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ECONOMIC IMPACTS ANALYSIS OF NEW HIGH-SPEED RAILWAY—— THE ECONOMIC RELATIONSHIP BETWEEN URBAN AND RURAL AREAS CHANGING DUE TO THE HIGH-SPEED RAILWAY

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ECONOMIC IMPACTS ANALYSIS OF NEW HIGH-SPEED RAILWAY—— THE ECONOMIC RELATIONSHIP BETWEEN URBAN AND RURAL AREAS CHANGING DUE TO THE HIGH-SPEED RAILWAY

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ABSTRACT

The new high-speed railway station can bring new visitors and business opportunities for the regions, which play an important role in the whole regional economic, not only urban areas, but also rural areas. So the new high-speed railway station had an impact on the urban-rural economic structure, and then the economic relationship between urban and rural areas was changed. This research examines the urban-rural economic relations to reveal economic impacts of new high-speed railway station. This paper is based on a regional economic development assessment aimed at researching on the economic impacts of high-speed railway. The data includes the economic data of cities and their surrounding areas along this high-speed railway between Guangzhou and Wuhan in recent years.

According to Grey Theory in Systems Science, Grey relational degree analysis identified economic relational degree based on the economic relationship between the central city and its surrounding areas. Then by comparing the value of economic relational degrees at different years around the high-speed railway had been built, it was proved that the economic relationships between urban and rural areas were changed by the impacts of the high-speed railway station. In addition, the impacts were different in different areas, which depended on different scales of economies in rural areas. The results indicate that the new high-speed railway enhanced the economic relationships between urban and rural areas. As well as the cities, the rural areas obtain rapid growth after the high-speed railway was built. The analysis indicates that high-speed railway stations affect the economic relationships between the central city and its surrounding areas. At the same time, the degree of the economic relationship change index depends on scales of economies at its surrounding areas. From a policy perspective the more rational high-speed railway stations were built, the more intimate relationship there were to promote the rural areas growth. While the number of the station was fixed, the degree of the economic relationship could be changed by improving the traffic within the region.

1 INTRODUCTION

With sustained economic development of China, the living standards of residents and the urbanization level of cities have been improved. And then there have been a significant increase in the Long-distance travel demands between cities. The large-capacity people-transportation systems begin to play an important role in the lives of the residents. In recent years, a large number of high-speed railways begin to appear in china, which largely changes the relationship between supply and demand of the residents travel. The high-speed railway not only improves the regional traffic, but also has an important impact on the economic structure of the region.

Due to the quasi-public goods nature of Chinese high-speed railway, the wider economic benefit of high-speed rail is an important part of its social and economic impact. Transportation as a mobile carrier of the national economy, which communicates with the production and consumption, is a very important factor in economic development. By studying the history of the development of the transportation, transportation development and economic changes in the structure are inseparable. New transportation facilities increase the possibility of a new flow, so that people are able to get more and better housing, employment and development opportunities in the greater range, and get a convenient to enjoy a variety of entertainment or to participate in social activities. The high-speed rail, as a new type of traffic travel mode, changes the intercity people-transportation system and will have an enormous impact on the economic structure of the areas along the high-speed rail.

Several authors have written review articles on regional economic structure impact of high-speed rail, often focusing on the changes in economic structure between several regions or cities, such as urban system model (Kiyoshi ,1997), or a new type of corridor with a high interregional accessibility (U.Blum.K,1997). Due to the differences of the social system, the socio-economic impact of Chinese high-speed railway is very different from other countries. The new high-speed railway station also largely changed the economic structure between the urban and rural in the same area within the central city and surrounding townships. Under the combined effect of the market mechanism and government, the current urban-rural dual economic structure will be gradually changed by the new high-speed railway. So our review differs from existing review articles in the following ways. Through the macro analysis of the changes of the economic development relationship between the urban and rural, we get some important laws in socio-economic impact of high-speed railway, which reflects the scope and manner of the impact of the high-speed railway.

2 ECONOMIC RELATIONSHIP BETWEEN THE CENTRAL CITY AND ITS SURROUNDING AREAS

The economic relations between the central city and its surrounding areas are formed on the basis of certain economic environment. With the flow of resources between urban and rural areas, such as economic, social and other elements, the economy correlation between the

urban and rural gradually formed. The linkage of the urban and rural economic development reflects the organizational structure of the urban and rural economy. So it could be used to study the economic relations of the central of the city and its surrounding areas.

