and fishery;

(2) Secondary industry includes mining and quarrying, manufacturing, and construction;

(3) Tertiary industry includes transportation, communications, wholesale and retail trade, finance and insurance, services, and government.

Table 7 shows secondary industry was the region's major employer, with a share of 40 percent in 2000, followed by 31 percent for primary and 29 percent for tertiary industries. The region's employment structure shifted over the years: a decrease in primary industry, slight decline in secondary industry, and steady increase in tertiary industry. Compared to Zhejiang Province, the regional shares were lower in primary industry, and higher in secondary and slightly lower in tertiary industries (note in 1999, the tertiary share for Zhejiang Province increased significantly from 1998 due to change in statistics).

The above trend is also evident from Table 8 describing the change of industrial shares of GDP for the three-city region and the Province. The region's share of secondary industry remained the highest (55.1 percent), followed by tertiary industry (36.6 percent), and primary industry (8.3 percent). The lower GDP proportion for primary industry may reflect the low productivity in primary sectors. Note that the region's shares are lower in primary industry, and higher in both secondary and tertiary industries than those for the Province as a whole.

4. Promoting Development in Small Towns and Urbanization

Urbanization is an important indicator for a nation's modernization. And promoting the urbanization of the countryside is an important policy in China's long-term strategy of stimulating the domestic demand to promote the national economy. The opening of HNE links the three cities of Hangzhou, Shaoxing and Ningbo, facilitates the movement of people in the region, and greatly promotes the development and construction of the originally large and medium sized cities. Traveling by expressway is so convenient, so safe and so comfortable that people spend less time and money on travel, which in turn promote the mobility of regional population, improve the living environment and quality of life of all residents.

Besides the large and medium sized cities, HNE also has to some extent promoting effects on the development of small towns in the region. Owing to its strong network effect of linking previously disconnected roads, HNE accelerated highway construction along its corridor location in the region. As a result, a large number of suburban satellite cities and small towns have been built up along the way. As shown in Table 9, from 1996 to 2000, the total number of towns in the three-city region increased by 130 percent, in contrast to an increase of only 12.5 percent for Zhejiang Province as a whole.

Table 9 Number of towns in the region and province

	1996	2000	Change
Three-City Total	158	364	130.4%
Hangzhou	93	140	50.5%
Ningbo	30	122	306.7%
Shaoxing	35	102	191.4%
Zhejiang Province	863	971	12.5%
Three-City as % of ZP	18.3%	37.5%	

* ZP = Zhejiang Province

Source: Zhejiang Statistical Yearbook.

In parallel to the rapid development in towns, the region's population structure has shifted towards a reasonable direction. As shown in Table 10, from 1996 to 2000, the share of agricultural population decreased and the share of non-agricultural population increased in the three-city region. This trend also held for Zhejiang Province as a whole, but at a slower rate. In 2000, the region's proportion of non-agriculture population was 28.2 percent, higher than the Province' proportion of 22.1 percent. In addition, the three-city region had a higher population density than Zhejiang Province on average, reflecting the region's better living and working conditions that attract population and labor force from other areas in the Province.

CONCLUSIONS

This paper presents an analysis of the economic impacts of the Hangzhou-Ningbo Expressway that connects three important cities, Hangzhou, Shaoxing, and Ningbo in Zhejiang Province of China. The study focused on the permanent indirect economic effects of the Hangzhou-Ningbo Expressway. Since its opening in December of 1996, the Expressway has generated significant savings in terms of distance and travel time to the users, and its daily traffic volume has grown rapidly.

Table 10 Total population (1000 persons) and population density (persons/sq.km)

	1996	1997	1998	1999	2000
Three-City Total	15601	15702	15770	15862	15952
Agriculture (%)	75.4	74.7	73.8	72.7	71.8
Non-Agriculture (%)	24.6	25.3	26.2	27.3	28.2
Zhejiang Province	44001	44223	44469	44675	45012
Agriculture (%)	81.1	80.4	79.6	78.8	77.9
Non-Agriculture (%)	18.9	19.6	20.4	21.2	22.1
Population Density:					
Three-City Total	460.7	463.7	465.7	468.4	471.1
Zhejiang Province	432.2	434.4	436.8	438.8	442.2

Note: Residents in China are divided into agriculture (for residents in countryside) and non-agriculture (for residents in cities and towns). An agricultural resident can become non-agriculture with his/her education or job endeavor. The terms *agriculture vs. non-agriculture*, which are used in the Statistical Yearbook, are somewhat equivalent to *rural vs. urban*.

Source: Zhejiang Statistical Yearbook.

According to an econometric model, the estimated contributions of the Hangzhou-Ningbo Expressway account for over 15 percent of the total gross domestic product for the three-city region, and the contributions have risen over the years. And statistical data provided evidence that the Hangzhou-Ningbo Expressway promoted the region's industrial development, by improving investment environment, promoting exchange and circulation of commodities, providing convenient transportation for tourists, improving the region's employment and industrial structure, and promoting development in small towns and urbanization.

The analysis results have important policy implications as the Zhejiang provincial government has recently proposed a long-term strategy of building a big transportation system to promote big economic development. And expressway construction is the key strategy in the province's Tenth Five-Year Plan (2001 – 2005). Further research may extend the scope of the study to the entire expressway and highway system in Zhejiang Province. Concerning the methodology, there is a need to develop more systematic and advanced methodology, e. g., input-output analysis, to quantify the economic effects of expressways.

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