In Neoclassical Microeconomics research, Yang X (1991) considers the regional space with urban system as the core is a kind of economic organization, as the result of the Market selection. Transaction costs and specialization, which are the main driving force of city formation and urban stratification, impact on the hierarchy of cities through the market. So technology or labour productivity, as well as transaction costs of change will directly affect the economic structure of the area. The emergence of high-speed rail has significantly changed the original transport system. And then, the original production efficiency and transaction costs could be changed. As the result of it, the economic structure in the region between the urban and rural areas will change. After the advent of high-speed railway, with the reachability of change, the whole economic environment of the region has changed and the flow of economic factors increased between the region and others. At the same region, internal economic structure has changed under the influence of external economic factors, which procure the links between urban and rural areas within the system to become more closely. Near the high-speed railway, the economy of the central city and the surrounding towns has achieved a more rapid pace of development driven by high-speed rail. Reasons not only include the direct impact of the high-speed railway，but also include indirect effects of the high-speed railway through other economic factors. The change of the economic development linkage between urban and rural is a very important part of the indirect economic impact generated by the high-speed railway. By a comprehensive evaluation of the linkage of the economic development in urban and rural areas，the degree of the impact of the urban and rural economic structure by the high-speed railway could be determined. Then we evaluated the influence of the high-speed railway to the urban and rural economic structure from this way.

2.1 Linkages estimates of the economic development between the central city and its surrounding areas

To assess the degree of the correlation of Urban and rural economic development, the complicated regional economic system should be evaluated, which involves many aspects of economic development, and it's difficult to analyse it with all of the data. At the same time, too complex evaluation of the structure will cover up a substantial cause, which leads to evaluation results. So the regional economic system should be analysed by Analytic Hierarchy Process to find the most important factors of the regional economic system. In regional economic theory, Imbalance in regional economic growth is considered an important law, such as the growth theory (François Perroux), the accumulation of causality theory (Gunnar Myrdal), Central - peripheral theory (Albert Otto Hirschman), and the space polarization theory (Milton Friedman). The main meaning of these theories is that Contact between the core city and its surrounding rely mainly on the flow of the resource through "bottom-up", and the core city is the dominant factor in this system. Although different Economists have different views in Composition of the urban-rural economic structure, general agreement is that the channels of communication with each other are substantially the same. From a marketing point of view, Rural-urban linkages are mainly achieved through

economic ties. Rural-urban linkages in the same region are mainly manifested through the movement of elements of the economic system. The Economic ties mainly include market models, raw materials, capital flow and backward production linkages in directions, consumer and shopping patterns, revenue streams, industry structure and interregional commodity flows. These economic activities linked together form a correlation between urban and rural areas.

China's Society is in rapid growth of the industrialization. Whether rural or urban, the main manifestation of economic in china is growth. So, to estimate Rural-urban linkages in economic, the most important thing is evaluation of degree of associated economic growth. Economic growth could be estimated as following. On one hand, as mentioned by William Arthur Lewis, economic growth is mainly reflected by the growth of per capita output. On the other hand, as Harro's views in Harrod-Domar model, the income growth rate equal to the labour and it is called natural growth rates in the case of full employment. In the economic growth of neo-classical theory, it believes that there is a balance of economic growth path, and output growth, capital growth, consumption growth rate, employment growth rate to maintain a consistent. The new growth theory put forward the endogenous growth theories, and noted that economic growth is caused by economic factors within the system. In that, endogenous technological progress, as a by-product of capital accumulation, generates economic growth through spill over effects of increased social productivity. To sum up, in the course of economic growth, different economic structures have developed different growth patterns, and composition of the main economic factors influencing not only shows a trend of economic growth, also reflects the current level of economic development. Therefore, during the process of evaluation of economic association, relevant economic factors could be focused on to assess the Rural-urban linkages.

According to David. N Well, economic development of major factors exists in the following areas:

First of all, regional income disparity is reflected directly in capital differences. Due to the role of capital in production, it makes labour to produce more products and Solow model interpreters the importance of physical capital for differences of capital per capita income between States. And then, the differences of the investment rate lead to different steady-state levels of the economy.

Secondly, the population changes have an important impact on the consumer demand and production capacity. There is a strong negative correlation between per capita income and population growth, and at the same time the population growth has a capital dilution effect. Human capital and material capital influence productivity and output of the nation in the similar form, and there are two main forms of human capital--health and education forms. Through the interpretation of the relationship between human capital and national income disparities, it demonstrates the relationship between economic growth and population, population.

Thirdly, productivity changes have the important contribution to the economic growth of various countries. This proved that technological change has become a powerful engine driving economic growth. A relationship model between technical innovation and economic growth has been established, which show that the impact of technology on economic growth are different from capital and labour.

Finally, trade and openness had a significant impact on economic growth. The experience has shown that increased openness could lead to rapid economic growth, and trade will increase the accumulation of physical capital and human capital. The implementation of the free movement of capital improved the efficiency of resource allocation and productivity, which contributed to economic growth.

The linkages of urban and rural could be analyzed with economic growth theory. Firstly, capital, as the important production elements of regional, directly reflect the economic relationship. Secondly, the distribution of labor resources in urban and rural also reflect differences of economic development level between urban and rural, which effects on the trend of economic development. Thirdly, industry structure, as the symbol of area production technology, implies links between urban and rural. Finally, the trade between urban and rural areas is the most direct reflex of relationship between urban and rural areas, which is also the important reason for appearing the gap between urban and rural areas. So trade level reflects the relationship between urban and rural economic development, which is the most important one of the evaluation.

Therefore this article considers that in the evaluation of economic association, economic development factors are the main factors in assessing the correlation of urban and rural economic. According to the above, the correlation degree of economic development between the central city and the peripheral rural mainly manifests in the capital, productivity level, economic openness, labour level and so on.

2.2 The Analysis of Rural-urban linkages Based on Grey System Theory

Based on these regional economic theories, we can determine the qualitative description of level of economic development. The level of economic development is always linked to a feature of capital, productivity levels and economic openness, and the level of labour supply. Under the certain level of economic development, there are certain characteristics on capital, productivity levels, economic openness, and labour supply, but they are not the uniquely determined，which has a clear connotation, but its denotation is uncertainty.

Grey system theory, abbreviated to GS or GST, was pioneer by J.L. Deng in 1982. The problems on uncertainty existing commonly in nature and thinking, the ones in myriad sample can be solved by probability and statics ways, the ones in kenning uncertainty can be dealt with by fuzzy mathematics. However, there also exists another category on uncertainty in less data little sample, incomplete information and devoid of experience, which is just suitable to be dealt with by grey system theory. In general term, the uncertainty in less data, incomplete information is designated as greyness. Thus the systems of what having greyness is said to be grey system; such that, there are whitening systems: complete information. Black system: devoid of information. Industry, social economic fields owing to exists vague operation mechanism, the myriad of changes in environment, devoid of conditioning status, and limited in operating means wherewith to observe these they also behave as greyness ones. In regional economic system, there are still many parameters in known nothing about capital, productivity levels and economic openness, and the level of labour supply. So in this paper, they could be considered as four grey numbers on behalf of the economic development level, and the Rural-urban economic linkages also behave as greyness ones. To measure the level of the Rural-urban economic linkages, according to the

four factors of economic development, we can construct the indicator system to determine the values as the adjacent values of the four grey numbers.

According to Grey relational analysis (GRA) theory, economic development behave can be defined as a series A. A is an indicators series of expression levels of economic development, $A = (A(1), A(2), \cdots, A(n))$, which Include n indicators as the expression of n economic development factors.

Hypothesis: there are s towns Around Central city M. let a series A_0 stand for the economic development behave of the central city M, let a series collection $\{A_i (i = 1, 2, \cdots, s)\}$ (including town i, $i = 1, 2, \cdots, s$) stand for the economic development behave of the surrounding towns.

The linkages between town i and Central city M could be described as the series relationships between A_0 and A_i. Based on the grey theory, we can get the grey relation grade of A_0 and A_i to strand for the linkages between town i and Central city M.

From the available, the series of town i is A_i $(a_i(1), a_i(2), \cdots, a_i(n))$. A_0 is the reference series and A_i is the compared series. To calculate the grey relation grade, A_0 and A_i $(i = 1, 2, \cdots, s)$ are initialized by initialize operator D. And then we can get new set of series collection, X_0, X_i $(i = 1, 2, \cdots, s)$, which met for three features as follows: Comparable conditions, approachility and uniformly polarities. So the Selection of the initialize operator D should be determined according to the characteristics of the data itself.

The new series are as follows:

$$X_0 = (x_0(1), x_0(2), \cdots, x_0(n)), \quad X_i = (x_i(1), x_i(2), \cdots, x_i(n)) \quad (i = 1, 2, \cdots, s)$$

And then we can establish a mapping $(X_0, X_i) \to E^1$ e.i. $\gamma_{0i} = f(X_0, X_i) = \sum_{k=1}^{n} \gamma(x_0(k), x_i(k))$,

which meet the GRA axiom:

Norm-interval. $0 < f(X_0, X_i) \leq 1, f(X_0, X_i) = 1 \Leftarrow X_0 = X_i + C$ $(C.is.\text{constant})$

Wholeness. $X_i, X_j \in \{X_s \mid s = 1, 2, \cdots, m; m \geq 2\} \Rightarrow f(X_i, X_j) \neq f(X_j, X_i)(i \neq j)$

Dual equivalent. $X_i, X_j \in X$, $f(X_i, X_j) = f(X_j, X_i) \Leftrightarrow X = \{X_i, X_j\}$

Approachility. $|x_0(k) - x_i(k)| < |x_0'(k) - x_i'(k)| \Rightarrow \gamma(x_0(k), x_i(k)) > \gamma(x_0'(k), x_i'(k))$

Where γ_{0i} is the grey relational grade of X_0 and X_i, $\gamma(x_0(k), x_i(k))$ is the Grey relational coefficient at the point k.

Because elements of the series A_i have different dimensions and implications, General initialization operator D may overwrite the existing information in the data. If a reasonable dimensioned is selected in the series A_i, $D(A) = X \Leftrightarrow A = X$. So the algorithm on grey relational grade is as follows:

$$\gamma_{0i} = f(X_0, X_i) = \frac{1}{n} \sum_{k=1}^{n} \gamma(x_0(k), x_i(k))$$

(1)

Where

$$\gamma(x_0(k), x_i(k)) = \frac{\min_i \min_k |x_0(k) - x_i(k)| + \zeta \max_i \max_k |x_0(k) - x_i(k)|}{|x_0(k) - x_i(k)| + \zeta \max_i \max_k |x_0(k) - x_i(k)|}$$

(2)

$\gamma(x_0(k), x_i(k))$ is the grey relational coefficient at utter points. $\zeta \in [0, 1]$, distinguishing coefficient, usually, $\zeta = 0.5$.

According to the calculation of grey relational grade, the Results can be used for analysis of economic linkages between the central city and the surrounding towns, which reflects the regional economic structure. Using grey theory analysis of economic structures in the region, we could get the effects of high speed railway system to the regional economy.

2.3 Data and regional economic Variables

In this paper, Wuhan – Guangzhou high-speed rail is the main research object. Wuhan-Guangzhou high-speed railway is one of the new important high-speed railway projects in China. The project started at 2005.06 in Changsha city, and complete at 2009. The Investment of the project amounted to 18.66 billion dollar. Wuhan-Guangzhou high-speed rail via Xianning North Station, Chibi North Station, Yuezhi east station, miluo East station, Changsha South Station, Zhuzhou West station, Hengshan West station, Hengyang East station, Weiyang West station, Binzhou West station, Shaoguan station, Qingyuan station, Guangzhou North Station, finally arrived at the Guangzhou South railway station, and the 15 stations are all new station. Wuhan – Guangzhou high-speed rail is one of the most representative high-speed railways, which have a more obvious impact on economic. It connects Central Province and the Pearl River Delta, and will have a profound impact on the regional economic development. Studying the Wuhan – Guangzhou high-speed rail can advance the research on the inherent law of regional economic impact of high-speed railway, and it also regard as a representative of high-speed rail in China.

Guangdong Province, as the critical endpoint of the Wuhan-Guangzhou high-speed railway, is one of the most economically developed provinces of China. 2011 Guangdong provincial gross domestic product (GDP) reached 842.768 billion dollar. However, in times of economic growth, there is inevitably a disparity in economic development in Guangdong. The gap between city with the highest per capita GDP of Guangdong Province and the minimum is large, about 7.5 times from top to bottom. Researching on Guangdong Province has a very significant role on the economic impact study of the high-speed railway.

The empirical analysis uses data from Guangdong Province, which have the Wuhan – Guangzhou high-speed rail. Wuhan-Guangzhou high-speed railway approach Shaoguan city, Qingyuan city, Guangzhou city in Guangdong Province. In these three cities, the influence of Guangzhou is the most widely. Therefore, Guangzhou should be selected as the Central City in this research, and in the 98 districts of Guangdong Province, some towns near Guangzhou are selected as the surrounding towns in the model. Selected towns are as follows:

Table 1 Adjacent counties and their respective cities near Guangzhou

City adjacent to the Guangzhou	The County
Qingyuan	Yingde, Lianzhou, Fogang, Qingxin, Lianshan, Liannan, Yangshan
Shaoguan	Lechang , Nanxiong, Renhua, Shixing, Wengyuan, Xinfeng, Ruyuan
Huizhou	Huidong , Boluo , Longmen

Dongguan	Dongguan
Zhongshan	Zhongshan
Foshan	Foshan
Zhaoqing	Sihui, Gaoyao, Guangning, Deqing, Fengkai , Huaiji
Jiangmen	Taishan, Kaiping, Heshan , Enping

Indicators system can be built based on past research and the availability of data. According to study, economic linkages in the central city and the surrounding towns are mainly reflected in the capital, productivity levels, economic openness, and level of labour. From each influencing factor, representative indicators that make up each region's economic behaviour series are selected to calculate grey relational degree. Based on the data from Guangdong Statistical Yearbook and Guangdong Statistical Bulletin, indicators are as follows:

Table 2 Influencing factors and indicators selected list

Influencing factors	indicators
capital	per capita Investment in Fixed Assets
	per capita Expenditure and Savings Deposits
	Per Capita Local Government General Budgetary Revenue
productivity level	per capita GDP
	Composition of Gross Domestic Product by Tertiary Industry
	per capita Gross Output Value of Industry
	Per Capita Gross Domestic Product Growth Rates
economic openness	Per Capita Total Retail Sales of Consumer Goods
labour	Average Wage of Fully Employed Staff and Workers

2.4 The changes of rural-urban linkages

According to grey theory, the grey relational grade of the rural-urban linkages can be calculated by steps as follows: (for example, 2009, Guangzhou)

Let the series A_0 $(a_0(1), a_0(2), \cdots, a_0(9))$ strand for Guangzhou economic development behaves in 2009. Let the series collection A_i $(a_i(1), a_i(2), \cdots, a_i(12))$ $(i = 1, \cdots, 37)$ strand for economic development behaves of the surrounding counties in 2009. By equation (1) and (2), the grey relational grade series is $\{\gamma \mid \gamma_{oi}(i = 1, \cdots, 37)\}$, and γ_{oi} as the grey relational grade between Guangzhou and the county i strands for the rural-urban linkages.

By the same way, the grey relational grade between each county and Guangzhou city in 2008, 2009, 2010, 2011 are calculated as follows:

Table 3 grey relational grade of each county

year / County	2008	2009	2010	2011	year / County	2008	2009	2010	2011
Conghua	0.760	0.770	0.861	0.933	Kaiping	0.757	0.760	0.847	0.932
Zengcheng	0.827	0.816	0.891	0.960	Heshan	0.797	0.792	0.859	0.934
Foshan	0.867	0.872	0.917	0.972	Enping	0.717	0.743	0.838	0.929
Shaoguan	0.788	0.788	0.861	0.935	Zhaoqing	0.803	0.805	0.868	0.941
Lechang	0.706	0.734	0.831	0.926	Sihui	0.807	0.769	0.830	0.933
Nanxiong	0.697	0.700	0.829	0.926	Gaoyao	0.738	0.740	0.865	0.930
Renhua County	0.759	0.752	0.844	0.931	Guangning County	0.698	0.740	0.842	0.927
Shixing County	0.689	0.746	0.820	0.927	Deqing County	0.705	0.716	0.831	0.927
Wengyuan County	0.689	0.732	0.829	0.926	Fengkai County	0.695	0.719	0.842	0.927
Xinfeng County	0.698	0.732	0.823	0.927	Huaiji County	0.696	0.716	0.832	0.926
Ruyuan County	0.731	0.727	0.843	0.928	Qingyuan	0.802	0.801	0.844	0.940
Huizhou	0.815	0.800	0.894	0.943	Yingde	0.738	0.716	0.814	0.928
Huidong County	0.715	0.745	0.842	0.931	Lianzhou	0.729	0.720	0.819	0.928
Boluo County	0.736	0.756	0.843	0.931	Fogang County	0.755	0.799	0.799	0.933
Longmen County	0.703	0.734	0.833	0.928	Qingxin County	0.756	0.729	0.827	0.929
Dongguan	0.822	0.813	0.866	0.949	Lianshan County	0.690	0.747	0.852	0.926
Zhongshan	0.841	0.855	0.912	0.951	Liannan County	0.713	0.707	0.851	0.926
Jiangmen	0.839	0.837	0.871	0.943	Yangshan County	0.733	0.714	0.834	0.926
Taishan	0.724	0.756	0.847	0.929					

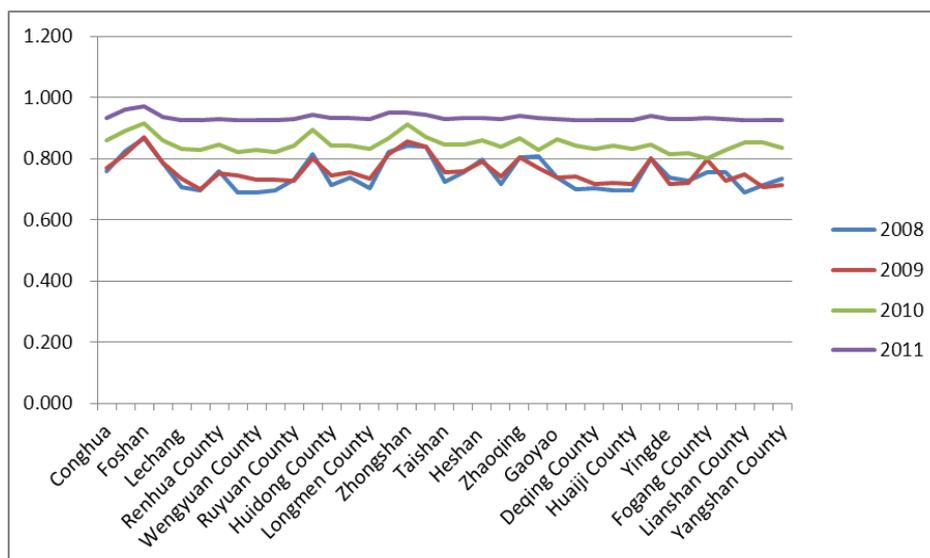Analysis of grey relational grade trends is as follows:

Figure 1. Annual grey relational grade of County

Due to the completion of Wuhan-Guangzhou high-speed railway in 2009, Wuhan-Guangzhou high-speed railway began to play an economic role in 2009-2011. Through analysis of the grey relational grade of Guangzhou and the surrounding counties after the Wuhan-Guangzhou high-speed railway completion in 2008-2011, some change trends can be found (Figure 1). After High-speed railway was completed, the economic structure of the region is gradually changing, and there are a lot of variability and different changes in Counties. In some counties, the change is obvious, while in the other counties their changes are smaller or even opposite trends.

In four years, the economic development linkages of Guangzhou and surrounding counties are increasing, and there are very large differences in different counties. Some counties have two a consecutive growth in recent years, such as Lechang, Deqing, while the growth of some counties was at a low level, such as Zhongshan. However, on the whole, the growths of counties each year are similar. According to these analyses, under the influence of high speed rail, the linkages of Guangzhou and surrounding counties generally increased in the region. Due to the different socio-economic attributes of counties, there are different degrees of impact on the linkage changes. But they follow some certain rules, which require further analysis to determine. From these results, there are some discoveries that the economic relationship between the central city and the surrounding counties of the region is undergoing great changes with the completion of new transport facilities. In order to get more social and economic benefits from such traffic facilities, the rules should be rendered more clearly.

3 REGIONAL ECONOMIC IMPACT OF THE HIGH-SPEED RAIL

3.1 variation of linkages and economic developed level of counties

In the above analysis, it concluded that the changes of the grey relational grade in different counties are very different. And then, the reason should be discussed that the economic and spatial attributes of counties cause different linkage changes to explain the socio-economic effects of the high-speed railway.
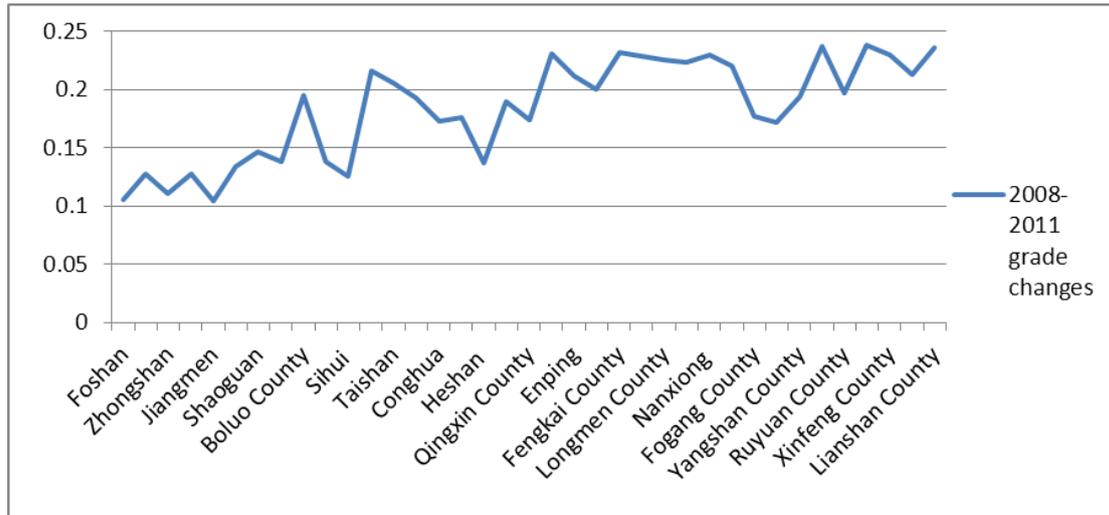
Figure 2. Changes of the grey relational grade of counties in 2008-2011(counties ranked by GDP from biggest)

In figure 2, Counties follow GDP arranged from largest to smallest, and it means that Foshan's GDP of > Zhongshan's GDP>Jiangmen' GDP >…>Lianshan's GDP. According to figure 2, there are greater changes of grey relational grade in the counties with smaller GDP in general. This can be explained that there is a certain correlation between the GDP and grey relational grade changes of the counties. GDP, as a kind of important economic attributes, has a significant impact on the influence of high-speed railway in counties. And then, through the use of statistical methods, we could verify the statistical correlation between County GDP and the changes of grey relational grade to verify above conclusions.

In statistical analysis, the 2008-2010 statistical data are used as the underlying data. The mean value of GDP for four years (2008-2011) are used as a variable in correlation tests, and the changes in the grey relational grades of 2008 and 2011 are used as the other variable in correlation tests. The results of correlation analysis (using Pearson Correlation and Spearman's rho) between them are as follows (in SPSS IBM):

Table 4 Results of Correlation

Correlations		Grade changes	GDP
grade changes	Pearson Correlation	1	-.570[**]
	Sig. (2-tailed)		.000
	N	37	37
GDP	Pearson Correlation	-.570[**]	1
	Sig. (2-tailed)	.000	
	N	37	37

**. Correlation is significant at the 0.01 level (2-tailed).			grade changes	GDP
Spearman's rho	grade changes	Correlation Coefficient	1.000	-.788**
		Sig. (2-tailed)	.	.000
		N	37	37
	GDP	Correlation Coefficient	-.788**	1.000
		Sig. (2-tailed)	.000	.
		N	37	37
**. Correlation is significant at the 0.01 level (2-tailed).				

Pearson correlation analysis revealed that by examining the correlation between GDP and linkages grade changes of the counties, the correlation between the two factors had significantly exceeded the level of correlation of 0.5. Meanwhile, they rendered a negative correlation, which mean that counties with the bigger GDP had smaller changes of the grey relational grade after the completion of high-speed railway. According to the above results, it was found that the counties near Guangzhou city with smaller GDP were more significantly affected by the high-speed railway.

Spearman correlation coefficient is also known as the rank correlation coefficient. The results of Spearman's rho test demonstrated the conclusions of the Pearson test. At the same time, rank correlation coefficient is much bigger than Pearson correlation coefficient, which shows that the GDP and the grade changes render an obvious inverse relationship in the process of regional economic development, and the relationship is non-linear. It needs for further empirical validation to find out an in-depth relationship between them, if necessary. However, it is already discovered by the above conclusions that the GDP of counties and the economic sensitive of high-speed railway impact render the reverse relationship. In the other words, the smaller the economics scale of county near the central city was, the more obvious influence the high-speed rail had on the county economic.

3.2 influence of high-speed railway and the changes of linkages

These series of analysis shows that high-speed railway have had a considerable effect on the regional economic structure. When the influence of high-speed railway interacted with regional so-economic attribute, the influence of high-speed railway is represented in the different forms. On the whole, through impacting the economic behaviour of the central city, the high-speed railway affected surrounding counties, and these effects not only brought the development opportunities to the peripheral area county, but also brought challenges to the original economic structure and mode of the surrounding counties. After the completion of the high-speed railway as a large capacity of passenger traffic, the influence of high-speed railway on the regional economic is profound. While the change of regional economic

structure is not the only impact of high-speed railway, it obviously shows that high-speed railway has the indirect influence to the regional economic. In order to more comprehensive evaluation of high speed railway construction and operation, these effects as high speed railway external benefit should be due attention and application.

In the operation process of High speed railway, the passenger flow and opportunities brought by high-speed railway, firstly effects on the central city. Then through the regional economic interaction, this kind of influence will be transferred to other parts of the region. This process is complex that the indirect influence of high-speed railway transfers through a variety of channels and ways. There are a lot of different forms in different areas; however, it does not mean that the influence of high-speed railway is diffused, disorderly or untidy. The high-speed railway influential diffusion will cause many regular changes of social economic elements, and these changes reflect the change process that the influence of the high-speed railway is transferred. In this paper, Guangdong province is considered as an example of the influenced region, and the whole regional economy system structure is considered as research object. The changes of area economic structure are used to reflect the influence of the high speed railway. Although the changes of economic structure are not only caused by high-speed railway, but the analysis of the economic structure change, which includes time law and space law of it, can reflect the degree of social economic impact caused by high-speed railway. In the other words, it reflects the transfer law of the influence of high speed railway in the region.

Because the influence of high speed railway is not direct measurement, the variable which can be measured and the effect of the judge, has to be used to describe the influence of high speed railway in this study. With the relationship between the high speed railway and regional economic structure, the linkages between the central city and the surrounding counties which are obviously impacted by high-speed railway, are selected to reflect regional economic structure between city and the surrounding towns, as the unit for research and calculation. On the one hand, it reasonable realizes the features of the influence of high-speed railway; on the other hand, it also can be accurately measured and carry on the analysis in statistical methods. Thus, in the further study, the evaluation of the linkages changes degree and analysis results can be used in high speed railway influential measure and analysis.

CONCLUSION

According to the analysis of the grey relational grade on linkages between the central city and surrounding areas, the high-speed railway, as a kind of large capacity traffics, has the apparent effect on the social and economic structure.

The correlation analysis of country GDP and relational grade changes can be concluded that the city which high-speed railway site is located in, more largely influence the surrounding in the economic development because of the development of high-speed railway. But the impact is not as the same as the past that is reflected only through the industry agglomeration. In the process of the economic development of surrounding counties, its economic development mode and the industrial structure have the benign interaction, which encourages the development of city in the centre and surrounding towns can get similar rate of the development. It is found that the smaller economy the peripheral county has, the

greater influence the high speed railway has with the county. It shows that the economies of the smaller areas are influenced obviously by the new traffic facilities. There may be several reasons for this phenomenon. One possible reason for this is that the allocation of resources and industry at these smaller economies is more flexible and the economics can take full advantage of the development opportunities from high-speed railway, which forms a closer relationship with the economic development of the central city. However, the situation is just the opposite at the bigger economies. Because the change of the industrial structure and economic development mode is more mature and more difficult at the bigger economies, the new economic opportunities always cannot be completely absorbed after the completion of high-speed railway, and the economic structures of these counties have no great changes. Therefore, the relationship between these counties and the central city has no changes. Combined with the view of layered urban structure theory, it is found that this kind of phenomenon accords to the laws that the division of labour formed naturally between different levels of cities in the process of city formation. The appearance of this division of Labour make that the urban agglomeration get long-term sustainable development.

In the overall effects, the structure of regional economic changes under the influence of high-speed railway, and the influence of the central city gradually increases with the high-speed railway operation. According to the research, high-speed railway makes the economic development of the surrounding counties and the central city closely together. Thus, the development of perimeter regional of high-speed railway will be gradually harmonious and unified, and reasonable allocation of economic factors and economic development of synchronous will effectively ease the contradictions that formed for the disequilibrium of the economic development, such as Guangdong. At the same time, with the influence of the high speed railway, distribution of social resources need in the larger range for not just limited to one city or a region. In many developing countries, the imbalance of economic development phenomenon is very serious. Economy was too concentrated to the central city, which caused many social and economic problems. This study shows that through the construction of modernization, large-capacity traffic facilities, such as high speed railway, it can ease aggregation as a whole to make the opportunities of distribution more reasonable for economic development in the region, which also had a more sustainable regional development.

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